7. GENERAL DESCRIPTION OF THE STUDY AREA ENVIRONMENT

The Northern Cape is considered to be the region most suitable for the establishment of a CSP Plant in South Africa. Potential areas surrounding Upington and Groblershoop have been identified. A general description of the study area environment is presented below.

7.1. Locality

The study area is situated within the Siyanda District Municipality, in the Northern Cape Province adjacent to the Orange River. The Siyanda District Municipality is situated to the north of the province and covers an area of 103 771 square kilometres with its borders aligned with Botswana and Namibia. This district municipality consists of six local municipalities. The N14 and the N10 are the primary roads in the region and are the main link between Gauteng and Namibia. The largest town in the study area is Upington. The population distribution is primarily concentrated in and around the small towns along the Orange River. Other towns/settlements in wider study area include, Keimoes, Kanoneiland, Louisvale, Oranjevallei, Klippunt, Grootdrink, Groblershoop, Hendriksdal and Boegoeberg.

7.2. Climate

The climatic conditions of this region of the Northern Cape are typical of conditions characteristics of semi-desert / arid savannah areas. The area is characterised by fluctuating temperatures, low and unpredictable rainfall and high evaporation rates. The low annual rainfall (average of 170 – 240 mm in Upington or even lower in some surrounding areas) is significantly lower than the evaporation rate. Rainfall usually occurs during the late spring and summer months.

The area experiences high temperatures, especially in the summer months, where daily maximums of >42^{o}C are experienced. The annual evaporation in the area is approximately 2 281 mm. Winter temperatures can drop to below 4°C. Frost is rare, but occurs occasionally in most years, though usually not severely.

Weather data was received for the Upington area for the time period 2001 – 2005. Table 7.1 gives an indication of the average monthly temperatures and humidity over the 5-year period. Figure 7.1 gives a graphic representation of the average monthly rainfall over the 5-year period.

Table 7.1: Average monthly temperatures and humidity for the Upington area (2001 – 2005).

Month	Average Temperature (°C)	Maximum Temperature (°C)	Minimum temperature (°C)	Humidity (%)
January	28.22	41.30	14.04	31.42
February	28.37	39.90	15.96	36.00
March	25.76	38.74	11.48	41.84
April	21.24	34.36	6.92	50.39
May	16.80	31.16	1.66	46.22
June	12.62	26.60	-2.78	47.97
July	12.42	27.26	-2.16	41.22
August	14.10	32.00	-2.10	38.96
September	18.64	36.38	2.42	32.95
October	22.95	38.32	6.00	30.07
November	25.45	39.14	10.72	32.27
December	27.41	40.16	14.04	26.65
Average	**21.16**	**35.44**	**6.35**	**38.00**

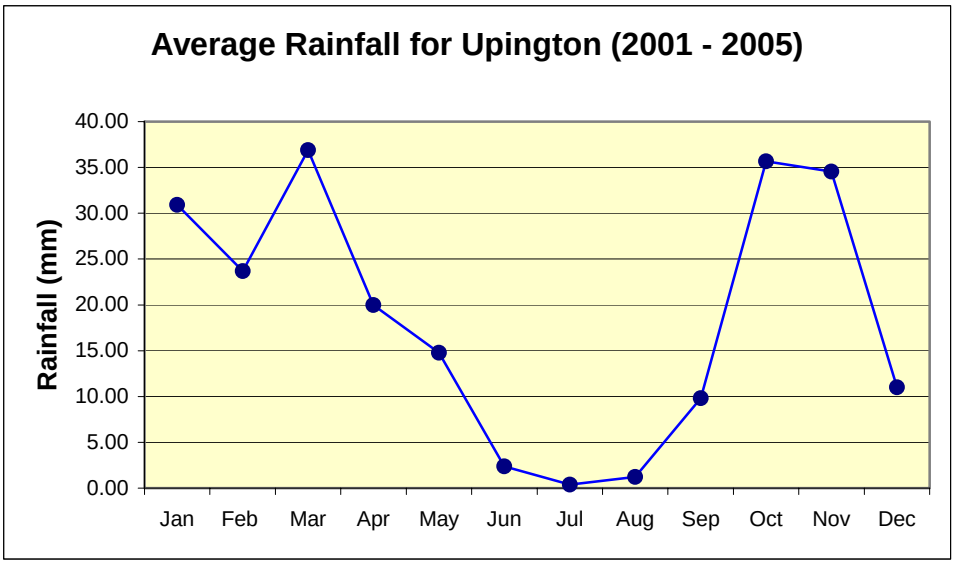

Figure 7.1: Average monthly Rainfall for the Upington area (2001 – 2005)

