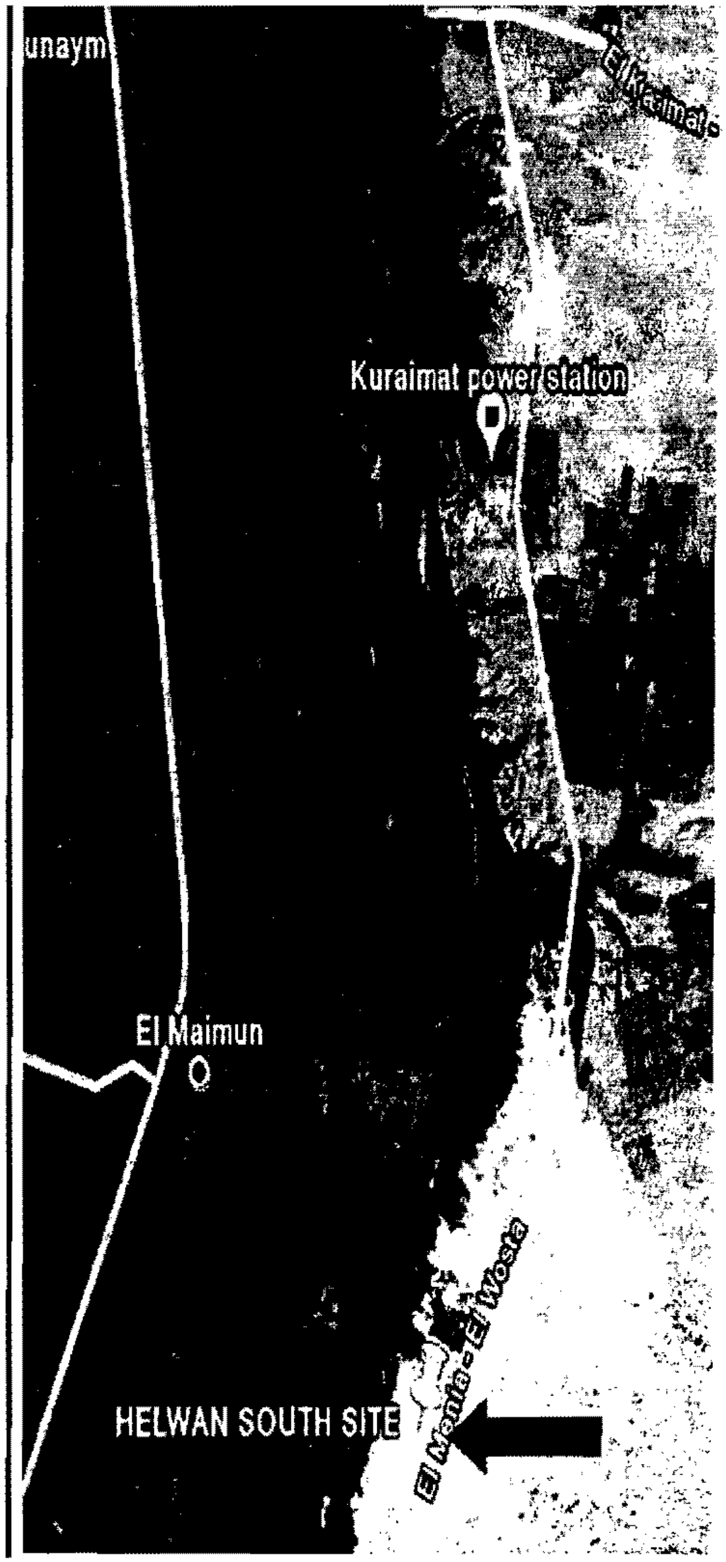
[redacted]

Arab Republic of Egypt
Ministry of Electricity and Energy
Egyptian Electricity Holding Company
Upper Egypt Electricity Production Company

HELWAN SOUTH 3x650 MWe GAS-FIRED STEAM POWER PROJECT

Environmental and Social Impact Assessment



FINAL REPORT
Volume – I

May 2011
Project 1573

Submitted by:

Engineering Consultants Group (ECG)
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Impact Assessment

Final Report

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(Attached Separately)

1. INTRODUCTION

Engineering Consultants Group (ECG), a private consulting firm (Egypt) was commissioned by the Egyptian Electricity Holding Company (EEHC) / Upper Egypt Electricity Production Company (UEEPC) to prepare the technical documents and procedures required by the World Bank Group (WB), the AfDB and other Development Banks concerning the Environmental and Social Assessment of the Helwan South Power Project.

EEHC is seeking financial assistance from the WB for the construction and operation of this 3x650 MWe, dual fuel supercritical steam power plant. The proposed plant is designated as a Category A project under WB rules, a Category 1 project under AfDB rules and a Category C project under the Egyptian environmental regulations and therefore requires a full Environmental Impact Assessment. Financing from WB, the AfDB and other Development Banks is conditional upon obtaining the environmental clearance from both the Egyptian regulatory authorities and the International & Regional Banks, i.e. the WB, the AfDB & other Development Banks.

1.1 BACKGROUND

1.1.1 The Power Plant

Upper Egypt Electricity Production Company (UEEPC), a company incorporated in Egypt and affiliated to the Egyptian Electricity Holding Company (EEHC) proposes to construct and operate a new thermal power plant at a selected site south of Helwan Governorate, which is along the Nile River and about 10km south of the village of Kureimat in the Dayr El-Maymoun area. The site is within an existing piece of land allocated to the Upper Egypt Electricity Production Company (UEEPC) by Presidential Decree No. 43 of 2010 issued on 14 February 2010 for the development of the power plant. The overall proposed site area is approximately 378,000 m^2.

The proposed power plant will consist of three supercritical thermal steam units, with a nominal electricity generating capacity of 650 megawatts (MWe) each, which will be known as Helwan South Power Plant. The overall generating capacity of the power plant will be 1950 MWe. The power plant is intended to be operational by the end of the year 2014. The power output from the proposed plant will be sold to the Egyptian Electricity Transmission Company (EETC).

The power plant will utilize natural gas as its primary fuel, and also have the capability to operate using mazout (heavy fuel oil). The ability to "dual-fuel" the power plant (with natural gas or mazout) will provide security of electricity supply in the event that gas supplies are unavailable for any reason. In addition, emergency generators, for the plant safe shut down, operating on sollar oil (light fuel oil) will also be provided on-site to drive key items of equipment within the power plant in the event of a power supply failure, and sollar oil will also be able to be used, if required, to operate the auxiliary boiler during start-up.

1.1.2 The Proposed Site

The Helwan South site is located within a bare sandy area of uncultivated land. It is entirely situated on approximately more than 37 hectare rectangle- shaped piece of land located in a rural/desert area approximately 10 km south of the village of Kureimat, in the ex-Helwan Governorate (this part was back to Giza Governorates after political events of 11 February 2011) on the east bank of the Nile river. The site of the new Helwan South 1950 MWe power plant facility is an area of about 276,000 m^2 within the existed allocated site. The site locus is approximately 100 km south of Cairo and 23 km north of Beni-sueif. Two physiographic zones occupy this area: a floodplain adjacent to the Nile, and a rocky desert plateau east of the floodplain. The site of the existing land is 450 meters wide and has an average length of 800 meters; in all the site encompasses 378,000 square meters.

On the north side of the site is the Kureimat Power Complex (2x600 MWe+ 2x750 MWe), at around 7.5 km and the Kureimat village (about 10 km) and the Helwan South irrigation pumping station (about 9 km). The site is about 700 m south of the Dayr al-maymoun village. On both of the south and the east sides of the site is a wide-extended desert land. On the east side, and across the power plant site is a two-lane road running paralle to the Nile river. On the western side of the site is an agricultural stripland parallel to the Nile river where the power plant's cooling water intake and discharge structures will be located.

The nearest town of importance is Es-saff, Markaz Es-saff, about 38 km along the road in the north direction. Towns of importance in the wide vicinity of the power plant site are Atfieh, Giza, Helwan, Imbaba, 15th of May, Beni-Suweif and El-Wasta.

The site entirely consists of approximately flat land, which is owned by the Upper Egypt Electricity Production Company (UEEPC).

The site of the proposed power plant is shown on *Figure 1-1*.

1.1.3 Power Generation

The proposed power plant consists of three gas/oil-fired supercritical units designed for a rated capacity of 650 MWe net output each. The boiler contained within this unit is designed for dual firing using natural gas as primary fuel and heavy fuel oil (mazout) as backup.

Continuous running time with heavy fuel oil will not exceed 7 days per annum and for non continuous operation, running time will not exceed 170 hours per year. In any event, heavy fuel oil will only be used if natural gas is unavailable. The ability to have dual fuel processing secures the supply of electricity from the plant, in the event that gas supplies are, for any reason, unavailable.

1.1.4 Fuel Supply

Natural gas will be delivered to the power plant via a new underground pipeline. The pipeline will be constructed by GASCo to provide gas requirements and link the plant with the gas network system in Egypt.

The emergency fuel oil-mazout-will be delivered to the power plant from Musturod or Helwan oil refineries by trucks and stored on site in storage tanks, with a capacity of 45,000m^3. Also sollar, required as a light fuel for use in the auxiliary boiler, will be delivered to the power plant from oil refineries by road trucks. On-site storage will be provided for sollar in a smaller tank. These tanks shall be located in the designed part of the proposed site.

1.1.5 Water Supply and Cooling

The power plant will incorporate a direct (once through) cooling system using water abstracted from the River Nile. The abstracted water will also be used, following pre-treatment demineralization, to provide process water make-up in the boiler system. Potable water supplies will be drawn from the same water supply system of the power plant.

The main demand for water is due to the direct cooling system. The use of a direct cooling system maximizes the electrical efficiency of the power plant and, after use, virtually all of the water will be returned to the River Nile at a slightly elevated temperature compared to the abstraction. No evaporative cooling towers are required, hence there is no opportunity for water drift or the formation of visible plumes of water vapor or ground fogging.

Nile water will be used as non-contact cooling water and for process water following demineralization. Nile water will be pumped through an intake pipeline buried under the bankline whilst heated cooling water will be returned to the Nile via a discharge pipeline.

Potable Water Connection

Potable water supply to the power plant will mainly be obtained as a byproduct of water treatment facility within the power plant itself. Process water will be abstracted from the River Nile for power plant usage and supplied via demineralization facilities for boiler make-up and other processes. Part of this treated water is further purified, disinfected and processed for human uses, mainly as potable water.

The other alternative for supplying potable water to the power plant is the potable water network of the Kureimat area. This network distributes water after treatment, purification and disinfection to domestic uses, including potable water. But this alternative needs a new pipeline to be extended for more than 10km to reach the power plant. Therefore the first alternative is the most appropriate one. The power plant will cover, also, potable water needs of the surrounding area.

At any cases, the power plant produces its demand of potable water via its own water treatment system. No potable water pipelines are envisaged to be extended particularly for the power plant.

Wastewater Treatment

A wastewater treatment facility on the site will treat liquid wastes and produce an effluent suitable for discharge into the plantation irrigation system. All oil waste effluents will be collected into a separate network and sent to an oil separator, then will be sold to an Petroleum Company.

1.1.6 Electricity Supply and Transmission

The electricity generated by the proposed Helwan South power plant will be exported by the EETC electricity network, via the transmission system, double circuit 500 kV lines. To evacuate the power generated from Helwan South power plant it is planned to interconnect the Helwan South to the 500kV network as follows :

- Construct 500 kV O.H.T.L double circuit SHPP(*) 500/ Minya East 500(proposed) with length of about 200 km.
- Construct 500 kV O.H.T.L double circuit SHPP 500/ Bader 500 (under constriction) with length of about 150 km.

