ARISTIDA PV (PTY) LTD

ARISTIDA PV

Stormwater Management Plan

Issue Date: 5th August 2022
Revision No: 1
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<tr><td>Author:</td><td colspan="2">Merchandt Le Maitre (Pr. Tech Eng.)</td></tr>
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<tr><td>For:</td><td colspan="2">ARISTIDA PV (PTY) LTD</td></tr>
<tr><td colspan="3">Confidentiality Statement
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EXECUTIVE SUMMARY

Objective

The Applicant, Aristida PV (Pty) Ltd, proposes the construction of a photovoltaic (PV) solar energy facility, known as the Aristida PV facility, located on a site ± 7.5 km west of Lichtenburg in the North West Province. The development area is situated within the Ditsobotla Local Municipality within the Ngaka Modiri Molema District Municipality and is accessible via the R503, located immediately southwest of the development area. The solar PV facility will comprise several arrays of PV panels and associated infrastructure and will have a contracted capacity of up to 120 MW.

The main objective of the 'Stormwater Management Plan' is to determine the impact/s of the proposed development on the immediate and greater area concerning stormwater and to include these findings in the Environmental Impact Assessment (EIA) submission. The assessment will comprise a desktop assessment and include preliminary stormwater-related matters arising during the construction phase, through the Operation & Maintenance Phase, up to and including the decommissioning phase of the development.

The proposed Aristida PV Facility forms part of cluster development with an additional development adjacent to this facility as a separate EIA application: - Themeda PV. Although this report only focuses on the Aristida PV Facility, all two developments are considered for this study as they share common boundaries adjacent to each other.

Key Findings

No significant risks concerning the proposed development are foreseen, provided the recommendations below are noted before and during the detailed design and construction stages. Furthermore, several recommendations were highlighted and therefore noted as important.

The proposed development / infrastructure will have a minimal impact on the stormwater quality and quantities post-development (operational phase). This development's construction phase typically generates the highest surface run-off during the construction phases coinciding with the wet season. However, it will be temporary, and impacts can be mitigated and considered nominal. The post-development stormwater flow from the operation phase will have a minimal impact on the immediate environment if adequate stormwater designs are implemented to maintain existing drainage patterns and flows in the catchment.

Many mitigation measures are proposed to accommodate the development and reduce the impact on the surrounding area.

Recommendation

Concerning this report, the associated assessment and the findings made within, it is SiVEST's opinion that the Aristida PV will have a nominal impact on the existing stormwater catchment. The project is therefore deemed acceptable from a stormwater perspective, provided the recommendations and mitigation measures in this report are implemented. Hence, Environmental Authorisation (EA) should be granted for the EIA application.

This document should also be read in conjunction with the EMPr. The developer, owner, and professional team must adhere to the requirements and conditions set out in the EMPr

DECLARATION BY SPECIALIST

I, MERCHANDT LE MAITRE, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of Specialist:

Name of Company: SiVEST SA (PTY) Ltd

Date: 5th August 2022

ARISTIDA PV (PTY) LTD

ARISTIDA PV FACILITY

STORMWATER MANAGEMENT PLAN

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1. INTRODUCTION

SiVEST Civil Engineering Division has been appointed by Aristida PV (Pty) Ltd (hereafter referred to as "Aristida PV") to complete a Stormwater Management Plan (SWMP) for the proposed 120MW Aristida PV Facility and associated grid infrastructure (hereafter the "proposed facility / facilities") situated ±7.5 km west of the town Lichtenburg and is within the Ditsobotla Local Municipality, the greater Ngaka Modiri Molema District Municipality of the North West Province.

The proposed facility and associated grid infrastructure north of Vryburg & Klerksdorp will not be located within Renewable Energy Development Zones (REDZ). The development is however located north of the existing 'Vryburg REDZ' and the existing 'Klerksdorp REDZ'.

The proposed Aristida PV Facility forms part of cluster development with an additional development adjacent to this facility as a separate EIA application: - Themeda PV. Although this report only focuses on the Aristida PV Facility, all two developments are considered for this study as they share common boundaries adjacent to each other.

2. PV FACILITY COMPONENTS

The PV facility will consist of the following:

2.1 Solar Farm Components

The proposed Aristida PV will comprise photovoltaic (PV) panels with a maximum total energy generation capacity of up to 120 MW. The electricity generated by the proposed PV development will be fed into the national grid via a 132 kV overhead power line. In summary, the proposed Aristida PV will include the following components:

- PV panels (number of will be determined in the design phase), connected in series to form a 'string' of panels. Several strings are connected in parallel to form an 'array of modules / panels', each typically between 4 MW and 7 MW, with a maximum export capacity of 120 MW. However, the final number of panels and layout of the PV will depend on the outcome of the Specialist Studies conducted during the EIA process, and detailed design process to be conducted in due course.
- Mounting structures that are either fixed, north-facing at a defined angle or single-axis tracking modules rotating in an east-west direction will be considered. (Will be determined at the design stage)
- Medium voltage electrical transformers (up to 33 kV) adjacent to each inverter station (typical footprint of up to approximately 3 m x 2.5 m) step up the voltage to between 11 kV and 33 kV.
- One (1) new up to 132 kV on-site substation including associated equipment and infrastructure.
- A Battery Energy Storage System (BESS) will be located next to the on-site 33/132 kV substation. The storage capacity and type of technology would be determined later during the development phase but most likely will comprise an array of containers and outdoor cabinets.
- A single inverter station is connected to several 'solar arrays' placed adjacent to the internal road.
- The inverter station will be connected to the proposed substation via medium voltage (up to 33 kV) cables. Cables will be buried underground along access roads wherever technically feasible.
- An overhead line servitude of up to 36 m wide for the the 132 kV line (to be located within a 100 m wide assessment corridor).
- Internal roads up to approximately 8 m wide will provide access to each PV panel and inverter station. Existing site roads will be used wherever possible, although new site roads will be constructed where necessary.

- One (1) construction laydown area of up to approximately ±3.0 ha. It should be noted that no construction camps will be required to house workers overnight as all workers will be accommodated in the nearby town.
- Operation and Maintenance (O&M) buildings, including offices, a guard house, operational control centre, O&M area / warehouse / workshop, canteen, visitor centre, and ablution facilities to be located on the site identified as Auxiliary Buildings. This site area is approximately ±1.0 ha.
- A new ±2.0 m high perimeter fence around the site perimeter will be erected.
- Water will be sourced from existing boreholes within the application site or trucked in should the boreholes within the application site be limited.

3. OBJECTIVE & SCOPE OF WORK

The study's main objective is to develop a conceptual stormwater management plan for the proposed development during the operation & maintenance phase. To achieve this objective, the following will be assessed and discussed under their relevant headings in this report: -

- Climate
- Surface Hydrology
- Development Stormwater Management
- Development run-off Calculations
- Conclusions & Recommendations

The scope of work consists of the following:

a) A site investigation (Completed on March 30 2022)

b) Consultations with the relevant authorities and / or stakeholders.

c) Extract the climate of the area from sources commonly available

d) Desktop analysis of the existing surface hydrology

e) Evaluate the impact of the proposed development on the existing catchment and propose a suitable SWMP.

f) Conclude & propose possible mitigation measures.

g) Seasonal impacts affect this assessment.

3.1 Legal Requirement & Guidelines

Key legal requirements and guidelines for the proposed facilities are as follows:

- Government Notice 509 (GN509) as published in Government Gazette 40229 of 2016 and refers to the National Water Act, 1998 (Act No. 36 of 1998)
- National Environmental Management Act, 1998 (Act No 107 of 1998) (NEMA)
- National Water Act, 1998 (Act No 36 of 1998) (NWA)

4. SPECIALIST CREDENTIALS

Merchandt Le Maitre from SiVEST Consulting Engineers compiled this Stormwater Management Plan. He has a B Tech (Baccalaureus Technologiae) in Civil Engineering with over 17 years of experience, with 12 years in renewable energy. His extensive experience in the different facets of Civil Engineering means he can advise clients in the renewable energy sector in; geotechnical engineering, topographical studies, stormwater management, water demand, transportation studies, access / layout designs and glint & glare assessments. A full Curriculum Vitae is included in 'Appendix A.

Table 4:1 Specialist Credentials & Experience

Company	SiVEST (Pty) Ltd
Contact Details	merchandtm@sivest.co.za
Qualifications	B Tech (Baccalaureus Technologiae) in Civil Engineering
Professional Registrations & Memberships	Pr. Tech Eng – Engineering Council of South Africa MSAICE – Member of South African Institute of Civil Engineers SAWEA – South African Wind Energy Association
Expertise to carry out the Stormwater Management Plan	Dyansons Klip 5 De Aar Solar Droogfontein Solar Mierdam Solar Prieska PV Hoekplaas PV Noupoort WEF Copperton PV Klipgats PV

5. ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations are to be noted:

- The analysis is based on the information Aristida PV (Pty) Ltd. and its representatives provided at the time.
- Digital Terrain Model: 25m DEM from NGI (2014) & 2m DEM from GeoSmart (2016:2626AA)
- Technical Specifications for the Facility:

Table 5:1 Technical Specification for Aristida PV Facility

Technical Component	Dimensions
PV Tracking System	Fixed axis tracking has been used for these simulations as it has the most significant impact on the surrounding road network
Height of PV Panels	≤ 5.5 m
Area of PV Array	± 251 ha
Number of Panels and Inverters	To be determined at the detailed design phase
Area of Inverter / Transformer stations / substations /	The inverter / transformer stations will be located within the area of the PV array, while the main HV transformers will be located within the substation complex
BESS	Up to 4 ha
Voltage of Substation Complex	11 kV / 132 kV – 33 Kv / 132 kV
Area of Substation Complex	≤ 3 ha
Height of Substation Complex	≤ 25 m
The area occupied by laydown areas (Permanent and Construction)	Temporary Laydown Area: ± 5 ha (per facility)

Technical Component	Dimensions
	Permanent Laydown Area: Less than ± 1 ha will remain in place for operations (per facility)
The area occupied by Buildings	≤ 1 ha for a site office and O&M buildings
Length of Access Road	≤ 3 km
Width of Access Road	Up to 8 m
Length of Internal Roads	≤ 25 km
Width of Internal Roads	Up to 8 m
Construction Period	± 12 months

6. PROJECT DESCRIPTION

6.1 Locality

Aristida PV facility and associated infrastructure are located ± 7.5 km west of Lichtenburg in the North West Province. The facility is adjacent to Road R503 regional road (P28-4) between Lichtenburg and Mahikeng (Refer to **Figure 6:2**) in the Ditsobotla Local Municipality and greater Ngaka Modiri Molema District Municipality, as indicated in **Figure 6:1**.

Figure 6:1 Aristida PV - Regional Context

The development area for the PV facility and associated infrastructure will be located on the following properties (Refer to **Figure 6:2**):

- Portion 7 of the Farm Elandsfontein 34

Figure 6:2 Aristida PV - Site Locality ()

7. GEOTECHNICAL STUDY

A comprehensive Palaeontological Impact Assessment[1] for the proposed development was completed in March 2022 by Prof Marion Bamford for Messrs' Beyond Heritage (Pty) Ltd on the proposed sites indicated in **Section 6**.

A summary extract from the Palaeontological Impact Assessment confirms the site comprises the following geological context. Refer to **Figure 7:1** and **Table 7:1**:

[1] Van Der Walt, J (2022). Heritage Baseline Report: For the Elandsfontein PV Cluster (Themeda PV and Aristida PV), Lichtenburg, North-West Province. Beyond Heritage.