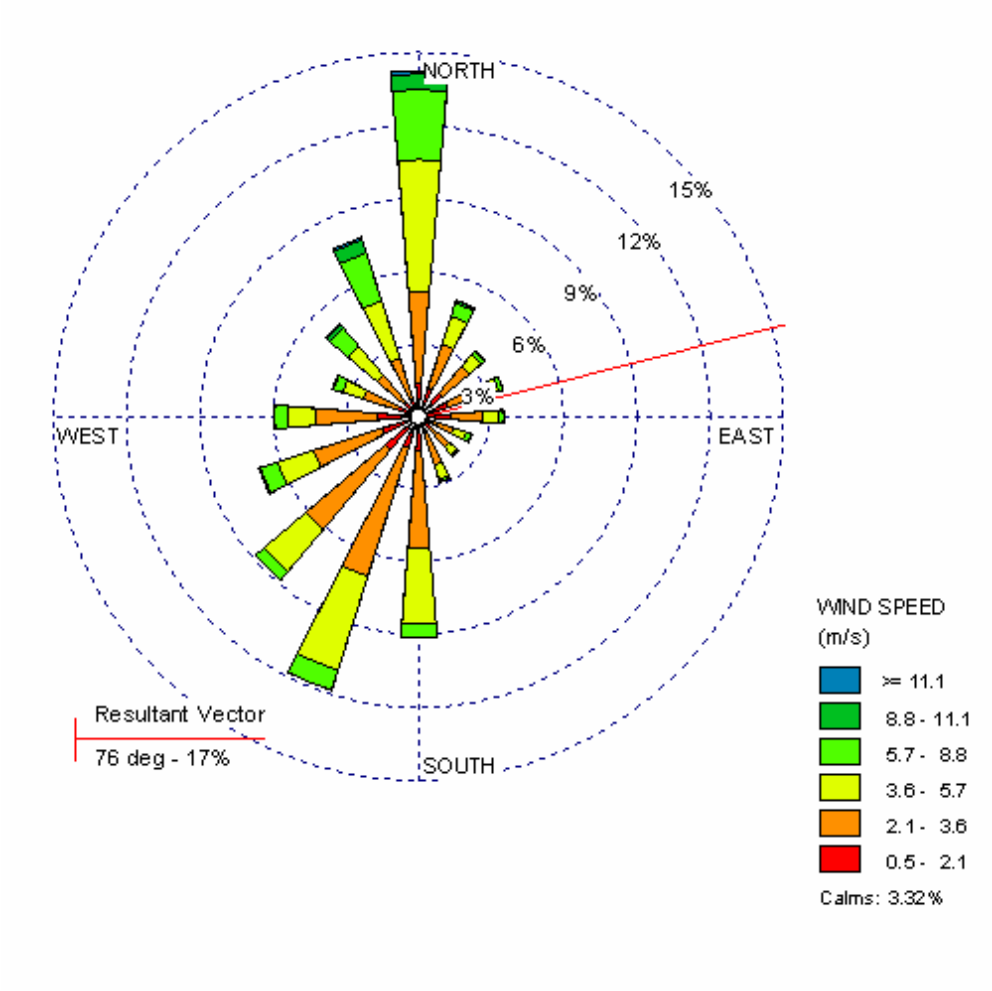

Figure 7.2: Windrose showing the average wind speed and wind direction for the years 2001 - 2005

7.3. Topography and Landscape

The area is characterized by flat terrain and is, in general, an area of little topographical relief. Isolated hills and mountains can be found in the area. The area surrounding Upington can be described as large sandy plans with windblown sand dunes and low hills breaking the flat relief. The area to the south of Upington becomes more mountainous as one travels to Groblershoop.

7.4. Geology and soils

The geology of the area is characterised by the metamorphosed sediments and volcanics, intruded by granites and is known as the Namaqualand Metamorphic Province.