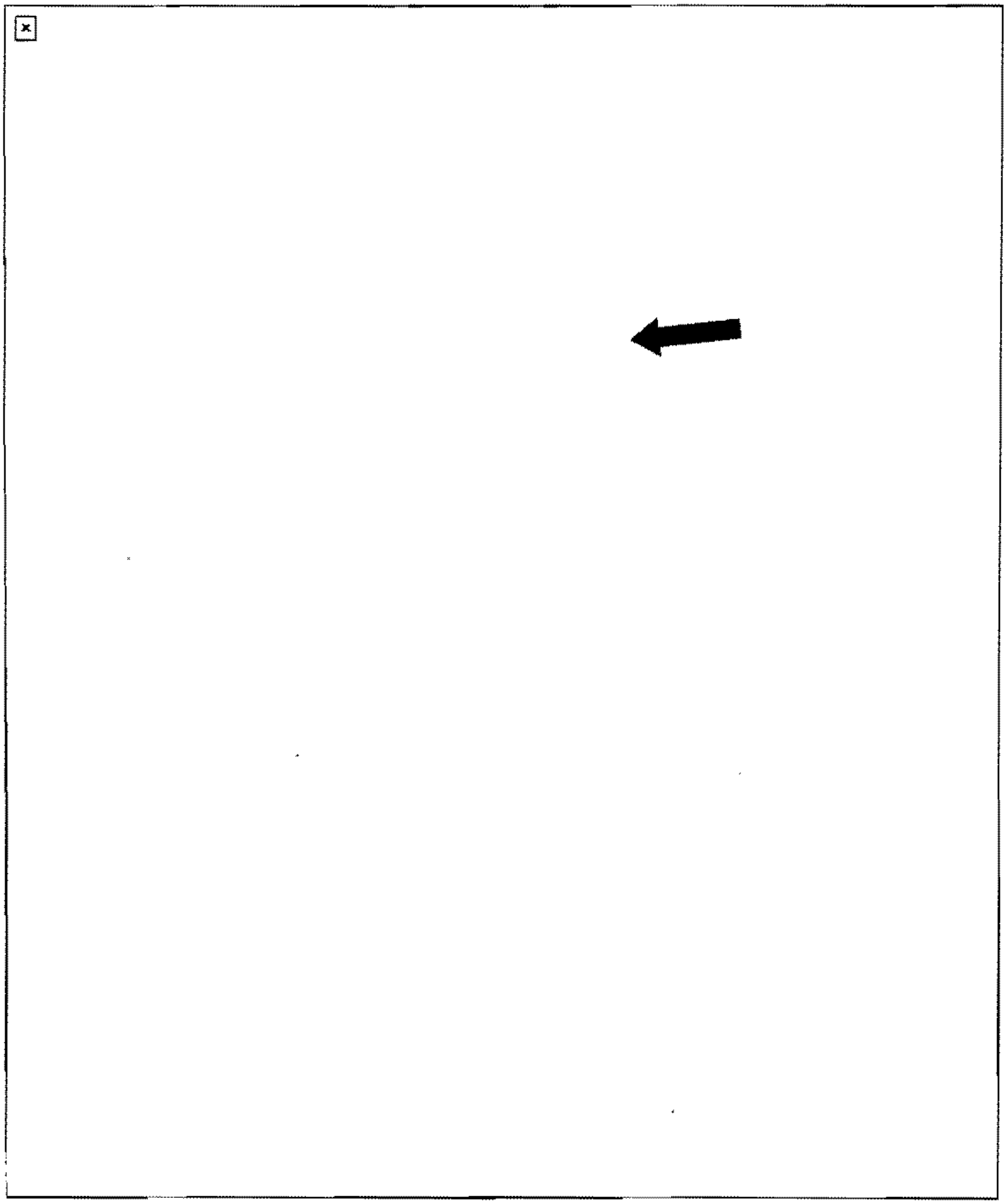
1.1.7 Access Roads

As part of the development of the power plant, there is an access road already running along the proposed site from Cairo to Beni-Suweif through Kureimat and Dayr El-Maymoun, which is connected to the main road network all over Egypt.

(*) SHPP = South Helwan Power Plant.

Figure 1-1

Location of the Proposed Site



1.2 ENVIRONMENTAL IMPACT ASSESSMENT OF THE PROJECT

1.2.1 Egyptian Requirement for an Environmental Impact Assessment (EIA)

The "Guidelines for Egyptian Environmental Impact Assessment" published by the Egyptian Environmental Affairs Agency (EEAA) specify that a " ...*thermal power plant falls within the category C projects"* (previously: Category of "Black List Projects") which, due to their potential and substantial environmental impacts, must submit a full EIA to the competent administrative authority (EEHC) and the Licensing Authority (the Governorate of Helwan and the EEAA) in order to obtain permission for development.

According to these requirements, UEEPC submitted their *"Helwan South Project 3x650 MWe Supercritical Steam Power Plant at Helwan- Arab Republic of Egypt ESIA"* to the designated competent administrative authority (EEHC) by the end of May.

1.2.2 This ESIA Report

This Environmental and Social Impact Assessment report (ESIA report) was prepared by Engineering Consultants Group (ECG) based on information provided by the project company and information contained in many baseline studies outsourced by UEEPC/EEHC and implemented by specialized consultants / consulting firms. It presents the findings of an assessment of the likely environmental and social impacts associated with the construction and operation of the new power plant and associated cooling water infrastructure. The ESIA report has been prepared to accompany the applications for consents from the Egyptian Government and local authorities to construct and operate the power plant. Also, the World Bank Group statutes and regulations require the World Bank to follow prescribed environmental procedures when involved with international assistance projects. For this, the ESIA report has been prepared to accompany the application for financing too.

1.2.3 Scope of the ESIA

This ESIA covers the main areas that might be affected by the construction and operation of the proposed power plant. Specifically, this includes ***studying environment and social impacts due to and on***:

- The ***power plant site, i.e.*** area within the perimeters of the proposed site;
- Areas immediately bordering and in the vicinity of the proposed site ***(i.e. surrounding environment and the community)***;
- Aquatic ecosystems that might be affected ***(i.e. water supply river, including ground water)***;
- ***Transmission lines;***
- ***Gas pipelines; and***
- Any other areas that might be affected by the proposed project.

2. POLICY, LEGAL AND ADMINISTRATIVE FRAMEWORK

2.1 WORLD BANK (WB) REQUIREMENTS FOR AN EIA

The World Bank follows a policy, which stipulates that all operations it support are carried out in an environmentally responsible manner and that projects must comply with all local environmental laws and procedures plus appropriate World Bank guidelines or, if these have not been specifically developed, IFC guidelines.

The World Bank sets out its procedures and policies with regard to conducting environmental assessments in *Operational Policy* 4.01: *Environmental Assessment* (October 1991) and its updates (1999, 2008) and other pertinent Guidelines. Annex E of the Policy identifies the process by which the level of investigation required in the environmental assessment is determined. It provides an illustrative list of Category "A" developments which require a full EIA and includes thermal and hydro power projects.

Accordingly, if World Bank funding is sought, a full EIA for the power plant following World Bank guidelines must be conducted and submitted to the World Bank for consideration as part of any application for funding.

2.1.1 World Bank Environmental Safeguard Policies

World Bank Environmental Safeguard Policies provide 10 potential issues that may need to be considered in an EA, depending on the specific characteristics of each project. *Table 2-1* summarizes the expected triggerability of the potential Safeguard Policies for the Helwan South Power Plant Project. The Safeguard Policies identified as "triggerable" are those which may be triggered and thus considered "Requiring Management". When the detailed design of the Helwan South Power Plant has been determined, the UEEPC should prepare project-specific plans to manage these potential impacts.

No safeguard policies were triggered except for the Environmental Impact Assessment. *Table 2-1* shows potential World Bank environmental Safeguard Policies and Helwan South project triggerability. The table justifies the triggerability or lack thereof for WB Safeguard Policies.

Annex B to Operational Policy 4.01 provides an outline of the information that should be included in a full EA. This Environmental and Social Impact Assessment follows the scope of Annex B.

2.1.2. World Bank (WB) Environmental Impact Assessment Guidelines

The proposed steam power plant is designated as a Category A project by the WB which means that a full EIA of the plant is required. WB policy and guidelines have been used for the assessment of impacts in this ESIA report.

The World Bank's new guidelines of December 2008 for the thermal power generation that outlines emission and discharge standards provides with maximum atmospheric emission guidelines for new source in both cases of gas and oil firing (Table 2-5 below).

The World Bank's *Pollution Prevention and Abatement Handbook-Part III* (July 1998), also provides with principles of industrial pollution management, monitoring and air emission & effluent discharge requirements presented in the industry Guidelines including Guidelines for New Thermal Power Plants.

The following World Bank publications have been used for guidance in this ESIA:

- Guidelines for carrying out environmental and social studies of the project.
- Guidance Note A: Checklist for potential issues for an Environmental Impact Study (EIS).
- Guidance Note B: Content of the Environmental Impact Study.
- Guidance Note C: Preparing and Updating Environmental Management and Mitigation Plan (EMP).
- Guidance Note F: Preparing the Public Consultation and Disclosure Plan.

Guidance Note B (*Content of an Environmental Impact Assessment*) in the World Bank's *Procedure for Environmental and Social Review of Projects* (December 1998) –and its updates- summarises the scope of the EIA as follows:

"An environmental impact assessment report for a Category A project identifies and assesses the potential environmental and social impacts of the projects, evaluates alternatives, and recommends appropriate mitigation, management and monitoring measures. The report's scope and level of detail should be commensurate with the project's potential impacts".

World Bank sector-specific guidelines for thermal power plants present maximum emission levels for thermal power plants and cover issues such as liquid effluents, ambient and workplace air quality, stack emissions, ambient and workplace noise, solid and liquid wastes, general health and safety, and general environmental requirements. The guidelines emphasise the use of cleaner fuels wherever economically feasible and focus on the operational performance of controls as well as their design standards.

2.1.3 Public Consultation Process

Public consultation and disclosure for the Helwan South power project, as presented in Section 9 of this report, has been designed in accordance with World Bank policy and guidelines shown below:

- Guidance for the Preparation of a Public Consultation and Disclosure Plan (January 1996);

- World Bank Policy on Disclosure of Information (1997);
- Doing Better Business Through Effective Public Consultation and Disclosure, A Good Practice Manual (IFC, October 1998);
- Procedure for Environmental and Social Review of Projects (December 1998); and
- Public Consultation in the EA Process: A Strategic Approach. World Bank Sourcebook Update, May 1999.

Under the public consultation process required for Category A projects, the Project sponsor is required to consult with the public at least twice; once during preparation of the Terms of Reference (ToR) for the EIA (Scoping), and also after the draft EIA has been prepared and submitted for public open review. The World Bank requires that a Public Consultation and Disclosure Plan (PCDP) be prepared, setting out the basis of consultation activities during and after the EIA, together with a schedule for the disclosure of information. The PCDP for this project is included in Chapter 9 of this report.

Other international banks and financing institutions, particularly AfDB, also follow a similar approach and use the World Bank guidelines as a benchmark for the environmental assessment of international power projects prior to provision of finance. Hence, an EIA of similar scope is likely to be required to obtain commercial funding for the power plant from international institutions.

Table 2-1

Potential World Bank Environmental Safeguard Policies and the New Helwan South Power Project Triggerability

No. Safeguard Policy	Applicability to Helwan South Project	Policy Triggered?	Justification
1. Environmental Assessment	Yes	Yes	• This policy applies to all projects requiring a Category A Environmental Assessment Under OP 4.01. • All environmental and Social aspects included in the New Helwan South project are adequately examined. • New Helwan South project is not likely to have significant potential (reverse) environmental risks & impacts in its area of influence (impacts on the natural environment: air, water & land; human health & safety; physical cultural resources; and transboundary and global environment concerns).
2. Forest	No	No	• No forest areas exist.
3. Involuntary Resettlement	Yes	Yes	• This policy applies to all projects triggering OP 4.12 • No relocation or loss of shelters. • No loss of assets or access to assets. • No loss of income sources or means of livelihood. • All activities related to the construction of the new plant will take place within on UEEPC land either on the site or on land directly adjacent to the site. i.e. no land acquisition. Not even temporary acquisition will result from the construction. • Experience from a number of similar power plants along the banklines of the Nile waters has shown that the impacts on fisheries of the discharge of warm water into the Nile waters have been positive. Consultations with the fishermen support this assertion. Impacts will be positive rather than negative, i.e. no loss of livelihood. • Transmission lines which will evacuate power generated by the Helwan South power plant will be extended as follows: o Construct 500 kV O.H.T.L double circuit SHPP 500/ Minya East 500(proposed) with length of about 200km. o Construct 500 kV O.H.T.L double circuit SHPP 500/ Bader 500 (under constriction) with length of about 150 km. Most of new transmission lines will be extended in a bare uncultivated, uninhabited, state owned desert land. No land take or resettlement will be associated to the power interconnecting lines. • A Resettlement Policy Framework (RPF) is prepared in order to handle any potential future changes. • Gas pipelines will be buried underground with no land take and fair compensation to any losses during excavation and land filling processes. • A separate RPF is prepared by GASCo in order to handle any potential future changes (GASCo has also prepared separate ESIA for the gas pipelines).

Table 2-1 (Contd.)

