ARAB REPUBLIC OF EGYPT

MINISTRY OF ELECTRICITY AND ENERGY

NEW AND RENEWABLE ENERGY AUTHORITY (NREA)

FEASIBILITY STUDY FOR A LARGE WIND FARM AT GULF OF EL ZAYT

EIA Survey and Assessment

Excerpts of the Study

January 2008

decon
Deutsche Energie-Consult Ingenieurgesellschaft mbH

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ENGINEERING SERVICES AND CONSULTANCY

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2.5.1 Executive Summary

Within the frame of the feasibility study to determine the viability of wind power development in the 650 km² "NREA concessionary area" at the Gulf of Zayt the likely environmental compatibility of such landuse was assessed. Wind-generated electrical energy is renewable, produces no emissions and is generally considered being environmentally friendly. According to general guidelines for EIAs issued by the Egyptian Environmental Affairs Agency (EEAA) wind power and associated power transmission line projects are considered to potentially result in substantial environmental impacts and, therefore, are classified as a "grey list" projects. Recently verbal information was received from the Environmental Authority that wind power projects have to undergo a full EIA. However, there are no regulations, directives or other written documents, which verify such statements. Thus, it seems that the environmental protection policy and the legal framework with regard to wind power development is not well defined, what could become a bottleneck for recent ambitious wind power development goals of the Government of Egypt. Thus, in the absence of clearly defined regulations in Egypt, the environmental screening of the overall area follows internationally accepted standards.

For the assessment of the overall NREA area the following surveys were carried out:

- Reconnaissance survey to assess the present landuse in the area
- A survey on the fauna others than avifauna) and flora
- An autumn and spring monitoring of bird migration and bird habitat
- A geological survey.
- An autumn and spring monitoring of bird migration and bird habitat

Except the avi-fauna monitoring, the surveys were of the character of a rapid assessment. Nevertheless, due to the homogeneous character of the desert plains in the NREA area, these rapid surveys deliver a quite accurate basis for assessing the environmental conditions in the overall area.

In the following, the identified environmental impacts are assessed in summary:

- **Land characteristics and use:** Almost all the area is consisting of desert ground (compacted gravel or rocky) and not ecologically sensitive. Very little deterioration is expected. Major issues are:
    - The area comprises one salt depression zone (Sekbha) in the northeast representing about 5 % of the overall NREA area, which is considered to be ecologically more sensitive and shall be kept free from wind power development
    - Possibly conflicting activities in the area are oil exploration and production. Although, a general agreement between the Ministry of Petrol and NREA exists the actual concession rights of the petrol companies have to be considered in the planning. Existing oil & gas pipelines have to be secured according to safety standards set by the pipeline authority.
    - The NREA area extends to the water well area of Ras Shukheir water supply. This area must be kept free from wind power development or at least minimum distances to the wells of 150 m shall be kept. Moreover, water pipelines have to be secured in case of construction of road crossings.
    - An asphalt making plant covering an area of 150 m x 150 m is operating at the access road from Ras Shukheir. Wind park construction development shall keep a safety distance of 150 m to the borders of this plant.
    - Military activities are observed directly outside the southern border of the NREA area, where a radar station is placed. A conflict could be caused by reflection of the radar beam by wind turbine blades. A clearance distance of 5 km to the radar station shall be kept.

- **Landscape character and existing views:** There is no special landscape or view existing in the desert plains of the NREA concessionary area worth for being protected against the erection of wind power plants.
- **Flora and Fauna (without avi-fauna):** The field survey revealed that wind park utilisation in the area will have no serious impacts on the biodiversity and other environmental characteristics of the site. Not a single specie, plant or animal recorded in the area or expected to occur in it, is included in the Red Data Lists, both internationally or nationally. Moreover, the nature of windparks, which leaves most of the wind park area untouched, is not critical to the rare existing fauna (not considering avifauna) and flora, in that area, if basic mitigation measures are kept.
- **Avifauna:** As the NREA area is located next to an registered Important Bird Area (IBA), the Gabal el Zayt IBA area, and near or partially in a major flyway area of migrating birds, impacts of wind power utilisation on migrating birds were likely to be significant. Therefore, ornithological monitoring in the overall area at 26 observation points over one autumn and one spring migration period was carried out. As observation samples had to remain spatially and timely limited for individual sites and because of not very pronounced migration routes inside the project area, the statistical evidence of the one year field observation data has to remain limited. This calls for a conservative judgement. The judgement of the area is mainly based on the occurrence of soaring and gliding migrants, as these less manoeuvrable species are more endangered by wind park constructions. Experience on specific collision risks of migrating birds with wind turbines is very limited and the collision risk with wind parks may even be low as most endangered species may bypass or overfly a wind park. Nevertheless, the disturbance on the flyway against the heavy wind during spring and the implied loss of fat reserves were judged to be critical. Considering competing environmental interests, such as bird protection and renewable energy generation and implied CO_2 avoidance, the "NREA concessionary area" was zoned according to the weight of the expected environmental impact.
    - **Zone 1: Wind Park construction is banned.** This southern part of the NREA area comprises about 60 % of the overall area and is considered to belong to the main migrating corridor heading towards Sinai.
    - **Zone 2: Construction subject to further ornithological monitoring and verification.** In this area of about 94 km² adjacent in the north to Zone 1, migration in the direction of the coastal mountain chain, Gabal El Zayt, was recorded during spring. Apparently, birds had followed the mountain chain of the foothills of the Red Sea Mountains so far north that they had to fly in south-easterly directions to reach the coastal mountains. This zone was presumed to be in the border area of the Zone 1 and might even belong to it. Based on the findings of the one year ornithological investigations only, an utilisation of this area for wind power development has to be rejected. Further ornithological monitoring and verification may lead to revised results.
    - **Zone 3: Construction critical.** In this most northern zone there is no immediately recognisable topographical bottleneck. The terrain opens out and offers the birds more room to manoeuvre. Most birds moving through here are heading in the direction of Suez. Any wind farm installation in that area would require technical avoidance/mitigation measures at the plants and in the infrastructure itself as to the best practicable standard. Moreover, a careful post installation monitoring programme needs to be executed to assess, whether the impacts in a wind park will remain on acceptable level or whether additional measures will have to be carried out.

- **Water quality:** A wind power utilisation in the area will not have any effects to the groundwater and surface water**.** However, minimum distances of 150 m of individual wind turbines to existing groundwater wells of the Ras Shukheir water supply shall be kept. Eventually constructed service buildings within the NREA area, such as store, control and apartment buildings, shall be interconnected to the existing water pipeline and equipped with an appropriate waste water treatment system (e.g. septic tank with underground seepage and regular sludge collection).

