Preliminary Water Consumption Study

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HOTAZEL SOLAR

Contact Person:
David Peinke
Atlantic Energy Partners
101, Block A, West Quay Building
7 West Quay Road, Waterfront
Cape Town, 8000
F: + 27 (0) 86 514 8184
M: + 27 (0) 84 401 9015
E: david@atlanticep.com

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Name	Title	Signed
David Peinke	Director	

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Name	Designation	Company
Anthony De Graaf	Director	AEP
Craig Stanley	Director	AEP
Dale Holder	EAP	Cape EAPrac

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LIST OF ACRONYMS

AC	Alternating Current
DC	Direct Current
kV	Kilovolt
MW	Megawatt
MWp	Megawatt Peak
PV	Photovoltaic
SEF	Solar Energy Facility
SWSA	Strategic Water Source Areas
UN	United Nations
Wp	Watt Peak
WUL	Water Use License

1. PURPOSE AND SCOPE

This document defines the scope of the study for the definition of water needs and consumption during the **Construction Phase** and in the **Operation Phase** for Hotazel Solar in the Northern Cape Province, South Africa.

2. LOCATION

Hotazel Solar is proposed to be developed on the Remaining Extent (Portion 0) of the farm York A 279, situated in the District of Hotazel in the Northern Cape Province, within the jurisdiction area of the Joe Morolong Local Municipality. The property is 636.79 ha in extent and is located approximately 3.5 km SSE of the town of Hotazel. The proposed development site in situated approximately 3 km south east of the ESKOM Hotazel Substation. Access to the site is provided via the R31 that connects the town of Hotazel to Kuruman.

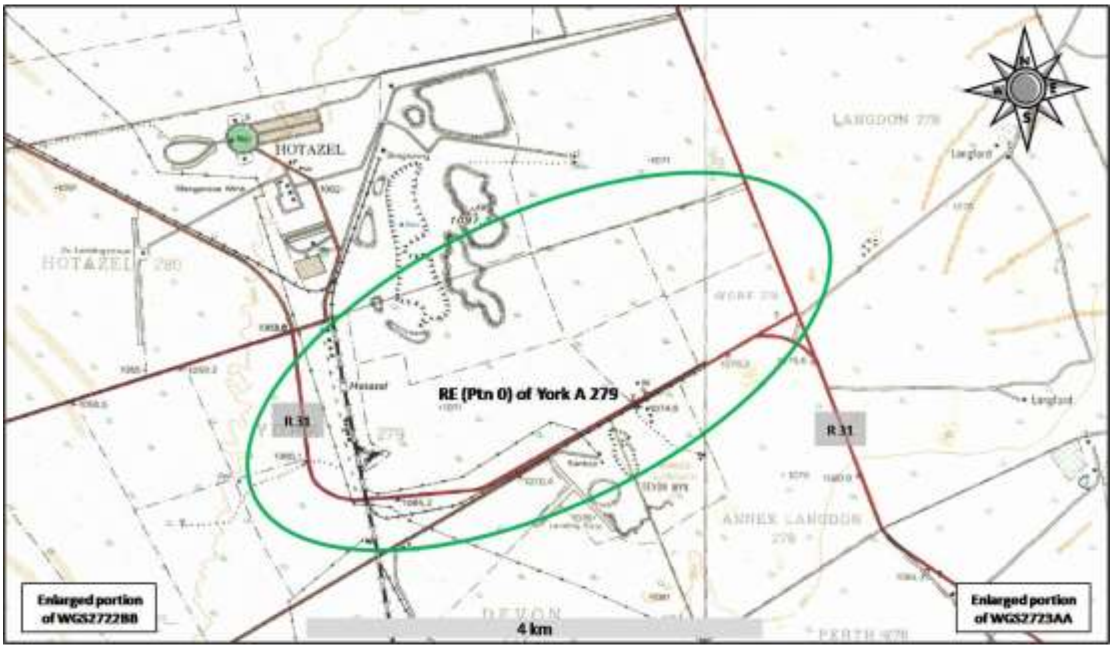


FIGURE 1: HOTAZEL SOLAR

3. BASIC DESCRIPTION OF THE FACILITIES

The solar photovoltaic (PV) plant will have a net AC electrical generating capacity of 100 MW.