Potential World Bank Environmental Safeguard Policies and the New Helwan South Power Project Triggerability

No. Safeguard Policy	Applicability to Helwan South Project	Policy Triggered?	Justification
4. Indigenous Peoples	No	No	• The project does not affect the indigenous peoples in the project area.
5. Safety of Dams	No	No	• The project does not involve construction of a large dam. • The project is not dependent upon an existing dam.
6. Pest management	No	No	• Procurement of pesticides or pesticide application equipment is not envisaged. • The project will not affect pest management in any way.
·hysical Cultural Resources	No	No	• Physical cultural resources are adequately examined. • The Helwan South project is not likely to have any significant impact on physical cultural resources.
8. Natural Habitats	No	No	• Natural Habitats are adequately addressed and examined. • The Helwan South project is not likely to have any significant impacts on natural habitats.
9. Projects in Disputed Areas	No	No	• The UEEPC/EEHC is not involved in any disputes over an area with any of its neighbors. • The project is not situated in a disputed area. • Any component likely to be financed as part of the project is not situated in a disputed area.
10. Projects on International Waterways	Yes	Yes	The impact of the project on the Nile River, which is an international waterway, as per the Bank's policy on projects on international waterways (Operational Policy 7.50) is addressed in the following topics: • Type of cooling system. • Source of water abstraction (surface water and ground water). • Pre-treatment of abstracted water before use inside the plant. • Water requirement per day for - (i) industrial cooling; (ii) processing or cleaning; and (iii) for domestic consumption by facility staff. • Water discharge per day from - (i) cooling/heating system, blow downs; (ii) storm water; and (iii) from use in toilets; floor cleaning, colony etc. • Point of discharge of water from power plant - directly into the water body. • Amount of discharged water from power plant - (i) untreated directly into water body and (ii) treated directly into the Nile River. • Average seasonal flow of water in the river water cum/hr (seasonal variation - minimum and maximum). • Average characteristics of water in the river (pH, total dissolved solids; suspended solids; chloride; sulfate and metals).

Table 2-1 (Contd.)

Potential World Bank Environmental Safeguard Policies and the New Helwan South Power Project Triggerability

No. Safeguard Policy	Applicability to Helwan South Project	Policy Triggered?	Justification
			• Average anticipated characteristics of discharge from (i) cooling system and (ii) from colony and non-industrial/process facility. • Information on mixing zones at the point. • Information about presence of fishes and other aquatic species in the Nile River including fish catch etc. • Distinguishment between the consumptive use of water (abstracted water that is not returned back to the source of abstraction) and non-consumptive use (abstracted water that is returned back to the source of abstraction. Main answers of the above topics are given in the ESIA Report per One Unit as follows: • Service water(1): 30.0m^3/hr (11.11% consumed(2)= 3.34 m^3/hr and 88.89% recycled(3) = 26.67 m^3/hr) • Boiler make – up water : 31.25 m^3/hr (totally recycled) • Cooling water : 82,800 m^3/hr (0.07% consumed = 57.96 m^3/hr and 99.93% recycled = 82,742.04 m^3/hr) • Total water usage : 82,861.25 m^3/hr (consumed = 61.295 m^3/hr, recycled = 82,799.955 m^3/hr) • Cooling water abstracted from the Nile River (23m^3/sec. per unit, i.e. 82,800 m^3/hr.) is returned totally back to it. Actual water consumption is around 0.07% of the abstracted water. • No disturbance to the Nile flow is expected either upstream or downstream. • Hydrological/hydraulic study is carried out and the study revealed that no impact is expected and the mixing zone is limited to 50-70m distance with 5°C above ambient, which is diluted to 3°C at a distance between 100 and 150 m with full compliance with Egyptian Law 48/1982 and WB regulations. • All waste water is treated. Water treated directly into waterbody: 120-220 m^3/hr. • MWRI is in full agreement with EEHC regarding its plan for water abstraction. Average seasonal flow of water in the Nile River is as follows: • Minimum flow (Winter time): 60 million m^3/day at a MSL of 21.28m (6.63% of the Nile total). • Dominant flow (Average time): 90 million m^3/day at a MSL of 23.63m (4.42% of the Nile total). • Maximum flow (Summer time): 250 million m^3/day at a MSL of 24.36m (1.59% of the Nile total).

Notes:
(1) "Service Water" includes water for utilities (toilets; floor cleaning; sanitary)
(2) Consumption = predominantly consumptive use.
(3) Recycling = predominantly non-consumptive use; returned to the original source.

2.2 AFRICAN DEVELOPMENT BANK REQUIREMENTS FOR AN EIA

The African Development Bank follows a policy which stipulates that "at the identification phase, the screening exercise focuses on the environmental and social dimensions of a project to categorize it in one of four categories". "Category 1 projects are those that are likely to have the most severe environmental and social impacts and require a full ESIA", which includes thermal and hydro power plants. ANNEX 7 of the Environmental and Social Assessment Procedures (ESAP) for AfDB's Public Sector Operations, published in June 2001, states that "the projects assigned to Category 1 require a full Environmental and Social Impact Assessment (ESIA), including the preparation of an ESIA Report and Environmental and Social Management Plan (ESMP). These project may also be improved by carrying out complementary studies that are not specifically required under ESAP, such as detailed gender analyses or institutional analyses. The need for such complementary studies shall be determined on a project-by-project basis during the preparation phase".

The African Development Bank sets out its procedures and policies with regard to conducting environmental assessment in a series of Policy and Guidelines documentation, out of them most importantly, the following documents:

- African Development Bank Group's Policy on the Environment (February 2004).
- Integrated Environmental and Social Impact Assessment Guidelines (October 2003).
- Environmental and Social Impact Assessment Procedures (ESAP) for AfDB's Puplic Sector Operations (June 2001).
- Assessment Guidelines – Energy (March 1997).
- Handbook on Stakeholder Participation (2201).
- Disclosure of Information Policy (2004).
- Environmental Assessment Guideline on Renewable and Non-renewable Energy (March 1997).
- Policy on Involuntary Resettlement (2003

2.3 EUROPEAN INVESTMENT BANK (EIB) REQUIREMENTS FOR AN EIA

The European Investment Bank (EIB) supports EU environmental policy. Its approach is based on the environmental principles enshrined in the Treaty establishing the European Community and the standards and practices incorporated in European Union (EU) secondary legislation on the environment. Beyond the EU-27 and the Candidate and potential Candidate

countries(1), the environmental standards of the Bank are also subject to local conditions. EU environmental principles, practices and standards are described and explained in a large body of EU law and other official documents, notably the 6^{th} Environmental Action Program (6EAP)(2) and its Thematic Strategies(3), as well as - for activities outside the EU - by the

(1) Definitions as at June 2007: Candidate: Croatia, Turkey, Former Yugoslav Republic of Macedonia (FYROM); potential Candidate: other Western Balkan countries.

(1) "Environment 2010: Our future, Our Choice" - The Sixth Environmental Action Program, COM/2001/0031.

(2) There are 7 approved Thematic Strategies, for air, waste, marine, soil, pesticides, resource use and the urban environment. Link http://ec.europa.eu/environment/newprg/index.htm.

mandates of the Bank. The Board of Directors approved the latest Bank environmental policy in the "Environmental Statement 2004" (the Environmental Statement). The same principles, practices and standards are the foundation for the "European Principles for the Environment" (EPE)[(4)].

The Environmental Impact Assessment (EIA) is the term used to describe a formalised process, including public consultation, in which all the relevant environmental consequences of a project are identified and assessed before authorisation is given. In the EU, if an EIA is required, the EIA is governed by EIA Directive 85/337/EEC, amended by Directives 97/11/EC and 2003/35/EC.

The Environmental Impact Study is the written report resulting from the EIA process. This is a document or documents containing the Environmental Information required under Article 5 of Directive 85/337/EEC as amended by Directives 97/11/EC and 2003/35/EC.

Also, The EIB applies a number of core environmental and social safeguard measures that reflect international good practice to all its lending activities. It requires that all its projects:

- Apply the European Principles for the Environment, i.e. comply with EU environmental principles, standards and practices, subject to local conditions in some regions[(5)].
- Comply with the EU environmental Acquits on environmental assessment.
- Apply "best available techniques", as appropriate.
- Apply good environmental management practices during project implementation and operation.
- Adhere to other specific international good environmental and social practices.

The EIB requires that all projects (irrespective of location) likely to have a significant effect on the environment be subject to an EIA, according to the definitions and requirements of Directive 85/337/EEC, amended by Directive 97/11/EC and 2003/35/EC. Annex I of the Directive lists the types of project for which an EIA is mandatory and Annex II the types of project for which the need to carry out an EIA is decided by the Competent Authorities. The EIA, which includes public consultation, is the responsibility of the Promoter and the Competent Authorities. It should be completed and its findings and recommendations should satisfy the requirements of the Bank prior to disbursement.

In all other regions, all projects should comply with national law; and benchmarked against the principles, standards and practices of EU environmental law14.

All projects should also comply with the obligations of relevant multilateral environmental agreements to which the host country - and the EU in the case of a Member State - is a party.

The Promoter is responsible for legal compliance whereas regulatory and enforcement tasks lie with the Competent Authorities.

The project Promoter is required to respect the requirements of the EU EIA Directive 85/337/EEC, amended by Directives 97/11/EC and 2003/35/E.

(3) Link to the "European Principles for the Environment", www.eib.org/epe.

(4) The regional coverage of the European Principles for the Environment concems at least the respective regions of operations of each signatory institution. For projects located in the Member States of the EU, the European Economic Area countnes, the EU Candidate and potential Candidate countries, the EU approach, which is defined in the EC Treaty and the relevant secondary legislation, is the logical, uncontested and mandatory reference. The projects in this region should also comply with any obligation and standards upheld in relevant Multilateral Environmental Agreements, such as Convention on Biological Diversity, the Espoo Convention, United Nations Framework Convention on Climate Change, etc. In all other countries, projects financed by the signatories should comply with the appropriate EU environmental principles, practices and standards, subject to local conditions, such as affordability, local environmental conditions, international good practice etc.

According to the sector, projects should comply with the relevant EU legal standards, for instance those of the Large Combustion Plant Directive[6] in the **power generation** sector and the Integrated Prevention Pollution and Control Directive[7] in the **industry** sector.

All projects listed in Annex I of the EIA Directive 85/337/EEC, amended by Directives 97/11/EC and 2003/35/EC are Categorized (A) and require Full EIA.

Category A Project is defined as " a Project Completion Report will be required from the Promoter to the Bank. Monitoring for these projects is in general delegated to promoters and the Bank will rely on the Promoter's information for its own reporting on environmental matters".

Annex I of the EU EIA Directive 85/337/EEC amended by 97/11/EC stipulates that thermal power stations and other combustion installations with a heat output of 300 megawatts or more are of Category (A), which need Full EIA.

The EIB Bank aims in its Environmental Assessment of projects outside the EU to promote public consultation and participation, according to EU standards, through appropriate discussions with the Promoter and other parties. **Consultation** is defined as a tool for managing culturally appropriate two-way communications between project sponsors and the public. Its goal is to improve decisionmaking and build understanding, by actively involving individuals, groups, and organizations with a stake in the project. This involvement increases a project's long-term viability and enhances its benefits to locally affected people and other stakeholders.

EIB policy towards EIA is summarised in its Environmental Statement 2004. The Bank applies the principles and practices of the EU EIA Directive (85/337, amended by 97/11 and by 2003/35/EC to incorporate the provisions of the Aarhus Convention, and since its introduction in July 2004, the NILE Directive (2001/42) - to all its regions of operation. The EIA Directive includes screening criteria, for purposes of determining the need for an EIA.

According to the EU EIA Directive, it is the responsibility of the host country and its Competent Authorities to ensure that the "public concerned" are informed and consulted on the proposed project (Articles 6 and 9). Bank staff as part of the environmental assessment check that these requirements have been fulfilled. Their findings are contained in the PJ Appraisal Report (Environmental Assessment D1) submitted to the CD.

2.4 APPLICABLE LOCAL LAWS AND REGULATIONS OF THE GOVERNMENT OF EGYPT

2.4.1 Egyptian Requirements for an EIA

The development of a new power plant can only commence if a permit has been granted by the appropriate Competent Administrative Authority (CAA). Egyptian *Law 4 of 1994, and its amending Law 9 of 2009, Law for the Environment* (hereafter referred to as *Law 4/1994*) stipulates that applications for a license from an individual, company, organization or authority, subject to certain conditions, require an assessment of the likely environmental impacts.

The Egyptian Environmental Affairs Agency (EEAA) is the authority responsible for determining the type of development that requires an environmental appraisal and the level of detail at which the study should be conducted. The EEAA publication "*Guidelines for Egyptian Environmental Impact Assessment*" stipulate that "..... *thermal power plant falls*

(1) Link to Large Combustion Plant Directive: http://europa.eu/scadplus/leg/en/lvb/l28028.htm.
(2) Link to Integrated Prevention Pollution and Control Directive: http://ec.europa.eu/environment/ippc/. http://ec.europa.eu/environment/eia/.

within the category of "C Listed Projects". This category requires a full EIA to be submitted to the Competent Administrative Authority (CAA) (i.e. the Egyptian Electricity Holding Company (EEHC) for this type of projects) or the Licensing Authority (which, for such type of project in the designated area, is the Helwan Governorate) in support of any application for a permit to develop a power plant). The EIA must analyze the impacts and specify what mitigation measures (if any) are necessary in order to minimize them.