- **Air quality:** Some additional dust will occur locally during construction works what, however, is not critical because of the absence of population or wildlife, that may be effected.
- **Noise levels:** The shortest distance of the NREA area to the next settlement area (Wadi Dara settlement) is more than 500 m. At this distance, the noise emissions from wind turbines are significantly below 30 Decibel.
- **Antiquities or sites of historical & cultural importance:** None
- **Social and Economic Context:** There is neither the need nor the possibility of a public hearing within the scope of an EIA process, as there are no people living in the immediate surrounding of the NREA area, who may be effected by wind power development. Wind park construction will create employment during both, the construction and the O&M phase. Personnel from the next villages or Bedouins are usually hired for simple work and security tasks. Wind energy utilisation will safe indigenous oil and gas, and thus contribute to economic sustainability in Egypt.
- **Infrastructure:**
    - **Waste** generated during the construction phase shall be collected and adequately disposed of by the Contractor. Solid domestic waste originating during operation from a service building complex within the NREA area shall be collected and adequately disposed off. A co-operation with the Rhas Gharib waste collection system is recommendable.
    - **Water supply:** There is only very limited water demand, which will not affect the overall water supply in the region
    - **Domestic waste water** originating from the construction yard facilities or permanently constructed service buildings shall undergo simplified treatment (septic tank) and infiltrated to the sandy underground for further natural treatment.
    - **Transport:** Wind power development at the NREA area will not cause traffic bottlenecks in the greater area, neither during the construction phase nor during the O&M phase.
    - **Electricity:** The wind park internal grid shall be made by underground cables. Any wind park, which would be erected on the NREA area, shall be connected to a substation to be built by EEHC/ETC. The interconnections shall be either by underground cable or built according to accepted bird protection guidelines.

The assessment of the different possible environmental impacts, which may be caused by wind power development in the NREA area did not show any significant bottleneck except limitations set by expected impacts to the avi-fauna. As the “NREA concessionary area” offers an exceptional high wind power potential there are no equivalent alternatives for wind power utilisation.

2.5.2 Description of the project

2.5.2.1 Objectives and scope

The NREA concessionary area shall be used for wind power generation in order to

- make use of the excellent wind power potential at the site , and
- to substitute oil and gas for electricity generation by CO_2 renewable wind energy.

The study shall analyse the viability of wind power development in the area on a general level. It does not aim at a definite planning of wind parks and even cannot result in a master planning, as type and size of future projects cannot be judged or reasonably be defined over the planning horizon.

Wind power development would be done in steps consisting of individual wind energy projects of NREA and possibly other investors, which would be implemented in clusters. The wind power target capacity for the overall area was about 3000 MW. However, technical considerations suggest that the area cannot absorb more than 2000 MW. The target is to develop the overall area until 2024. The lifetime of wind power plants is 20 years. Wind Power would be developed in south-west to north-east rows at distances of about 1 km. Typical features of such a project are the wind turbine foundations of about 2 m depth and a surface of up to 20 x 20 m², the turbines itself with tubular tower diameters of up to 4.5 m at the footing and maximum blade tip heights of about 100m, the wind park internal grid through cable trenches or overhead MT lines, small transformer stations next to the wind turbines or inside the turbines and wind park internal earth roads of 5 m width. At central locations MT/HT substations would to be erected. Moreover, one service area of NREA shall be planned consisting of a control building, storage buildings and housing facilities for staff.

The assessment of environmental impacts caused by wind power development is essential for the judgement of the viability of the wind power utilisation in the “NREA concessionary area”. The assessment is targeting

- to determine any likely significant impact caused by wind power development in the area
- to assess, whether such impacts can be mitigated or whether they require an restriction or a cancellation of wind power development,
- to define eventually necessary mitigation measures and environmental management (EM) requirements.
- to assess the effects of possibly required mitigation and EM measures with regard to the overall viability of wind power development in the area.

The scope of the project can be summarized as follows: Wind power development shall, take place in the “NREA concessionary area” with about 650 km². This area is located to the West of the Hurghada - Suez road and extending about 70 km from North to South and about 9 to 10 km to the inland. The area starts about 60 km in the North of Hurghada. The definition of the area considers already the results of discussion held between different ministries and the Governorate. Accordingly, the defined area reflects already the requirements of the Ministry of Petrol and of the Ministry of Agriculture and excluded areas of competing or conflicting activities such as the agricultural and settlement area at Wadi Dara or a corridor along the Hurghada - Suez road of 200 to 500 m, to secure ongoing activities and existing pipelines. The “NREA area” is shown on the satellite map (Fig. 2.5.1) in little bright contrast. The Wadi Dara exclusion area is the white area in the west of the area.

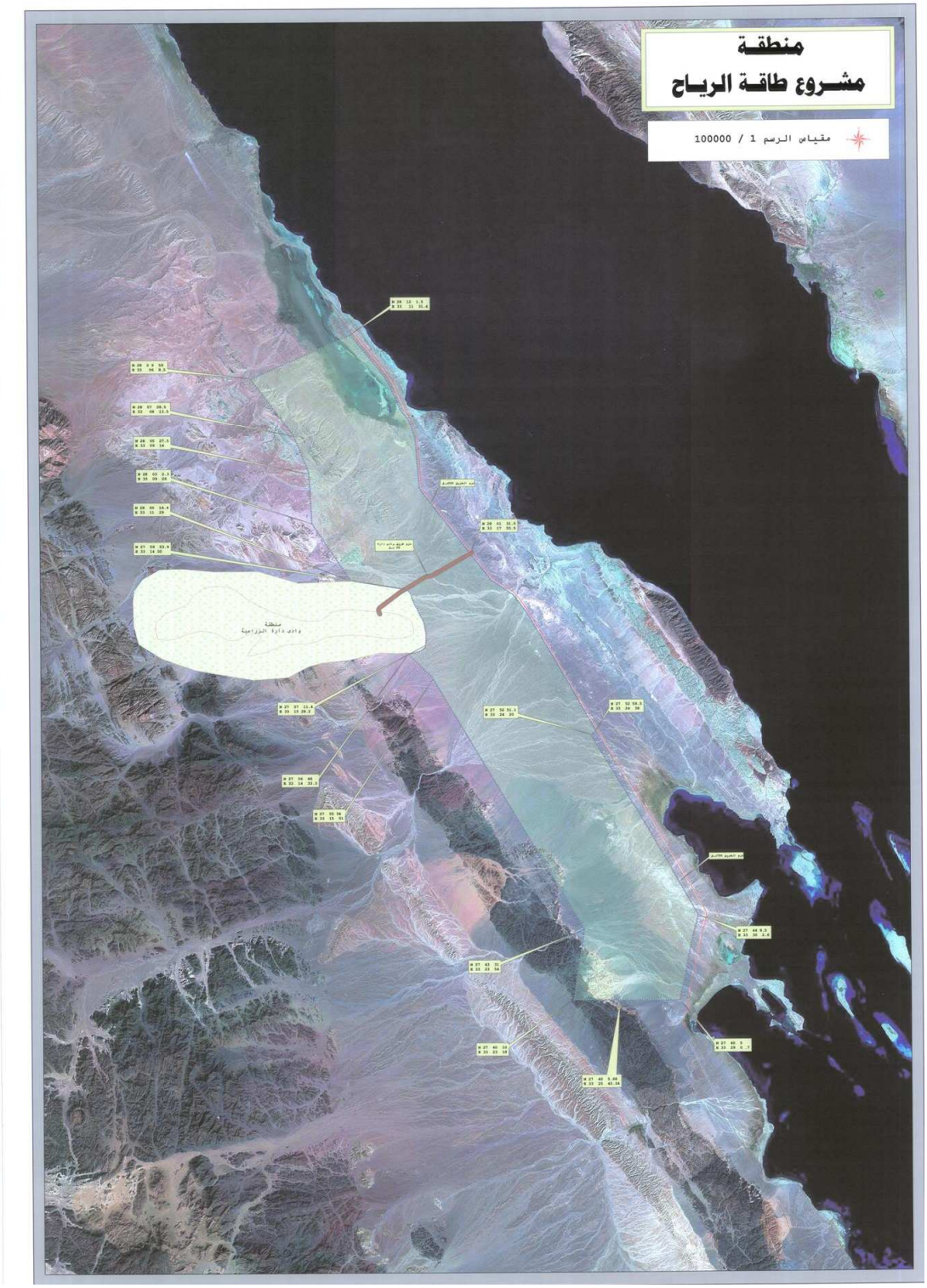

Figure 2.5.1: Satelite map of the "NREA concessionary area"

2.5.2.2 The location

The location of the area is already described in chapter 2.5.2.1 and shown on Fig. 2.5.1. The southern border is at N 27° 40' 5". The most northern point is at E 33° 11' 31.4" / N 28 ° 12' 1.5" (WSG84 coordinates).

