

**NAMIBRAND NATURE
RESERVE
INTERNATIONAL DARK SKY
RESERVE**



**Annual report and light audit
2016**



Photo: M. Hauptfleisch (Visiting NUST Lecturer)

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Table of Contents

INTRODUCTION	3
Reserve expansion	4
Outreach	
1. Namib Desert Environmental Education Trust schools Stargazing program	5
Monitoring	6
1. External lighting audit	6
2. Fixed-point Sky Quality Meter readings	7
3. Sky Quality M readings throughout the Reserve	8
Summary	10
Appendix	11

INTRODUCTION

International Dark Sky Association – NamibRand Nature Reserve Annual light audit report

NamibRand Nature Reserve (NRNR) has for the last four years kept up its Gold Tier Status. This has been done by auditing new light fittings, buildings and additions to the reserve. This auditing process is only possible due to the Reserve management's commitment, as well as the commitment of all concessionaires.

The NamibRand Nature Reserve concessionaires have all shown their passion for this in a number of ways; Namib Desert Environmental Education Trust (NaDEET) Centre, which hosts to numerous school groups annually, keep a meticulous record of light fittings added removed or changed; Sossusvlei Desert Lodge (SDL), a member of the andBeyond group, hosts astronomers. These are here for three months at a time and are always followed by others, so as to avoid a time where there is no astronomer. The Astronomers take their time at SDL seriously, showing the immense night skies to the andBeyond guests, as well as educating the guides and lodge staff on the night skies; The Wolwedans collection hosted a course for the Namibia Tourism and Hospitality Academy (NATH), where one of the larger topics discussed and lectured on was the night sky and how to use the knowledge to educate visitors to the Reserve.

NamibRand Nature Reserve would like to use the new year to do further outreach to our neighbours and colleagues in conservation. This would be a relatively large undertaking in getting as many people as one could on board. The benefits in this would be darker skies across the Namib Desert, a healthier night time environment – the effects that constant and excessive bright lighting can have on the surrounding, the animals and the people inhabiting these spaces are profound and are often found to go beyond what is presumed. 'Missing the Dark: Health effects of light pollution'

(<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2627884/>)

Light pollution over a city. There is never true darkness



Photo Credit: Alamy, dailymail.co.uk

Beyond the effects on the people, the effect this has on wildlife is incredible. The natural state of affairs, allows animals to fall into a natural and ancient pattern relative and relevant to their

species. It has been scientifically proven, using crickets as test subjects, that excessive exposure to unnatural light and light pollution can cause great harm and imbalances. 'Constant illumination reduces circulating melatonin and impairs immune function in the cricket *Teleogryllus commodus*', (<http://www.ncbi.nlm.nih.gov/pmc/articles/PMC4558066/>).

A brief general summary of the effects of excessive light on wildlife, 7 effects of light on wild animals (<http://www.yourarticlelibrary.com/environment/what-are-the-major-effects-of-light-on-animals-7-effects/3799/> .)

With this all in mind, the importance of darkness cannot be underestimate for balance of the environment, realising this and being aware of these affect across the board, mean that the responsibility the Gold Tier status brings is enormous. The onus is on us, as the first International Dark Sky Reserve in Africa to use this prestige and the invaluable knowledge we have gained in the last fouryears to educate and encourage like-minded people and organisations to follow in our footsteps.

In the course of this report we will go into detail of equipment used, light audits done, light fixtures changed and of course the readings taking and where they were taken.

Reserve expansion

At the Annual General Meeting of the NamibRand Nature Reserve held in May 2016 it was unanimously agreed to incorporate the farm Dina into the Association. As members of the Pro-Namib Conservancy, the farm's owners have already shown a commitment to conservation and the farm has enjoyed a porous border with the NamibRand Nature Reserve allowing for the free movement of wildlife between the properties for many years. Covering an area of approximately 12,480 hectares the farm is a welcome addition to the Reserve and work has already begun to remove the remaining boundary fences between the two properties. A map of the NamibRand Nature Reserve including the newly added farm Dina can be seen in Appendix 1.

At this stage the owners have opted not to construct any accommodation facilities, but rather utilise the already existing facilities on the Reserve as well as on neighbouring properties during their frequent visits. This means that there is now an additional buffer to the South-east of the core area of this Dark Sky Reserve that is completely devoid of any light sources which could potentially contribute to light pollution. Should the situation change in the future and plans to develop a homestead or camp are proposed, such infrastructure would be subject to the Reserve's Lighting Management Plan which aims to aid in the preservation of the night sky by reducing light pollution. The stakeholders involved have already agreed in advance to these constraints and have been incredibly supportive of the Reserve's efforts to date to reduce the visual impact of insensitive lighting.