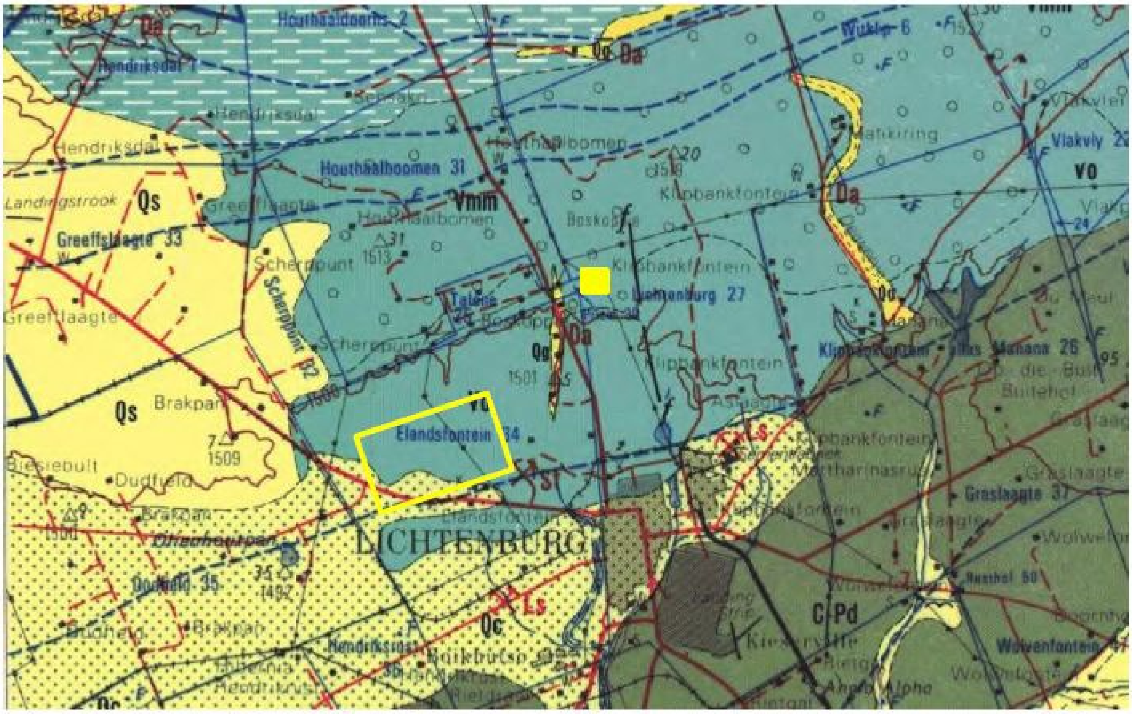

Figure 7:1 Geological Map of Proposed Development Area

Abbreviations of the rock types are explained in **Table 7:1** below:

Table 7:1 Explanation of Figure 7:1 and Approximate Ages

Symbol	Group / Formation	Lithology	Approximate Age
Qs	Quaternary	Alluvium, Sand, and Calcrete	Neogene, ca 2.5 Million years (Ma) to present
Qc	Quaternary Calcrete	Calcrete and Sand	Neogene, ca 2.5 Ma to present
C-Pd	Dwyka Group	Diamictites, Tillites, Mudstone, and Shales	Early Permian, Middle Ecca. Ca 280-270 Ma
Vml	Transvaal Super Group, Chuniespoort Group, Malmani Subgroup, and Littleton Formation	Dark Chert (Poor Dolomite)	Ca 2585 – 2480 Ma
Vmm	Transvaal Super Group, Chuniespoort Group, Malmani Subgroup, and Monte Christo Formation	Dark Chert (Poor Dolomite)	Ca 2585 – 2480 Ma
Vo	Transvaal Super Group, Chuniespoort Group, Malmani Subgroup, and	Dark Chert (Free Dolomite)	Ca 2585 – 2480 Ma

Symbol	Group / Formation	Lithology	Approximate Age
	Oaktree Formation		
Vbr	Transvaal Super Group, and Black Reef Formation	Quartzite, Conglomerate, and Shale	< 2618 Ma

In summary, the facility will have the following typical soil profile: -

- *Alluvium, Sand, and Calcrete (red soil)* covering the site
- *Chert-rich & poor dolomite underlying the red alluvium sand with exposed dolomite in patches.*

Material excavation (soils and sand) is expected to be soft in the upper layers of alluvium / sand with *intermediate to hard* excavation techniques below in the dolomites.

We recommend that a comprehensive Geotechnical Report be carried out to form part of the detailed design stage and refinement of the SWMP.

8. CLIMATE

8.1 Climate Classification[2]

Aristida PV is located ± 7.5 km west of Lichtenburg in the North West Province. Referring to the Klöppen-Geiger climate classification system, the North West Province has a variety of climates and is predominantly dominated by hot semi-arid climates (type 'BSh'). However, the Lichtenburg area is classified as a cold semi-arid climate (type 'BSk').

8.2 Average Temperature[3]

The Average Maximum temperatures range between 17.9 °C and 28.5 °C. December is the warmest month of the year, with an average high temperature of 28.5 °C. The coldest month of the year with an average low temperature of 5.4 °C is the month of July. Refer to **Figure 8:1** below.

[2] en-climate-data

[3] Weather Atlas

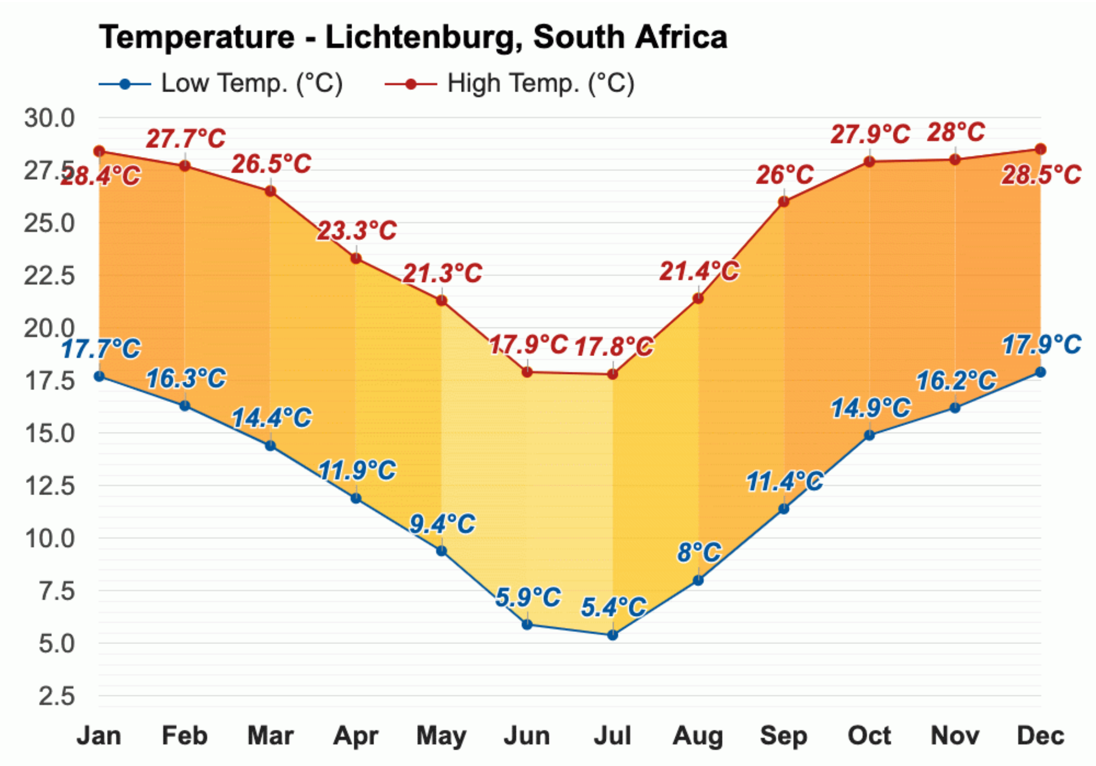

Figure 8:1 Average Temperature – Lichtenburg, South Africa

8.3 Mean Annual Precipitation (MAP)[4]

As mentioned in **Section 8.1** above, the Lichtenburg region is a cold semi-arid climate with an annual average rainfall of ± 351 mm, mainly between October and April. The month of December is on average, the wettest month of the year, with ± 72 mm accumulated for the month. The driest months with the least amount of rainfall of ± 1 mm accumulated for July and August, respectively. Refer to **Figure 8:2** below.

[4] Weather Atlas

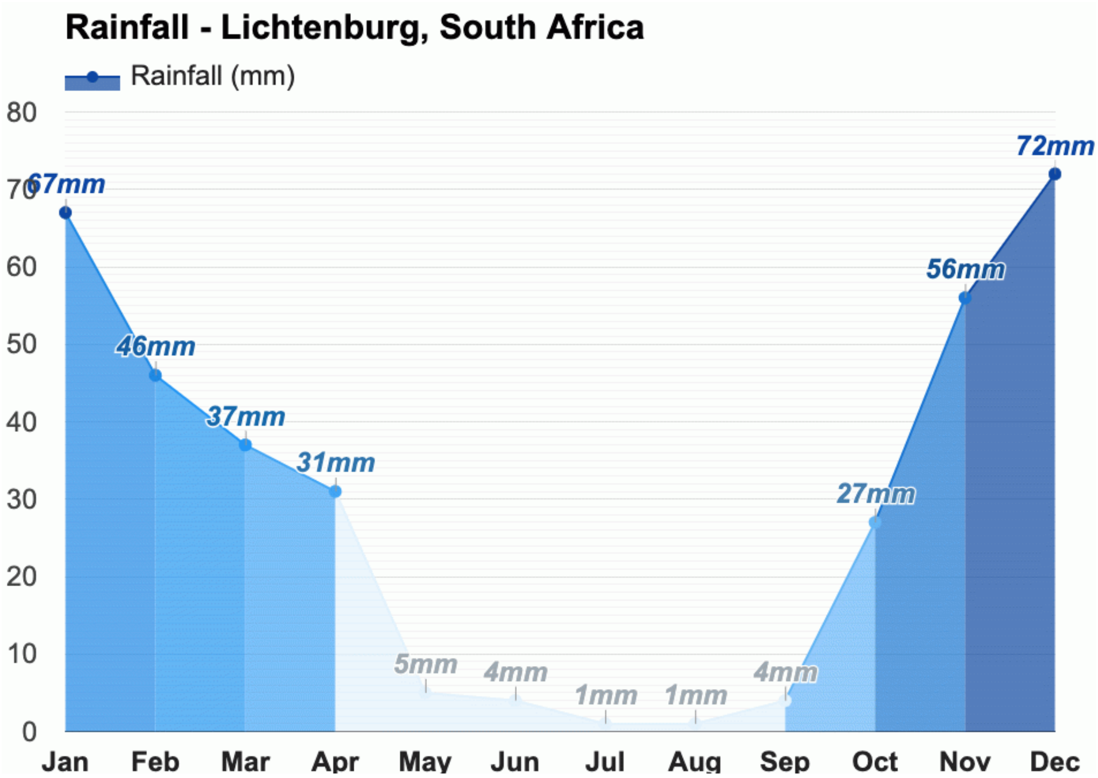

Figure 8:2 Average Rainfall – Lichtenburg, South Africa

The average rainfall days per annum is ± 101 days with January having the highest number of rainfall days (17.8 days). The month with the least number of rainfall days is August (0.8 days). Refer to **Figure 8:3** below.