The "NREA concessionary area" is a desert area. Only at very limited spots some very scattered desert vegetation is observed. The southern part of about 55 km (reaching to about 5 km to the north of the Wadi Dara road) is almost completely consisting of desert plains formed by the extraordinary wind. This area is crossed by two main Wadis, the Wadi Dibb and the Wadi Dara. However, due to the high wind speeds and the large sand transport/ sedimentation potential, the wadi beds are not pronounced at most of the wadi courses. The northern part of the NREA area shows both, undulated land and gravel desert plains. The western side of this northern area shows hills up to 250 m height.

The ground surface in most of the area is covered with compact angular gravels and pebbles forming what can be called desert armour. The level of the whole project area above sea level ranges from 9 m below sea level in the north eastern side to hills and slightly elevated mountains rising to levels of 250 m in the west. In general, the smaller mountainous areas in the Northwest would be kept free from wind power development because of difficult access conditions.

Further characteristics of the area are:

- **Landuse:** There is very limited land-use within the area:
  - For a significant part of the area oil exploration and production concessions are given to petrol companies. Although, a general agreement between the Ministry of Petrol (General Petroleum Authority) and NREA exists the actual concession rights of the petrol companies have to be considered in the planning for the individual projects. Existing oil & gas pipelines have to be secured according to safety standards set by the pipeline authority.
  - The western part of the NREA area extends to the water well area of Ras Shukheir water supply. This is at about N 28° 04' 0 0". As this area is within a valley it is likely to be kept free from wind power siting.
  - An asphalt making plant covering an area of 150 m x 150 m is operating at the access road from Ras Shukheir. Wind park development can easily avoid this area.
  - Military activities are observed directly outside the southern border of the NREA area, where a radar station is placed. A conflict could be caused by reflection of the radar beam by wind turbine blades.
  - The southern part of the NREA area is near to the Red Sea Protectorate at minimum distances of about 1 km. Within this protected zone a giant tourist development is planned along the beaches. This was agreed with the Ministry of Tourism in December 2006 and the area shall comprise 3,000 hectares. As this area is completely outside the NREA area and as the NREA area was allocated before 2006 there should be no conflict.
  - One salt depression zone (Sekbha) in the northeast representing about 5 % of the overall NREA area. This area shall be kept free from wind power development.
- The area does not contain any **water bodies** except in the Sekbha zone mentioned before.
- The area does not contain any **habitats** (natural or man made) for flora and fauna.
- **Infrastructure:** The project area has no infrastructure except a few desert tracks, gravel roads and the crossing asphalt road to the Wadi Dara settlement. The next settlement is at minimum distances of about 800 m from the border of the area. ´
- The area does not contain any **historical sites** or **environmental protection areas**.

2.5.2.3 The project - Layout of wind power development

The final design of wind power development in the “NREA concessionary area” would be known after detailed planning only, which would be carried out within the frame of individual projects to come. Therefore, potential environmental impacts have to be assessed for typical wind park layouts at this stage.

Wind parks in the NREA area would typically be developed in rows perpendicular to the main wind direction with a distance between each row around of 1000 m, a distance between turbines in a row of around 300 m and a turbine height up to the upper blade tip of about 100m. The size of foundations would be less than 20 x 20 m and a maximum of 4 m depth. Depending on the type of selected wind turbine transformer stations may be contained inside the wind turbine towers or a small transformer compact station might be placed next to each turbine. The housing of such compact station would be not more than 2 m x 6 m. Power cable trenches will be attached along the rows near to turbines, having a depth of about 1.5 m and a width of not more than 2.5 m. Inside the trenches plastic pipes with diameter of 5 cm for the control cables will be placed on top of the power cables. The power cables will be connected to a central substation with an area of about 300 m x 300 m adjacent to the wind farm. For larger distances 69 kV overhead lines instead of cables may be constructed. Within the wind park earth roads of about 5 m width will be constructed, consisting of compacted desert material. The compacted area will be enlarged next to each wind turbine to a size of about 25 x 20 m for the erection of the wind turbines. The wind park design will exclude wadi and steep mountainous areas. Due to both, the nature of the project and the weather conditions, there is no need for surface drainage.

Power cables or MT transmission lines will be connected to main substations (220kV or 500 kV), which would be located inside the “NREA concessionary area”. Such substations would be probably located near to the 230 kV line Hurghada - Zafarana to come or other future transmission lines and would have space requirements in the order of 200 x 200 m² each. In addition, two service buildings of NREA especially for accommodation, maintenance and control would be built probably next to the main coastal road, near to the main substation and the water pipeline along the Suez road. The number of persons living & working permanently in the area would be less than 100. Accordingly, the amount of domestic waste water generated would not be more than 10 m³/d.

2.5.2.4 Site preparation and construction measures

Typical works to be carried out for wind power projects are limited to:

- Excavation, backfilling and compaction works for road and platform construction as well as for foundations and trenches will be limited. No material will be taken from or to the area.
- Concrete works for foundations
- Wind turbine installation works using large mobile lifting capacities.

Construction measures for a service area of NREA would be limited to typical house and storage building works.

For wind park construction projects mobile construction yards would be erected. Water supply would be via tankers. Electricity would be generated by mobile generators. Construction measures of NREA would be supervised by NREA engineers. Moreover, usually international Consultants would be employed for assistance. This supervision includes the assurance of Contractor’s proper waste management and the proper land reclamation at the end of construction measures.

2.5.3 Background information

2.5.3.1 Legislative framework

- The legal basis for EIA is established by Law No. 4 of 1994, the Law on Protection of the Environment. It is implemented through its Executive Regulations issues by Prime Ministerial Decree No. 338 of 1995. These came into full force in 1998.

Of special relevance for wind power projects are the following annexes to this law:

- Annex 2: Establishments subject to environmental impact assessment
- Annex 7: Permissible limits of sound intensity and safe exposure periods

There are no national laws and regulations on shadowing/flickering from wind turbines. According to German stipulations (Emission control law) the limit for affecting residencies by shadowing from wind turbine blades is 30 hours per year and/or 30 minutes per day.

- As a signatory state the Government of Egypt has to meet environment protection obligations with regard to the

- Convention on the Conservation of Migratory Species of Wild Animals (the Bonn Convention) and the
- Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA).