Outreach

Namib Desert Environmental Education Trust (NaDEET) Stargazing program

NaDEET hosts between 30 and 35 school groups per year comprising of between 30 and 40 learners per group where they are offered the opportunity to experience environmental education in the desert. A part of this program is made up of learning about the skies. Below is the program which they do with kids and the activities and methods used. Thanks to NaDEET for allowing us access to this documentation.

2016 Astronomy and Light Pollution Activities at NaDEET Centre

NaDEET astronomy activity is divided in an indoor and an outdoor part. The learners learn not only about planets, galaxies and stars and their constellation, but are also taught about light pollution. During the indoor session, boards with paintings of the different elements of the sky are used to support the learning process with a practical approach.

The indoor session contains the following parts:

- Watching the movie “Losing the Dark” and discussing about light pollution and dark sky reserves.
- Explanations about some of the elements of our solar system (Sun, Earth, Moon, Communication Satellite, International Space Station and a Shooting Star). Six learners get a board with one element and together they demonstrate the different processes.
- Explanations about different galaxies (Andromeda, Large Magellanic Cloud, Small Magellanic Cloud, Sombrero Galaxy, Milky Way Galaxy). The Milky Way Galaxy is painted on a black cloth and the learners sit on it during the whole activity. The other galaxies are painted on boards and are placed in different corners of the classroom to illustrate the distances.
- Explanations about different types of stars, star clusters (Jewel Box, Omega Centauri, Pleiades), star constellations and the life cycle of stars (white dwarf, neutron star and black hole).
- Explanation about the planets of our solar system. The learners get boards with the different planets and have to arrange themselves in the correct order regarding the distance to the sun. They also learn a mnemonic to remember the order (“**My Very Educated Mother Just Showed Us NaDEET**”).

The outdoor part of the activity takes place up on a sand dune. Depending on the weather and moon situation we point out the visible planets and constellations (Southern Cross, Orion or Scorpio). Additionally, the problematic of space junk is discussed. At the end learners are asked about myths or stories about the sky or the stars they know.

The learners also get additional information about the night sky and light pollution during the whole program. Explanations are given about International Dark Sky Reserves during the introduction about NamibRand Nature Reserve and they also have educational posters in their rooms. Additionally, light pollution is addressed in environmental dramas. One group of learners has to present the problem of light pollution and also a possible solution in their performance.

Monitoring

Compliance with the Reserve's Lighting Management Plan is ensured through a variety of monitoring mechanisms. Ongoing engagement is vital to ensure that all stakeholders understand the importance and benefits of limiting external lighting instead of seeing it as unnecessary and irritating regulation. These mechanisms are described below.

1. External lighting audit

The control warden of NRNR conducts an annual external lighting audit. However, he is also aware of and involved in any changes made within the Reserve as they occur. This allows the opportunity to address potential impacts before any significant investment is made which may not fit in with the Reserve's Lighting Management Plan. The concessionaires are also required to send a report detailing any changes that have been put into effect, for our records as well as to assist with annual audit. An extensive record of this audit is maintained at the Reserve's headquarters in the northern part of the Reserve. This year there were a few changes made by a couple of the concessionaires, these are listed below.

Wolwedans Collection: The base at Wolwedans received a new classroom for students of the Desert Academy, an institution dedicated to training hotel and hospitality staff. The classroom itself is housed within the Wolwedans Base complex. Exterior lighting is limited to four LED Down lighters emitting approximately 218 lumens each, a picture is included below. There were no outside wall-mounted lights added, as these were not needed due to the fact that there were already existing, shielded (and previously reported) lights in the vicinity.



NaDEET Centre:

NaDEET recently replaced some old bathrooms with new ones. The only external lighting comprises LED strip lighting underneath the structures to illuminate the steps leading to the bathrooms. These are fully shielded by the structures and unobtrusive. Below see the photos of the newly added lights.

Below left, the internal light fitting in the bathroom. Below middle, the external LED strip light, below right, internal LED light placed at the sink/wash area.