The main elements of Hotazel Solar will be as follows:

- Modules (solar panels),
- Inverters,
- Transformers,
- Medium-voltage grid,
- Transformer Substation, and
- Internal and external roadways.

4. WATER NEEDS AND CONSUMPTIONS

4.1. INTRODUCTION

The estimates are based on two distinct phases, the first one being for the **construction** of the solar energy facility (SEF), and the second phase corresponding to the **operation and maintenance** of the installed energy-generating infrastructure.

4.2. CONSTRUCTION PHASE

The **Construction Phase** of Hotazel Solar is broken down into two categories of requirements, **Sanitation** (drinking, cooking and cleaning) and **Construction Processes**. The construction duration of the SEF is estimated to be 18 months.

4.2.1. SANITATION WATER REQUIREMENTS

It is estimated that there will be a maximum of approximately 400 workers on site at the peak of the construction period. The average number of construction workers on site per day is estimated to be a maximum of approximately 200. The United Nations (UN) suggests that a person needs in the region of 20 - 50 litres of water a day to ensure their basic needs for drinking, cooking and cleaning (UN-Water, n.d.). The following calculations assume 50 litres/worker/day with the assumption that **portable chemical toilets** will be used at the construction site.

TABLE 1: CONSTRUCTION SANITATION WATER REQUIREMENTS

Consumption (Litres/worker/day)	**Construction Duration**	**Workers on site**	**Total Consumption** (Litres)	**Total Consumption** (m^3)
50	540 days	200	5,400,000	**5,400**

4.2.2. CONSTRUCTION PROCESS WATER REQUIREMENTS

Water consumption during the construction process is associated primarily with the compaction of roads to meet minimum quality requirements. The requirement is estimated to be 50 litres/m^3. A further 1,500 m^3 quantity has been allowed for other general uses such as concrete curing, road maintenance, dust suppression etc.

TABLE 2: CONSTRUCTION PROCESS WATER REQUIREMENTS

Construction Process	Consumption (Litres/m^3)	Construction Quantities	Total Consumption (Litres)	Total Consumption (m^3)
Compaction of roads	50 Litres/m^3	72,000 m^3 of granular material	3,600,000	**3,600**
Others	-	-	-	**1,500**
TOTAL				**5,100**

Note: Recycled water as opposed to potable water may be used for the above construction processes.

4.3. OPERATIONAL PHASE

The **Operational Phase** of Hotazel Solar is broken down into two categories of requirements, **Sanitation** (drinking, cooking and cleaning) and **Plant Maintenance** (module cleaning and road maintenance & irrigation). The operation duration of the SEF is estimated to be 20 years.

4.3.1. SANITATION WATER REQUIREMENTS

Employment numbers at a solar energy facility depends largely on the extent to which operational processes are automated. For the purpose of these calculations, it is assumed that Hotazel Solar will employ a maximum of 60 workers at any given point in time during the 20-year operational lifespan of the Plant. The United Nations (UN) suggests that a person needs in the region of 20 - 50 Litres of water a day to ensure their basic needs for drinking, cooking and cleaning (UN-Water, n.d.). Assuming 50 Litres/worker/day, the total annual consumption during the operational phase of the facility is calculated to be **1,095 m^3**.

4.3.2. PLANT MAINTENANCE WATER REQUIREMENTS

Module cleaning

For this purpose it is assumed that the solar PV modules will be cleaned twice per annum. A plant with a net generating capacity of 100 MW corresponds to a total peak installed capacity of between 115 MWp and 125 MWp, depending on the permitted inverter ratio. Assuming a module size of 330 Wp, the facility will see a maximum 378,788 units installed. The estimated water consumption is calculated in the following table.