2.5.3.2 Methodology

Baseline investigations were carried out with regard to any potential impacts caused by wind energy utilisation in this very homogeneous, non-populated desert area. These were with regard to competing uses, to flora & fauna and especially with regard to avi-fauna. In the latter case special emphasis was laid on migrating birds. In detail the following surveys were undertaken to determine the baseline situation:

- A reconnaissance survey to assess the present land-use in the area was carried out in April 2007 (see chapter 2.1.1).
- A survey on the fauna others than avifauna and flora was carried out by one fauna and one flora specialist in July 2007. The results are compiled in the study, “EIA screening for the NREA wind farm area with special emphasis on flora and fauna (except avifauna)”, Annex 2.5.1
- An autumn and spring monitoring of bird migration and bird habitat in the overall area by a team of 6 ornithologists. The results are compiled in the studies
    - Ornithological Field Monitoring Report, Annex 2.5.2.
    - Ornithological Expert Opinion as part of the Feasibility Study for a large wind farm at Gulf of Zayt, Annex 2.5.3.
    - Ornithological Assessment, Summary of Findings and Conclusions, Annex 2.5.4.

Possible impacts were assessed within the specialist reports itself. Accordingly, in this main report only summary results are presented.

2.5.3.3 Consultation

Due to lack of residential areas and population inside and directly adjacent to the “NREA concessionary area” there is no need and possibility for a public consultation. A consultation with possibly competing users inside the area such as the petrol companies having prospection or production business or the water well field in the area has to be carried out within the planning process of individual projects in a later stage, if such activities would be affected.

2.5.3.4 Alternatives

Wind power projects have to be developed at areas with good wind conditions. Previous wind measurements revealed that the "NREA concessionary area" avails of unique high wind power potential. Therefore, there are no equivalent alternative areas for wind power development.

Alternatively to power generation by renewable wind energy, conventional thermal power stations might be built. However, such would be likely to be fed by heavy fuel oil and to generate considerable amount of CO_2. This would also contribute to the exhaustion of oil and gas resources.

2.5.4 The existing environment

2.5.4.1 Overview of existing environment

The "NREA area" is a desert area. Only at very limited spots some very scattered desert vegetation is observed. The southern part of about 55 km (reaching to about 5 km to the north of the Wadi Dara road) is almost completely consisting of desert plains formed by the extraordinary wind. This area is crossed by two main Wadis, the Wadi Dibb and the Wadi Dara. However, due to the high wind speeds and the large sand transport/ sedimentation potential, the Wadi beds are not pronounced at most of the wadi courses. The northern part of the NREA area shows both, undulated land and gravel desert plains. The western side of this northern area shows hills up to 250 m height.

Moreover, the area or it's direct neighbourhood is characterised by:

- Very scarce vegetation and fauna, except avi-fauna; no rare or endangered species or plants; the area is in or nearby to a major migration route with endangered and protected birds.
- No surface water except small lakes within a salt depression (Sekbha) in the northeastern part of the area.
- Air quality affected by dusts having their origin in the desert itself and caused by strong winds; in the north eastern part acidic emissions from flare gas burning is observed.
- Natural noise level high due to frequent strong winds; no man made noise emissions except those from the traffic at the Suez – Hurghada road and from singular petroleum exploration activities.
- Not any antiquities or other sites of historic and cultural significance in the overall area.
- Access to the area from the Suez- Hurghada road, which is a four lane road; not any bottleneck with regard to traffic/transport capacity.
- Not any utility services in the area; transmission water pipeline (Nile water) is routed on the western side and in parallel to the Suez – Hurghada road, i.e. at the eastern border of the NREA area; at about N 28° 00' 00" the water pipelin e between the Rhas Gharib water supply well field and Ras Shukheir road entry is crossing the area.

The area is characterised by average maximum temperatures ranging from 20 C° (January) to 33 ℃ (August) and average minimum temperatures ranging from 13℃ (January) to 28 ℃ (August), an average annual precipitation of about 4 mm in the winter months, relative humidity in the order of 30 to 40 % and a zero cloudiness almost all through the year. Wind speeds can be derived from NREA's own measuring stations. Extreme gust wind speeds are in the order of 35 m/s. The average wind speed at 25 m height is about 11 m/s. Rainfall is very sporadic in this hyper-arid area. It is variable from year to year and characterized by its irregularity both in time and space.

It is noteworthy that the natural conditions, especially the drastic dry and windy conditions, are very much limiting the biodiversity of the site:

- In exceptionally rainy years, runoff water be be collected in low parts, what may lead to the growth of some plants. However, these plants are subjected to long dry periods leading to their death.
- The high wind velocity in the site. Such a factor plays an important role in the severe

erosion of the soil. The ground surface in the site is mainly covered by compact layer of pebbles and gravels. These represent a desert armour. This prevents the permeation of rain water to the subsoil. The high wind velocity removes the seeds and other propagules. So, the chance for seeds to germinate and establish themselves is very poor. It is interesting to mention that fruits of *Acacia* are trapped by the dead dry branches felling from the trees.

2.5.4.2 Flora and fauna (without avi-fauna

A detailed assessment on the flora and fauna of the area is contained in the EIA screening report enclosed as Annex 2. The area of the site encompasses different habitats. Each of these habitats has its own characteristic features. Consequently, the plant and animal lifes are different in the various habitats, if existing at all.

Habitats:

The habitats identified in the site are:

- **Sebkhas (Saline habitats): (*Al Mallaha*)**
  This habitat usually occupying land below or slightly above sea level. The main saline area in the NREA area extends from north west to south east in the north eastern corner of the site. (Fig.1). This sebkha occupies a piece of land with a breadth of 4 km at maximum and length extending for 8 km from north to south.

  Zonation of the landscapes and habitats within the sebkha area is usually clear. It s affected by the level of land above sea level and the depth f the water table. Such factors affect the plant and animal life. The sebkhas can be classified as follows:
  a) Elevated habitats occupied by a community dominated by ***Tamarix passerinoides***. The dominant plant forms phytogenic mounds as high as 3 m and a diameter of more than 10 m.
  b) Elevated habitats along the western side of the sebkha supporting a plant growth dominated by ***Nitraria retusa***. The plant forms mounds reaching more than 5 m in height and 10 m in diametre.
  c) Flat wide area is devoid of plant cover. This habitat is usually located at a level below those occupied by the ***Tamarix*** and ***Nitraria*** communities. The ground surface is covered by a thick brownish, sometimes cracked, layer. This layer is composed of mixed sand and salt. It is usually wet.
  - d) Brine with salt crust at a lower level, where water is shallow. No plant life in this habitat.
  e) Free saline water in the deepest part of the sebkha. It is devoid of and plant cover.
  It is to be noted that this habitat will not be considered for the wind farm. This is for reason of expected soft grounds.

- **Wadi Downstream**
  Within the NREA project area there are some downstream ends of some wadis e. g. Wadi Dara, Wadi Dibb, Wadi Abo Mesallah and Wadi Abu Jad. These wadis reach the Ras Ghareb-Hurghada road and cross it towards the sea. Spillways are constructed to allow the drainage water flowing towards the sea. However, due to the high wind speeds and the large sand transport/ sedimentation potential, the Wadi beds are not pronounced at most of the wadi courses. These wadis harbour some vegetation, i. e. about 2-7% cover. It is to be noted that the growth of this vegetation is sporadic depending on the very rare rainfall accidents. Plant communities are dominated by Ochradenus baccatus, Haloxylon salicornicum, and Zygophyllum coccineum are observed in these wadis.