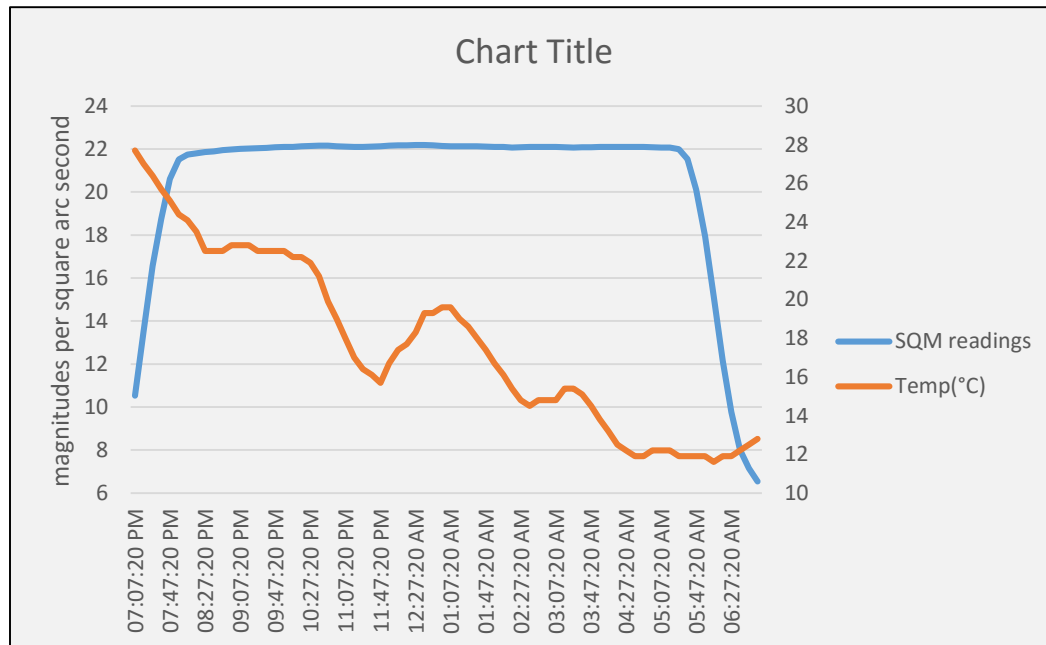


For a complete list of all light fittings on the NamibRand Dark Sky Reserve, please refer to [Appendix 2](#).

2. Fixed-point Sky Quality Meter (SQM) readings

A Sky Quality Meter with a USB interface which was installed on the Reserve in July, 2012, and still gives regular readings throughout the night. This SQM is situated on the roof of the Keerweder office. The graph below shows the readings taken by the SQM over one particular evening.

Figure 1



As can be seen from this graph Sky Quality meter readings on this night exceeded 22 magnitudes per square arc second, an exceptionally dark sky!

Readings are slightly higher than for the readings taken throughout the Reserve. This may be due to the narrower field of view of the fixed-point sky quality meter.

3. SQM readings throughout the Reserve

A second portable SQM (Unihedron Sky Quality Meter with Lens - Narrow Field of View SQM-L), purchased in October 2013 is used to take SQM readings at the sites where the quality of the night sky was originally measured when our submission was made. These readings are done annually and are shown in Table 1 below.

The darkness of the sky measured on the nights of 22, 23 and 24 September 2016, was done at strategic locations spread throughout the Reserve these points are indicated on the map in Appendix 1. These are kept the same for each report, so as to be able to compare the results from year to year. At each location 3 readings are taken and an average reading is worked out and used for the report.

These reading are taken at a distance of 10m, from vehicles, buildings, light fittings or structures. This allows for the most honest reading. It is worth noting that at no point is the reading to be taken by pointing at the Milky Way.

Table 1 below shows the Dark-Sky reading taking on the nights of the 22 to 24 September 2016 Compared to previous years. As mentioned above, these locations are kept as they are, to provide consistency and accuracy for reporting purposes.