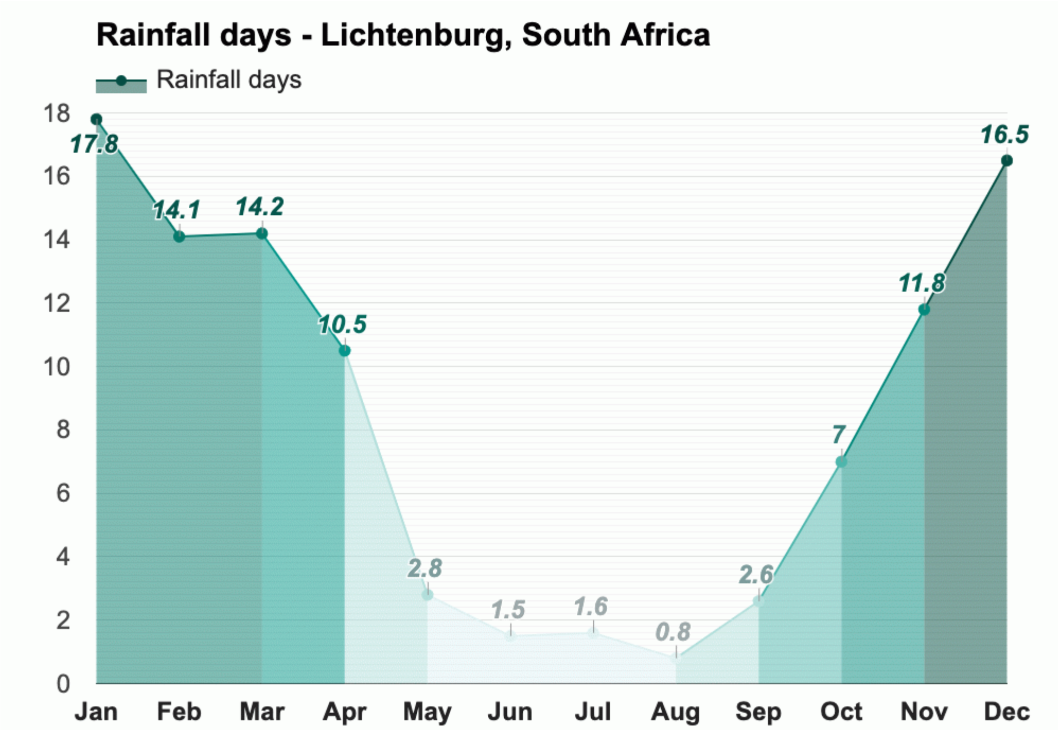

Figure 8:3 Average Rainfall Days – Lichtenburg, South Africa

8.4 Humidity[5]

The region's relative humidity ranges from a maximum of 61 % in February to a minimum of 31 % in September.

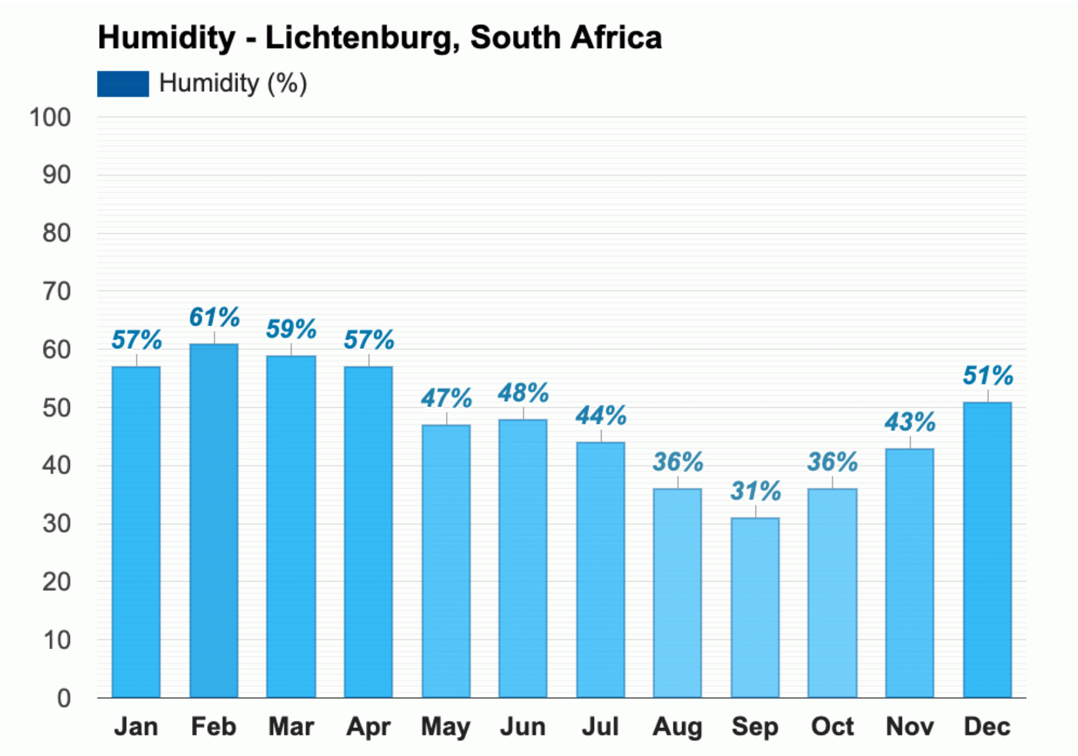

Figure 8:4 Average Relative Humidity – Lichtenburg, South Africa

8.5 Design Rainfall

Design Rainfall Estimation[6] software was used to obtain the rainfall data (tabulated below in **Table 8:1**) required for the run-off calculations.

Table 8:1 Aristida PV Design Rainfall Data

Return Period		2yr	5yr	10yr	20yr	50yr	100yr	200yr
Duration		Rainfall Depth (mm)						
5	min	9.20	12.60	14.90	17.10	20.10	22.50	24.90
10	min	13.70	18.70	22.10	25.50	29.90	33.40	36.90
15	min	17.30	23.60	27.80	32.10	37.70	42.10	46.50
30	min	21.90	29.80	35.30	40.60	47.70	53.30	58.90
45	min	25.20	34.30	40.50	46.60	54.80	61.10	67.60
60	min	27.70	37.80	44.60	51.40	60.50	67.40	74.60
90	min	31.90	43.40	51.20	59.10	69.40	77.40	85.60
120	min	35.10	44.80	56.50	65.10	76.50	85.40	94.40
240	min	41.00	55.80	65.90	76.00	89.30	99.60	110.20
360	min	44.90	61.10	72.20	83.20	97.80	109.00	120.60

[5] Weather Atlas
[6] *Design Rainfall Estimation in South Africa Version 3 developed by MJ Gorven, JC Smithers and RE Schulze*

Return Period		2yr	5yr	10yr	20yr	50yr	100yr	200yr
Duration		Rainfall Depth (mm)						
480	min	47.80	65.10	77.00	88.70	104.20	116.30	128.60
600	min	50.30	68.40	80.90	93.20	109.50	122.20	135.10
720	min	52.40	71.30	84.20	97.10	114.10	127.20	140.70
960	min	55.80	76.00	89.80	103.50	121.60	135.70	150.00
1200	min	58.70	79.90	94.40	108.80	127.80	142.60	157.70
1440	min	61.10	83.20	98.30	113.30	133.10	148.50	164.20
1	day	50.80	69.20	81.70	94.20	110.70	123.50	136.50
2	days	62.50	85.10	100.50	115.80	136.10	151.80	167.90
3	days	70.50	96.00	113.40	130.70	153.60	171.40	189.50
4	days	76.40	104.00	122.90	141.70	166.50	185.70	205.40
5	days	81.40	110.80	130.90	150.80	177.20	197.70	218.60
6	days	85.60	116.60	137.70	158.70	186.50	208.10	230.10
7	days	89.40	121.70	143.80	165.70	194.80	217.30	240.20

9. SURFACE HYDROLOGY

9.1 Drainage of Catchment

9.1.1 Primary Catchment

The site falls within the 'Vaal River' drainage catchment (Primary Catchment' C'), which covers an area of ± 192 000 km² and extends from the northern border of Lesotho, the Mpumalanga escarpment towards the east, Johannesburg CBD to the north and Douglas to the west as shown in **Figure 9:1** below.

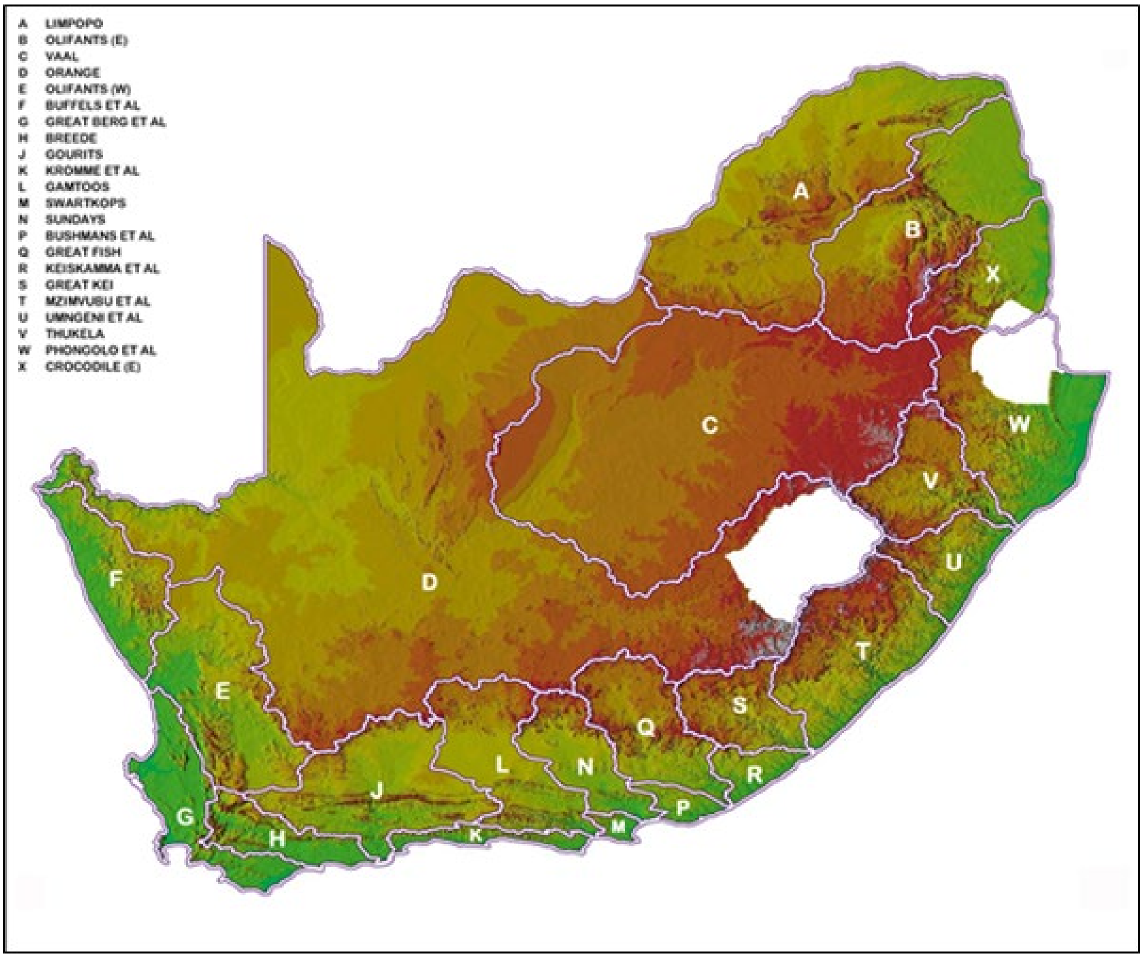

Figure 9:1 Department of Water and Sanitation (DWS) – Primary Catchments

9.2.1 Quaternary Catchment

The proposed facility is located in Quaternary Catchment C31A. This quaternary catchment forms part of the upper reaches of the Harts River, which then flows into the lower reaches of the Vaal River.

10. STORMWATER MANAGEMENT

10.1 Impact of Development[7]

Development is defined as the process of modification or evolution which historically involves the improvement / construction of buildings and civil infrastructure. A new development leads to an alteration in the hydraulic properties of the subjected area, changing surface run-off properties into pervious or impervious layers and subsequently increasing the surface run-off and altering inundation areas. Common historical stormwater infrastructure and surfaces are constructed to efficiently manage the run-off, resulting in shorter catchment response times and increased peak flows.

As a result of the proposed development, stormwater management is key to reducing the negative impacts and ultimately keeping the receiving environment in its natural state. The management is achieved with adequate mitigation measures, per the applicable stormwater drainage standards and policies, to ensure the development can be accommodated within the receiving environment.