- **Gravely Desert Plains**
  - The major part of the project area is represented by flat, wind eroded gravely and pebbly plains. These are completely devoid of plant cover. Only at some spots there are smaller hills originating from sand deposits. These singular spots may allow the growth of a very thin plant cover.
- **Hills & mountains**
  - Proceeding landward in the project area, the land becomes hilly. At some parts in the West the foothills of the western barrier mountains reach the NREA area. These parts are devoid of any plant cover.

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Flora:

Plant species observed in the area are very few in number and most of them were dead caused by the hyper-arid climate. All plants were common ones, not being red-listed:

Trees:

Acacia raddiana is very rare at the site. 12 trees up to about 5 m height can be found in a 25 km² large spot in the southern part of the area. It is interesting to note that numerous fruits are fund on he ground below the canopy of the trees, where they are trapped by the dead fallen branches. A few green branches occur on the trees, usually near the ground surface.

Shrubs:

Tamarix sp. (T. passerinoides). *Athl- Tartfa*. This very common species occurs mainly along the borders of the *Sebkha* in the north eastern corner of the site.

Nitraria retusa (Forsk.) Asch. Ghakad - Ghrdak. A halophytic plant that grows along the margins of the *sebkha* in the north eastern corner of the site.

Undershrubs

Halopytes

Salsola longifolia *Suweid.* A halophytic plant with succulent leaves grows at salt affected habitats along the less saline habitats in the sebkha area.

Zygophyllum *album L. Rotreit Abyadh*. It is halophyte with succulent leaflets and petioles. The plant forms phytogenic mounds in saline habitats along the margins of the sebkha.

Xerohpytes

Crotalaria aegyptiaca Benth a leguminous undershrub and **Zygophyllum coccineum L. *Rotreit*** a succulent undershub and **Tribulus terrestris L. *Hasak*** (only one plant observed)**,** a small herbaceous perennial plant occur in particular habitats along the water pipeline crossing the site from west to east, where using water is available. They will disappear after stoppage of leakage.

Haloxylon salicornicum (Moq.) Bunge ex Boiss. Rimth. The plant occurs in rills and shallow drainage lines or on flat gravely plains. The plant forms phytogenic mounds by collecting the wind-drifted sand. The tail of the mounds points to the wind direction.

Zilla spinosa Pranl. Sillah. The plants recorded in the area were dead. It seems that in exceptionally rainy years, there is a chance for the growth of some individual. These desiccate due to lack of water supply and die**.**

Pergularia tomentosa *Ghalaqa*. Its occurrence in the site is confined to a runnel in its southern part. The plant forms small mounds. However, due to long dry period over years, the plants are dying and their buried stems are exposed due to wind erosion.

Cleome droserifolia (Forssk.) Del. Samwa. The few recorded individuals are confined to a narrow drainage line in the southern part of the area.

Aerva javanica Raá. One individual of this desert undershrub was recorded in a drainage line in the southern part of the site.

Ochradenus baccatus: It occurs in many parts of the site. The plant is a common desert undershrub in the Eastern desert of Egypt.

Fagonia arabica *Showeika*. These very common plants were dead in many cases. It is expected that the numerous dead individuals grew after the last exceptionally considerable rainfall. The cessation of rainfall for many consecutive years leads to their death.

Desert Grasses

Stipagrostis plumosa Nasy. A herbaceous grass growing in microhabitats near the water pipe. A few individuals were recorded.

Ephemeral Plants

Erodeum laciniatum It is an annual desert plant that grows at the site only in the oozing area of water from the pipe line. It was found dead.

Fauna – (without avifauna)

The fauna composition of the project site can be classified into two main categories; namely: vertebrate and invertebrate animals.

- **Invertebrates**

Six species were observed in the project area or in the near farm land in Wadi Dara. These are arthropods. Scorpionida (scorpion) is represented by only one species; the Yellow scorpion. Diptera and Hymenoptera are orders represented by two species in the project site. Only one species from order Coleoptera was found in the project site (Table 1).

Order	Family	Species
Coleoptera	Tenebrionidae	Tentyrina bohmi
Hymenoptera	Formicidae	Cataglyphus bicolor
		Monamorium subobacum
Diptera	Muscidae	Musca domestica
		Tabanus gratus
Scorpionida	Buthidae	Leiurus quinquestriatus
4	**4**	**6**

Table 2.5.1: ***Systematic list of arthropods observed in the project site or in the adjacent Wadi Dara farm area***

Scorpions

Two individuals of only one species of the scorpions (Yellow Scorpion) were captured from the farm area of Wada Dara adjacent to the western margin of the project site. ***Leiurus quinquestriatus* (Hemprich and Ehrenberg, 1828)**, **Yellow scorpion**: The main characteristic feature is the blackish colour of last segment of the tail. One of the most dangerous scorpion species in the world and is common in Egypt.

Insects

Individuals of three different orders of insects were observed in the study area. These includes a small beetle: *Tentyrina bohmi* (Coleoptera), a small ant*: Monamorium subobacum* and a large ant*: Cataglyphus bicolor* (Hymenoptera) and other two species belonging to order Diptera; namely House Fly: *Musca domestica* and Blue Fly: *Tabanus gratus*.

Vertebrates

The vertebrates in the site comprise reptiles and mammals. Both groups are expected to be represented by different species. Direct observation could not show the presence of these species. But other evidences were used as well as the previous records. The species record, either previous or present indirect observations shows that five reptiles and seven mammals are apt to occur in the site (Table 2.5.2).

Order	Family	Species
Reptiles		
• Squamata	Agamidae	Agama agama spinosa
	Gekkonidae	Hemidactylus turcicus
		Tropioiclotes steudneri
	Lacertidae	Acanthodactylus boskianus
• Ophidia	Viperidae	Cerastes cerastes
Mammals		
• Lagomorpha	Leporidae	Lepus capensis
• Rodentia	Gerbillidae	Gerbillus gerbillus
		Meriones crassus
	Muridae	Mus musculus
		Acomys cahirinus
• Carnivora	Canidae	Vulpes vulpes
		Vulpes rueppelli
5	**8**	**12**

Table2.5.2: ***Systematic list of terrestrial reptile and mammal species expected to occur in the project site***

All species are of a status “low risk/least concern”.

Species	Habitat types			Evidence	Previous Record
	SB	GP	WD		
Agama agama spinosa	-	++	-	Previously Record	Marx, 1958
Tropiocolotes steudneri	-	+	+	Previously Record	Saleh, 1997

Acanthodactylus boskianus	+	-	-	Observed	First record
Cerastes cerastes	+	-	-	Tracks	Marx, 1958

(-=absent; + = present up to three times; ++ = present up to five times; +++ = present more than five times) (SB= Sebkha; GP=Gravely plains, WD= Wadi downstreams)

Table2.5.3: ***List of reptilian species expected to be found in the project area***

Mammalian Habitats

The recorded mammal species in the project site can be found in different habitats. Table 4 shows the distribution of these species in the various habitats.

