Figure 28: Location of the proposed Schulpfontein site in relation to the surrounding areas (Bulman, 2007)

(b) Topography

The coastal plain on which Schulpfontein is located is generally flat and consists of dune fields, which gently elevate from sea level to about 20 m asl towards the escarpment. The coastline consists of a virtually unbroken line of rocky outcrop of approximately 50 to 100 m wide with very little outcrop on the coastal plain. A graphical representation of the topographic location of the proposed Schulpfontein site, in relation to the broader geographical area, is provided in Section 6.1.1(b).
The Site is situated between two small embayments\textsuperscript{34} in the coastal outcrops on very homogeneous basement rock. Immediately inland of the site the topography rises gradually. The thin overlying dune sand is mostly semi-consolidated and well vegetated with odd patches of unvegetated calcrete, calcric sand and basement outcrop. The area surrounding Schulpfontein is very flat with active dunes occurring about seven km further north along the coast and five km inland from the site (Low and Desmet, 2007).

The dune systems at Schulpfontein are more complex than those at Brazil. Tinley (1985) describes these as an extensive sea of migratory parabolic dunes between the Bitter and Spoeg Rivers, which extend into Schulpfontein.

(c) Climate

As with the Brazil site, no meteorological data was available and thus the weather data was acquired from the closest automatic weather station, which is also located at Koiingnaas. Thus, the meteorological data as depicted in Section 6.1.1(c) is applicable to both the Brazil site as well as the Schulpfontein site.

(d) Geology and Seismology

The geological description as described for the Brazil site (6.1.1(d)) is applicable to the Schulpfontein site, based on its physical proximity to each other, thus the information has not been repeated here.

(i) Tectonics

The largest faults encountered along the coast are two km to the south and at Noopbaai, four km south of the Schulpfontein site. The faults are marked by breccias and quartz veins and strike approximately NNW-SSE, disappearing into the sea at both localities. None of these faults have displacements of more than a few tens of metres.

(ii) Palaeo-seismicity

The seismic hazard of the sites is thought to be dominated by the hazard for reactivation of the regional NNW striking, coast-parallel faults. The only fault confirmed to have experienced Cenozoic movement is the Langklip fault, which structure shows enough circumstantial evidence of having generated one post-Early Pliocene (< 3.6 Ma old) seismic event.

(iii) Seismic Hazard

The physical proximity of the Schulpfontein and Brazil sites render similarities with respect to the seismic hazards. Preliminary investigations indicate that there is no fatal flaw with respect to seismic risk.

(e) Geohydrology

The geohydrological information was taken from SRK (2007b).

(i) Groundwater occurrence

Two types of aquifer occur in the study area, namely intergranular (primary) aquifers in the unconsolidated sediments, such as riverbeds or surficial deposits and fractured-rock (secondary) aquifers in the fractures of the crystalline basement rocks.

\textsuperscript{34} Embayment refers to an indentation of a shoreline, larger than a cove (small inlet) but smaller than a gulf (arm of a sea or ocean partly enclosed by land).
Locally, the only major aquifer in the Schulpfontein area is the Schulpfontein-Noup Aquifer, which consists of lenses of sand, gravel and interbedded clay in a palaeochannel of Quaternary age (SRK, 1990). The saturated aquifer horizons are overlain by approximately 40 m of unsaturated sediments of similar lithology. Refer to Figure 21 for a simplified groundwater map.

(ii) Groundwater flow and depth
The regional groundwater flows towards the coast but locally the flow emanates from the watersheds and flows towards the river channels. According to DWAF’s Groundwater Resource Assessment Phase 2 project (2005), the average groundwater depth in the quaternary catchment F40A is approximately 48 mbgl.

(iii) Groundwater quality
According to DWAF (1995) the area surrounding the Site may be classified as a poor aquifer region, which means that it can be described as having a low to negligible yielding aquifer system of moderate to poor water quality. The EC in the study area ranges between 300 and 1 000 mS/m immediately around the Site. Further east, at Komaggas and the Schulpfontein-Noup Aquifer the EC ranges between 70 and 300 mS/m.

(iv) Groundwater potential
The area has a yield ranging from < 0.1 L/s in the west to 0.1 – 0.5 L/s in the east. The Noup-Schulpfontein Aquifer, which occurs in the study area, has an estimated yield potential of ± 540,000 m³/annum whilst abstraction by the Koingnaas Mine is reportedly ± 216,000 m³/annum (SRK, 1990). A relatively small amount of groundwater is also pumped from a dug well located approximately five km southeast of the Site for water supply to the Noup Caravan Park and a few bungalows.