[7] *Guidelines for Human Settlement Planning and Design compiled by CSIR Building and Construction Technology*

10.2 The Purpose of Stormwater Management[8]

The purpose of stormwater management is based on several aspects: health and safety, quality of life, and water conservation. These aspects are briefly described below:

- Directing and discharging the stormwater allows the public to protect their health, welfare, and safety. It also provides for the protection of property from flood hazards.
- Enhance the quality of life in communities that are affected.
- To grasp the opportunity to conserve water for beneficial public uses.
- To safeguard the natural environment.
- The balance of economic development and the necessity for a sustainable environment; and
- Optimum stormwater management methodologies are adopted so that the primary beneficiaries pay as per their possible gains.

10.3 Stormwater Management Policies & Design Guidelines

Urban Stormwater Management policies require that the post-development run-off from an area for storms of similar recurrence intervals may not exceed the run-off generated under the pre-development condition. For rural developments, the emphasis should focus more on the detrimental effect to the immediate environment concerning the control of water velocity and erosion rather than minor increases between the pre and post-development flow volumes.

This study area falls within Ditsobotla Local Municipality and greater Ngaka Modiri Molema District Municipality, and, to our knowledge, specific policies, design guidelines, and standards are not available. Therefore, we recommend that the stormwater drainage system refers to the "Red Book[9]" and the "Drainage Manual[10]".

10.4 Stormwater Management Philosophy

The Stormwater Management Philosophy for the proposed development urges the developer, the professional teams, and contractors to achieve the following:

- Always maintain adequate ground cover in all areas to reduce the risk of erosion by wind, water and all forms of traffic.
- Prevent concentration of stormwater flow at any point where the ground is susceptible to erosion. Where unavoidable, adequate protection of the ground must be provided.
- Reduce concentrated stormwater flows as much as possible by providing effective attenuation measures.
- Ensure the development does not increase the stormwater flow rate above what the natural ground can safely accommodate.
- Ensure that all stormwater control structures are constructed safely and aesthetically pleasing in keeping with the overall development.
- Prevent pollution of waterways and water features.
- Contain soil erosion by constructing protective works to trap sediment at appropriate locations. This protection applies particularly during construction; and
- Avoid situations where natural or artificial slopes may become saturated and unstable during and after construction.

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[8] *Guidelines for Human Settlement Planning and Design compiled by CSIR Building and Construction Technology*
[9] *Guidelines for Human Settlement Planning and Design compiled by CSIR Building and Construction Technology*
[10] *Drainage Manual 6th Edition, Published by The South African National Roads Agency SOC Ltd, 2013*

10.5 Stormwater Management Drainage System

Today, stormwater drainage systems can be seen as dual systems incorporating minor and major systems.

The minor stormwater drainage system caters for frequent storm events. Storms of a minor nature usually include stormwater run-off with frequent return periods such as 2 yr, 5 yr & / or 10 years.

The major stormwater drainage system caters for severe, infrequent storm events and includes less frequent return periods such as 20 yr and more.

11. PRE-DEVELOPMENT RUN-OFF CHARACTERISTICS

11.1 Catchment Description

The development falls within two (2) main catchment areas that will affect the proposed development site. The catchment sizes are 20.105 km^2 and 25.953 km^2 and are approximately flat at < 1% slope. As mentioned above in **Section 9**, the catchments all fall within the C31A quaternary catchment. It shows no evidence of clearly defined watercourses. Overland sheet flow occurs in multiple directions through the respective catchments.

The land use is predominantly rural grasslands. Soils were classed under the SCS hydrological soil group C, with a moderately high stormflow potential (slow infiltration rates, shallow soil depths and restricted permeability).

The site is located safely away from any streams, rivers or floodplains and, therefore, will not be impacted by a flood line.

11.2 Site Topography

Both developments combined naturally and uniformly slope in one direction, namely south-east. As mentioned above, no defined drainage lines run through the proposed developments; however, larger drainage lines, namely the Harts River, can be found within the Quaternary catchment outside the proposed developable area, running through Lichtenburg. (Refer to **Figure 11:1** below).

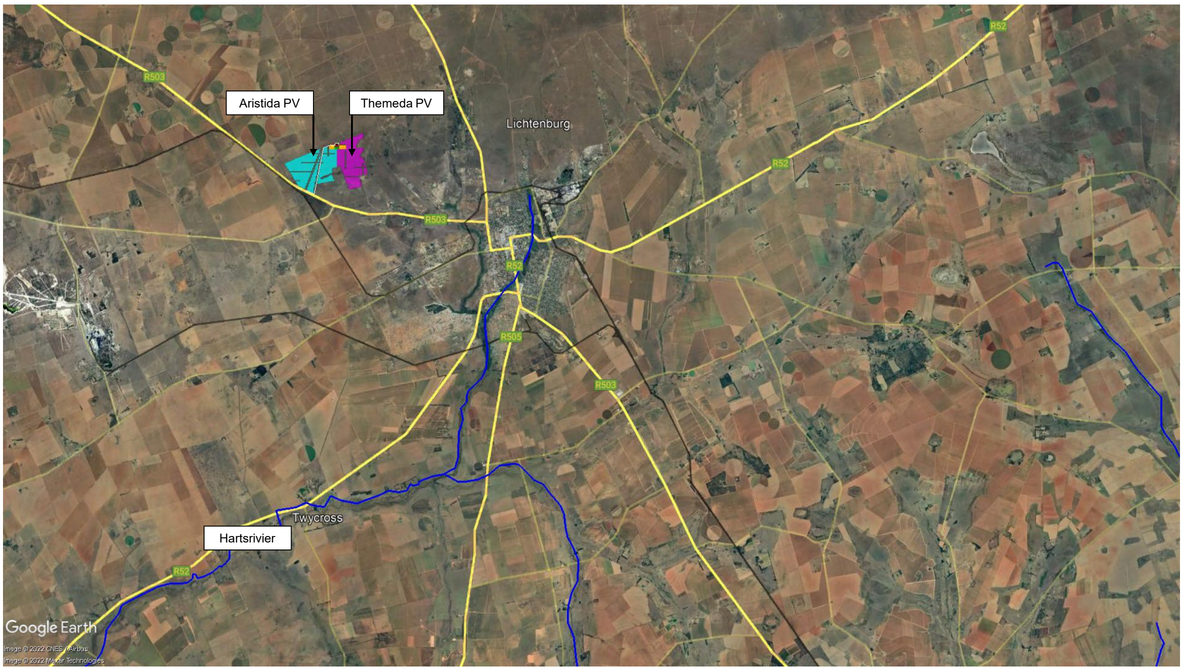


Figure 11:1 Larger Drainage Lines (Blue) outside the Site Parameters (Aristida PV in Cyan)

Please note that detailed contour data was not available for the broader study area. Therefore, the National Geo-Spatial Information (NGI) 's 25 m DEM was sourced to provide terrain data for this area.

Contours were generated from the Digital Elevation Model (DEM) at 2.5 m intervals using ESRI's 3D Analyst Extension for ArcGIS. Therefore, we recommend that an updated, detailed SWMP be completed once a more accurate Digital Terrain Model (DTM) of the site is available

From **Figure 11:3** below, we confirm a natural slope of ± 1:518 or 0.193 % with the following percentages:

- Wetlands & Pans – 80 %
- Flat Areas (3 % to 10 % slope) – 20 %
- Hilly Areas (10 % to 30 % slope) – 0 %
- Steep Areas (> 30 % slope) – 0 %

11.3 Site Vegetation

We confirm that the majority of the site covering is made up of short to medium grass with scattered small shrubs and trees.

Figure 11:2 Aristida PV - Current Site Vegetation

Regarding **Figure 11:2** above, being the typical ground cover on the site, the following percentage splits are applicable: -

- Thick Bush & Plantations – 2.5 %
- Light Bush & Farmlands – 30 %
- Grasslands – 62.5 %
- No Vegetation – 5 %

11.4 Geotechnical Conditions

Concerning **Section 7** – **Geotechnical Study** above, we have assumed the soil conditions to be as follows: -

- Very Permeable – 20 %
- Permeable – 70 %
- Semi-permeable – 0 %
- Impermeable – 10 %

11.5 Hardstand Areas

The property currently has no areas of hardstand: -

- Hardstand Areas – 0 %

11.6 Run-Off Coefficient

Based on *Table 3C.1* of the *Drainage Manual – 6th Edition*[11], the following run-off coefficients have been assigned for this calculation: -

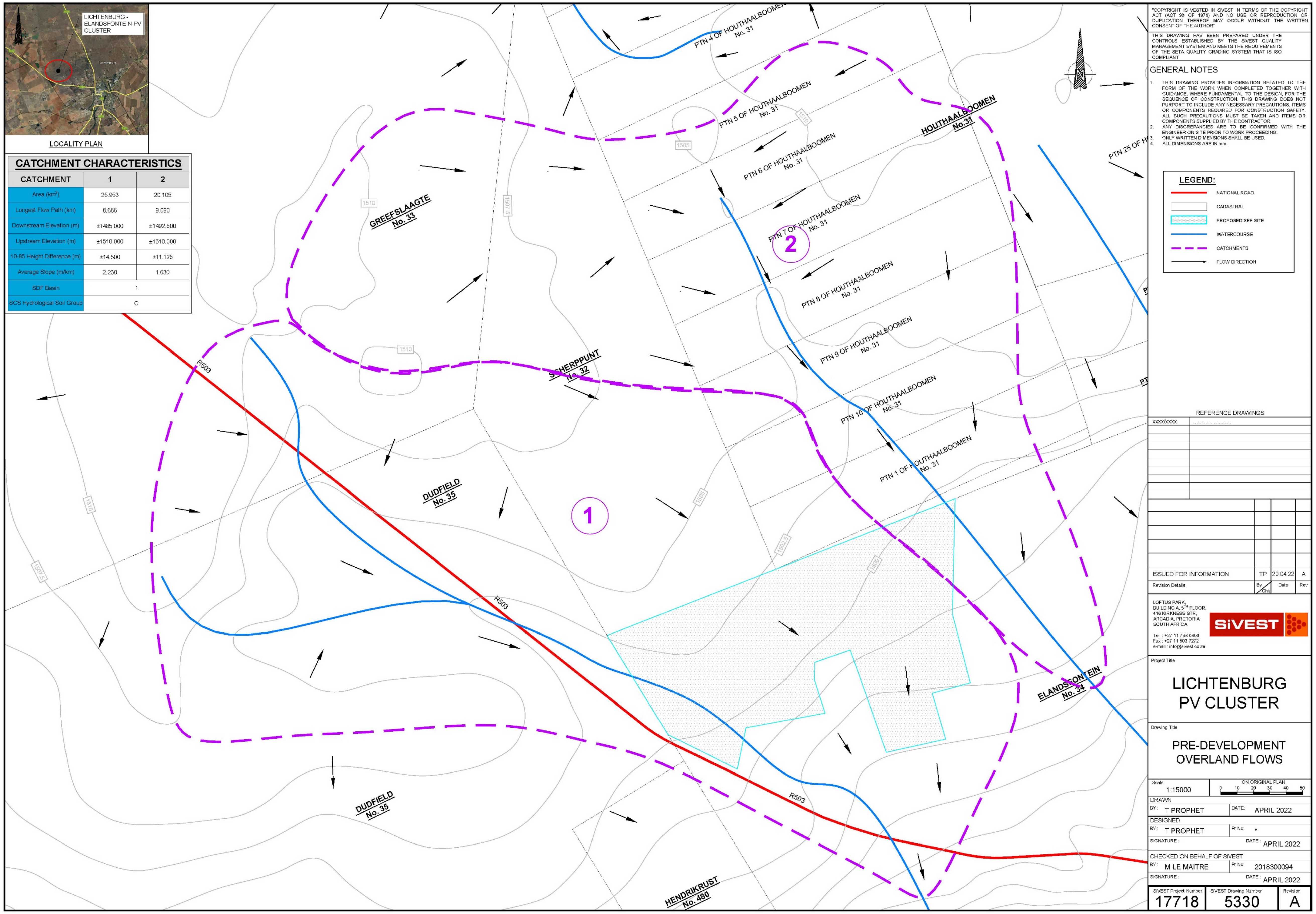
Table 11:1 Pre-Development Run-Off Coefficient

UN-DEVELOPED COMPONENT: Run-off Percentages			
Surface Slope - Wetlands & Pans	**0.03**	**80.0 %**	0.024
Surface Slope - Flat Areas (3 % - 10 %)	**0.08**	**20.0 %**	0.016
Surface Slope - Hilly Areas (10 % - 30 %)	**0.16**	**0.0 %**	0.000
Surface Slope - Steep Areas (> 30 %)	**0.26**	**0.0 %**	0.000
Soil - Very Permeable	**0.04**	**20.0 %**	0.008
Soil - Permeable	**0.08**	**70.0 %**	0.056
Soil – Semi-Permeable	**0.16**	**0.0 %**	0.000
Soil - Impermeable	**0.28**	**10.0 %**	0.026
Vegetation - Thick Bush / Plantations	**0.04**	**2.5 %**	0.001
Vegetation - Light Bush / Farmlands	**0.11**	**30.0 %**	0.033
Vegetation - Grasslands	**0.21**	**62.5 %**	0.131
Vegetation - No Vegetation	**0.28**	**5.0 %**	0.014
			0.309

Based on the preceding, we calculated a **PRE-DEVELOPMENT Run-Off Coefficient** of **0.309**.