The soils are reddish, moderately shallow, sandy and often overlay layers of calcrete of varying depths and thickness. The soils are typically weakly

structured with low organic content. These soils drain freely, which results in a soil surface susceptible to erosion, especially wind erosion when the vegetation cover is sparse.

The soils of the flat lowland areas can be described as red, eutrophic (high base status) and excessively drained sandy soils. The soils often overlay thick layers of calcrete, which is known for its hardness. The average clay content of the topsoil is less than 10 – 15 % and the soil depth varies between 400 and 750 mm.

The land type units represented within the study area include Ae4, Ae10, Ae108, Af7, Af8, Af29, Ag1, Ag4, Ia1, Ia2 and Ic2 (Eloff *et al*, 1986). A Land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area.

7.5. Land use and Agricultural Potential

Most areas in the wider study area do not have a high agricultural potential, except few portions in the alluvial zones close to the Orange River, where irrigation may be practiced.

In addition, there are also severe climatic restrictions to agricultural potential. Rainfall is very low, while evaporation is extremely high, due to the high temperatures. For this reason, even the best soils are unsuited for dryland agriculture under these conditions.

Land use of the uncultivated areas is predominantly livestock farming, with overgrazing evident in many areas. The grazing capacity of the natural grasslands of the plains can vary between 25 and 35 hectares per large stock unit (equal to 3.5 to 5 hectares per small livestock unit).

7.6. Conservation Areas

The Northern Cape has extensive areas under management by Nature Conservation. Some of the key conservation areas in the area include:

- Augrabies Falls National Park
- Kgalagadi Transfrontier Park
- Witsand Nature Reserve
- Spitskop Nature Reserve
- Numerous private game farms and nature reserves.

None of the areas currently registered as conservation areas are impacted on by the proposed sites. According to ENPAT (Van Riet et al, 1997) this area has a

high scenic value (4 out of 5), a high environmental resources index and low population pressure. It is therefore, listed as one of the areas in South Africa with the highest environmental resources conservation requirements and falls within the highest category for environmentally sustainable tourism and/or ecotourism development.

7.7. Water Resources

7.7.1. Surface Water

The Orange River is the primary water resource for the area. This river is used extensively for irrigation, and is heavily cultivated along its banks. Crop production is reliant on water availability and irrigation potential, and therefore the reliance on the available water supply is great. Abstraction from the river and water storage in reservoirs are common at many sites where it is mainly used for irrigation purposes within the areas flanking the Orange River. Several small drainage lines and water courses can be identified within the study area, but are mostly seasonal.

7.7.2. Groundwater

The study area is located in an area of complex pre-Cambrian basement geology, including volcanic, igneous and metamorphic rocks. Groundwater is stored and transmitted mainly via secondary features such as fractures, although some intergranular porosity and permeability is present in certain areas. Fractured aquifers are more vulnerable to pollution than aquifers where the storage and transmission of groundwater is primarily intergranular, due to the higher rates of groundwater movement and lower attenuation potential. Once polluted, such aquifers are difficult and expensive to remediate. Soluble pollutants are likely to travel vertically downwards to the water table together with recharging water, and then move with the water in the direction of regional groundwater flow. Recharge mechanisms in this area are not fully understood, but are thought to be episodic, following sporadic heavy rainfall.

7.8. Ecology and Biodiversity

7.8.1. Olifantshoek Plains Thornveld (Savanna).

This savanna type is found on extensive plains of loose sand of aeolian origin. Most of the sand deposit is underlain by calcrete which forms outcrops in places (Van Rooyen & Bredenkamp 1996).

In the study area the tree layer is mainly absent. The shrub layer is fairly well developed and individuals of Black Thorn (*Acacia mellifera*), Weeping Candle

Thorn (*Acacia hebeclada*), Karee-thorn (*Lycium hirsutum*), *Grewia flava* and *Acacia haematoxylon* dominate this layer (Van Rooyen & Bredenkamp 1996).

The grass layer is relatively well-developed in places. The cover depends on the amount of rainfall during the growing season. Lehman's Love grass (*Eragrostis lehmanniana*), Sour Bushman grass (*Schmidtia kalahariensis*), Silky Bushman grass (*Stipagrostis ciliata*) and *Stipagrostis obtusa* can dominate extensive areas (Van Rooyen & Bredenkamp 1996).

Due to the palatability of the vegetation, presence of sweet grasses and sometimes relatively high livestock densities, grazing and browsing could have a major influence on the vegetation structure.