Species	Habitat types			Evidence	Previous record
	SB	GP	WD		
Lepus capensis	+++	++	++	Tracks	Osborn and Helmy (1980)
Gerbillus gerbillus	+++	+++	+++	Tracks	
Meriones crassus	+	-	-	Tracks	
Vulpes vulpes	+++	-	-	Tracks and scats	
Vulpes reuppelli	-	++	++	Tracks	

(-=absent; + = present up to three times; ++ = present up to five times; +++ = present more than five times) (SB= Sebkha; GP=Gravely plains, WD= Wadi downstreams)

Table 2.5.4: ***List of mammalian species expected to be found in the project area.***

Threatened Species in the deserts of Egypt

The above-mentioned data and information show clearly that no species of both, reptiles and mammals in the Egyptian desert, is threatened globally (according IUCN categories) and nationally (according to their status in Egypt).

2.5.4.3 Birds - Avifauna

As the NREA site is located near to a declared important bird area (the Gabal El Zayt IBA located along the coastal mountain range up to Ras Gemsa including the southern islands), and within/partly within a major migrating route, emphasis was laid on a detailed assessment of the bird life in the NREA area. The focus was on migrating birds. Results are based on one autumn and one spring observation. During that time regular observations were carried out from 26 different observation points equally distributed over the large area of more than 650 km² the observation times were about 20 hours (autumn) and about 23 hours during spring at each observation site. In addition radar observations were carried out at one site to observe night migration. Due to the time-wise small observation samples assessment had to remain conservative. Detailed results are enclosed in special reports enclosed as Annexes:

- Ornithological Field Monitoring Report, Annex 2.5.2.
- Ornithological Expert Opinion as part of the Feasibility Study for a large wind farm at Gulf of Zayt, Annex 2.5.3.
- Ornithological Assessment, Summary of Findings and Conclusions, Annex 2.5.4.

Habitats:

The large area can be classified in 3 categories:

- Most of the area consists of **flat or slightly hilly gravel plains**, completely exposed to the wind mostly blowing from Northwest with wind speeds of 10 to 14 m/s near the ground and not offering shelter for bird resting except within a few wadis or depressions.
- The **red see mountains in the west of the area** with foothills about 2 km outside the western border but in the southwest reaching the NREA area. This range forms the western border of the 20 km wide high wind speed plains up to the foothills of Gebal el Zayt, where the wind is accelerated because of the tunnel effect. The slopes of the hills are causing upwind effects. It was observed during spring, that a large number of birds of prey are moving along this mountain range in parallel and outside the NREA area towards Suez.
- In the northwest of the NREA area near to Ras Shukheir the **Sabkhet Ras Shukheir** is located. This contains several pools of hyper-saline water and large patches of saltmarsh. This area offers resting places for water birds. Flamingos, spoonbills and pelicans were observed.

Local Birds:

o The harsh windy and hyper-arid climate and the desert bare of vegetation offers no attraction for birds. Almost all birds found in the area do not stay the whole year but appear there during migration. Very few local birds and birds species were observed, all of them classified in the IUCN red list to be of least concern. The chief group of local birds were the sandgrouse (*Pterocles senegallus*), brown-necked raven (*Corvus ruficollis*) and a few Bar-tailed desert larks (Ammomanes cinturus), hoopoe larks (*Alaemon alaudipes*) and pale crag martins (*Hirundo obsoleta*).

Migrating Birds:

With regard to migrating birds reference is made to the detailed reports enclosed as Annexes. The results can be summarised as follows:

- Bird migration is more concentrated in the southern part of the NREA area. The main migrating route is from north-east to south-west (autumn) and vice versa during spring. In both cases the Gebel El Zayt mountain range is the target for birds crossing from and to Sinai. During spring a significant number of birds is coming from the red sea mountains when heading towards the Gebel El Zayt coastal mountain range. Due to the turbulent wind and weather conditions the migration is following no straight corridors if passing the plains of the NREA areas.
- A secondary migration route is along the red sea mountain range during spring mainly about 2 to 3 km outside NREA area to the west, which is mainly used by birds of prey.
- In some cases during spring it was observed that birds following secondary migrating route to Suez changed the route and returned to the Gebel el Zayt from north-western direction to go for Sinai, thus crossing the “NREA concessionary area”.
- All bird species observed during systematic observations are globally classified in the IUCN red list as “lower risk/least concern” except the Lesser Kestrel classified as vulnerable and the Pallid Harrier classified as near threatened. The Lesser Kestrel was observed area within the first 200 m of the overall area 14 times during autumn and 19 times during spring. Figures for the nearly threatened Pallid Harrier were 73 (autumn) and 12 (spring). The spotted eagle was observed 1 time in the first 200 m and 8 times flying higher. This specie is classified by IUCN as DD (Data Deficient) and might be threatened as well. All three species are contained in Appendix 1 of the Convention of

Migratory Species (CMS), which is signed by Egypt.

- The focus of the EIA studies was on soaring and gliding birds because of their suspected relevance for being endangered by wind parks. They
    - have restricted flight agility,
    - are susceptible to additional mortality because of their low annual off-spring rate and
    - are very much dependant on up-winds to sustain their migration flight and sensitive to increased energy consumption due to forced active flight, e.g. by avoiding wind park barriers.

The NREA wind park area is near to the Gebal el Zayt mountain range, which is used as a jumping point with uplift winds for crossing the red sea (water body with no or little uplift winds) to Sinai at the narrowest path during spring and which is the site, where birds arrive usually at low heights, when crossing the red sea from Sinai during autumn. For heading to Gebal el Zayt (spring) or for proceeding migration from Gebal el Zayt during autumn a significant portion of these birds, following the main Sinai migration route, is passing through major parts of the NREA concessionary area on the way to and from the Red Sea Mountains about 20 kms to the West. On the way through these plains no clear migrating corridors are observed. Depending on wind force and wind direction birds may be drifted over the plains away from the straight routes or even forced to rest.

2.5.4.4 Water resources and waste water

The NREA area can be classified to be hyper-arid. It is crossed by two three major Wadis, i.e. Wadi Jarf, Wadi Dibb and the Wadi Dara. However, due to the high wind speeds and the large sand transport/ sedimentation potential, the Wadi beds are not pronounced at most of the wadi courses. In absence of statistics surface runoff reaching up to the NREA area is expected to be very seldom.

Open surface waters are met in the Sekbha area in the Northeast of the NREA area, where the surface is near to or even below the sea level. Accordingly, the lakes in that area receive their saline water by infiltration of seawater or, in very rare cases from rain runoff in Wadi Jarf. Groundwater is expected in general at increasing depths towards the inland. However, groundwater with little salt content is met at Wadi Dara (outside the NREA area) and at Wadi Jarf at the western border of the NREA area (Ras Gharib water wells). From there water pipelines cross the NREA area towards Ras Shukheir. A main Nile water pipeline is lined in parallel to the Suez - Hurghada road outside the eastern border of the NREA area.

There are no human activities in the area that use water or cause drainage.

2.5.4.5 Air quality

Due to the high wind speeds in the NREA area and the desert character of this area the level of dust or fine sand content in the air is frequently high. In the north- eastern part of the NREA area, south of the sekhba, sulphate containing flare gases from EPC production wells cause acidic ambient air conditions in the surroundings.