Since the proposed power plant has a nominal generating capacity of 1300MWe, a full EIA must be prepared and submitted to the Helwan Governorate and EEHC for consideration prior to development of the plant. The Governorate is, also, required to forward the EIA to the EEAA for review in order to obtain the environmental permit for the development of the power plant. The EEAA must provide the EEHC (the Competent Administrative Authority) with its opinion concerning the assessment within 30 days of its receipt. The EEHC will then communicate this result to the owner of the power plant, i.e. UEEPC, and will then be responsible for verifying and implementing the EEAA's proposals requirements. The owner has 30 days to appeal the result of the assessment. This ESIA Report was prepared in line with the Agency's Guidelines for Egyptian Environmental Impact Assessment.

The construction of electrical transmission lines and pipelines (of less than 50km length) on local levels, are considered to be "List B Project" according to the Guidelines for Egyptian Environmental Impact Assessment. For these developments, Egyptian regulations require the proponent to submit a Screening Form, possibly followed by a scoped EIA on certain identified impacts, to the relevant Competent Authority, which in this case is the EEHC and Ministry of Petroleum respectively. However, when such an infrastructure is associated with a "C Listed Project", it should be considered as part and parcel of the full EIA study report if it is addressed during the study (see associated infrastructure-Section 6.16). In this regard, a Resettlement Policy Framework (RPF) is prepared in order to handle any potential future changes *(see Volume IV)*.

2.4.2 Permits Required to Construct and Operate the Power Plant

The key Egyptian. permits required and obtained by UEEPC for the construction and operation of the proposed power plant are set out in *Table 2-2*. These permits set out and regulate the standards to which the power plant must be designed, constructed and operated.

In addition, a number of subsidiary permits will be required related to the connection to, and use of, existing services and infrastructure, including the following:

- Electricity Supply Permit (if required) (North Upper Egypt Electricity Distribution Company (NUEEDC), Egyptian Electricity Holding Company (EEHC), Ministry of Electricity & Energy);
- Connection to Gas Pipeline, Utilization of Gas Supply and Alternative Fuel Storage Permit (Egyptian Natural Gas Holding Company (EGAS) and Egyptian General Petroleum Corporation (EGPC), Ministry of Petroleum);
- Water Supply Permit (Helwan South Water Authority);
- Roadside Occupation (or Construction) Permit (General Authority for Roads and Bridges, Ministry of Transport);
- Transport of Special Loads Permit (Central Administration for Executing and Maintaining Roads and Bridges, Ministry of Transport);
- Communications Network Permit (Helwan South Telephone Authority, Egyptian Company for Communications, Ministry of Communications and Information Technology);

- Carrier (Portable) Communication Devices Permit (Helwan South Telephone Authority, Egyptian Company for Communications, Ministry of Communications and Information Technology).

The status of these permits today is that all these permits are procedural and straightforward to be obtained.

Table 2-2

Key Permits Required for the Construction and Operation of the Power Plant

Permit	Permitting Authority	Relevant Legislation	Role of Permit	Status
Construction Permit (for establishing a power plant project)	Regulatory Body	Presidential Decree of the Arab Republic of Egypt, No. 326/1997, to Establish the Regulatory Body for Electric Utility and Consumer Protection	Authorization to construct the power plant project	[Secured]
Construction Permit (for Buildings)	Markaz Atfieh, Helwan Governorate	Law 101 (1996), *"Law for Buildings"*	Authorization to construct the power plant buildings	[Secured]
Environmental Permit	Egyptian Environmental Affairs Agency (EEAA), Ministry of State for Environmental Affairs in conjunction with the Helwan Governorate and Egyptian Electricity Holding Company (EEHC)	Law 4 (1994), *"Law for the Environment" amended by Law 9 (2009).*	Authorization of the environmental effects of development and operation of the power plant	[to be obtained][(1)]
Water Abstraction and Discharge Permit	Egyptian General Authority for Shore Protection, Ministry of Water Resources and Irrigation (MWRI) in conjunction with the EEAA	Law 4 (1994), *"Law for the Environment" amended by Law 9 (2009) and* Law 12 (1984), *"Law for Irrigation and Drainage"*	Authorization to construct and operate the abstraction of cooling water and discharge of effluent	[to be obtained][(1)]
Stack Construction Permit	Armed Forces Operations Authority, Ministry of Defense and Civil Aviation Authority, Ministry of Transport	Defense Regulations Aviation Regulations	Authorization to construct a stack with respects to military and aviation considerations	[to be obtained][(1)]
Operating Permit	Regulatory Body	Presidential Decree of the Arab Republic of Egypt, No. 326/1997, to Establish the Regulatory Body for Electric Utility and Consumer Protection	Authorization to produce electricity	[Secured]

Notes:
(1) For these permits to be obtained, communications with the permitting agencies have been initiated.

2.4.3 Relevant Environmental Policy, Legal and Administrative Issues

The environmental policy, legal and administrative framework which is relevant to the permitting of the power plant comprises the following:

- Requirement to conduct an ESIA to accompany the development of the power plant.

- Regional development planning, which must be addressed in the development of the power plant, in particular:
  - land use planning and control;
  - siting;
  - protection of environmentally sensitive areas;
  - protection of endangered species; and
  - Integrated Coastal Zone Management.

- Environmental standards which must be considered in the design, layout, construction and operation of the power plant, including:
  - atmospheric emissions;
  - generation and disposal of liquid effluents, including cooling water;
  - generation and disposal of solid wastes;
  - ambient environmental quality; and
  - health and safety.

Each of these aspects is reviewed in the following sections. In each case, both Egyptian and World Bank standards and guidelines are considered, to reflect the relevant national requirements and those which may be expected from international financial institutions.

2.4.4 Regional Development Planning

The guidelines for EIA produced by the EEAA specify that the power plant should demonstrate compliance with national, regional and local development plans with respect to the following key aspects:
- Land use planning and control in a new industrial zone, and surrounding developments;
- Siting;
- Protection of environmentally sensitive areas; and
- Protection of endangered species.

The proposed site lies on land zoned for the development of power generation facilities by the UEEPC/EEHC within the Helwan South development area.

The site of the proposed power plant lies within the area covered by the *Urgent Development Plan* (UDP) of the Helwan Zone, which was developed by the Ministry of Development, New Communities, Housing and Public Utilities for land use planning and control (see *Figure 2-1*). This Plan is currently being implemented and its key policies and land use zoning relevant to the proposed site are summarized in *Table 2-3*. According to consideration for this UDP, designated Helwan South area (was back to Giza Governorate after 11 Feb. 2011) has been assigned as an Industrial Domain. This identification has been adhered to the Helwan area since the establishment of the Kureimat power plant complex.

Table 2-3

Key Policies and Land Use Zoning in the Urgent Development Plan-Helwan Governorate Area, Update 2009

Summary of Policy	Relevance to Power plant
Industrial Development, including changes in the physical setting of South Helwan - and their planning frameworks.	Potential increase in the number of industrial facilities of each type (broad & medium classes) and industrial properties on land surrounding the sites.
Housing programs surrounding South Helwan for some residential communities.	Potential increase in the number of residential properties on land surrounding the site.
Water supply system, sewerage system, and roads, pavements & earth works.	Potential provision of utilities services adequately and easily on areas surrounding the power plant.
Power supply system.	Upgrade of the national HV transmission system near to the site of the power plant.
Preservation of the natural character to maintain tourist enjoyment.	Maintenance of the amenity value of the natural character.
Regulations of air pollution and water pollution near rural and urban areas.	Control of liquid effluent and atmospheric discharges from power plant.
Acknowledgement of the importance of the tourist and cultural features of the area, and aim to enhance them.	Avoidance of tourist and cultural impacts through development and operation of the power plant.

Figure 2-1 (A)

Urgent Development Plan (UDP)
for Helwan Zone, Update 2009

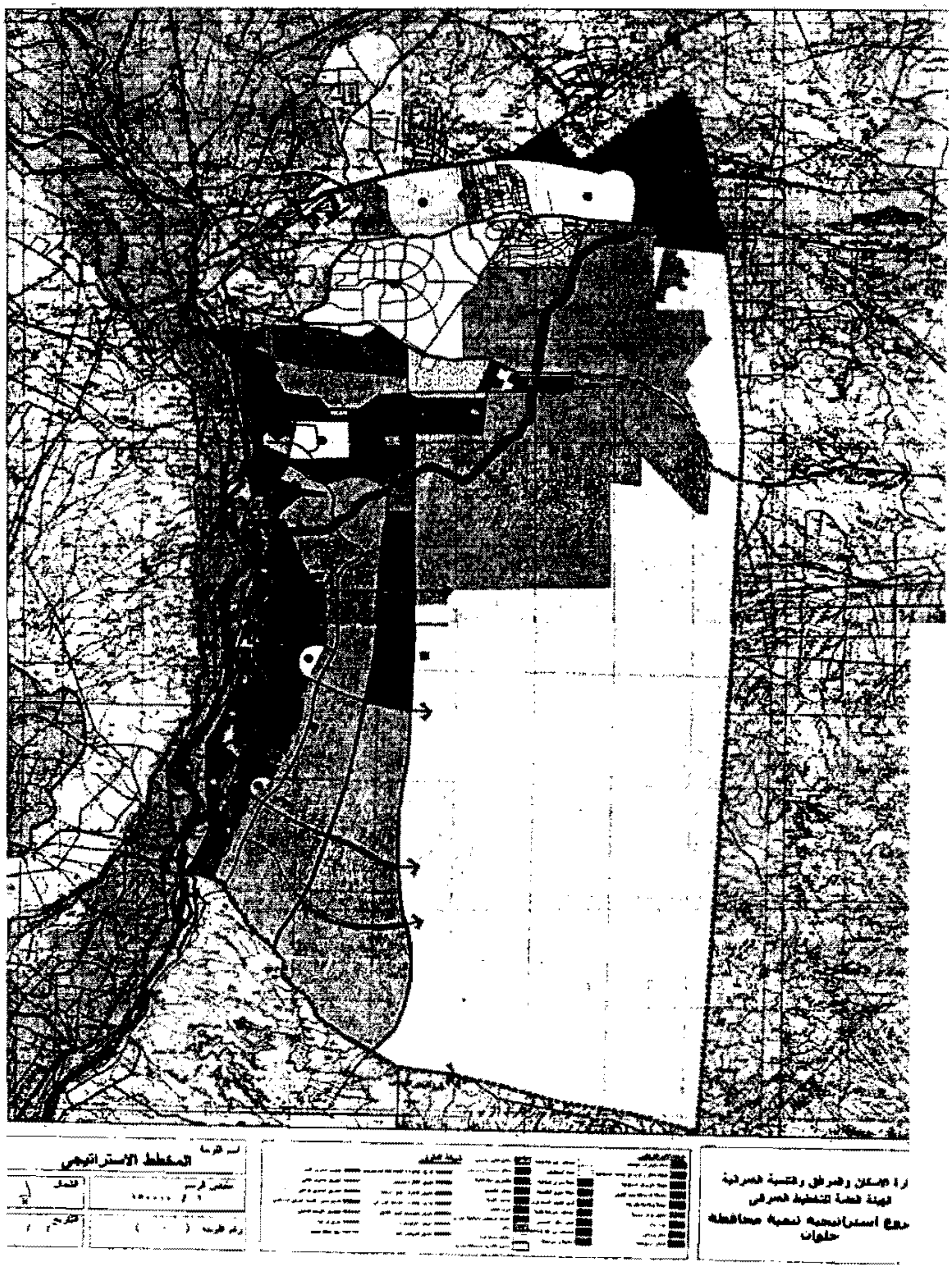
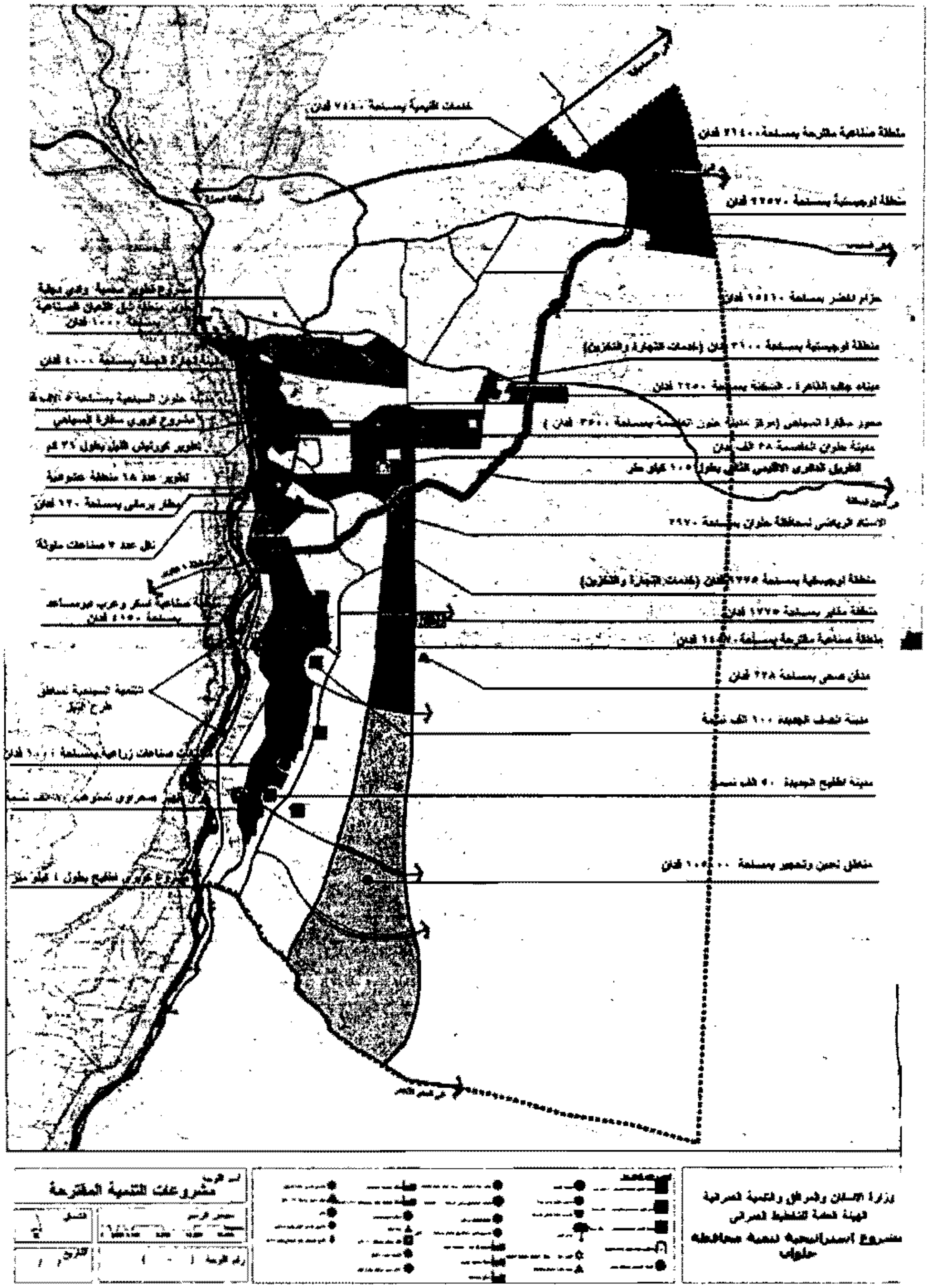