It should also be noted that no 'Area Reduction Factor' has been applied as we believe the drainage catchment areas are too small.

[11] *Drainage Manual 6th Edition, Published by The South African National Roads Agency SOC Ltd, 2013*



CATCHMENT CHARACTERISTICS

CATCHMENT	1	2
Area (km²)	25.953	20.105
Longest Flow Path (km)	8.686	9.090
Downstream Elevation (m)	±1485.000	±1492.500
Upstream Elevation (m)	±1510.000	±1510.000
10-85 Height Difference (m)	±14.500	±11.125
Average Slope (m/km)	2.230	1.630
SDF Basin	1	
SCS Hydrological Soil Group	C	

Figure 11:3 Aristida PV Development Area– Pre-Development Overland Flow

12. POST-DEVELOPMENT RUN-OFF CHARACTERISTICS

12.1 Site Development Plan (SDP)

Concerning the SDP, we confirm this proposed PV Plant layout will consist of a series of PV Panels in a structured pattern along with an access road, internal roads, substation, battery energy storage system (BESS), laydown areas, auxiliary buildings, and external access roads etc. The total development area envisaged for the greater Elandsfontein Cluster will cover a combined area of ± 440 ha, whereas AristidaPV will only cover ±251 ha.

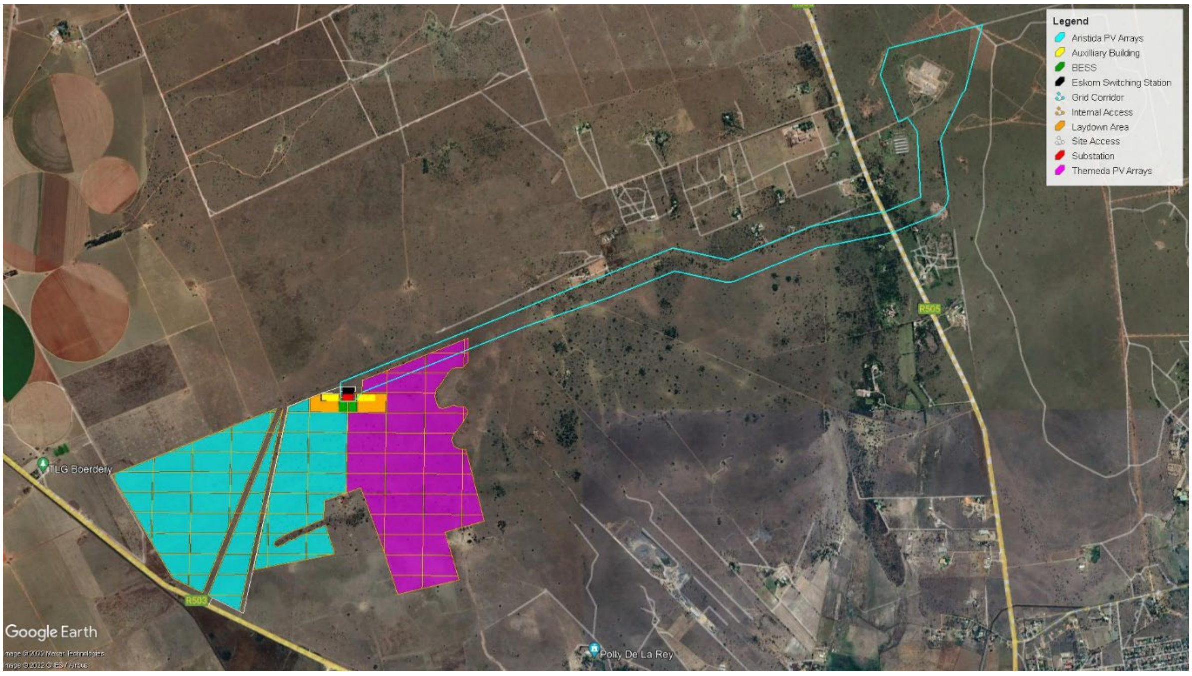


Figure 12:1 Aristida PV SDP (Indicated in Cyan)

12.2 Site Vegetation

The intention is to clear the site void of large bushes and shrubs and to rejuvenate the area over time to its original state in **Figure 11:2** above.

The following percentage splits are applicable: -

- Thick Bush & Plantations – 2.5 %
- Light Bush & Farmlands – 30 %
- Grasslands – 62.5 %
- No Vegetation – 2.5 %

12.3 Geotechnical Conditions

Concerning **Section 7 – Geotechnical Study**, we have assumed the percentages used in the 'pre-development' run-off coefficient to remain unchanged for the 'post-development' as there would be little or no effect from the facility on the existing ground conditions.

The following percentages will be used: -

- Very Permeable – 20 %
- Permeable – 70 %
- Semi-permeable – 0 %

- Impermeable – 10 %

12.4 Developed Components

Once developed, we confirm that the property will have no significant impervious surfaces in the form of surfaced roads or surface covering other than the natural ground cover. However, gravel roads will be constructed across the site to provide access to the PV panels for maintenance purposes. Gravel roads will have frequent discharge points to reduce stormwater concentrations and ultimately minimise the development impact.

We have therefore assumed a slight increase in the area of imperviousness.

- Gravel Roads – 2 %
- PV Facility – 93 %
- Grasslands – 0 %
- No Vegetation – 5 %

12.5 Run-Off Coefficient

Based on *Table 3C.1* of the *Drainage Manual – 6th Edition*[12], the following run-off coefficients percentages have been assigned for this calculation: -

Table 12:1 Post-Development Run-Off Coefficient

UN-DEVELOPED COMPONENT: Run-off Percentages			
Surface Slope - Wetlands & Pans	**0.03**	**80.0 %**	0.024
Surface Slope - Flat Areas (3 % - 10 %)	**0.08**	**20.0 %**	0.016
Surface Slope - Hilly Areas (10 % - 30 %)	**0.16**	**0.0 %**	0.000
Surface Slope - Steep Areas (> 30 %)	**0.26**	**0.0 %**	0.000
Soil - Very Permeable	**0.04**	**20.0 %**	0.008
Soil - Permeable	**0.08**	**70.0 %**	0.056
Soil – Semi-Permeable	**0.16**	**0.0 %**	0.000
Soil - Impermeable	**0.28**	**10.0 %**	0.026
Vegetation - Thick Bush / Plantations	**0.04**	**2.5 %**	0.001
Vegetation - Light Bush / Farmlands	**0.11**	**30.0 %**	0.033
Vegetation - Grasslands	**0.21**	**62.5 %**	0.131
Vegetation - No Vegetation	**0.28**	**5.0 %**	0.014
			0.309
DEVELOPED COMPONENT: Run-off Percentages			
Surface Slope - Wetlands & Pans	**0.03**	**80.0 %**	0.024
Surface Slope - Flat Areas (3 % - 10 %)	**0.08**	**20.0 %**	0.016
Surface Slope - Hilly Areas (10 % - 30 %)	**0.16**	**0.0 %**	0.000
Surface Slope - Steep Areas (> 30 %)	**0.26**	**0.0 %**	0.000
Soil - Very Permeable	**0.04**	**20.0 %**	0.008
Soil - Permeable	**0.08**	**70.0 %**	0.056
Soil – Semi-Permeable	**0.16**	**0.0 %**	0.000
Soil - Impermeable	**0.28**	**10.0 %**	0.026
Gravel Roads	**0.50**	**2.0 %**	0.010
PV Facility	**0.22**	**93.0 %**	0.205

[12] *Drainage Manual 6th Edition, Published by The South African National Roads Agency SOC Ltd, 2013*

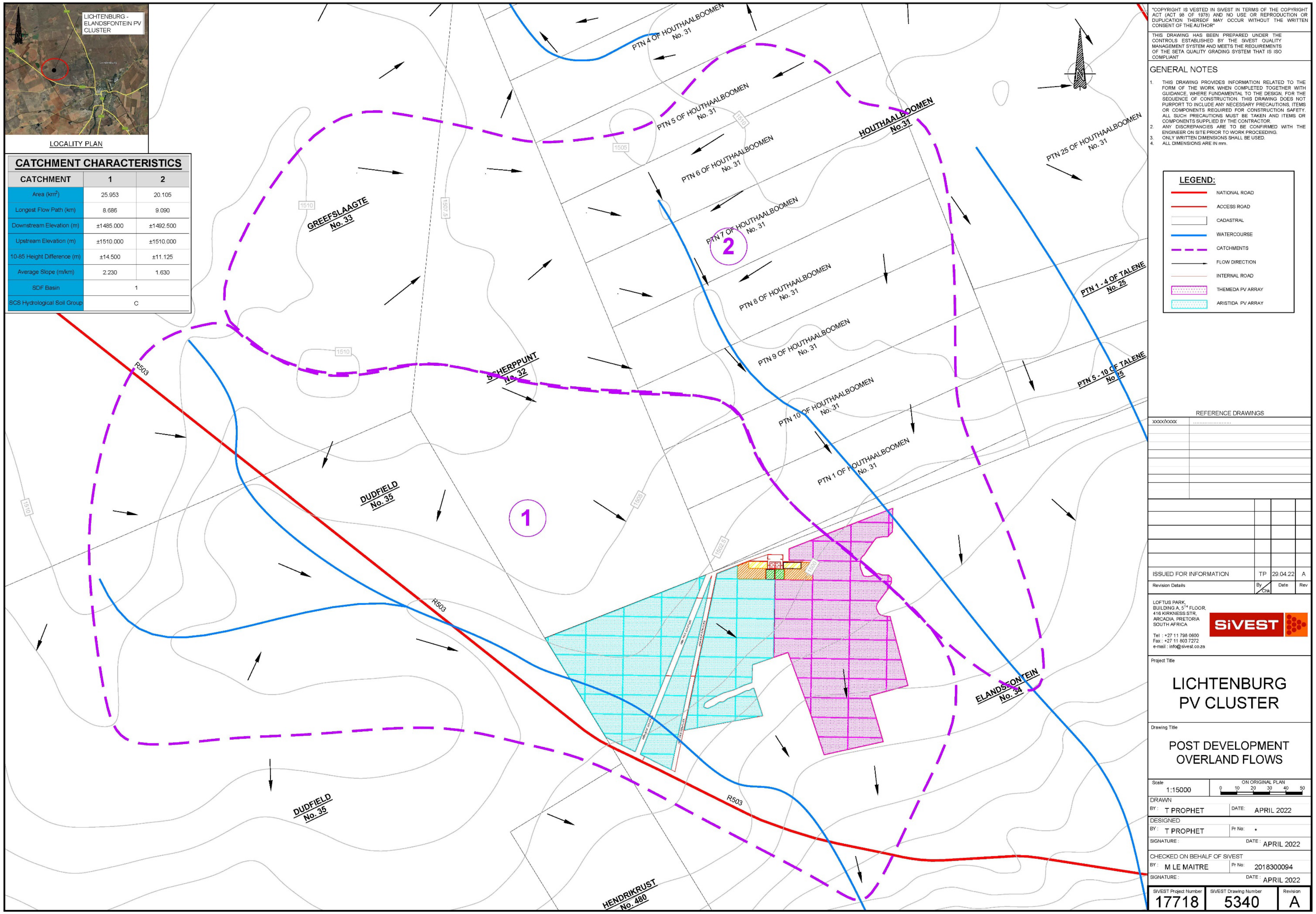
Vegetation - Grass	**0.21**	0.0 %	0.000
Vegetation - No Vegetation	**0.28**	5.0 %	0.014
			0.359

RUN-OFF COEFFICIENT: WITH DOLOMITE								
Description	**%**	**Q2**	**Q5**	**Q10**	**Q25**	**Q50**	**Q100**	**Q200**
UN-DEVELOPED	**92.0**	**0.128**	**0.141**	**0.154**	**0.172**	**0.213**	**0.257**	**0.285**
DEVELOPED	**8.0**	**0.029**	**0.029**	**0.029**	**0.029**	**0.029**	**0.029**	**0.029**
TOTAL Run-Off Coefficient		**0.157**	**0.170**	**0.183**	**0.201**	**0.242**	**0.285**	**0.313**

Based on the preceding, we calculated a **POST-DEVELOPMENT Run-Off Coefficient** for the development area for the following return periods;

- Q2 - 0.157
- Q5 - 0.170
- Q10 - 0.183
- Q25 - 0.201
- Q50 - 0.242
- Q100 - 0.285
- Q200 - 0.313

The above coefficients were then factored into the existing catchments with the appropriate **POST-DEVELOPMENT Run-Off Coefficients** for each return period used in the modelling below.