Table 1

Table 1 Location	Latitude	Longitude	SQM reading 2013	SQM reading 2014	SQM reading 2015	SQM reading 2016
C19 to D845 Intersection*	24° 41' 55.95"S	16° 1' 13.42"E	-	-	21.37	21.56
C27 to D845 Intersection*	24° 42' 25.40"S	15° 52' 56.24"E	-	21.74	21.62	21.61
C27 Road at Northern Reserve Boundary	24° 45' 14.16"S	15° 53' 46.68"E	21.56	21.69	21.75	21.65
Sossusvlei Desert Lodge Staff Quarters	24° 45' 43.52"S	15° 53' 30.56"E	21.57	21.70	21.79	21.65
Sossusvlei Desert Lodge	24° 46' 45.06"S	15° 53' 18.72"E	21.52	21.73	21.80	21.64
C27 Road at Entrance to Sossusvlei Desert Lodge	24° 46' 51.84"S	15° 54' 13.02"E	21.58	21.70	21.79	21.68
C27 Road at Entrance to Kwessiegat	24° 50' 11.52"S	15° 54' 35.58"E	21.62	21.72	21.80	21.70
C27 Road at Entrance to Camp Musho	24° 52' 59.88"S	15° 57' 16.19"E	21.56	21.73	21.79	21.70
C27 Road at Entrance to Keerweder	24° 57' 32.74"S	16° 1' 26.33"E	21.55	21.75	21.79	21.73
C27 Road at Entrance to Wolwedans	24° 59' 46.19"S	16° 3' 27.45"E	21.55	21.73	21.79	21.64
C27 Road at Entrance to Toekoms	25° 2' 7.39"S	16° 5' 41.08"E	21.52	21.68	21.74	21.73
Wolwedans – Ohorongo Waterhole	25° 5' 36.50"S	15°58'46.93"E	-	21.78	21.81	21.70
C27 Road at NRRR Motor Gate	25° 6' 19.69"S	16° 6' 7.66"E	21.55	21.64	21.54	21.73
C27 Road at Entrance to NaDEET*	25° 12' 11.81"S	16° 9' 31.60"E	21.72	21.62	21.60	21.71
NaDEET Centre (within Core)	25° 13' 42.49"S	16° 3' 37.35"E	21.69	21.71	21.60	21.70
NaDEET/Tokk Tokkie Trails Base	25° 14' 30.20"S	16° 3' 43.43"E	-	-	21.65	21.69
C27 Road at Entrance to Aandstêr	25° 19' 0.50"S	16° 10' 13.92"E	21.55	21.57	21.54	21.70
Aandstêr	25° 21' 40.44"S	16° 5' 59.74"E	21.59	21.62	21.77	21.69
Springbokvlakte – Two Pumps	25° 26' 15.94"S	16° 1' 36.10"E	21.62	21.64	21.67	21.61

(* Reading taken outside the boundary of the Reserve)

Notes on the NamibRand Nature Reserve (NRNR) SQM measurements:

- Readings tabled in order of north to south.
- Readings were done by NamibRand staff members.
- A Unihedron Sky Quality Meter with Lens - Narrow Field of View was used to take the readings.
- Readings were taken with the SQM pointing towards the zenith.
- Measurements were made on two consecutive nights in 2016, the night of September 22-23 and the night of September 23-24.
- Conditions for all measurements were clear and cloudless. The Milky Way was between the zenith and the horizon.
- Readings were taken before moonrise.

Summary

SQM reading throughout the Reserve show that the quality, or darkness, of the sky above the Reserve have changed little over the four years during which monitoring has taken place. There have been some slight fluctuations at individual sites and this may be attributed to the times that readings were taken and what celestial objects were overhead at the time. For example, this year the Milky Way, while not directly overhead, was still quite high and may have influenced the readings due to the amount of light it emits. Similar events may have influenced individual readings in the past. Further training of staff responsible for taking readings will take place this year in order to provide greater consistency in future.

The few external light fittings that were added this year were all compliant with the Reserve's Lighting Management Plan. This shows that all the stakeholders are aware of the importance of maintaining the quality of our night skies.

These reports are a reminder and an aid in allowing us to keep focused on what is important and to remember that all things are connected.

With that in mind and in conclusion, NRNR management and the concessionaires understand and believe that the IDSA Award is not just a prestigious honor and a recognition of what nature has lent us for a brief duration, but that it also forms part of the foundation upon which a balanced and soundly assisted environment and ecology can rest. It is the opportunity to let Nature shine (so to speak) and to step up and be custodians of what matters and what in years to come will be a part of our generations' legacy.