Figure 2-1 (B)

Strategic Development Plan for the Helwan South Zone, Update 2009



2.5 EGYPTIAN REQUIREMENTS FOR THE SCOPE OF THE ESIA

The Egyptian Environmental Affairs Agency (EEAA) has published guidelines (last updated January 2009) which require that certain information is provided in an EIA report (i.e. specified information).

The requirements for the scope of the EIA under Egyptian, AfDB and World Bank procedures, as described in Section I.2, include the following:

- description of the proposed power plant;
- description of the baseline environment at the site;
- identification of the environmental standards which will be applied to the project, including those applying to protection of ambient environmental quality and specific conditions on the construction and operation of the power plant;
- identification of potential environmental impacts associated with the project;
- description of alternatives to the power plant, in terms of options for electricity supply in Egypt, design of the power plant and operating system;
- development of proposals for mitigation and management of any potential environmental impacts;
- description of monitoring plans proposed to provide surveillance of the environmental impacts of the power plant during construction or operation;
- demonstration that consultations with interested parties have been carried out as part of the ESIA process.

In addition, all Egyptian, AfDB and World Bank guidelines specify the broad organization of the ESIA report, requirement for a non-technical summary for local, especially public, information and clear referencing of sources of data used in the assessment.

2.6 INTERNATIONAL AND NATIONAL ENVIRONMENTAL STANDARDS/ GUIDELINES

2.6.1 Introduction

The Egyptian, AfDB and World Bank environmental standards and guidelines relevant to the construction and operation of the power plant cover the following issues:

- Atmospheric emissions and ambient air quality.
- Liquid effluent discharges to the marine environment.
- Noise emissions and ambient noise levels.
- Solid waste management.
- Hazardous waste management.
- Operation management: health and safety, air quality and noise levels.
- Construction management.
- Other environmental management issues.

The Egyptian standards have been drawn from the range of provisions in *Law 4/1994 and Law 9/2009* and the *Prime Minister's Decree No. 338 of 1995,* which promulgated the *Executive Regulations of Law 4 and their amendments.*

The Egyptian *Law of Labor 12/2003* follows a philosophy, which gives high consideration to *environmentally safe work and workers health inside workplace.* It stipulates that all operations are carried out in an environmentally safe manner and that workplaces must comply with appropriate health and safety guidelines.

The World Bank guidelines have been taken from the World Bank **Pollution Prevention and Abatement Handbook – Part III** *(July, 1998). Supplementary to the guidelines set out in the WB/International Finance Corporation (IFC)* **Pollution Prevention and Abatement Handbook,** *reference has also been made to the World Bank guidelines as set out in the* **World Bank Environment, Health and Safety Guidelines: Thermal Power Plants** *(1994). Also, recent updates of the World Bank guidelines (2007) have been considered.*

The following sections detail the requirements under both Egyptian and World Bank standards and guidelines.

2.6.2 Atmospheric Emissions and Ambient Air Quality

The Egyptian Government and World Bank have established ambient air quality standards applicable to power projects. The Egyptian standards and the World Bank guidelines on ambient air quality are shown in *Table 2-4.*

Table 2-4

Ambient Air Quality Guidelines (μgm^{-3})

(Maximum Limits as per the Law 4/1994 and the Law 9/2009, Executive Regulations, Annex 5)

Pollutant	Averaging Period	Egyptian Standards	WB Guidelines[1]
Nitrogen oxides (NOx)	1 hour	400[2]	No Limit
	24 hours	150	150
	1 year	--	100
Sulfur dioxide (SO_2)	1 hour	350	No Limit
	24 hours	150	150
	1 year	60	80
Carbon monoxide (CO)	1 hour	30,000	-
	8 hours	10,000	-
Thoracic particles (PM_{10})	24 hours	150	150
	1 year	70	50
Total suspended particles	24 hours	230	230
	1 year	90	80

Notes:

(1) World Bank Updates of Thermal Power-Guidelines for New Plants, December 2008.

(2) NO_2: There are no NOx Egyptian Standards for ambient air quality.

The World Bank Group guidelines *(World Bank Pollution Prevention Handbook, Thermal Power-Guidelines for New Plants, July 1998)* refer to the concept of the "airshed". The airshed for a power plant is defined as:

"The local area around the plant whose ambient air quality is directly affected by emissions from the plant. The size of the relevant local airshed will depend upon plant characteristics (such as stack height) as well as local meteorological conditions and topography".

Where the airshed is degraded (i.e. has concentrations of pollutants which exceed World Bank standards) the World Bank power plants are subject to site-specific requirements that include offset provisions to ensure that there is no net increase in the total emissions of particulates and/or SO_2 within the airshed and the resultant ambient levels of NO_2 do not exceed the levels specified for moderately degraded airsheds[1].

Egyptian standards and World Bank guidelines require the Developer to ensure that emission levels during construction and operation do not exceed set maximum limits for pollutant concentrations. Egyptian and World Bank guidelines for power plants on the maximum limits for pollutants in emissions to the air are shown in *Table 2-5.*

(1) NO_2 exceeds 100 $\mu g/m^3$ and the 98th percentile of 24 hour mean values of NO_2 over a year exceeds 500$\mu g/m^3$ in an airshed classified as having moderate air quality.

Table 2-5

Maximum Atmospheric Emission Guidelines (mg/Nm^3)(1)

(Maximum Limits as per the Law 4/1994 and Law 9/2009, Executive Regulations, Annex 6)

Pollutant	**Egyptian Standards**		**World Bank Guidelines(2), (3)**					
			Natural Gas(4)		**Fuel Oil(4)**			
					Plant>50MWth to 600MWth		**Plant>/= 600 MWth(5)**	
	Natural Gas	**Fuel Oil**	**NDA(6)**	**DA(7)**	**NDA**	**DA**	**NDA**	**DA**
Nitrogen Oxides (NO_x)	300	300	240	240	400	200	400	200
Sulfur dioxide (SO_2)	N/A(8)	3,600	N/A	N/A	900-1,500(9)	400	200-850(10)	200
Particulate Matter (PM)	N/A	150	N/A	N/A	50	30	50	30
Suspended ashes Sources in urban areas or near residential areas (11) Sources far from inhabited urban areas (12)	N/A N/A	250 500	- -	- -	- -	- -	- -	- -
Carbon monoxide (CO)	250	500						

Notes:

(1) The Egyptian regulations for fuel burning sources (Law 4, Article 42) do not specifically state whether emission limits refer to emission under standard or actual flow conditions. For consistency with other standards it has been assumed that the limits refer to standard flow conditions.

(2) World Bank Environmental, Health, and Safety Guidelines: Thermal Power Plants; December 19, 2008.

(3) World Bank guidelines should be achieved for 95% of the operating time of a plant.

(4) Values taken at 3% dry gas excess O_2 content and for 100% load.

(5) MWth= Megawatt thermal input on HHV basis.

(6) NDA= Non-degraded airshed.

(7) DA= Degraded airshed (poor air quality); Airshed should be considered as being degraded if nationally legislated air quality standards are exceeded or, in their absence, if WHO Air Quality Guidelines are exceeded significantly.

(8) N/A= Not Applicable.

(9) Targeting the lower guidelines values and recognizing issues related to quality of available fuel, cost effectiveness of controls on smaller units, and the potential for higher energy conversion efficiencies (FGD may consume between 0.5% and 1.6% of electricity generated by the plant).

(10) Targeting the lower guidelines values and recognizing variability in approaches to the management of SO_2 emissions (fuel quality vs. use of secondary controls) and the potential for higher energy conversion efficiencies (FGD may consume between 0.5% and 1.6% of electricity generated by the plant). Larger plants are expected to have additional emission control measures. Selection of the emission level in the range is to be determined by EA considering the project's sustainability, development impact, and cost-benefit of the pollution control performance.

(11) Law 4, Article 42 states that emissions of suspended ashes in urban / residential areas should not exceed Ringlemann Chart 1, which Article 42 states is equivalent to an emission concentration of 250 mg/m^3.

(12) Law 4, Article 42 states that emissions of suspended ashes far from inhabited areas should not exceed Ringlemann Chart 2, which Article 42 states is equivalent to an emission concentration of 500 mg/m^3.

Egyptian *Law 4/1994 and Law 9/2009* also apply specific conditions to the burning of fuels in power plants, as follows:

- Fuel / air mixtures and the combustion process should provide full burning of the fuel.
- The use of mazout and heavy oil is prohibited in residential areas.
- The sulfur content of fuels is restricted to equal or less than 1.5% in or near urban and residential areas. The use of high sulfur content fuels is permissible in regions far from inhabited urban areas provided that suitable atmospheric factors are present and adequate distances are observed to prevent these gases from reaching residential and agricultural areas and watercourses.
- Emissions of carbon dioxide should be through stacks of sufficient height to ensure that the gases are dispersed before reaching ground level.
- Stack height should reflect the volumetric flow of flue gases. *Law 4/1994* states that for emission rates of 7,000-15,000kg/hr the stack height should be between 18-36m. If emission rates exceed 15,000 kg/hr, then the stack height should be at least 2.5 times the height of surrounding buildings.

World Bank guidelines reinforce the Egyptian requirement of minimum stack heights by requiring plants to use stack heights not less than the Good Engineering Practice(1) values unless impact analysis has taken into account building downwash effects.

2.6.3 Liquid Effluent Discharges

Law 4/1994 and Law 9/2009 state that all establishments are prohibited from polluting the marine environment. As a result, no permit will be granted for an establishment on, or near, the coastline, which may result in discharges of polluting substances.

Annex 1 of the Executive Regulations of Law 4 and Law 9/2009 set out the Egyptian standards concerning the concentration of pollutants in effluent discharged to the marine environment. A selection of the standards, relevant to thermal power plants, is shown in *Table 2-6*. In addition, the table also presents the equivalent WB guidelines. It should be noted that WB guidelines relate to all liquid effluent discharges, not solely to those to the marine environment.

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(1) US Code of Federal Regulations Title 40, Part 51.100. Good Engineering Practice Stack Height = H + 1.5 L where H is the height of nearby structures and L is the lesser dimension of height or projected width of nearby buildings.