CATCHMENT CHARACTERISTICS

CATCHMENT	1	2
Area (km^2)	25.953	20.105
Longest Flow Path (km)	8.686	9.090
Downstream Elevation (m)	±1485.000	±1492.500
Upstream Elevation (m)	±1510.000	±1510.000
10-85 Height Difference (m)	±14.500	±11.125
Average Slope (m/km)	2.230	1.630
SDF Basin	1	
SCS Hydrological Soil Group	C	

Figure 12:2 Aristida PV (Indicated in cyan above) – Post-Development Overland Flow

13. SURFACE MODELLING

13.1 Modelling Selection

EMPIRICAL and STATISTICAL METHODS were not considered for this project as insufficient hydrological records and observed points were available for the area. Therefore, a deterministic method has thus been selected to determine the results.

This method comprises mainly manual, graphic and computer-generated spreadsheets. Therefore, we believe our selection of the 'UNIT HYDROGRAPH METHOD '(HRU 1972) and the 'RATIONAL METHOD' is appropriate because the site does not have a varying degree of post-development land change and does not have any existing permanent dams and sub-catchments. Computerised spreadsheets have been used to assist with iterations and to eliminate manual calculation errors.

As noted in **Section 11**, the proposed site is affected by two (2) main catchments: Catchments No. 1 & 2. **Section 13.2** below modelled the surface run-off for each catchment for Pre and Post-Development conditions.

13.2 Surface Run-Off Modelling Results

13.1.2 CATCHMENT N˚ 1

Table 13:1 Pre-Development Modelling Results

Return Storm Period	Unit Hydrograph Method	Rational Method 'Kerby'	Rational Method 'Empirical'	SDF Method	SCS Method
	(m^3 / s)	(m^3 / s)	(m^3 / s)	(m^3 / s)	(m^3 / s)
1: 2 year	3.41	6.19	9.56	14.00	18.54
1: 5 year	17.12	12.26	17.74	30.80	33.02
1: 10 year	24.43	18.59	25.31	47.35	44.03
1: 25 year	35.77	28.82	37.06	63.88	55.73
1: 50 year	52.27	44.45	54.15	85.66	72.00
1: 100 year	72.68	64.95	75.18	108.48	85.13

Table 13:2 Post-Development Modelling Results

Return Storm Period	Unit Hydrograph Method	Rational Method 'Kerby'	Rational Method 'Empirical'	SDF Method	SCS Method
	(m^3 / s)	**(m^3 / s)**	**(m^3 / s)**	**(m^3 / s)**	**(m^3 / s)**
1 : 2 year	3.84	6.97	10.76	14.00	18.54
1 : 5 year	18.95	13.57	19.63	30.80	33.02
1 : 10 year	26.66	20.28	27.62	47.35	44.03
1 : 25 year	38.40	30.93	39.78	63.88	55.73
1 : 50 year	54.57	46.40	56.53	85.66	72.00
1 : 100 year	74.34	66.43	76.89	108.48	85.13

13.2.2 CATCHMENT N˚ 2

Table 13:3 Pre-Development Modelling Results

Return Storm Period	Unit Hydrograph Method	Rational Method 'Kerby'	Rational Method 'Empirical'	SDF Method	SCS Method
	(m³ / s)	(m³ / s)	(m³ / s)	(m³ / s)	(m³ / s)
1 : 2 year	2.39	4.45	6.54	9.76	13.92
1 : 5 year	12.28	8.80	12.14	21.48	24.79
1 : 10 year	17.52	13.35	17.32	33.01	33.06
1 : 25 year	25.65	20.70	25.37	44.55	41.84
1 : 50 year	37.49	31.92	37.07	59.73	54.06
1 : 100 year	52.37	46.65	51.46	75.64	63.92

Table 13:4 Post-Development Modelling Results

Return Storm Period	Unit Hydrograph Method	Rational Method 'Kerby'	Rational Method 'Empirical'	SDF Method	SCS Method
	(m³ / s)	(m³ / s)	(m³ / s)	(m³ / s)	(m³ / s)
1 : 2 year	2.69	5.01	7.36	9.76	13.92
1 : 5 year	13.59	9.75	13.44	21.48	24.79
1 : 10 year	19.12	14.57	18.91	33.01	33.06
1 : 25 year	27.54	22.22	27.23	44.55	41.84
1 : 50 year	39.13	33.32	38.70	59.73	54.06
1 : 100 year	53.57	47.71	52.64	75.64	63.92

The results above indicate the proposed development will have a minor increase between the Pre and Post-Development flows. Therefore, we believe implementing adequate stormwater management guidelines can accommodate the proposed development without negatively impacting the downstream catchment.

14. STORMWATER MANAGEMENT & GUIDELINES

The buildings / structures within the development will require the control of stormwater run-off as per the stormwater management philosophy and policies of the local authority / municipality. The following guidelines are intended to assist in the design of the major and minor stormwater infrastructure and to ensure that the objectives of this SWMP are met during the planning, design, construction, and operational phases of the development.

14.1 Buildings

Any building will inevitably result in some degree of flow concentration or deflection around buildings. The developer / owner shall ensure that all stormwater flow paths are protected against erosion.

Any inlet to a piped system shall be fitted with a screen / grating to prevent debris and refuse from entering the stormwater system. This must be installed immediately on the installation of the infrastructure. The onus is on the owner / developer to maintain the state of the screen / grating to ensure smooth flow.

No building works, earthworks, walls or fences may obstruct or encroach on a watercourse inside or outside the site without approved plans that do not compromise the objectives of the SWMP in addition to any required Authority approvals.

14.2 Roof Drainage

Building designs must ensure that rainfall run-off from roofing and other areas, not subjected to excessive pollution, can be efficiently captured for re-use for on-site irrigation and non-potable water uses.

Where storage for re-use and ground conditions permit, rainwater run-off should connect to detention areas to maximise groundwater recharge. These detention areas must be designed to attenuate run-off, specifically, the peak flows experienced in the reaches of a watercourse.

14.3 Parking and Paved Areas

Parking or paved areas should be designed to attenuate stormwater run-off to an acceptable degree by allowing ponding or infiltration. Stormwater from such areas must be discharged and controlled as overland sheet flow or larger attenuation facilities.

14.4 Roads

Roads should be designed and graded to avoid the concentration of flow along and off the road. Regular side drains discharge points along roads for overland flow to continue as sheet flow towards drainage lines per pre-development conditions (Refer to **Figure 14:1**). Where flow concentration is unavoidable, measures to incorporate the road into the major stormwater system should be taken, providing appropriately designed attenuation storage facilities at suitable points.

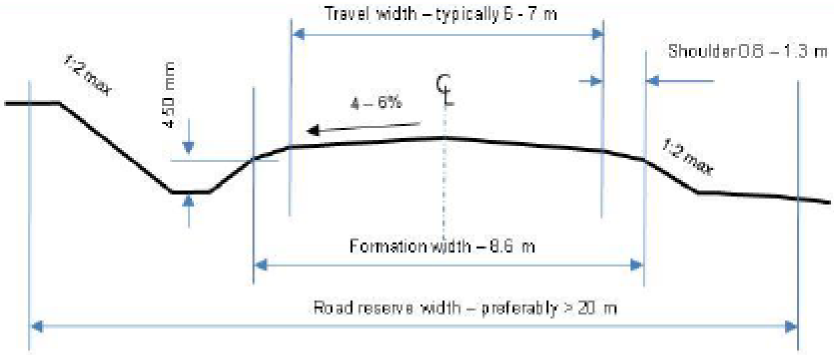


Figure 14:1 Typical Road Cross Section showing side drains

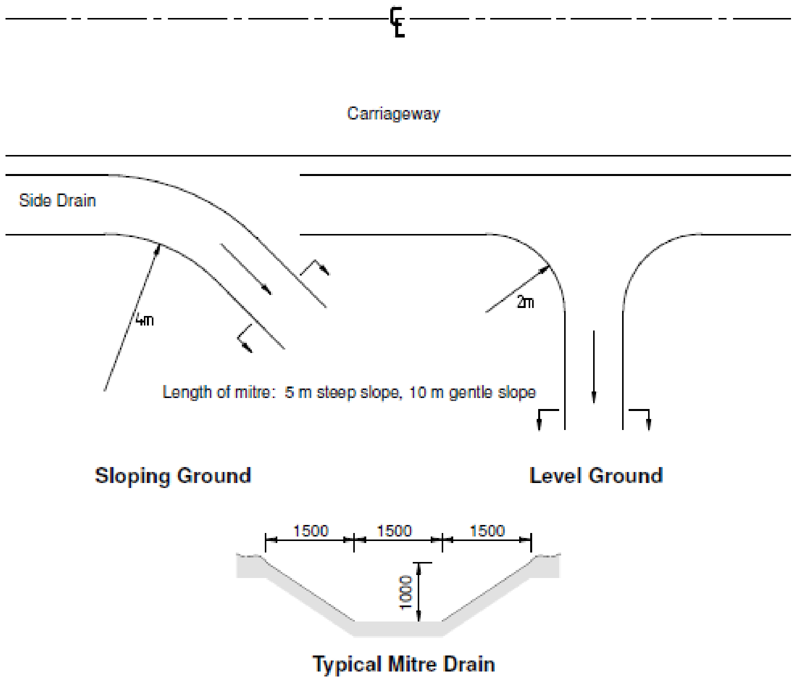


Figure 14:2 Typical Stormwater Mitre Drain / Channel

Gravel roads crossing drainage lines require a suitable sized culvert, concrete causeways or cut-off walls to ensure vehicles can safely pass over natural drainage lines. Culverts for roads must be designed to ensure that the capacity of the culvert does not exceed the pre-development stormwater flow at that point, and attenuation storage should be provided on the upstream side of the road crossing.