(f) Geotechnical characteristics

The sand/boulders/cobbles have accumulated in the undulating erosion gullies of the bedrock and are likely to be of the order of two to six metres thick and calcretised over extensive areas. Due to the relative thinness of the overburden, stability of this material is unlikely to cause problems. However, the presence of a clayey sand horizon under the calcrite that is more susceptible to erosion (and is possible dispersion) will result in undercutting and potential instability of the more competent calcrite bands.

It is likely that the calcrite and sand horizons can be used to form construction terraces with a minimum of imported base course material as a wearing surface. Bearing capacity with the sand horizons are likely to be in the range 150 to 300 kPa depending of the consistency and the presence of calcrite and boulders.

The underlying gneiss and quartzite bedrock will form an excellent founding layer. However, some caution must be exercised in the design of foundation in places due to the sugary weathered texture of both rock types. Excavations in fresh rock are likely to be stable to five metres. However, local mapping and assessment must be carried out to ensure that this is achievable and that the rock structure is not detrimental.

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35 Water with an EC > 300 mS/m is of poor quality and unfit for human consumption, whilst water with an EC of between 70 and 300 mS/m is brackish and of marginal quality for human consumption.
The availability of construction materials on site remains uncertain. Goraap se Kop in the vicinity has previously been identified as a source of aggregate and the Buffels River as a source of sand.

### 6.2.2 Biophysical

#### (a) Flora

Four vegetation types, similar to that of the Brazil site, were found at the Schulpfontein site (Figure 22). The key difference is the presence of Namaqualand Sand Fynbos presumably found on the more acidic, red inland sands as well as the absence of the Namaqualand Salt Pans. The Schulpfontein site does, however, exhibit a greater diversity of communities as opposed to the Brazil site, with differences between inland and coastal dunes and a community on exposed granite-gneiss at the coast itself.

Except for a thin strip along the coast, the site is regarded as irreplaceable for conservation (sensu Driver et al., 2003) (Figure 23). In addition Schulpfontein receives the most significant conservation rating (Highly Vulnerable). Certainly the unique combination of vegetated parabolic and mobile (unvegetated) transverse dunes must rank as a key ecological feature on this section of coastline.

Namaqualand Sand Fynbos, occurring on the eastern edge of Schulpfontein is unique owing to its acid sands, which support the northern outlier of this type of vegetation. The deep soils overly dorbink with occasional layers of laterite on the surface in dune slacks. Species diversity is much higher than the other vegetation types described for the Namaqualand sites. Lampranthus procumbens, a recently described new species from the Schulpfontein fynbos, is known only from this single locality and is therefore probably extremely rare.

#### (b) Invertebrate Fauna

The invertebrate fauna at Schulpfontein is considered similar to that at the Brazil site, given that the physiognomy of the vegetation and habitat diversity of the Brazil and Schulpfontein sites are similar. Refer to Section 6.1.2(b) for further details.

#### (c) Vertebrate Fauna

Special features with respect to terrestrial vertebrates and ecosystem processes are similar to that associated with the Brazil site. Refer to Section 6.1.2(c) for further details.

#### (d) Hydrology

The site is situated just north of Koiingnaas on the west coast (and south of the Brazil site). Within the 20 km radius, several quaternary catchments exist (Figure 24), namely:

- Catchment F30G also to the north and drained by the Buffels River;
- Catchment F40A within which the Schulpfontein site is situated;
- Catchment F40D to the south drained by the Swartlintjies River;
- Catchment F40F to the south and drained by the Spoeg River; and
- Catchment F40B to the east and drained by the Koukam se Brak River.
Table 13: Catchment characteristics of Schulpfontein