Table 2-6

Liquid Effluent Discharge Guidelines

Water Quality Standards and Specifications Mandated by the Egyptian Laws in Comparison with the World Bank Guidelines (mgl^{-1}) [(a)]

Parameter	Limits & Specifications for draining and disposing of certain substances mandated by Law 4/1994 and the Law 9/2009 in the marine environment	World Bank Wastewater Effluent Guidelines (1996)
Temperature	Not more than 10 degrees over existing level	3°C increase above ambient[(b)]
pH	6-9	6-9
Color	Free of colored agents	
Biochemical Oxygen Demand (BOD)	60	-
Chemical Oxygen Demand (COD) (Dichromate)	100	
Total Dissolved Solids	2000	
Fixed (Ash of) Dissolved Solids	1800	
Suspended Solids	60	50
Turbidity	NTU 50	
Sulfides	1	
Oils and Grease	15	10
Hydrocarbons, of oil origin	0.5	
Phosphates	5	
Nitrates	40	
Phenolates	1	
Fl uorides	1	
Aluminum	3	
Ammonia (Nitrogen)	3	
Mercury Compounds	0.005	
Lead	0.5	
Cadmium	0.05	
Arsenic	0.05	
Chromium, total	1	0.5
Copper	1.5	0.5
Nickel	0.1	0.5
Iron	1.5	1.0
Manganese	1	
Zinc	5	1.0
Silver	0.1	
Barium	2	
Cobalt	2	
Pesticides	0.2	
Cyanide	0.1	

Table 2-6 (Contd.)

Water Quality Standards and Specifications Mandated by the Egyptian Laws in Comparison with the World Bank Guidelines (mgl^{-1}) (a)

Parameter	Limits & Specifications for draining and disposing of certain substances mandated by Law 4/1994 and the Law 9/2009 in the marine environment	World Bank Wastewater Effluent Guidelines (1996)
Fecal Coliform Count (No. in 100ml)	5000	
Dissolved Oxygen		
Organic Nitrogen		
Total Alkalinity		
Sulphate		
Synthetic Detergents		
Phenol		
Selenium		
Chemical Oxygen Demad (Permanganate)		
Total Heavy Metals		-
Total Residual Chlorine(c)		0.2 (c)
Total Coliform (MPN/ 100ml)		
Odour		
Tannin + lignin		
Carbon derivatives (chloroform)		

Notes:

(a) Units of mgl^{-1} unless otherwise stated.

(b) The effluent should result in a temperature increase of no more than 3 °C at the edge of the zone where initial mixing and dilution take place. Where this zone is not defined, use 100 m from the point of discharge when there are no sensitive aquatic ecosystems within this distance (This zone is defined in Egypt within 150-300 m, according to HRI).

(c) "Chlorine shocking" may be preferable in certain circumstances, which involves using high chlorine levels for a few seconds rather than a continuous low level release. The maximum value is 2 mgl^{-1} for up to 2 hours, which must not be more frequent than once in 24 hours (and the 24 hour average should be 0.2 mgl^{-1}).

Further to these guidelines, *Law 4/1994 and Law 9/2009* also apply certain planning conditions for developments along or adjacent to the coastline:

- The location of the exit of the outfall must be at least 500 m from the coast.
- The discharge of effluents into swimming or fishing zones, or natural reserves, is prohibited to ensure that the economic or aesthetic value of the zones or reserves are not compromised.
- Any measures which are likely to cause changes in the natural coastline (erosion, sedimentation, coastal currents and pollution from the project or associated works) are restricted, except with the approval of the Competent Administrative Authority.
- Any development within 200 m of the coast must gain approval from the Competent Administrative Authority.

Drainage of Liquid Wastes (Law no. 39 for 1962)

The term "sewage system" shall apply to installations which are prepared for collecting waste liquids from houses, factories, public, communicational & international establishment, and other, as well as leaking waters & rains, for the purpose of disposing in a sanitary, after purifying of them or without purification.

- Article 7: rules *"liquid wastes from ...... industrial ...... may not be drained ...... without a license ..."*

Article 8: rules that *"liquid wastes which are licensed ...... shall adhere to the standards & specification limits ..."*

Article 9: rules that *" analysis shall be carried out on specimens of liquid wastes ...... by the Ministry of Health ..."*

Article 14: rules that *"liquid wastes may not be surface-drained except by virtue of a license from the department in charge of sewerage works ..."*

Article 18: discussed the penalties for contravention to the provision of articles 3, 4, 13 and 14 (fine not less than 10 pounds), and to articles 6, 7, 8, 9, 11 and 12 (fine not less than 50 pounds).

Chapter 6(1): *Decree M.649 for 1962* sets the criteria & specifications that authorize liquid wastes to be drained into public sewers. Parameters are:

- Temperature not more than 40°C.
- pH value less than 6 not more than 10.
- BOD not more than 400 particles per million.
- COD not more than 700 particles per million.
- Phenol not more than 0.005 particles per million.
- Sulphur dioxide not more than 1 particle per million.
- Lubricants, oils & resins not more than there 100 particles per million.
- Silver, mercury, cadmium, chrome, etc... not more than 10 particles per million (liquid wastes $50m^3$/day) or 5 particles per million (liquid wastes exceed $50m^3$/day)

Chapter 6(2): also sets the conditions and criteria that should be fulfilled by liquid wastes drained by surface irrigation or by irrigating cultivable land. In general sewage wastewater may not be disposed of by surface draining method until after obtaining permission from the concerned Health Authority and drained wastes should not be less than primary treated liquids.

2.6.4 Noise Emissions and Ambient Noise Levels

Law 4/1994 and Law 9/2009 stipulate that a developer must ensure that an establishment is compatible with the character of its setting. Amongst other issues, this involves limiting the effect of combined noise from all site sources on the surrounding environment to acceptable ambient limits. Guidance levels for ambient noise is dependent upon the land use surrounding the site, and Egyptian ambient noise guidelines are set with respect to five different land use categories. The Egyptian ambient noise guidelines are shown in *Table 2-7*, together with the related land uses.

The World Bank ambient noise guidelines differ from those of the Egyptian Government in that they only differentiate between two land use categories, as presented in *Table 2-8.*

Table 2-7

Egyptian Ambient Noise Limits for Intensity in Different Land Use Zones

(Maximum Limits as per the Law 4/1994 and Law 9/2009, Executive Regulations, Annex 7-Table 2)

Receptor	Daytime (a) dB(A)	Evening (b) dB(A)	Night (c) dB (A)
Industrial areas (heavy industries)	70	65	60
Commercial, administrative and "downtown" areas	65	60	55
Residential areas, including some workshops or commercial businesses or on public roads	60	55	50
Residential areas in the city	55	50	45
Residential suburbs having low traffic	50	45	40
Rural residential areas (hospitals and gardens)	45	40	35

Notes:
(a) Daytime from 7 am to 6 pm
(b) Evening from 6 pm to 10 pm
(c) Night-time from 10 pm to 7 am

Table 2-8

WB Ambient Noise Guidelines for Intensity in Different Land Use Zones

Receptor	Maximum Allowable $L_{Aeq,\ 1\text{-hour}}$ dB(A) (a)	
	Daytime 07:00 – 22:00	Night-time 22:00 – 07:00
Residential, institutional and educational	55	45
Industrial and commercial	70	70

Notes:
(a) Noise abatement measures should achieve either the WB guidelines or if background levels are already above these limits, a maximum increase of background levels of 3 dB (A). Measurements are to be taken at noise receptors outside the project property boundary.

2.6.5 Solid and Hazardous Waste Management

Law 4/1994 and Law 9/2009 stipulate that handling of hazardous substances and waste is prohibited unless a permit has been issued by the competent authority.

The handler of wastes must:

- possess a permit issued by the appropriate CAA to handle wastes;
- store and dispose of wastes in designated sites agreed with the CAA;
- maintain appropriate systems of storage, including packaging and labeling, containers and storage duration;

- operate appropriate transportation systems to authorized disposal sites;
- maintain a register of all hazardous wastes and disposal methods; and
- develop an emergency plan in case of spillages.

Further to the Egyptian guidelines, the World Bank requires that the individual/ company operating the power plant must ensure that:

- all hazardous materials are stored in clearly labeled containers;
- storage and handling of hazardous materials is in accordance with national and local regulations appropriate to their hazard characteristics;
- fire prevention systems and secondary containment should be provided for storage facilities, where necessary, to prevent fires or the releases of hazardous materials to the environment.

2.6.5 Occupational Environmental Management and Health and Safety

Workplace Air Quality, Temperature and Humidity

Egyptian regulations, including *Labor Law no. 12/2003* and its Executive Regulations stipulated by *Ministerial Decree no. 211/2003*, require that the owner of the power plant must ensure that air quality in the workplace is maintained within fixed limits. Accordingly, the owner is obliged to ensure the protection of the work force through implementing health and safety measures on-site, including by the choice of plant and equipment, process substances, types of fuels, ventilation of working areas or other air cleaning methods.

The World Bank requires that any individual / company managing or operating a power plant must:

- conduct periodic monitoring of the workplace air quality with respect to air contaminants relevant to employees tasks;
- maintain ventilation and air contaminant control, and provide protective respiratory and air quality monitoring equipment;
- ensure that protective respiratory equipment is used by employees when levels of welding fumes, solvents and other materials exceed international, national or local accepted standards.

Egyptian and World Bank threshold limit values for carbon monoxide, nitrogen dioxide, Sulfur dioxide and particulate in the workplace are provided in *Table 2-9.*

In addition to air quality, under *Law 4/1994 and Law 9/2009*, the owner of the power plant must also ensure that temperature does not exceed maximum and minimum permissible limits, as set out in *Table 2-10.* In case of work in temperatures outside these limits, the owner must provide suitable acclimatization to workers and/or protective measures.

Table 2-9

Egyptian and WB Air Quality Guidelines in the Workplace

(Maximum Limits as per the Law 4/1994 and Law 9/2009, Executive Regulations, Annex 8)

Atmospheric Pollutant	Egyptian Guidelines [(a)]	WB Guidelines
Carbon monoxide	55 mg/m^3	29 mg/m^3
Nitrogen dioxide	6 mg/m^3	6 mg/m^3
Sulfur dioxide	5 mg/m^3	5 mg/m^3
Particulate [(b)]	10 mg/m^3	10 mg/m^3

Notes:

(a) Egyptian air quality guidelines in the workplace are determined by exposure time. Readings provided are "mean time"- the limit to which workers are exposed during a normal working day.

(b) Inert and nuisance dust.

Table 2-10

Egyptian Maximum Air Temperature Limits [(a)]

(Maximum Limits as per the Law 4/1994 and Law 9/2009, Executive Regulations, Annex 9)

Type of Work	Low Air Flow	High Air Flow
Light	30.0°C	32.2°C
Medium	27.8°C	30.5°C
Hard	26.1°C	29.8°C

Notes:

(a) In periods of high temperature, workers should be monitored. No worker should work be exposed to heat stress (above 24.5°C for women and above 26.1 °C for men) for more than one continuous hour or one intermittent hour in every two, without acclimatization.

Workplace Noise

Law 4/1994 and Law 9/2009 and the *Labor Law no. 12/2003* and their Executive Regulations restrict noise in the workplace to within limits of intensity and exposure time. Egyptian guidelines are shown in the following tables:

- *Table 2-11* presents occupational noise guidelines with respect to continuous exposure to noise below 90 dB (A);
- *Table 2-12* presents occupational noise guidelines with respect to permitted exposure periods to continuous noise in excess of 90 dB (A);
- *Table 2-13* presents occupational noise guidelines with respect to exposure periods to intermittent noise.

It has been assumed that these limits apply at worker positions and will be generally free field noise levels.

In addition to the Egyptian guidelines, the World Bank guidelines require that the individual/ company managing or operating a power plant must ensure that:

- Noise in work areas is reduced by using feasible administrative and engineering controls (including sound-insulated equipment and control rooms).
- Good maintenance practices to minimize noise productio: from plant and equipment.
- Personnel use hearing protection equipment when exposed to noise levels above 85 dB (A).

Table 2-11

Egyptian Guidelines for Maximum Permissible Limits of Sound Intensity Inside Places of Industrial Activity

(Maximum Limits as per the Law 4/1994 and Law 9/2009, Executive Regulations, Annex 7-Table 1)

Receptor	Maximum Allowable Level of Sound (dB(A))
Work premises with up to 8 hour shifts with the aim of limiting noise hazards on hearing[(a)]	90
Places of work that require hearing signals and good audibility of speech	80
Places of work for the follow up, measuring and adjustment of operations with high performance	65

Notes:
(a) For periods extending longer than 8 hours lower noise limits will be defined

Table 2-12

Egyptian Guidelines on Periods of Exposure to Noise

(Maximum Limits as per the Law 4/1994 and Law 9/2009, Executive Regulations, Annex 7-Table 1, contd.)

Noise Intensity (dB(A))	Period of Exposure per Day (Hours)
> 90-95	4
>95-100	2
>100-105	1
>105-110	0.5
>110-115	0.25

Table 2-13

Egyptian Guidelines on Permissible Limits Concerning Intermittent Noisè Inside the Workplace

(Maximum Limits as per the Law 4/1994 and Law 9/2009, Executive Regulations, Annex 7-Table 1, contd.)