TABLE 3: PLANT MAINTENANCE WATER REQUIREMENTS

Quantity (modules)	**Area** (m^2 per module)	**Water Consumption** (Litres/m^2)	**Consumption per Clean** (Litres)	**Cleans/year**	**Total Consumption** (m^3)
378,788	1.95	3	2,215,910	2	**4,432**

Road maintenance

It is assumed that 200 m^3/year will be required for road maintenance and irrigation purposes.

4.4. WATER STORAGE REQUIREMENTS

It is assumed that potable water will be stored in small water tanks on site. A typical example of such would be a standard JoJo 5,000 Litre water tank measuring 1,820 mm in diameter and 2,100 mm in height.

Grey water and sewerage will be discharged to an approved watertight septic tank system, for collection by authorized agents.

4.5. SUMMARY OF WATER CONSUMPTIONS

The total water consumption estimated for the **Construction Phase** is **10,500 m^3**, for the total **18-month construction period**.

The total water consumption estimated for the **Operational Phase** is **5,727 m^3 per annum**, for the **20-year operational lifespan** of the SEF.

5. GROUNDWATER AND RAINWATER

5.1. INTRODUCTION

In order to reduce the demand placed on the municipality, the Project will look to use both rainwater and groundwater during the construction and operational phases.

5.2. GROUNDWATER

The proposed Hotazel Solar facility will be located near Hotazel in the Northern Cape Province. According to Figure 2 below, the area may have a groundwater occurrence of between 0.1 and 2 litres/second.

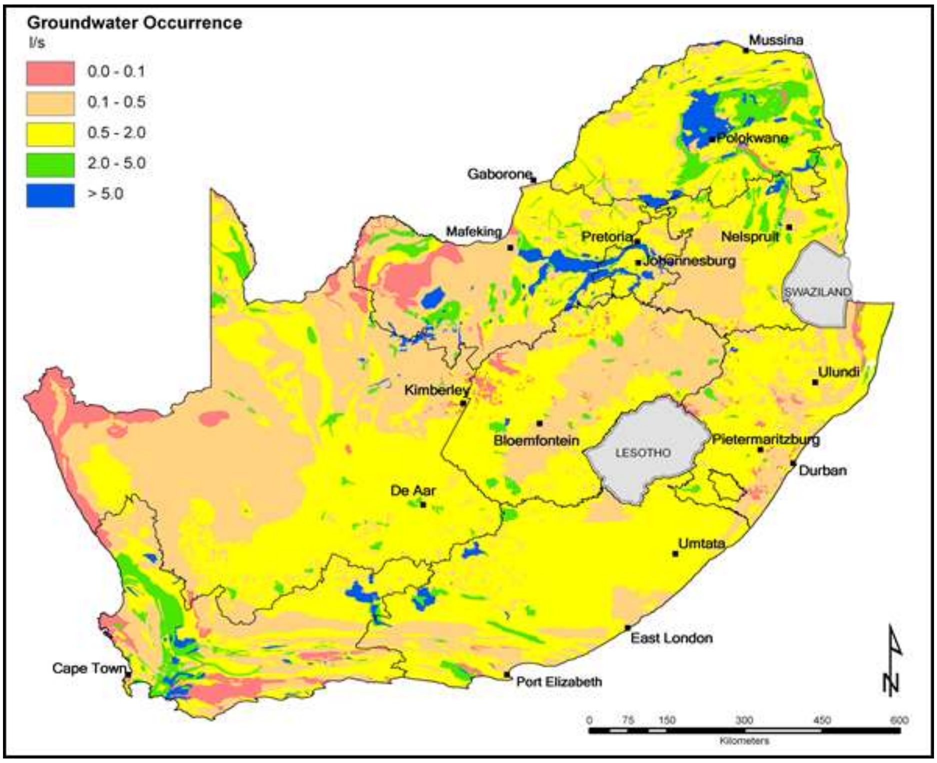


FIGURE 2: GROUNDWATER OCCURENCE IN SOUTH AFRICA (DEPARTMENT OF WATER AFFAIRS)