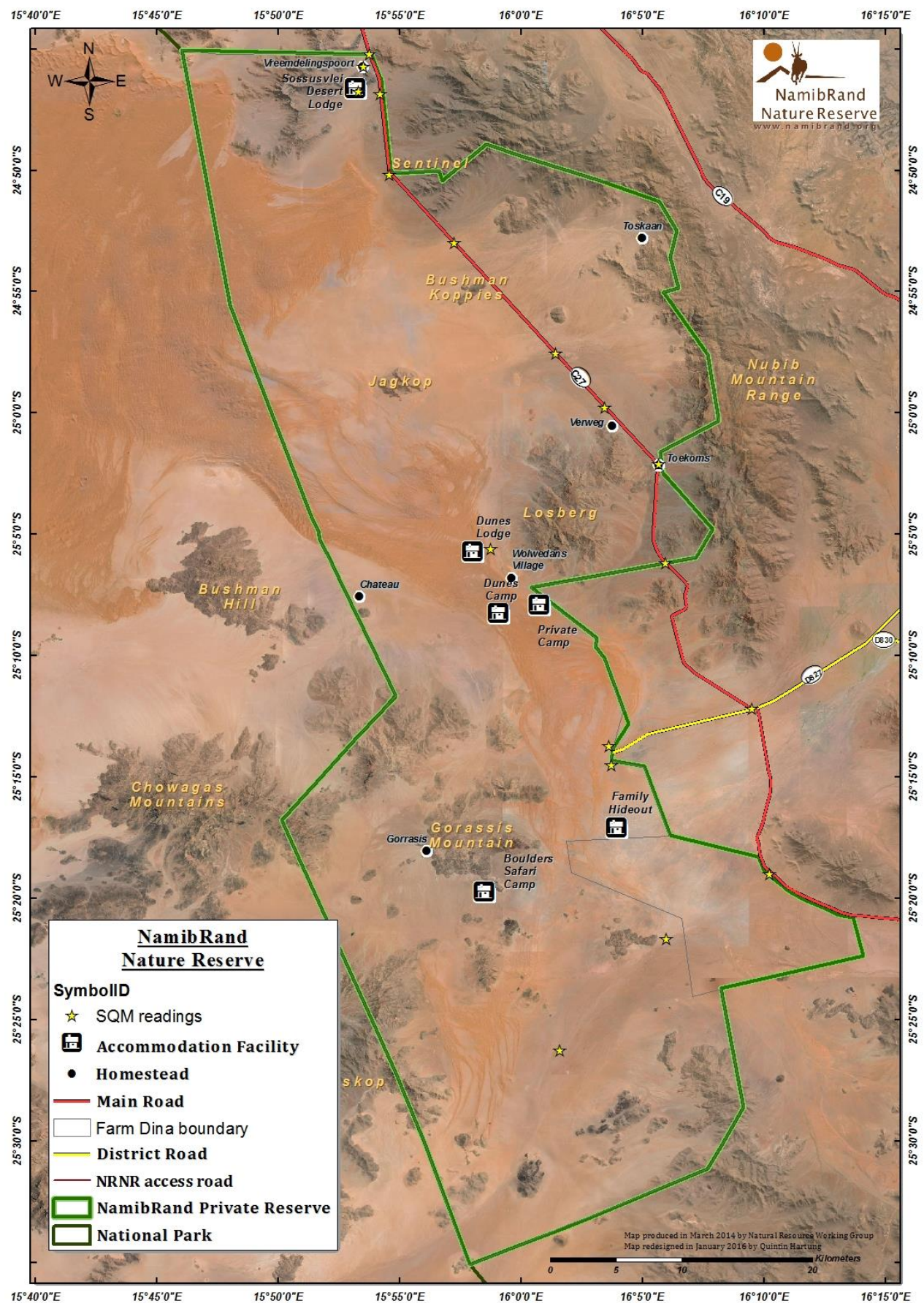
'The old Lakota was wise. He knew that man's heart away from nature becomes hard; he knew that lack of respect for growing, living things soon led to lack of respect for humans too.'