Noise Intensity	Number of Permissible Noise Events

(dB(A))	During Normal Working Hours
135	300
130	1,000
125	3,000
120	10,000
115	30,000

Electrical Safety in the Workplace

The Egyptian Code of practice for electrical safety in power system, issued by the Egyptian Electricity Authority, as well as the *Labor Law no. 12/2003* and its regulations, require that any power plant management, and the World Bank requires that any individual/company managing or operating a power plant, must ensure that:

- strict procedures are provided and followed for de-energizing and checking electrical equipment before maintenance work;
- strict safety procedures are implemented, including constant supervision, when performing maintenance work on energized equipment;
- personnel training is provided on revival techniques for electrocution.

Working in Confined Spaces

The Egyptian Industrial Codes of practice, issued by the Egyptian Industry Authority, as well as the *Labor Law no. 12/2003* and its regulations, and the World Bank require that the individual / company managing or operating an industrial facility (such as a power plant) must ensure that:

- prior to entry and occupancy, all confined spaces must be tested for the presence of toxic, flammable and explosive gas or vapors and lack of oxygen;
- adequate ventilation is available in any confined working spaces;
- personnel working in confined spaces that may become contaminated or deficient in oxygen are provided with air-supplied respirators;
- observers are stationed outside when personnel are working in confined spaces which are likely to become contaminated or to be affected by a shortage of air supply.

General Health and Safety

The Egyptian concerned laws and regulations mentioned above and the World Bank require that the individual / company managing or operating an industrial facility (such as a power plant) must ensure that:

- sanitary facilities are well equipped with supplies and employees should be encouraged to wash frequently, particularly those exposed to dust, chemicals or pathogens;
- ventilation systems are provided to control the temperature and humidity of working areas;

- personnel working in high temperatures or humidity are allowed frequent breaks away from these areas;
- pre-employment and periodical medical examinations are conducted for all personnel and surveillance programs instituted for personnel potentially exposed to toxic or radioactive substances;
- personnel are protected by shield guard or guard railings from all belts, pulleys or gears and other moving parts;
- elevated platforms, walkways, stairs and ramps are equipped with handrails, toeboards and non-slip surfaces;
- electrical equipment is "earthed", well insulated and conforms with applicable codes;
- personnel use special footware, masks and clothing when working in areas with high dust levels or contaminated with hazardous materials;
- employees are provided with appropriate protective equipment when working near molten or high temperature materials (protective equipment may include, amongst others, non-slip footwear, safety glasses, etc);
- employees wear eye protective measures when working in areas at risk of flying chips or sparks or where bright light is generated;
- employees wear protective clothing and goggles in areas where corrosive materials are stored or processed;
- appropriate eyewash and showers are installed in areas containing corrosive materials; and
- a safety program is implemented and regular drills are conducted.

2.6.7 Personnel Training

Law 4/1994, *Law 9/2009* and *Labor Law 12/2003* stipulate that operators should be trained when using or handling any hazardous waste materials.

In addition, the EEAA Master Plan for Solid & Hazardous Waste Management and the World Bank require that the individual / company managing or operating an industrial facility (such as a power plant) must ensure that:

- employees are trained on the hazards, precautions, and procedures for the safe storage, handling and use of potentially harmful substances;
- training incorporates information from the "Material Safety Data Sheets" (MSDSs) for potentially harmful materials;
- personnel are trained with regard to environmental health and safety matters, including accident prevention, safe lifting practices, the use of MSDSs, safe chemical handling practices and proper control and maintenance of equipment and facilities.

2.6.8 Monitoring and Record Keeping and Reporting

Law 4/1994 (Articles 17 & 18) and Law 9/2009 require - for industrial facilities - the operator monitors the site in order to optimize performance. Direct measurement of emissions and atmospheric concentrations of pollutants dispursed with the exhaust gas is required. Averaging times for ambient air quality should be based on regular measurements.

Law 4/1994 and Law 9/2009, also, stipulates that the owner of the power plant should maintain an Environmental Register of written records with respect to the environmental impacts from the establishment. The written records should identify the characteristics of discharges and emissions, details of periodic testing and its results, procedures of follow-up environmental safety, and the name of the person in charge of follow-up, The owner of the power plant, or its representatives, are responsible for informing the EEAA of any emitted or discharged pollutants deviating from prescribed standards and any appropriate procedures taken to rectify them.

Also, the World Bank guidelines require the operator monitors the site in order to optimize performance. Direct measurement of atmospheric concentrations of particulate matter, NOx and SO_2 and heavy metals in the exhaust emissions is preferable. Averaging times for direct emissions should be based on an hourly rolling average.

The World Bank guidance requires ambient air quality to be monitored at least at 3 locations where there is: a) least pollution expected; b) maximum pollution concentration expected; and c) sensitive receptors. The ambient air quality parameters that require monitoring for gas fired plants are NOx.

Law 4/1994 and Law 9/2009, as well as World Bank guidance, also require the owner/ operator to monitor the wastewater discharges. The parameters to be examined and sampling frequency are set out in *Table 2-14.*

Table 2-14
World Bank [a] Requirements for Monitoring Wastewater Discharges

Parameter	Proposed Monitoring Frequency
pH	Continuous
Temperature	Continuous
Suspended solids	Daily
Oil and grease	Daily
Residual chlorine	Daily
Heavy metals	Monthly
Other pollutants	Monthly

Notes:
(a) World Bank: Guidebook for Preparation and Review of EA, January 2000.

In addition, the EEAA and the World Bank require that the individual/ company managing or operating an industrial facility (such as a power plant) must:

- maintain records of significant environmental matters, including monitoring data, accidents and occupational illnesses, and spills, fires and other emergencies;
- review and evaluate information from the above to improve the effectiveness of the environmental, health and safety program;
- submit an annual summary of recorded information to the EEAA (and to the World Bank).

2.6.9 Construction Management

Law 4/1994 and Law 9/2009 require that guidelines on environmental management and protection, including related to noise, land, marine and atmospheric pollution, waste management and health and safety must be adhered to during the construction process.

In particular, when handling and storing soils and wastes during construction, all organizations and individuals must ensure that storage and transportation is undertaken in such a manner to minimize release or dispersion into the environment.

2.6.10 Other Environmental Issues

Chemical Compounds

Law 4/1994 and Law 9/2009 state that spraying of pesticides or other chemical compounds is prohibited except after complying with the conditions, norms and guarantees set by the Ministry of Agriculture, the Ministry of Health and the EEAA. The conditions for such use are as follows:

- notification to the health and veterinary units of the types of sprays being used and antidotes before spraying;
- provision of necessary first aid supplies;
- provision of protective clothing and materials;
- warning of the public in spraying areas;
- training of laborers conducting the spraying.

Other Chemicals

The EEAA and the World Bank require that the individual / company managing or operating an industrial facility (such as a power plant) must ensure that:

- use of formulations containing chromates is avoided;
- transformers or equipment that either contain polychlorinated biphenyls (PCBs) or use PCB-contaminated oil are not installed;
- processes, equipment and central cooling systems that use or potentially release chlorofluorocarbons (CFCs), including Halon, are avoided;
- storage and liquid impoundment areas for fuels and raw and in-process materials, solvents and wastes and finished products are designed in such a way to prevent spills and the contamination of soil, groundwater and surface waters.

2.7 INTERNATIONAL MARINE AND ENVIRONMENTAL COMMITMENTS

The following section identifies the global and regional environmental conventions of relevance to the proposed power plant, to which Egypt is party.

2.7.1 International Conventions

Global Conventions

- Convention concerning the Protection of the World Cultural and Natural Heritage.

- International Convention on Economic, Social and Cultural Rights.
- United Nations Framework Convention on Climate Change (UNFCCC) and its Kyoto Protocol.

Regional Conventions

- African Convention on the Conservation of Natural Resources.

Nature Conservation Conventions

- World Heritage Convention.
- Convention on Biological Diversity, UN (1992).
- Convention of Migratory Species of Wild Animals (Bonn Convention).
- Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention, 1971).

3. ANALYSIS OF ALTERNATIVES

3.1 CURRENT SITUATION ("NO ACTION" OPTION)

3.1.1 Electricity Demand

Egypt has a rapidly expanding economy that is dependent on the availability of reliable and low cost electric power. The annual average rate of growth of electricity demand in Egypt is expected to range between 6-7% during this decade and beyond. Peak demand is expected to rise from 22,750 MWe in 2009/2010 to 26,600 MWe by 2012 and installed capacity is expected to increase from 24,726 MWe to 30,200 MWe during the same period.

In 2009/2010, about 99% of the population was served by the Egyptian electricity grid. Of total demand of 139,000TWh on the interconnected system, about 9.25% was met by hydropower, principally the High Dam and Aswan 1 & 2, and the remaining was met with thermal power plants, of which around 68.24% were supplied from natural gas and 31.76% heavy fuel oil.

The rate of growth in demand for electricity is forecasted to continue at the aforementioned level for the next 5 years before gradually decreasi to a growth rate of 5.7% per year over the subsequent 10 years.

In order to meet the forecasted demand, the Ministry of Electricity & Energy (MEE) estimates that more than additional 26,000 MWe of new generating capacity will be required during the next ten years.

3.1.2 Electricity Generation and supply

Currently, the Egyptian Electricity Holding Company (EEHC) holds 16 affiliate companies: 6 for power generation, one for electrical energy transmission and 9 for electricity distribution. The Egyptian Electricity Transmission Company owns and operates the high voltage electricity transmission system, and the Electricity Distribution Companies own and operate the electricity distribution system. High voltage electricity transmission through medium voltage transmission system consists of over 38,400 km of 500 kV, 220 kV, 132 kV, 66kV and 33 kV transmission lines. Further expansion of the transmission system is also planned.

In addition to EEHC, the power sector contains a few IPPs selling power to EEHC: New and Renewable Energy Authority (NREA) Zaafarana wind farms and three privately owned power plants under Build, Own, Operate and Transfer (BOOT) financing schemes, and few IPs selling power in the isolated market.

As mentioned above, the Six Electricity Generating Companies supported in 2009/2010 almost 24,700MWe of installed capacity. This resulted in 139,000 TWh of generated energy. Over 24 million customers have access to electricity supply, representing about 99% of Egypt's population.

Table 3-1 shows the breakdown on existing installed capacity by fuel/ process type.

Table 3-1

Installed Capacity Corresponding to Fuel Type, 2009/2010

Installed Capacity	MWe	% age
Steam	11,457	46.33
Gas	842	3.43
Combined Cycle	9,136	36.94
Hydro	2,800	11.32
Wind	490	1.98
Total	**24,726**	100

Source: Arab Republic of Egypt-Ministry of Electricity and Energy/Egyptian Electricity Holding Company, Annual Report-2008/2009.

3.1.3 The "No Action" Option

The no action alternative will result in the demand for electricity exceeding supply, with an increasing deficit as demand increases in future years. A lack of a secure and reliable electricity generation and supply system has significant social and economic implications, since it will:

- constrain existing and future economic development and investment through lack of energy resources to meet industrial demand;
- restrict socio-economic development through lack of electricity supply, or poor reliability and shortages in electricity supply for domestic users, community and other public facilities and public services;
- inhibit provision of social services, including public health and poverty eradication.

As a result, the "no action" option is not a viable or acceptable alternative to the proposed project.

3.1.4 Planned Additional Capacity and the Helwan South Power Plant

The EEHC has established a generation expansion plan which is intended to achieve the following:

- meet future demand for electricity;
- maintain and improve generation and transmission reliability; and
- introduce new technologies.

The expansion plan also corresponds to the national Government's development aspirations and growth poles of economic and industrial expansion throughout the country. As part of this plan, the EEHC has identified Helwan South power project to help implement its expansion in generation capacity. Hence, the proposed project is compatible with and, indeed, a fundamental part of the EEHC generation expansion plan to meet existing and future demand for electricity.

3.2 ALTERNATIVE TECHNOLOGIES AND FUELS

3.2.1 Selection of the Proposed Technology

The EEHC has an objective to provide a secure, reliable electricity generation and distribution system for Egypt. A key element in meeting this objective is to establish a diverse range of technologies to avoid over-reliance on any particular fuel or technology, which may adversely affect the ability to provide electricity or meet the fluctuations in demand which occur on a day-to-day or seasonal basis.

The EEHC generation expansion plan includes provision of the following:

- gas/oil-fired steam units;
- gas/oil-fired combined cycle units;
- gas/oil-fired simple cycle combustion turbine units;
- pumped storage;
- nuclear generation;
- wind farms; and
- integrated solar-thermal generating units.

Other possible options include “importing electricity”, “rehabilitation of existing power plants”, “transmission and distribution investment” and “IPPs”.