Black Thorn (*Acacia mellifera*) tends to encroach into degraded areas and sometimes forms very dense impenetrable stands.

7.8.2. Kalahari Karroid shrubland (Nama-Karoo).

This Nama-Karoo vegetation type is found in the drainage basin of the Orange River Calcrete outcrops, where alluvial deposits as well as soils derived from the ancient basement granites and gneisses of the Namaqua Mobile Belt can be found on extensive plains. Pockets of aeolian sand can also be found in places, but most of the top soils and sand deposits have been washed away. In places the area is very rocky (Hoffman 1996).

On the pediments the shrub layer is poorly to well developed and individuals of Black Thorn (*Acacia mellifera*), Three Thorn (*Rhigozum trichotomum*), Karee-thorn (*Lycium boscifolium*), Shepherd's Tree (*Boscia albitrunca)* and Stink Shepherd's Tree (*Boscia foetida*) can be found. On the banks of the Orange River as well as in seasonal stream that drains into it, shrubs and tree such as Buffalo Thorn (*Ziziphus mucronata*), Wild Tamarisk (*Tamarix usneoides*), Ebony (*Euclea pseuoebenus*) can be found (Hoffman 1996).

The grass layer is in most cases poorly developed. The cover depends on the amount of rainfall during the growing season. Lehman's Love grass (*Eragrostis lehmanniana*), Sour Bushman grass (*Schmidtia kalahariensis*), Silky Bushman grass (*Stipagrostis ciliata*) and *Stipagrostis obtusa* can dominate large areas (Hoffman 1996).

Due to the palatability of the vegetation, presence of sweet grasses and sometimes relatively high livestock densities, grazing and browsing could have a major influence on the vegetation structure.

Aggressive invaders noted are the exotic Mesquite (*Prosopis glandulosa*) and the indigenous Three Thorn (*Rhigozum trichotomum*).

7.9. Social Environment

The study area is situated within the Siyanda District Municipality (DC8) which is one of the 5 District Municipalities located in the Northern Cape Province. Siyanda District Municipality (DC8) is situated to the north of the province and covers an area of 103 771 square kilometres with its borders aligned with Botswana and Namibia. This district municipality consists of 6 local municipalities. One potential site identified for the construction of CSP plant falls within the area of jurisdiction of the Khara Hais local Municipality (NC083) while the other two potential sites fall within !Kheis Local Municipality (NC084). The !!Khara Hais Local Municipality (NC083) consists of 12 wards and !Kheis Local Municipality (NC084) consists of 4 wards. The preferred site, site 1, is located approximately 10km south west of Upington within Ward 10 of !!Khara Hais Local Municipality. This ward has an area of 1474 square kilometres.

The map below (figure 7.3) indicates the location of the three alternative sites, evaluated during the scoping phase, in relation to the wards and the boundaries of the two local municipalities within which they occur.