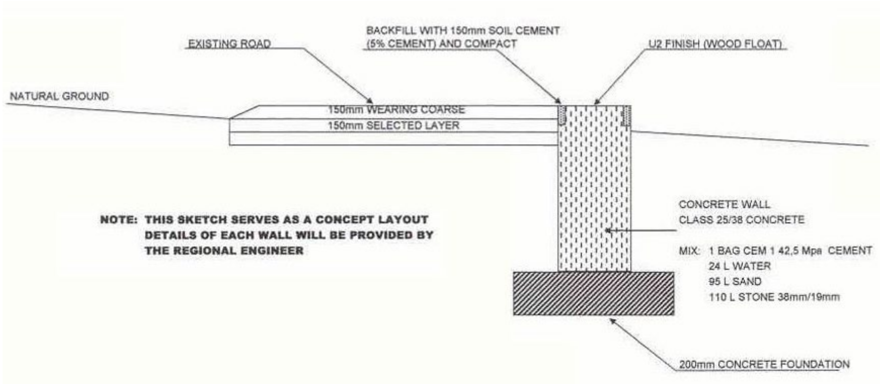


Figure 14:3 Typical Detail of a Cut-Off wall

Figure 14:4 Typical Low-Level Concrete structure

Outlet and culvert discharge points into the natural watercourse must be designed to dissipate flow energy, and any unlined downstream channel must be adequately protected against soil erosion. (Refer to **Figure 14:5**)

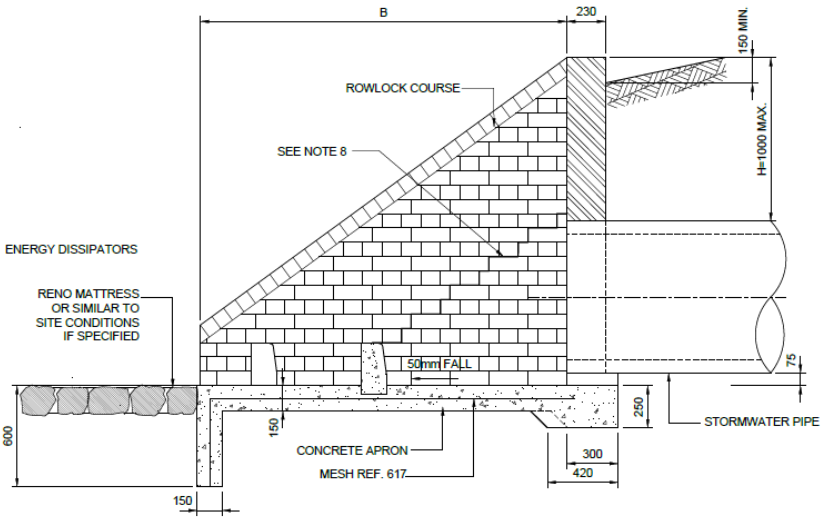


Figure 14:5 Typical Stormwater Headwall with Energy Dissipators

14.5 Subsurface Disposal of Stormwater

Any construction providing for the subsurface disposal of stormwater should be designed to ensure that such disposal does not cause slope instability or areas of concentrated saturation or inundation. Infiltration structures should be integrated into the terrain to be unobtrusive and in keeping with the natural surroundings.

14.6 Channels

Channels may be constructed to convey stormwater directly to a natural watercourse where deemed necessary and unavoidable. The channels must be suitably lined to prevent erosion and scour and provide maximum possible energy dissipation of the flow. Such linings will vary from vegetated earthen to stone pitching or reinforced concrete.

14.7 Energy Dissipation

Measures should be taken to dissipate flow energy wherever concentrated stormwater flow is discharged onto the natural ground.

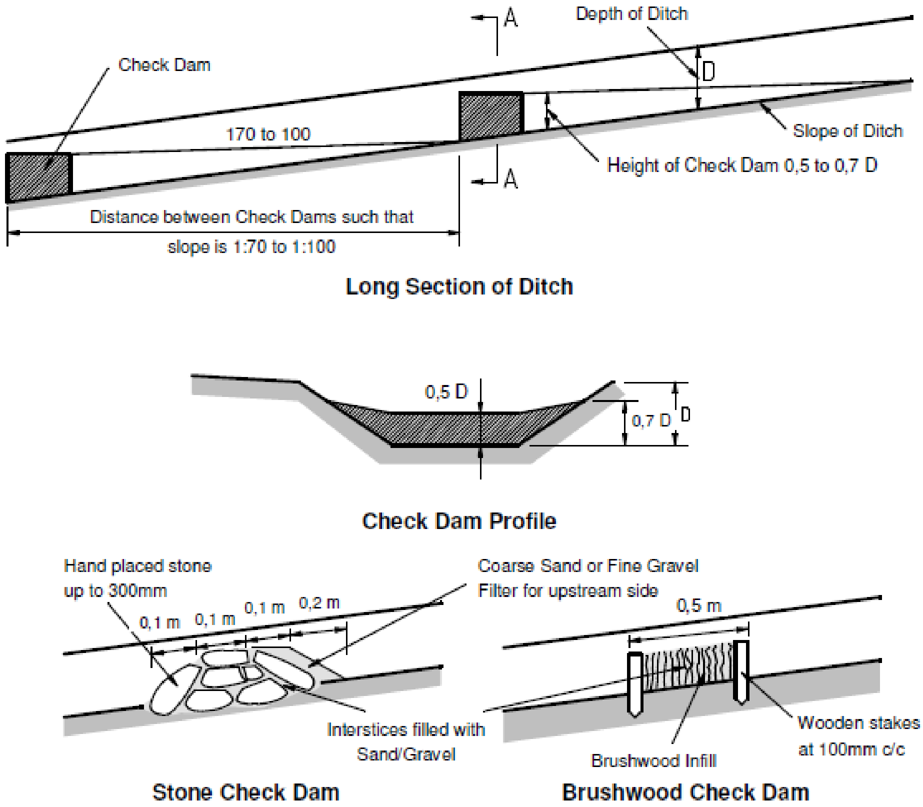


Figure 14:6 Typical Erosion Control

14.8 Open Trenches

Open trenches should not be left open and unprotected for extended periods and should be progressively backfilled as construction proceeds. Excavated material to be used as a backfill must be placed close to the trench on the upstream side to avoid loose material from washing away.

14.9 Stockpiles

Material is to be stockpiled away from drainage paths. Loose material such as stone, sand or gravel must be covered or kept damp to minimise dust. Temporary silt screens are to be positioned immediately downstream of stockpiles to intercept loose material which may be washed away.

14.10 Photovoltaic Panels

For the orientation of panels, we recommend the drainage pattern, flow concentration, drainage area and velocities be considered at the detail design stage. Rows perpendicular to the contours may result in higher run-off concentrations; therefore, mitigation measures are to be included to optimise orientation and keep the run-off as sheet flow across the entire site.

PV panels shall be designed and constructed in such a manner to allow for vegetative growth and maintenance beneath and between the panels. Although not applicable to this development, if any of the PV modules / strings are greater than 3 m high, from the lowest vertical clearance of the panels to above the ground. In that case, non-vegetative control measures will be required to prevent / control erosion and scour along the drip line or otherwise provide energy dissipation from the water running off the panels.

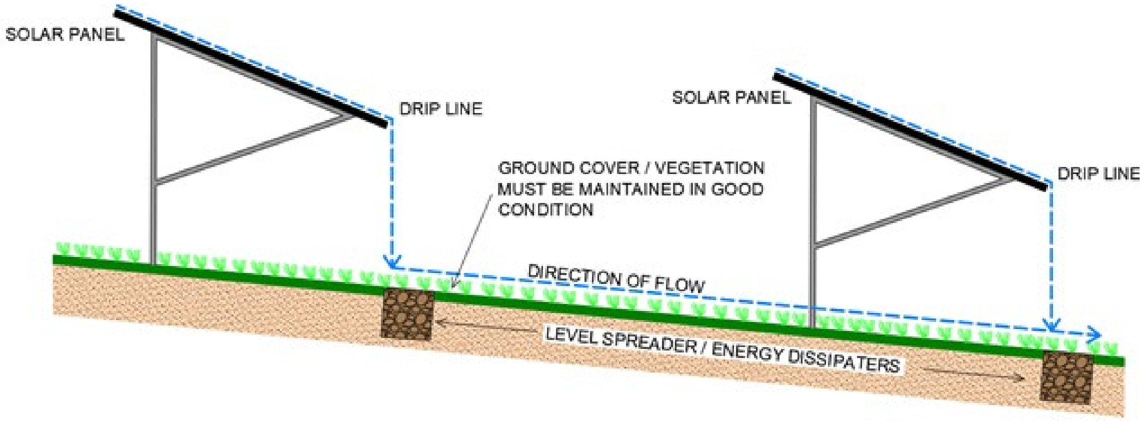


Figure 14:7 Stormwater control of Fixed Tilt PV showing drip line (Conceptual)

14.11 Stormwater Pollution Control

The stormwater systems should be free from materials that could harm the water systems' fauna, flora, and aquatic life.

Sites which generate "dirty" (Grey or Black) water must have measures in place that separates the clean and "dirty" water. Depending on the nature of the "dirty" water, the water must either be discharged into the wastewater system or contained on-site for off-site treatment.

15. STORMWATER MANAGEMENT POLICY

The following rules are to be observed by the owner, developer, professional team, contractors, and sub-contractors:

- The Environmental Management Program (EMPr), as per the EIA and approved by the competent authority, will manage stormwater run-off during construction. All construction activities within the development must comply with the EMPr. This SWMP document is supplementary to the EMPr. The control measures herein are not considered all-encompassing as the contractor will have to adapt site-specific control measures.
- Before the commencement of any construction activities, the contractor must compile and submit his construction SWMP, which needs to comply with the approved EMPr. The plan must include measures to control and prevent erosion during and after construction.
- Existing flood lines / wetlands / stormwater attenuation areas should be protected from encroachment by the development.
- Development designs must include measures for attenuating the increased concentration of stormwater run-off. The post-development peak flows can be attenuated to pre-development conditions if adequate stormwater mitigation measures are not implemented.
- On-site stormwater control systems, such as swales, berms and attenuation ponds, must be constructed before any other construction commences. These systems are to be monitored and appropriately adjusted as construction progresses to ensure complete stormwater, erosion and pollution control.
- All formed embankments must be adequately stabilised.
- This development is located in an area where dolomite is present, and therefore NO stormwater must be allowed to pond for extended periods.

- An approved landscaping and re-vegetation plan must be implemented immediately after building works have reached a stage where newly established ground cover is not at risk from the construction works.
- The contractor must show that all the provisions, regulations and guidelines in this document have been considered.
- In the event of a failure to adequately implement the approved SCP, the contractor shall be responsible for all consequential damage at his own cost. The developer is therefore advised to ensure that all members of the professional team and contractors are competent to undertake the development work and are adequately insured.
- Appropriate designed dolomitic attenuation / detention facilities will be located at appropriately selected sites based on geotechnical, environmental and topographical conditions, including wetland conservation.
- Where conditions permit, open ditches, drains and channels will be used instead of pipes. On steeper slopes, where high flow velocities are anticipated, appropriate linings for all channels must be provided to withstand erosion. Such linings will vary from vegetated earthen to stone pitching and reinforced concrete.
- Flow velocities must be reduced wherever possible to reduce the erosion potential in channels and points of flow concentration (typically at outlets).
- Silt, trash and oil traps must be strategically provided to ensure water quality is not compromised and to prevent blockages in the drainage systems.
- Areas within the proposed development that are bound on stormwater attenuation areas, near road crossings, watercourse confluences and water features might be subject to flooding. In these situations, all development should take place above the outfall levels with an appropriate freeboard allowance.
- Potential future development in these sub-catchments should be considered and any stormwater attenuation requirements should be identified for areas flowing into the development area. Likewise, consideration must be given to the stormwater flowing out of the development, which may impact the downstream areas and watercourses. Appropriate measures must be taken to ensure any upstream development does not result in an increased flood damage risk downstream; and
- All-natural and unlined channels should be inspected for adequate binding of soil by sustainable ground cover. Stone pitching should be used to reinforce channel inverts on steep slopes.