2.5.4.6 Noise levels

The natural ambient noise level in the area is high because of noises caused by frequent strong winds. The only sensitive receptor location is the Wadi Dara settlement. However, the most near residences are about 1 km away from the western border of the NREA area.

2.5.4.6 Antiquities and other sites of historical and cultural importance

Not existing inside or adjacent to the NREA area.

2.5.4.7 Social and economic context

There is only one small settlement at Wadi Dara village about 2 km outside the NREA area, where agricultural trials on desert ground using slightly saline groundwater are carried out by a co-operative. Moreover, in the surrounding of the NREA area petrol activities are carried out. The most near significant site is at Ras Shukheir, about 3 km outside the western border of the NREA are. At this location living facilities for workers7employed personnel (apartments, guesthouses, etc.) exist. Most personnel is coming from the central or upper part of Egypt. Others are living in Ras Gharib, the district town at about 25 km distance from the NREA area.

2.5.4.8 Existing transport infrastructure and traffic flows

The access to the area is from the Suez- Hurghada road, which is a four lane road. This road has very little traffic load compared to its capacity.

2.5.4.9 Existing utilities

There is not any water use or water distribution inside the NREA area. The same is valid for electricity. The next electricity supply system is the Ras Gharib island grid. One 10 kV branch of this grid is extended to the Ras Gharib water wells in parallel to the water pipeline. Thus, this overhead line is crossing the NREA area in parallel to the earth road between Ras Shukheir and a petrol company owned water well field. A 230 kV overhead line between Hurghada – Zafarana was planned since long and the works are now contracted. This line is also to supply Ras Gharib and is built independently from any wind power development at the NREA area.

2.5.5 Prediction of impacts

2.5.5.1 General

Expected or possible environmental impacts of wind energy projects in a desert area, as it is the case of the NREA area, are very much limited. This is valid for both the construction and the operation phases. The limitation of environmental impacts is due to

- the nature of the area with a hyper arid climate, shows no population, very limited vegetation and wild life inside or near to the area that can be affected by the measure.
- the nature of a wind park project with very little specific land-use typically consisting of 3 m deep wind turbine foundations (about 3 per km² with a land requirement of about 0.1% of the area), underground cabling at distances of about 1 km (alternatively MT overhead lines, eventually small transformer foundations using 0.005 % of the area) and 5 m wide gravel roads made from compacted desert gravel. A few rare desert acacias in the South could be easily protected by avoiding a nearby wind turbine siting.
- there is only one central building facility for wind park service and a central substation with limited dimensions of less than 200 m x 200 m each.

Local fauna and flora are very few in numbers and were common ones, not being red-listed. Also possible impacts caused by waste water and domestic waste generation at the service buildings would be of minor nature and could be easily be mitigated.

However, as the location of the NREA area is partly inside a main migration route and adjacent to a IBA area the assessment of likely impacts on migrating birds caused by future wind park during the operation phase is a key issue of EIA considerations for the area.

2.5.5.2 Presumed environmental impacts caused by construction and operation

There are not any significant environmental impacts expected resulting from the wind park construction phase. Minor impacts may originate from,

- littering of solid waste at the construction yard or at the construction sites spread over the area,
- spills of oil and grease at the machinery park,
- deterioration of landscape due to not adequate backfilling or levelling after excavation,

They can easily be avoided by good housekeeping and strict supervision of construction measures.

Environmental impacts during the operation phase would be limited to the change of the landscape, which, however, would be no deterioration in this desert area and due to the waste water and solid wastes originating from the Service buildings of NREA and a ETC substation, if being built inside the area.

The only major impacts expected are those to migrating soaring and gliding birds where the wind park area is within the migrating corridor of low flying birds.

- They have restricted flight agility and are may be suffering from collisions with turbine blades,
- Wind parks have barrier effects for many bird species as they tend to by-pass or over-fly wind park areas. This forces them to active flight at high energy consumption, which would cause loss of energy and increased likelihood for mortality on their migration routes.

Although expected collision rates might be low, the indirect effects on mortality need to be taken into account. The expected impacts are discussed in detail in the specialist reports enclosed as Annex 2.5.2 to 2.5.4.

Considering competing environmental interests, such as bird protection and renewable energy generation and implied CO_2 avoidance, the “NREA concessionary area” was zoned according to the weight of the expected environmental impact /see Fig. 2.5.2.

- **Zone 1: Wind Park construction is banned.** This southern part of the NREA area comprises about 60 % of the overall area and is considered to belong to the main migrating corridor heading towards Sinai.
- **Zone 2: Construction subject to further ornithological monitoring and verification.** In this area of about 94 km² adjacent in the north to zone 1 significant migration in the direction of the coastal mountain chain, Gabal El Zayt, was recorded during spring. Apparently, birds had followed the mountain chain of the foothills of the Red Sea Mountains so far north that they had to fly in south-easterly directions to reach the coastal mountains. This zone was presumed to be in the border area of the Zone 1 and might even belong to it. Based on the findings of the one year ornithological investigations only an utilisation of this area for wind power development has to be rejected. Further ornithological monitoring and verification may lead to revised results.
- **Zone 3: Construction critical.** In this most northern zone there is no immediately recognisable topographical bottleneck. The terrain opens out and offers the birds more room to manoeuvre. Most birds moving through here are heading in the direction of Suez. Any wind farm installation in that area would require technical avoidance/mitigation measures at the plants and in the infrastructure itself as to the best practicable standard. Moreover, a careful

post installation monitoring programme needs to be executed to assess, whether the impacts in a wind park will remain on acceptable level or whether additional measures will have to be carried out.