-- Chief Luther Standing Bear



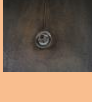
Photo: Pattrick Schoonbee (Wolwedans Ops Manager)

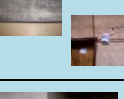
Appendix 1:

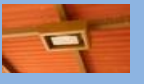
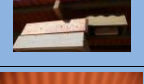


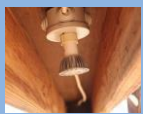
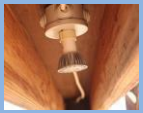
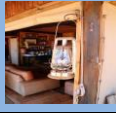
Appendix 2:

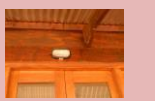
Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Application	Image 2015	2016	Notes
Sossusvlei Desert Lodge Staff Village (on map shown as Vremdelingspoort)	Staff Quarters	22	Wall Light 7W CF 400 lumens	Yes	Building Egress		Remain Unchanged since 2014	Remain unchanged
	Walkways	11	Post Light (Bollard) 15W Red CF		Safety Lights on Walkways		Remain unchanged since 2014	90 lumen red bulbs - Remain unchanged
	Workshop	2	Wall Light 7W CF 400 lumens	Yes	Building Egress		Remained unchanged since 2014	Remain unchanged
	Staff Quarters	1	Wall Light 7W CF 400 lumens	Yes	Building Egress		Remain unchanged since 2014	Remain unchanged
	Chef's Quarters	1	Wall Light 7W CF 400 lumens	Yes	Building Egress		Remain unchanged since 2014	Remain unchanged
	Chef's Quarters	2	Wall Light 7W CF 400 lumens	Yes	Building Egress		Remain unchanged since 2014	Remain unchanged
	Ranger's Quarters	2	Wall Light 12W Red CF	Yes	Building Egress		Remain unchanged since 2014	166 lumen red bulbs - Remain unchanged
	Ranger's Quarters	1	Wall Light 12W Red CF	Yes	Building Egress		Remain unchanged since 2014	166 lumen red bulbs - Remain unchanged

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Application	Image 2014	2015	Notes
Kwessiegat	Residence	2	Wall Light 7W Amber CF 300 lumens	Yes	Illuminate Porch		Remain Unchanged since 2014	Remain unchanged
	Residence	2	Overhead Light 7W Amber CF 300 lumens	Yes	Illuminate Porch		Remain Unchanged since 2014	Light Fixture was changed but is still shaded and at the same location
Toekoms	Residence 1	1	Wall Light 7W Amber CF 300 lumens (1 light removed)	Yes	Egress		Remain Unchanged since 2014	Remain Unchanged and fully shielded
	Residence 2	1	Wall Light 7W Amber CF 300 lumens (1 light removed)	Yes	Egress		Remain Unchanged since 2014	Remain Unchanged and fully shielded

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Application	Image 2014	2015	Notes
Keerweder	Guest House	1	Wall Light 7W Amber CF 300 lumens	Yes	Egress		Remain Unchanged since 2014	Remain Unchanged and fully shielded
	Guest House	1	Wall Light 7W Amber CF 300 lumens	Yes	Egress		Remain Unchanged since 2014	Remian unchanged and fully shielded
	Warden's Residence	3	Wall Light 7W Amber CF 300 lumens	Yes	Egress		Remain Unchanged since 2014	Remain unchanged and fully shielded
	Warden's Residence	3	Bare Bulb 7W Amber CF 300 lumens	Yes	Egress		Remain Unchanged since 2014	Fully Shielded by Structure - Remain unchanged
	Workshop	0	No Light, Removed from Service	NA	NA		Remain Unchanged since 2014	Remian unchanged and fully shielded
	Student Residence	1	Wall Light 7W Amber CF 300 lumens	Yes	Egress		Remain Unchanged since 2014	Remain Unchanged and fully shielded
	Workers' Quarters	1	Wall Light 7W Amber CF 300 lumens (1 light removed)	Yes	Egress		Remain Unchanged since 2014	Remain unchanged and fully shielded
	Workers' Quarters	1	Wall Light 7W Amber CF 300 lumens	Yes	Egress		Remain Unchanged since 2014	Remain Unchanged and fully shielded
	Butchery	1	Wall Light 7W Amber CF 300 lumens	Yes	Work area illumination		Remain Unchanged since 2014	Remain Unchanged and fully shielded
	Waterhole	0	No Light, Removed from Service	NA	NA	Light Removed	Remain Unchanged since 2014	Remain Unchanged and fully shielded