16. CONCLUSION & IMPACT STATEMENT

- In conclusion;
  - The Surface Modelling **(Section 13)** reveals that the proposed development / infrastructure will have a minimal impact on the stormwater quality and quantities of post-development stormwater flow (operational phase).
  - The highest impact will, in all likelihood, occur during the construction phase, and these impacts must be strictly managed under the advisement of the guidelines set out in this document.
  - The need for formal stormwater interventions can be minimised if the development is designed to maintain the existing drainage patterns. Overland flow via poorly defined drainage paths will be the primary form of conveyance.
  - The Civil Engineers must prepare a detailed stormwater management plan describing and illustrating the proposed stormwater and erosion control measures during the detailed design phase.
  - A comprehensive geotechnical study is completed before the detailed design stage of this development.
  - The guidelines described in **Section 14 – STORMWATER MANAGEMENT & GUIDELINES** should be incorporated into the detailed design of the development.

- The policy described in **Section 15 – STORMWATER MANAGEMENT POLICY** be implemented.
- Impact Statement;
  - Concerning this report, associated assessment and the findings made within, it is SiVEST's opinion that the Aristida PV and associated grid infrastructure will have a nominal impact on the existing stormwater catchment. The project is therefore deemed acceptable from a stormwater perspective, provided the recommendations and mitigation measures in this report are implemented. Hence, Environmental Authorisations (EA) should be granted for the EIA application.
  - This document should also be read in conjunction with the EMPr. The developer, owner, and professional team shall ensure that the requirements and conditions set out in the EMPr are adhered to.

17. REFERENCES

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Van Der Walt, J – Heritage Baseline Report: For the Elandsfontein PV Cluster (Themeda PV and Aristida PV), Lichtenburg, North-West Province. Beyond Heritage (2022)

Weather Atlas (Lichtenburg) – *www.weather-atlas.com*

Western Cape Provincial Administration – *Gravel Roads Manual Rev 0*

APPENDIX A: SPECIALIST CURRICULUM VITAE

CURRICULUM VITAE

Name	Merchandt Le Maitre
Profession	Civil Engineer
Name of Firm	SiVEST SA (Pty) Ltd
Present Appointment	Divisional Manager: Civil Engineering Division
Years with Firm	17 Years
Date of Birth	25 September 1982, Johannesburg, South Africa
ID Number	820925 5037 086
Nationality	South African

Education

- University of Johannesburg (2006)
- University of South Africa (2016)

Professional Qualifications

- N Dip: Civil Engineering
- B Tech: Civil Engineering (Water)
- Pr.Tech.Eng. (Reg. No. 2018300094)

Membership in Professional Societies

- Engineering Council of South Africa (ECSA) – Pr Tech Eng; (Reg N° 2018300094)
- South African Institute of Civil Engineers (SAICE)
- South African Wind Energy Associations (SAWEA)

Employment Record

Nov 2020 – present	SiVEST SA (PTY) LTD: Divisional Manager
May 2004 – Oct 2020	SiVEST SA (PTY) LTD: Senior Civil Engineering Technician
Jan 2004 – April 2004	Con Roux Zambia - Junior Foreman
Dec 2002 – Dec 2003	Neda Engineering - Vacation Work

Language Proficiency

LANGUAGE	SPEAK	READ	WRITE
English	Fluent	Fluent	Fluent
Afrikaans	Fluent	Fluent	Fluent

Years of Working Experience: 17

Countries of Work Experience

- South Africa
- Swaziland
- Zambia
- Kenya
- Namibia

Fields of Expertise

- Bulk Services Studies
- Feasibility Studies
- Service Reports
- Infrastructure Design
- Contract Documentation & Procurement
- Contract Administration
- Procurement and Construction Monitoring

Overview

Merchandt joined SiVEST as a student Civil Engineering Technician in 2004 to which he received a company bursary to complete his studies and join the company permanently thereafter. Since joining permanently he has been actively involved in numerous township projects and associated infrastructure projects.

A summary of the experience in each field is indicated below:

Roads & Stormwater
Design, Implement & Contract Administration:

- Provincial Road Intersections (Class 2 Roads)
- Municipal Roads (Class 3-5 Roads)
- Residential & Industrial Township services
- Bulk Stormwater Infrastructure

Hydrology

- Attenuation Reports
- Flood Inundation Assessments / Floodline Reports
- Stormwater Management Reports
- Stormwater Assessments / Investigations
- Roof Gutter & Down Pipe Design / Assessments / Reports

Water & Sanitation
Design, Implement & Contract Administration:

- Water supply lines including Bulk Water
- Water pump stations
- Sanitation networks including Outfall Sewers
- Sewer pump stations
- Farm Irrigation Network

Renewable Energy

- Transportation Impact Assessments
- Water Demand Assessments
- Glint & Glare Assessments
- Stormwater Management Reports

- Preliminary Engineering Reports & Designs

Projects Experience (by Sector)

TOWNSHIP SERVICES

- Tijger Valley Extension 10, 20, 21, 22, 23, 27, 38-44, 72, 105-113, 19, 62, 103, 104, 34, 35, 36, 123 etc. - Design, Procurement, Contract Administration and Monitoring.
- Derdepoort Extension 181- Design, Procurement, Contract Administration and Monitoring.
- Project Springbok, Sasolburg - Design, Procurement, Contract Administration and Monitoring.
- Arcadia Extension 11 - Design, Procurement, Contract Administration and Monitoring.
- Lakeside Erf 181- Design, Procurement, Contract Administration and Monitoring.
- Longmeadow Extension 10, 11 & 12 - Design, Procurement, Contract Administration and Monitoring.
- Bushwillow Estate - Design, Procurement, Contract Administration and Monitoring.
- Forum Homini – Draughting Monitoring of Dam Spillway construction & sewer reticulation.
- Longmeadow Extension 7, 8, 9, 10, 11, 12 – Township services and design of earth retaining wall.
- Lakeside Erf 181 – Design and supervision of Township Services including Attenuation facilities.
- Mbabane Kingdom Hall – Bulk earthworks and road Design, Procurement, Contract Administration and Monitoring.
- Kungwini Bulk Water – Draughting and supervision of a Steel Bulk Water Supply Pipe.
- Mooikloof Booster Station – Design and supervision of a water booster pump facility..
- PTN 2 of 148 Athol – Compiling and analysis Stormwater Assessment.
- Mooibosch Development – Compiling of Services reports and Floodline Determination.
- Hazeldean Extension 39 – Design and supervision of Township Services.
- Hazeldean Retirement – Design of Township Services.
- Kungwini Collector Sewer – Design of Collector Sewer.
- Maroeladal Extension 9 – Design and compilation of Services Report.
- Hazeldean Oukraal – Design of Township Services
- Hazeldean Business Park – Design and compilation of Services Reports.
- Erf 181 Derdepoort – Design and compilation of Services Reports and preliminary design of Provincial Intersection.
- Erf 92 Edenburg – Floodline Determination and design and compilation of the Services reports.
- Longmeadow Extension 12 Stormwater – Design of Stormwater Reticulation.
- Astral Foods - Design, Procurement, Contract Administration and Monitoring of civil services.
- Eastgate Solar Roof – Glint & Glare Assessment
- Cotton Gin Mpumalanga – Design & Procure all services

ROADS & INTERSECTION DESIGN

- D631 Intersection – Design, Wayleave Approval, Procurement, Contract Administration and Monitoring.
- D36 Intersection & Road Widening - Design, Wayleave Approval, Procurement.
- K34 Intersection – Design, Wayleave Approval, Procurement, Contract Administration and Monitoring.
- K101 Intersection – Design, Wayleave Approval.
- Justice Mahomed, University, Walton Jameson Rd Intersection – Design, Wayleave Approval.
- Cedar Road West – Design, Wayleave Approval, Procurement, Contract Administration and Monitoring.
- Brikor – Design of New Intersection.
- New Zealand Embassy – Design of Intersection.
- East Point Game - Design, Wayleave Approval, Procurement, Contract Administration and Monitoring.

HYDROLOGY AND STORMWATER

- Hazeldean Floodline - Data collection, Flood determination and compilation.

- Gautrain Railway Stormwater Management – Design and compile stormwater management and attenuation facilities.
- Stormwater Modelling for Project Springbok – Attenuation of hazardous material in stormwater system.
- Sappi Ngodwana Floodline – Data collection, Flood determination and compilation. This floodline included cognisance of the Ngodwana dam.
- Irene Mall Stormwater Management - Accommodation of the Post Development stormwater flow through an existing township / suburb.
- Loftus Park Stormwater Management – Accommodation of the Post Development stormwater flow through an existing township / suburb.
- Pienaars River Floodline Modelling – Modelling of the river through two future Class 1 & 3 road bridge structures.
- Renewable Energy Stormwater Management – A number of Management Plans for the Renewable Energy sector has been completed.
- Longmeadow Extension 10 (Pick & Pay) – Design and compilation of Stormwater Management report.
- Erf 4173 Peter Place – Floodline Determination.
- Irene Mall Township – Design of Township Services and Stormwater Management.
- Mitsubishi McCarthy Midrand – Design and compilation of Stormwater Management report.
- Isago @ N12 – Floodline Determination.
- Innoland – Floodline Determination.
- Lot 204 Edenburg – Floodline Determination
- Erf 90 Douglasdale – Floodline Determination.
- PTN 35 Houtkoppen – Floodline Determination.
- Erf 4173 Peter Place – Floodline Determination.
- Hyde Close Floodline – Floodline Determination.
- Chartwell Floodline – Floodline Determination
- Hyundai East Rand – Roof Gutter & Down Pipe design
- Oilifants River – Floodline Determination

WATER TRANSFER / RETICULATION AND SANITATION COLLECTORS / OUTFALLS

- Bojanala Platinum District Municipality – Water & Sanitation Bulk Master Planning.
- Hazeldean Development – Bulk Water Supply & Collector Sewer Design, Procurement, Contract Administration and Monitoring.
- Mamba Kingdom – Bulk Water Analysis.
- Lesedi Local Municipality Bulk Water - Design, Wayleave Approval, Procurement, Contract Administration and Monitoring.
- NEF Tomato Paste Project – Design of Farm Irrigation Network

RENEWABLE ENERGY

- Dyansons Klip 5 – Stormwater Management Report
- De Aar Solar – Stormwater Management Report
- Droogfontein Solar – Stormwater Management Report
- Mierdam Solar – Stormwater Management Report
- Prieska– Stormwater Management Report
- Hoekplaas – Stormwater Management Report
- Noupoort WEF – Stormwater Management Report
- Copperton PV – Stormwater Management Report
- Klipgats PV – Stormwater Management Report
- Tooverberg Wind Energy Facility – Transportation Impact Assessment & Water Demand Assessment
- Umsobomvu Solar Energy - Transportation Impact Assessment
- Prieska Solar Energy - Transportation Impact Assessment Amendment
- Droogfontein Solar Energy - Transportation Impact Assessment Amendment

- Loeriesfontein Solar Energy - Transportation Impact Assessment Amendment
- Koeris WEF - Transportation Impact Assessment Amendment
- East Gate Shopping Centre - Glint & Glare Assessment
- Oya Energy - Glint & Glare Assessment
- Yemaya – Glint & Glare Assessment
- Beaufort West WEF – Preliminary Engineering Design
- Heuweltjies WEF – Transportation Study
- Kraaltjies WEF – Transportation Study
- Koup 1 & 2 – Transportation Study
- Grootegeluk Solar Project – Transportation Study
- Renewstable Swakopmund – Glint & Glare Assessment
- Several projects are Confidential as they are not yet in the public domain and hence have not been included in the list above.

OTHER

- Project Springbok – Design of Services and Railway Siding.
- Phalaborwa Mining Company – Preliminary Design of Bulk Water feed and Railway Line.
- Kansanshi Copper Mine, Zambia – Junior Site Foreman.
- Final QC for Sasol Secunda.
- NDT testing – MMC Nelspruit, Global Forest Products Sabie.
- Boiler inspections and preliminary design – MMC Nelspruit, Global Forest Products, TSB Malelane.

Computer Skills

- AutoCAD Civil 3D
- AutoCAD Storm and Sanitary Analysis
- Microsoft Office
- Microsoft Project
- TechnoCAD
  - Surfmate
  - Roadmate
  - Pipemate
  - Watermate
- AutoTURN (Vehicle Turning Simulation Software)
- RiverCAD
- HecRAS
  - 1D Flood Modelling
  - 2D Flood Modelling

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