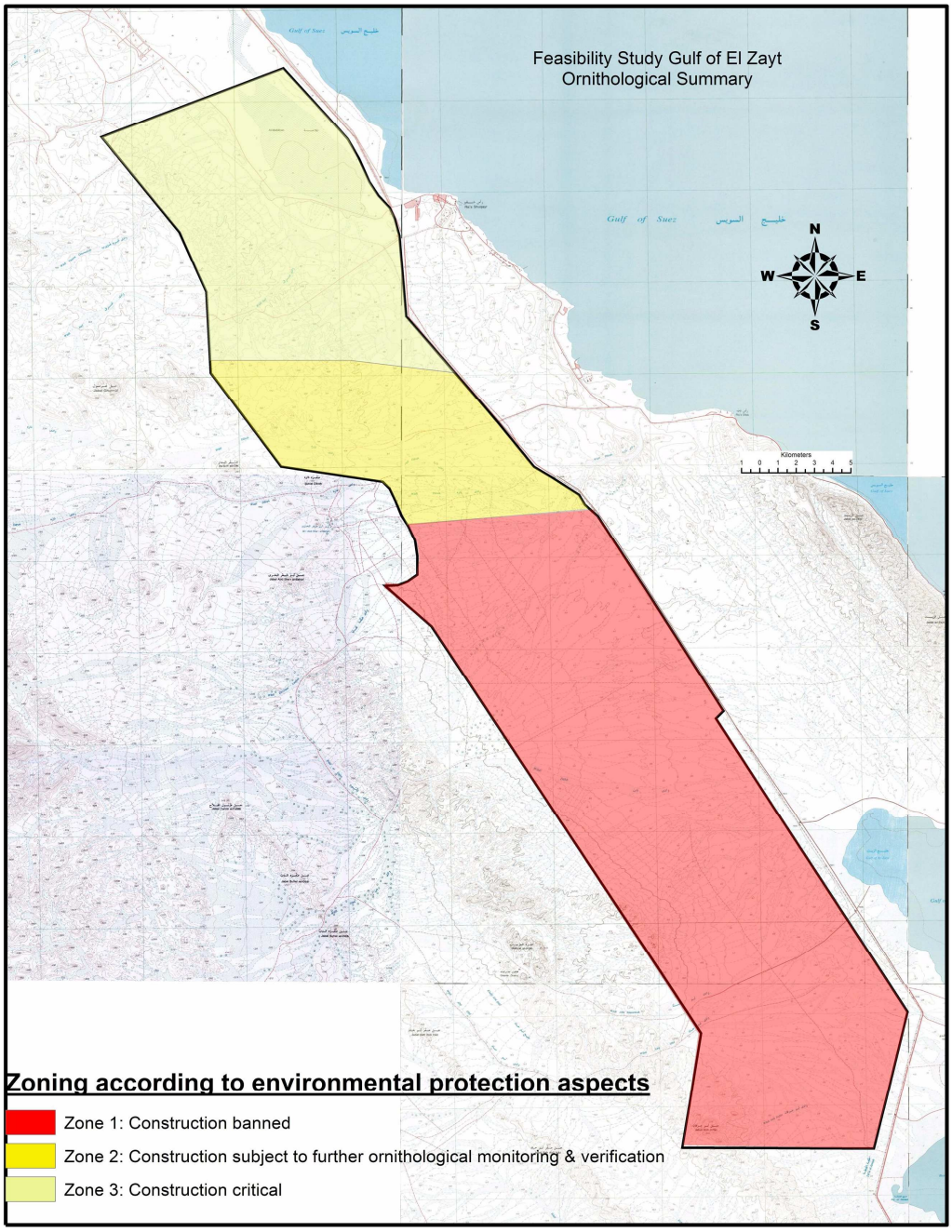

Figure 2.5.2: Zoning of the "NREA concessionary area" for bird protection

2.5.5.3 Economic Impacts

Both, wind park construction and operation would have economic benefits.

- About 30 to 40 % of the investment volume would be produced locally.
- During construction local personnel would be employed for civil, electrical and installation works. The works would be carried out essentially by Egyptian companies.
- During the operation a significant number of electricians, mechanics, engineers and workers would be employed for O&M of the wind park.
- At steadily increasing oil prices wind power utilisation, especially at a site with very high wind energy potential like the NREA area, is very competitive. It saves indigenous oil reserves, which alternatively could be exported at high world market prices.

2.5.5.4 Emissions

Wind park projects at a site like the NREA area will not have any emissions, which would have measurable impacts on flora, fauna, soils or human being. Domestic waste water generated at the central O&M facilities of NREA may be of an order of 10 m^3 per day and would be no harm to the environment, even if it would undergo natural treatment only. Domestic solid waste collection can be easily controlled and would be no major issue. The same is valid for smaller amounts of hazardous waste (e.g. used oils and grease) originating from O&M.

2.5.6 Mitigation

2.5.6.1 Mitigation strategy

Except impacts on migratory birds in major parts of the “NREA concessionary area” there are only a few minor impacts expected from wind power projects in the area. These can be easily avoided or mitigated by good design, workmanship practice, housekeeping and supervision.

Possible impacts on migrating birds shall be taken care of by

- following a precautionary approach, i.e. to develop wind power only in areas, where the one year bird monitoring showed minor quantities of low flying soaring and gliding birds and where sufficient easy bypass options are available,
- limiting the max tip height of wind turbines to 100 m in order to limit the barrier effect. This limitation was also an evaluation condition for the ornithological studies.
- equipping the wind turbines/blades with all means commercially available that makes them more visible for soaring and gliding bird species flying during daylight,
- to ban wind power development from areas unless a further ornithological monitoring would prove it’s suitability, for which the one year monitoring being of limited statistical relevance could not yet prove an acceptable risk level for birds,
- To establish a post construction monitoring programme for the first wind park projects and to take any correction measure, that might become necessary.

2.5.6.2 Mitigation measures

Minor impacts that can be caused during the construction shall be mitigated as follows:

- Micro-siting of wind turbines and design shall not affect the few desert acacias found in the area

- The contractor shall be forced to good workmanship and housekeeping during construction by supervising engineers in order to assure adequate disposal of solid waste and waste water, to avoid or to collect spillages of used oils, greases, diesel, etc.
- To force the contractor not to leave the construction site unless the area was put into tidy conditions, excavations are backfilled, heaps of excavation material is levelled and waste is adequately disposed off.

Minor impacts that can be caused during operation (from service installations) shall be mitigated by

- Regular disposal of domestic waste, e.g. in connection with the municipal waste collection scheme at Ras Gharib,
- Regular disposal of hazardous wastes, especially of used oils, which from time to time is generated during oil exchange at the wind turbines.
- Collection of domestic waste water, purification in a simply treatment plant and rinsing of treated water into desert gravel for natural after treatment. Regular disposal of domestic sludge.

Major impacts that can be caused to migrating birds shall be mitigated as described below.
For wind park projects developed in the already environmentally cleared northern zone (zone 3) of the NREA area, by

- keeping the maximum tip height of not much more than 100 m in order to limit the number of endangered low flying birds and to facilitate eventually necessary over-flying,
- targeting to keep distances between turbine rows at not less than 14 turbine diameters and perpendicular to that at 3.5 rotor diameters to facilitate wind park crossing of species, which do not avoid wind parks in general but tend to cross at lower heights,
- painting the blades by visible colours and equipping turbines with navigation lights,
- building the wind park internal grid by underground MT cables. If the use of overhead lines cannot be avoided, such overhead lines have to be designed according to the guidelines “Protecting birds from power-lines, Nature and environment No. 140, Council of Europe Publishing”. Analogous measures shall be applied at any substation to be built in that area,
- avoiding the Ras Shukheir Sekhba area as this area is judged to be environmentally more sensitive and as wind power development at this salt depression/salt lake area would be anyhow difficult/more costly.
- carrying out a very careful post construction monitoring in order to identify any bird risks beyond acceptable level and to apply additional protection measures, whenever necessary,
- banning wind power development from “Zone 2” areas, unless a further ornithological monitoring would prove it’s suitability (the one year monitoring with limited statistical relevance could not yet prove an acceptable risk level for birds in “Zone 2”,
- banning definitely wind power development in the southern part of the NREA area as this zone is definitely heavily used by soaring and gliding birds for resting or passing from/to the Gebal el Zait mountain range.

2.5.6.3 Environmental management plans

Any wind power project in the NREA area would have very limited impact. There would be no requirement for a special environmental management plan for the individual projects. It would be absolutely sufficient, if a strong project supervision will force a contractor to keep basic standards during planning and construction.

The implementation of the first wind parks in the North would require an ornithological post construction monitoring during peak migration seasons in autumn and spring. This monitoring needs to focus on studying the flight behaviour at and near the wind park and on the determination of collision rates and mortality. The post monitoring may lead to further mitigation measures.