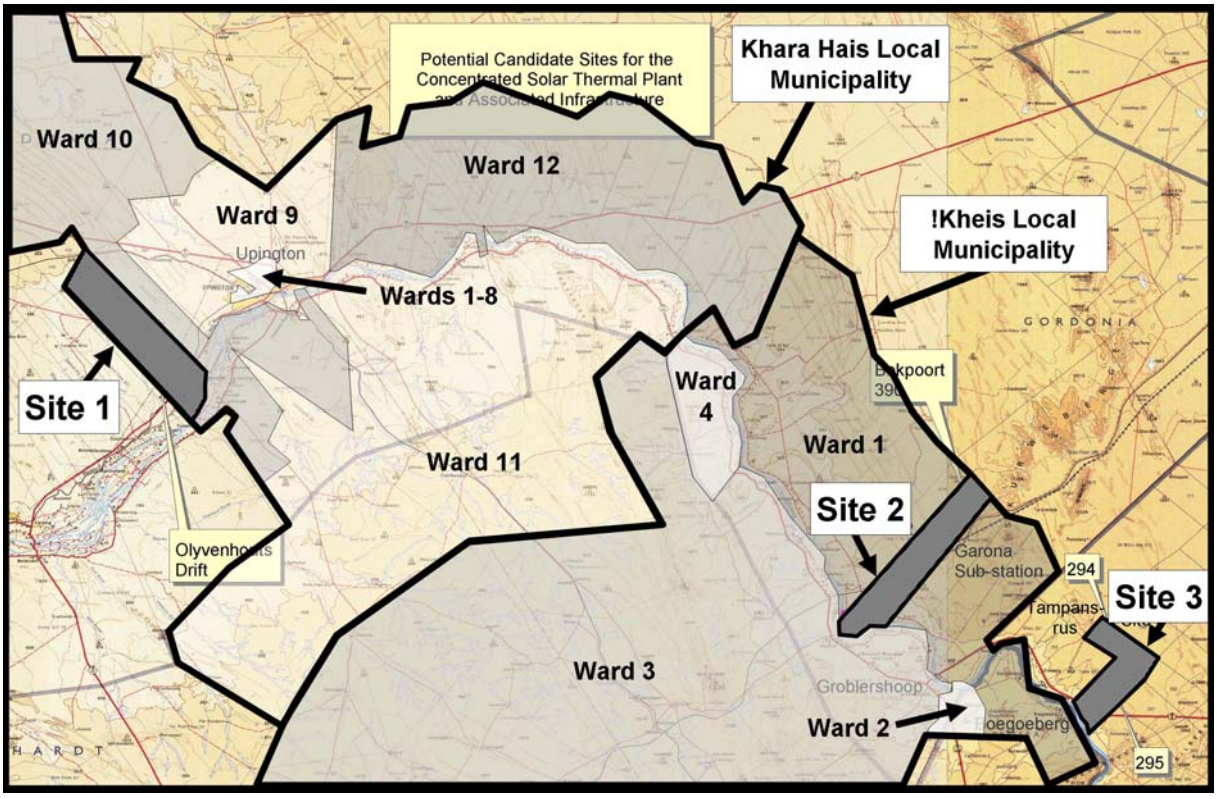

Figure 7.3: The three alternative sites in relation to local municipalities

7.9.1. Land Use

Principle land uses in the study area include:

- Agricultural land devoted mainly to game, sheep and grape farming.
- Residential and industrial areas – i.e. Upington and Groblershoop.
- Tourism – Upington.
- Game farms and lodges including the Witsand Nature Reserve, Spitskop Nature Reserve and Kalahari Adventure Centre

7.9.2. Population

The total population of the Siyanda District Municipality is approximately 210 000, which may be equated to approximately a quarter of the total population for the Northern Cape Province. Correspondingly the racial distribution of the population is similar to that of the Northern Cape, with 64% Coloured and 24% African people, while the population density is exactly the same at 2 people per square kilometre.

As far as the relevant Local Municipalities within Siyanda are concerned, !Kheis Local Municipality had a total population of 16 000 in 2001 and a population density slightly higher than that of Siyanda with an average of 3 people per square kilometre. Coloured people comprise a significant 86% majority of this population, followed by White people who make up 9% and Africans who make up 5% of the population. The population density for Ward 1 was double that of Siyanda and the Northern Cape as a whole, with 4 people for every square kilometre. The racial distribution within the ward included a large majority of Coloured people (84%), the remainder of the population being made up of Africans and Whites. Groblershoop was determined in 2001 to have an overwhelming 97% Coloured distribution in its population with the remainder consisting mainly of Africans.

7.9.3. Age and gender distribution

Within the Siyanda District Municipality, the male and female population were largely equal in 2001 with there being about 5000 more females. Just over a third of the male and female population in Siyanda was seen to fall between 15 and 34 years of age. Of interest in relation to the given project may be the distribution of individuals between the ages of 15 and 64 as the sector of the population that is of the age to enter, act within or just be leaving the employment arena. In Siyanda 31% of the males and 33% of the females fell between the ages of 15 and 64. Within !Kheis Local Municipality and !!Khara Hais Local Municipality a majority of approximately a third of the population fell between the ages of 15 and 34 years old while a further 25% to 28% of the population were aged from

35 to 64. Ward 1 (site 2 and 3) within !Kheis Local Municipality imitates the district age and sex distributions with up to a third of the female and male population falling into the 15-34yr age gap and the distribution of male and females being relatively. Correspondingly Groblershoop's population was made up of 34% 15 to 34 year olds followed by a fifth aged between 35 and 64 and a further fifth aged between 5 to 14. Similarly when considering Ward 10 within !!Khara Hais Local Municipality the gender distribution remains roughly equal and the highest density of age distribution remain at 15 to 34 closely followed by 34 to 64. In relation to this, Upington also showed a major distribution of their population within the 15-34 year age gap with 35% of the total population being that age, with a further 27% of the population aged between 34 and 64.