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Application	Image 2014	2016	Notes
Wolwedans Base	Workshop	0	No Light, Removed from Service	NA	NA		Remain Unchanged since 2014	Remain unchanged
	Workshop	6	Wall Light 14W CF	Yes	Work area illumination		Remain Unchanged since 2014	Remain unchanged
	Workshop	1	Overhead Light 72W Fluorescent	Yes	Work area illumination		Remain Unchanged since 2014	Remain unchanged
	Reception	1	55 W att W arm W hite	Yes	Varenda Reception		Remained unchange since 2014	Fully Shielded
	Reception Coffee Lounge	1	55 W att W arm W hite	Yes	Coffee Lounge		Remained unchange since 2014	Fully Shielded - Newly fitted light fixture
	Kitchen	2	55 W att W arm W hite	Yes	Kitchen Varenda/Dining Area		Remained unchange since 2014	Fully shielded
	Front of Kitchen	2	55 W att W arm W hite	No	In front of the Kitchen		Remained unchange since 2014	Remain Unchanged
	Laundry Varenda	1	55 W att W arm W hite	Yes	Laundry Varenda / Dining area		Remained unchange since 2014	Light were replaced by a fully shielded light
	Farm Shop	1	18 W att W arm W hite	Yes	Farm Store Varenda		Remained unchange since 2014	Light was replaced with a new fully shielded light fixture
	Store Room	1	11 W att W arm W hite	Yes	In Front of the Store		Remained unchange since 2014	Put in after first Audit
	Back of Guide Room	2	11 W att W arm W hite	Yes	Varenda		Remained unchange since 2014	Put in after first Audit
	Welding Workshop	2	2 nt Bulb 1185 W att		Used for occasional night welding		Remained unchange since 2014	Not used very often Half Shaded - Put in After first audit
	Car Park	1	85 W att Cool W hite				Remained unchange since 2014	Not used very often Half Shaded
	Student (DA) House	6		Yes			Remained unchange since 2014	Shaded by the Building Roof- Put in After first audit
	Walkways	8	Cool W hite LED	Yes	0		Remained unchange since 2015	Added in 2015

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Application	Image 2015	2016	Notes
Wolwedans Dune Lodge	Main lodge	1	W all Light 15W Incandescent	No	Porch Lighting		Remained unchanged since 2014	Remain Unchanged and fully shielded
	W alkways	13	Mounted Under Benches 15W Incandescent	Yes	Illumination of W alkways		Remained unchanged since 2014	Remain Unchanged and fully shielded
	Guest Chalets	10	W all Light 7W Amber CF 300 lumens	No	Egress		Remained unchanged since 2014	Remain Unchanged and fully shielded
	W alkways	9	Flood Lamp 3W LED Mounted Under Benches	Yes	Illumination of W alkways		Remained unchanged since 2014	Remain Unchanged and fully shielded
	Guest Rooms	20	Flood Lamp 3W LED Mounted Under Benches	Yes	Egress		Remained unchanged since 2014	Remian unchanged and fully shielded
	W alkway Lights	15	Solar Jar Lamps	Yes	Illuminaiton of W alkways		Remained unchanged since 2014	Added in 2015
Wolwedans	Old Dune Camp	9	Under Railing Mounted 5W Incandescent	Yes	Illumination of W alkways		Remained unchanged since 2014	Remain Unchanged and fully shielded
	W alkways	10	Unpressurized Oil Lantern	No	Illumination of W alkways		Remained unchanged since 2014	Remain Unchanged
Wolwedans Private Camp	W alkways	9	Unpressurized Oil Lantern	No	Illumination of W alkways		Remained unchanged since 2014	Remain Unchanged
	New Room	5	W all Mount 3watt warm white LED 60 Lumens	Yes	Lights up the Deck		Remained unchanged since 2014	New external light fixtures to new Private Camp Room
	Deck LED Strip	2	W all Mount 3watt warm white LED 60 Lumens	Yes	Light up the deck		Remained unchanged since 2014	New external light fixtures to new Private Camp Room
Wolwedans	W alkways		Unpressurized Oil Lantern	No	Illumination of W alkways		Remained unchanged since 2014	Remain Unchanged

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Application	Image 2014	Image 2015	Notes
NaDEET Centre	Main Building	1	Wall Light 11W CF	Yes	Egress		Remained unchanged since 2014	Unchanged since 2011
		1	Wall Light 11W CF	Yes	Dish Washing		Remained unchanged since 2014	On motion detector/timer (foil around fixture) Unchanged since 2011
NaDEET (Die Dune)	Base	1	Overhead Bare Bulb 14W CF	Yes	Front Office		Remained unchanged since 2014	Unchanged since 2011
	Director's Residence	1	Wall Light 5W CF	Yes	Veranda lighting		Remained unchanged since 2014	Fully Shielded By Building Unchanged since 2011
	Director's Residence	1	Wall Light 5W CF	Yes	Veranda lighting		Remained unchanged since 2014	Fully Shielded By Building Unchanged
	Base	1	18 Watt Warm White	Yes	Work Area		Remained unchanged since 2014	Unchanged since 2011
	Little House	1	Wall Light 15 Watt CF	Yes	Veranda lighting		Remained unchanged since 2014	Unchanged since 2013
	Back Rooms	1	Overhead Bare Bulb 11W CF	Yes	Residence Veranda Lightning		Remained unchanged since 2014	Unchanged since 2011