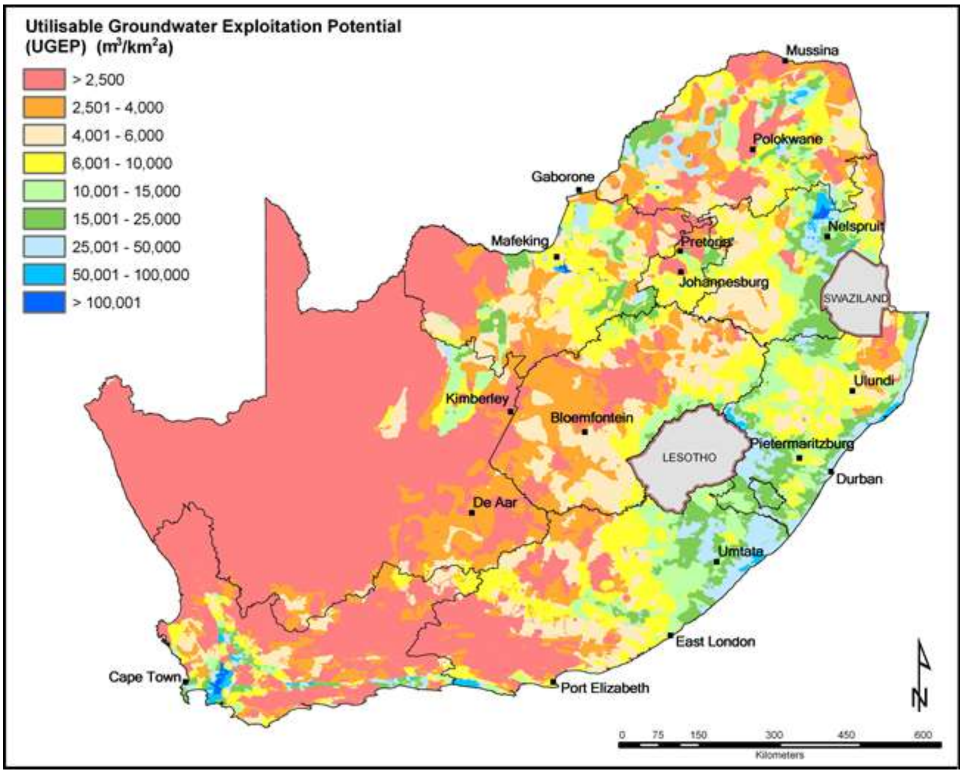


FIGURE 3: UTILISABLE GROUNDWATER EXPLOITATION POTENTIAL, SOUTH AFRICA (DEPARTMENT OF WATER AFFAIRS)

The Developer will solicit the services of a consultant to undertake an assessment of groundwater resources that will include hydrocensus and yield test studies. Should borehole extraction prove to be a feasible water supply option for the proposed Hotazel Solar facility, then the formal processes will commence for registration of the necessary water use license (WUL) applications and the municipality notified accordingly.

5.3. RAINWATER

Figure 3 below (World Weather Online, 2018) depicts the average rainfall amount and rainy days in Hotazel over a 12 month period. The average rainfall for Hotazel over a 12 month period is calculated to be 531.4 mm. Figure 4 below depicts a mean annual runoff map of South Africa (Biodiversity GIS, 2007) in which it is shown that Hotazel may experience anywhere between 0 – 60 mm/year runoff.