7.9.4. Education

The education level of over 20 year olds in Siyanda District Municipality in 2001 showed the majority of the population having done secondary schooling (30%) followed by 24% having done some primary school and 17% not having any form of formal education.

Within !Kheis Local Municipality there were fewer individuals over 20 years of age that have a secondary school education (23%) and the majority have some primary school education (30%). Approximately a fifth of the population did not have any education. Ward 1 within !Kheis Local Municipality had even lower levels of education amongst its population aged over 20, with a third having some primary education and 28% having no education. This can be compared to Groblershoop, where 28% of the population over 20 have had some primary education followed by 24% with a secondary education and 22% with no education at all.

!!Khara Hais Local Municipality had a better educated population over 20 years in 2001, with only 13% with no education, 20% with some primary education and up to 36% possessing secondary education. An impressive 22% of the population had Grade 12. Ward 10 within !!Khara Hais Local Municipality had a lower secondary education at 27% in their population over 20 years of age, while it had a higher level of this population who have just had some primary school education (25%) and a 13% with no education. In comparison, Upington showed a 12% rate of no education, 37% with secondary schooling, 19% with Grade 12 and 18% with some primary education in the population aged over 20.

7.9.5. Employment

- *Unemployment rates*

  The Siyanda Local Municipality has a total labour force of roughly 83 000 of which 27% are unemployed. The unemployment rate within the Local

Municipalities stands at 35% in !!Khara Hais and 20% in !Kheis Local Municipality – significant figures when considering the intended labour force for the development. Ward 1 within !Kheis Local Municipality boasts half the rate of unemployment with 10% of the labour force without work. In contrast to this, Groblershoop has a 29% unemployment rate. Related to the above Upington has an unemployment rate of 7%, while Ward 10 of !!Khara Hais has a significant 26% unemployment rate.

- *Sectoral employment*

  The largest source of employment within Siyanda District Municipality in 2001 was agriculture with 42% of the employed labour force working within this sector. This is followed by community, social and personal employment occupying 14% of the employed labour force. Agriculture remains the main source of employment for the labour force in !Kheis Local Municipality with up to 60% of the employed labour force engaged in such. Similarly within Ward 1 of !Kheis Local Municipality a large majority of 67% of the labour force is employed or is working within the agricultural industry while 8% of the labour force is working from private households. This differs significantly in Groblershoop as 24% of the employed labour force of 393 people works in wholesale and retail, followed by 18% involved in agriculture and 17% working from private households.

  The above figures seem to differ significantly for !!Khara Hais where there seems to be a greater distribution of the labour force over the various vocations. A majority of the employed population (23%) is occupied with community, social and personal employment followed by employment in the agricultural sector (13%). In comparison to Ward 1 in !Kheis Local Municipality, whose labour force was disproportionately occupied with agriculture, Ward 10 in !!Khara Hais seems to offer more opportunities to its labour force with it being more dispersed over the various occupations even though agriculture was still the dominant employment occupying 27% of the labour force. The remainder of the labour force within Ward 10 works within retail and wholesale (10% of total labour force), community, social or personal sector (8% of labour force), private households (8% of total labour force), business and finance sector (6% of labour force) and manufacturing (4%). This decline in agricultural employment with a correlated distribution of the labour force over a larger variety of vocations is continued in Upington. The employed labour force in Upington consists of approximately 12 000 people, of whom only 4% are employed in the agricultural sector, 28% are working in the community, social or personal sector, 22% work within wholesale or retail and 11% work from private households. The pie charts below demonstrate the differing vocational employment in the two relevant Local Municipalities.

7.9.6. Income

Poverty appears to be a widespread problem in the Siyanda District Municipality with up to 60% of the total population not earning a monthly income in 2001. In addition this does not seem to be a stable figure, as this percentage has increased from 51% in 1996. Of those earning a salary a further 17% of the total population in the Siyanda District Municipality only earned between R400 and R800 a month. This situation was reflected in the same way in !Kheis Local Municipality were the circumstances appear just as severe and two thirds of the population went without a monthly income along with 19% earning between R400 and R800 a month. Similarly just over half of the total population in Ward 1 within !Kheis did not earn a monthly income followed by 24% earning between R400 and R800 per month. Although the situation appears to be most severe in Groblershoop where up to 65% of the population did not earn a monthly income followed by 15% earning between R400 and R800 a month and 10% earning up to R400 a month.