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Application	Image 2014	Image 2015	Notes
Die Dunie Tok Tokkie Trails	Base	1	Wall Light 5W CF	Yes	Veranda lighting		Remain unchanged since 2014	Shield Added
	Base	1	Wall Light 14W CF	Yes	Egress		Remain unchanged since 2014	On motion detector/timer Unchanged since 2011
	Base	1	Overhead Bare Bulb 11W CF	Yes	Work Area		Remain unchanged since 2014	Shield was changed to cover the whole light
	Base	1	Wall Light 10 Watt CF	Yes	Veranda lighting		Remain unchanged since 2014	Foil removed and Shield painted black
	Horseshoe Camp	2		Yes	Campsite		Remain unchanged since 2014	Both lights shielded by the roof - Newly fitted fixtures
	Horseshoe Camp	1		Yes	Campsite		Remain unchanged since 2014	Fully Shielded - Newly fitted light fixture
	Horseshoe Camp	1			Campsite		Remain unchanged since 2014	Not Shielded - Newly fitted Light fixture
	Horseshoe& Schafsberg Camp	4			Campsite		Remain unchanged since 2014	Not Shielded - Newly fitted Light fixture
	Horseshoe& Schafsberg Camp	2			Camp site		Remain unchanged since 2015	Parafin Lamps replaced with solar lamps
	Schafberg	1			Campsite		Remain unchanged since 2014	Fully Shielded - Newly fitted light fixture
	Campsites	2					Remain unchanged since 2014	Not Shielded - Newly fitted Light fixture

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Application	image 2014	Image 2015	Notes
Family Hideout	Residence	1	Wall Light 9W CF	Yes	Porch Lighting		Remained unchanged since 2014	Fully Shielded By Building unchanged since 2011
	Campsite 1 (Orion)	1	Wall Light 5W CF	Yes	Dish Washing Station		Remained unchanged since 2014	Unchanged since 2011
	Campsite 1(Orion)	4	Wall Light 5W CF	Yes	Dish Washing Station		Remained unchanged since 2014	Unchanged since 2014
	Campsite 2 - New Campsite (Venus)	1	Wall Light 5W CF	Yes	0		New Light fixtures added in 2015	
	Campsite 2 - New Campsite (Venus)	1	Wall Light 5W CF	Yes	0		New Light fixtures added in 2015	
Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Application	Image 2014	Image 2015	Notes
Aandster	Residence	8	Recessed Ceiling Light 3W LED	Yes	Porch Lighting		Remain unchanged since 2014	Remain Unchanged
	Annex	0	No Lights, Removed from Service	NA	Egress		Remain unchanged since 2014	Remain Unchanged
	Annex	1	Wall Light 40W Incandescent	Yes	Egress		Remain unchanged since 2014	Fully Shielded By Building
	Annex	0	No Light, Removed from Service	NA	Security		Remain unchanged since 2014	Remain Unchanged
	Garage	1	Wall Light 40W Incandescent	Yes	Security	Remain Unchanged	Remain unchanged since 2014	Remain Unchanged

Location	Area	Number of Lights	Fixture, Wattage and Type	Fully-Shielded	Application	Image 2014	Image 2015	Notes
Springbokvlakte	Bunk House	2	11A Under roof	Yes			Remain unchanged since 2014	Shielded By Building - Remain unchanged
	Main House	2	7 A Exposed	Yes			Remain unchanged since 2014	Shielded By Building - Remain unchanged
	Main House	3	65mA Oranng Light	Yes			Remain unchanged since 2014	Shielded By Building - Remain unchanged
	Main House	12	Under Roof	Yes			Remain unchanged since 2014	Shielded By Building - Remain unchanged
	Staff Quarters	2	Under Roof	Yes			Remain unchanged since 2014	Shielded By Building - Remain unchanged
	Pool Area	4	75Ms Under roof	Yes			Remain unchanged since 2014	Shielded By Building - Remain unchanged