FIGURE 4: AVERAGE RAINFALL AMOUNT (MM) AND RAINY DAYS (WORLD WEATHER ONLINE, 2018)

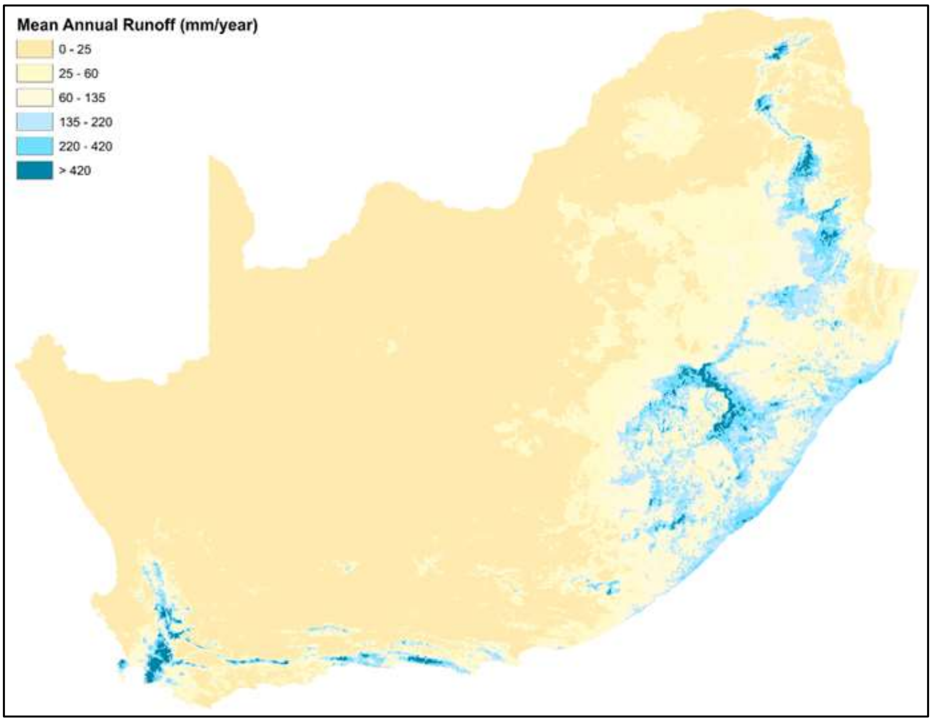


FIGURE 5: MEAN ANNUAL RUNOFF FOR SOUTH AFRICA (BIODIVERSITY GIS, 2007)

5.4. FLOW ESTIMATE

As a minimum it is intended to catch and store rainfall that falls on the roof of the substation building. These calculations are indicative, and are based on the monthly average rainfall of 44.28 mm.
The Rational Method is used to calculate the rain flow: **Q = C x I x A**

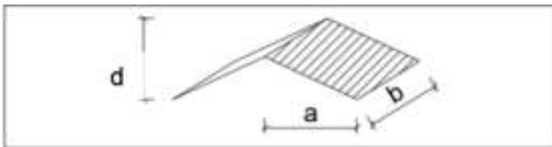
Where:	**Q**	is	**Flowrate**
	C	is	the **Coefficient of Runoff**
	I	is	the **Intensity of the storm**, and
	A	is	the **Catchment Area**

For the roof, the coefficient of runoff, **C**, is equal to **1**.

The Intensity of the storm, **I**, is equal to **0.0615 mm/hr**.

The dimension of the roof is:

- b = 33 m; 2a = 8.55 m; d = 0.6 m, with a total area of 282,15 m^2.



Area considering wind effect

$$A_c = \left(a + \frac{d}{2}\right) \cdot b$$

FIGURE 6: WIND EFFECT FORMULA

Taking wind effect into consideration (see Figure 5), the rainfall catchment area, **A**, of the roof is reduced to **151 m^2**.

The total flowrate, **Q**, is equal to **0,009 m^3/hr**.

Therefore, for an average of 365 days it would be possible to accumulate 81.3 m^3 of rainfall, which meets only 7.4% of the annual sanitation water needs during operation of the solar energy facility, indicating that potable water will need to be trucked in to the facility.

6. LIST OF REFERENCES

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