Correspondingly, !!Khara Hais reports a high rate of up to 64% of their population not earning a monthly income in 2001 followed by the subsequent majority of 12% earning between R400 and R800 a month. These statistics are reflected in Ward 10 of !!Khara Hais with 60% of the population not earning any monthly income, 13% earning between R400 and R800 and 12% earning up to R400. Upington experiences and even higher rate of 71% of its total population not earning a monthly income, followed by 14% earning up to R800 pm and 6% earning up to R400 pm. These are significant figures when one considers the above stats noting that a majority of the population in the Siyanda District Municipality falls between the ages of 15 and 34, a prime bracket within which individuals become economically active.

7.9.7. Housing

In Siyanda District Municipality as well as the relevant Local Municipality the large majority of dwellings remained formal. This was also carried over to the wards with Ward 1 in !Kheis Local Municipality, which consisted of around 1 200 households. Of these, 78% lived in formal residences. Roughly two-thirds of households in Ward 10 within !!Khara Hais are formal. The large majority of households within Groblershoop and Upington were also formal households. The majority of households in Siyanda have a size of 2 people per household with the average household consisting of 4 rooms. This household size also hold true for !Kheis Local Municipality as well as Ward 1 within the Municipality although the average household in this municipality and ward was smaller, being made up of 2 rooms. In !!Khara Hais Local Municipality as with !Kheis the average family size was 2 people per house while the majority of households consist of 4 rooms. For

Ward 10 within !!Khara Hais, the majority of households have 2 people yet the bulk of houses were either 1 or 2 room abodes.

7.9.8. Services

- *Transport*

  The main mode of transport for individuals living within the Siyanda District Municipality was by foot in 2001 with 62% of the individual needing to travel to work or school walking. This was followed by 10% being passengers in cars. In Upington, 25598 members of the population travel to school or work every day, of that number a majority of 67% travel by foot, followed by 9% using taxies or minibuses. In Groblershoop 7636 members of the population travel to work or school every day. Of those people 69% walk, a further 8% were car passengers and 6% drive cars. This is particularly noteworthy for the potential labour force that may be used for the site, for some of them may be drawn from the closest town, namely Groblershoop or Upington but may have no means of getting to work outside of the town. Travel by foot holds as the prevailing means of transport for !Kheis Local Municipality and Ward 1 (60% of those going to work or school) as well as !!Khara Hais Local Municipality and Ward 10 (56% of those going to work or school).

- *Water and sanitation*

  Access to water within the Siyanda District Municipality was mainly via water inside the dwelling (36% of dwellings) or in the yard (44% of households) while a remaining majority of households obtained water from a community stand or a river/stream. While the relevant Local Municipalities show similar statistics, Ward 1 within !Kheis Local Municipality indicates that 37% of its households accessed water from their yards, while a further fifth accessed it in their dwellings and a fifth at the community stand. In Groblershoop, close to a half of the households got water from their yards and a further 21% had access to water in their dwelling and 14% obtained water from a community stand. Ward 10 in !!Khara Hais differs in that approximately a third of the households get water from their yards and a further third get water from within their dwellings. Whereas 43% of the households in Upington obtain water from inside their yard, 37% have access to water inside their dwellings and 9% fetch water from communal pumps.

  Within the Siyanda District Municipality, up to 58% of the total households had flush toilets, while 13% of households had no means of sanitation. In !Kheis Local Municipality, the majority (34%) of household have flush toilets, while 33% of households with no means to sanitation. However, the figures for Ward 1 within !Kheis differ notably from !Kheis Local Municipality as a whole: a preponderance of 42% of the households not having any means to sanitation, while 31% the households have flush toilets.

Within the !!Khara Hais Local Municipality just over half of all of the households have flush toilets and only 7% of households have no access to a means to sanitation. In Upington the percentage of households with adequate sanitation is 82%. Within Ward 10 in !!Khara Hais, approximately a third of households have flush toilets, while 12% do not have access to any means to sanitation.