<table>
<thead>
<tr>
<th>Catchment</th>
<th>Gross Area (km²)</th>
<th>Mean Annual Evaporation (MAE) (mm)</th>
<th>Mean Annual Precipitation (MAP) (mm)</th>
<th>Mean Annual Runoff (MAR) (mm)</th>
<th>MAP-MAR RESP</th>
<th>NET MAR (10⁶m³)</th>
<th>Gross MAR (10⁶m³)</th>
<th>Coefficient of Variation (CV)</th>
</tr>
</thead>
<tbody>
<tr>
<td>F30G</td>
<td>980</td>
<td>2200</td>
<td>102</td>
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<td>6</td>
<td>0.2</td>
<td>0.3</td>
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<tr>
<td>F40A</td>
<td>984</td>
<td>1900</td>
<td>118</td>
<td>0.4</td>
<td>6</td>
<td>0.2</td>
<td>0.0</td>
<td>1.358</td>
</tr>
<tr>
<td>F40D</td>
<td>741</td>
<td>1900</td>
<td>123</td>
<td>0.4</td>
<td>6</td>
<td>0.2</td>
<td>0.3</td>
<td>1.343</td>
</tr>
<tr>
<td>F40F</td>
<td>682</td>
<td>1900</td>
<td>118</td>
<td>0.4</td>
<td>6</td>
<td>0.2</td>
<td>0.3</td>
<td>1.358</td>
</tr>
<tr>
<td>F40B</td>
<td>404</td>
<td>1900</td>
<td>130</td>
<td>0.4</td>
<td>5</td>
<td>0.2</td>
<td>0.2</td>
<td>1.325</td>
</tr>
</tbody>
</table>

(i) Surface water features
As a function of the aridity, the rivers are non-perennial as with the Brazil site.

(ii) Surface water run off
Runoff values are indicated in Table 13.

(e) Freshwater water supply

(i) Local Authority Supply
The Schulpfontein site falls within the Lower Orange WMA as with the Brazil site. The information pertaining to the Brazil site is also applicable to the Schulpfontein site. Refer to Section 6.1.2(e)(i) for further details.

(ii) Community Supply
The local communities of Koiingnaas and Hondeklip Bay are supplied by groundwater from the Schulpfontein-Noup Aquifer. Kleinzee is supplied from the Orange River.

(iii) Water Quality
Orange River water is of good quality and is treated by filtration, deflocculation and chlorination. Groundwater quality is variable and that from the Schulpfontein-Noup Aquifer has an EC of ~270 mS/m.

(iv) Desalination
Information applicable to the Brazil site is also applicable here. Refer to Section 6.1.2(e)(iv) for further details.

(f) Fresh water ecology
The fresh water ecology for the Brazil site also applies to the Schulpfontein site. Refer to Section 6.1.2(f) for further details.

(g) Oceanography
The oceanographic features applicable to the Brazil site are also applicable to the Schulpfontein site. Please refer to Section 6.1.2(g) for further details.
(h) Marine Biology

The Schulpfontein site also lies within the cold temperate Namaqua Bioregion, which is characterised by low species richness, low endemicity and the absence of rare or endangered marine species. No features of special biological interest are noted by Jackson and Lipshitz (1984). The site is relatively less disturbed by mining and exploitation of marine resources than that of the Brazil site.

A wave exposed rocky shore with large gullies and rock pools, interspersed with small bays characterise Schulpfontein. The area is heavily invaded by the introduced mussel *Mytilus galloprovincialis*, and as with the Brazil site, the shore supports several potentially harvestable resources.

(i) Air Quality

As with the Brazil site, emissions data are not available at this stage and ambient air quality was not measured. However, the site is located in a relatively pristine environment and thus the air pollutant concentrations are considered low.

6.2.3 Socio-economic

(a) Population

The site falls within the same municipality as the Brazil site and therefore shares the same population dynamic characteristics (Dippenaar, 2007). Refer to Section 6.1.3(a) for further details.

(b) Surrounding Land Use

The surrounding coastal areas are currently utilised for diamond mining by De Beers Consolidated Mines (Ltd) with the surrounding rural towns of Kleinzee and Koiingnaas mainly housing the diamond mining industry staff. Refer to Figure 26 for a graphic illustration thereof. Springbok is the largest town located 120 km northeast of the site. The inland areas are utilised mainly for farming. Koiingnaas, which is located 20 km south of the site, falls outside the five km PAZ. No development falls within this five km radius from the Schulpfontein site.

(c) Economy

As with the Brazil site, the Schulpfontein site falls within the Namakwa District Municipality located in the Northern Cape. The two sites therefore share economic characteristics, however, the sectoral characteristics differ (Figure 29). Refer to Section 6.1.3(c) for further details. Maasdorp (2007b) identified the following local Authorities part of the economic impact region:

- **Garies Local Municipality and Springbok Local Municipality** - Although Garies is some distance away from Brazil, it could benefit if Brazil is selected, especially in terms of employment and upgrading of infrastructure.
- **Nama Khoi Local Municipality** - The area can benefit from improved road infrastructure and other services.