These technological alternatives constrained by the following:

- ***Importing electricity:*** Egypt is interconnected to Libya and Jordan and is exporting electricity to both countries. Interconnection to Libya has a capacity of 300 MWe, and that of Jordan has a capacity of 350 MWe, which was increased to 450 MWe in 2006. Libya and Jordan are currently paying 4 US¢/kWh for the Egyptian power supply. As they are net importers, there is currently not much scope for electricity imports to Egypt from the interconnected networks. In addition, the cost of electricity in both countries is much higher than that of Egypt, making it an uncompetitive alternative. There is currently no south border connection to Sudan, although there is an ongoing activities in the context of the Nile Basin Initiative (NBI) whereby Egypt could potentially import hydroelectric power starting approximately in 2014, if the price is competitive. However, considering the abundance of natural gas and thus the low cost electricity provision in Egypt, it will be difficult for imported electricity to be competitive.

- ***Renewable energy:*** Current world market cost of wind based electricity is 5.9-7.38 US¢/kWh, whilst is 3.75 US¢/kWh with current grant financing for wind projects, which is higher than the cost from natural gas thermal plants. Therefore, renewable energy is not competitive unless further subsidies are provided.

- ***Rehabilitation of existing power plants:*** EEHC has concluded that the rehabilitation option is cost effective in seven of its existing power plants, and these sites have already been or will be rehabilitated. However, these efforts are not enough to cope with the growing demand for electricity.

- ***Transmission and distribution investments:*** EEHC has developed a transmission and distribution (T&D) development plan and the T&D system is optimized for the current load requirements and generation capacity. To meet the demand growth for the fast track period and medium term expansion, a T&D investment plan has been developed. New electricity generation capacity is required in the network; therefore, strengthening of T&D capacity alone will not replace the need for the generation capacity. Furthermore, T&D losses are at a relatively low level, around 10% on average, and reducing the losses further would not free up the amount of electricity supply required.

- ***BOOTs/IPPs***: Three BOOT projects (650 MWe each) have been built in Egypt in late 1990's and early 2000's. The government is encouraging private sector participation in order to attract private investment. However, given the worldwide reduction in investor's interest in the power sector, private financing for power generation in the near term is still in process.

Consistent with the generation expansion plan, the EEHC has stipulated that the Helwan South should be gas/oil-fired supercritical steam units of a net 2x650 MWe generating capacity. The reasons for the selection of this technology are as follows:

The steam cycle (SC) technology, which fires natural gas as a main fuel and mazout as a back-up fuel, has been used for decades in Egypt. The plant efficiency is around 46% with 600 MWe size drumless type super-critical steam cycle, which exceeds the similar sub-critical unit efficiency with at least 4% ratio. The investment cost of Steam Cycle Super-critical plant, based on recent worldwide market experience, is around $ 1700/kWe (EPC basis with multiple packages). The application of large scale (750MWe) gas turbine combined cycle (CC) technology, which fires natural gas as a main fuel and diesel fuel as a back-up fuel, has been operational since 2004. Plant efficiency exceeds 50% and the investment cost, based on recent worldwide market experience, is around $760/kWe (EPC basis with multiple packages). Given that CC plants show lower investment cost and higher plant efficiency, there should be a distinguished rationale to justify why the SC technology has been selected for the proposed project. The reasons are the following:

- *Operational flexibility:* The EEHC plans to operate large scale (i.e., 750 MWe) CC plants at 100% full flat base-load with a possibility of reducing operations to 50% once a week. This is because the cycling capacity of large-scale CC plants is still to be confirmed (frequent start and stop, and partial load operation capacity). Consequently, SC plants are required to take the role of reducing the load, while CC plants keep 100% full load. EEHC therefore sets the maximum proportion of CC in the generation mix to be 30-35%. As a result, the Electric Generation Expansion Analysis System (EGEAS) model selected the proposed Helwan South SC plant as the most viable option based on this generation mix criteria. If the CC technology were selected, it would exceed the limit of CC in the generation mix, requiring CC plant cycling operation beyond what it is capable of.

- *Grid stability:* SC turbine has bigger inertia and is therefore more stable to network disturbances. When the CC ratio is too high in the generation mix, CC may overreact to the disturbances and interfere with each other, which could cause load instability.

- *Unforeseen risk of new technology:* Applying a new technology to the Egyptian specific climate and environment may have unforeseen risks. For example, recently, dust and humidity caused a quick filter pressure drop in the Cairo North plant, commissioned in May 2004, which was not expected when the CC plant was designed.

- *Fuel flexibility:* SC plants use mazout as a back-up fuel, easily available domestically, while CC plants use imported diesel oil. The ability to "dual-fuel" the power plant (with natural gas or mazout) will provide security of electricity supply in the event that gas supplies are unavailable for any reason.

- *Local manufacturing capacity:* In Egypt only 30% of CC plants are manufactured locally, in comparison to about 40-45% of SC plants manufactured locally. Therefore, the use of SC technology creates more local employment and requires less foreign exchange.

Given this rationale, existing and planned generating capacity using gas/oil-fired combined cycle units is already considered sufficient by the EEHC and further reliance on this particular technology is not preferred for reasons of security of supply, response to demand and economics. As shown in Table 3-1, almost 29.88% of installed capacity in 2008/2009 was provided by combined cycle technology. The new combined cycle units at New Kureimat and El-Atf, Sidi Krir and New Talkha have added more 3000 MWe to the installed capacity within the last 2 years. Also, declared combined cycle additions of Giza North (3x750) MWe and Banha (1x750) MWe will increase the combined cycle capacity by another 3000 MWe within the next 2 years. The EEHC is implementing a process of meeting and generating increased demand through the provision of conventional steam generation plants in order to generate sufficient demand to install further CCGT capacity in the future. This will result in increased potential to incorporate more CCGT capacity.

Hence, with the current policy to limit CC to 30-35% in the generation mix (as identified by EGEAS), and with urgent need of supply capacity with load following capability, SC technology has been identified as the most viable option for the Helwan South project. This will ensure operational flexibility, network stability, fuel flexibility, local job creation, and avoid unforeseen risks of applying new technologies too rapidly in Egypt.

3.2.2 Alternative Fuels

Natural gas has been selected as the main fuel for the power plant. Compared to other fossil fuel generating technologies, gas fired steam generators have a relatively low emissions of carbon dioxide (CO_2), moderate emission levels of nitrogen oxides (NOx) and the lowest emission levels (almost traces) of sulfur dioxide (SO_2) and particulates.

The greenhouse effect is caused by the build-up of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and chlorofluorocarbons (CFCs) in the atmosphere. Water vapour and ozone (O_3) can also act as greenhouse gases. For power generation processes, CO_2 is the key emission of concern, as methane and CFCs are not emitted by power plants and none of the other greenhouse gases are emitted in sufficient quantities from power generation to be considered important in terms of the greenhouse effect.

A comparision of the efficiency and CO_2 emissions from natural gas-fired steam generators compared to other technologies and fuels is provided in Table 3-2 below.

Table 3-2

Comparison of CO_2 from Alternative Technologies for Power Plants

Technology	Generating Efficiency (%)	CO2 Emissions (g per kWh)
Steam Generators - gas fired	36-45%	520
Combined Cycle Gas Turbine - gas fired	50-58%	360-420
Combined Cycle Gas Turbine - oil fired	Not available	600
Steam Generators - coal fired	42-48%	1,000
Pressurised Fluidised Bed - pulverized coal	42-45%	740-840
Integrated Coal Gasification Cycle - coal-gas fired	40-45%	750-1,000
Conventional Coal without FGD - pulverized coal	38-40%	820-950
Conventional Coal with FGD - pulverized coal	36-40%	800-980

Source: EDF Port Said East SAE: EIA for Port Said East BOOT Steam Power Plant, Final Report, October 2000.

The efficiency of the proposed steam power plant is 42-45% with natural gas, with associated CO_2 emissions of about 520 g/kWh. This compares with the efficiency of a typical CCGT power plant of 53-54%.

Emissions of carbon dioxide are estimated to be up to 6,750 kilotonnes per year (expressed as CO_2). This assumes that the plant operates for the whole year and consumes around 180 tonnes of gas per hour. The emissions of CO_2 from fuel burning in Egypt amounted to around 160,000 kilotonnes in 2000 (Ref: EEAA: Egypt's Second National Communication). Fuel combustion will account for most of Egypt's CO_2 emissions from all sources. Hence, the power plant as proposed will emit up to around 4.2% of the total Egyptian CO_2 emissions in 2000. This is an upper estimate as the plant will not operate 100% of the year or at full load 100% of the time.

Natural gas, which is the main fuel to be used in the Helwan South plant, contains very low concentrations of sulfur or particulate matter, therefore the potential for emissions of SO_2 and particulates from the electricity generating process are also very low. Fuel oil however, leads to greater emissions of SO_2 and particulates, due to the relatively high sulfur content of these fuels and the generation of ash during their combustion.

Natural gas fuel also has the significant benefit over fuel oil of being able to be delivered by an existing pipeline, whereas oil requires delivery to the power plant by road, rail and/or sea. The use of a pipeline avoids the potentially significant environmental impacts of road, rail or seaborne traffic and fuel unloading operations at a power plant. The very limited use of fuel oil at the proposed plant does not justify use of a pipeline for this fuel.

Therefore, the selection of natural gas as the main fuel for the Helwan South power plant offers a range of environmental advantages over alternative fuels.

Light fuel oil, which is less polluting than the chosen heavy fuel oil or mazout, is not readily available in Egypt and its use would incur significant economical impact on the project.

3.3 ALTERNATIVE DESIGNS OF THE POWER PLANT

There are a wide variety of potential designs for the proposed power plant which consider technical, economic and environmental issues. Key design features of the power plant which are related to environmental impacts are summarized in *Tale 3-3*.

On the basis of the key design features selected for the power plant summarized in *Table 3-3*, together with general good practice included within its overall design and layout, fuel and chemical storage facilities and pollution monitoring equipment, the power plant offers a range of environmental benefits whilst minimizing its potential site-specific impacts on the environment and ensuring safe, secure and efficient operation.

Table 3-3

Key Design Alternatives for the Helwan South Power Plant

Item	**Summary of Alternatives**	**Selected Design**
Stack Configuration	The two generating units and the auxiliary boiler in the power plant each require an exhaust for combustion gases. Alternative configurations are: • three separate stacks, • two separate stacks, • one single stack for both units and one stack for the auxiliary boiler, • one single stack with three flues, • one single stack with one flue. The two stacks will have an appropriate diameter each, which will improve dispersion through buoyancy effects. The visual appearance of the power plant will change with stack configuration.	The power plant is primarily designed with a flue housed in a single stack for each unit, which improves the buoyancy and dispersion of the emissions. This also minimizes the visual impact.
Stack Height	The stack can be a range of heights. Dispersion is improved by increasing the stack height, but engineering requirements, e.g. structural support and foundations, and associated costs are also increased with stack height. Clearly, the higher the stack the greater the visual impact, but the higher the stack the better dispersion of atmospheric emissions.	The stack height was tentatively defined as 150 m at minimum (may be more elongated) via atmospheric modeling carried out for Helwan South power plant by ECG in October 2010 which is in excess of the Good Engineering Practice (GEP) stack height.

Air Pollution Control	There is a range of technologies which may be used to minimize emissions from the power plant, which can be divided into two categories: • fuel combustion controls; • "end-of pipe" gas cleaning. The most effective approach is to control combustion of the fuel such that the production of the emissions is minimized, obviating the need to use gas cleaning equipment (which addresses the results rather than the source of emissions). End- of- pipe solutions are also expensive compared to combustion controls. The use of Heavy Fuel Oil will result in SO_2 emissions and particulates.	The boilers will be equipped with low-NOx burners, minimizing the emission of NOx which is the key pollutant associated with combustion of natural gas. Detailed design will also consider further NOx reduction techniques, such as flue gas re-circulation. Air pollution control systems will ensure compliance with both the WB and EEAA emission standards for power plant. Heavy Fuel Oil will be used in emergencies only and for a period not exceeding 2% of operating time.

Item	Summary of Alternatives	Selected Design
Cooling System	ere are 3 generic cooling systems which may be used: • direct (once-through) water cooling; • indirect water cooling using evaporative cooling towers; • air cooling via air cooled condensers. Direct water cooling maximizes the generating efficiency of a power plant, but requires large quantities of cooling water and the construction of intake and outfall infrastructure. A cooling tower system (closed system) uses less water, but is associated with lower generating efficiency and visible plumes of water vapor which causes salt drift and can cause ground fogging. Although cooling towers use less water they result in a net water loss which needs to be compensated by make-up. Air cooled condensers (closed system) have the lowest generating efficiency but do not use water, although noise and visual impacts are higher than for the other options.	Direct water cooling will be used, which maximizes generating efficiency, minimizes visual impact and noise and the potential for visible vapor plumes or ground fogging. A sustainable water is available from the Nile River and the intake and outfall structures can be constructed without significant environmental impacts.

Cooling Water Intake and Outfall Structures	The cooling water intake and outfall may have a range of alternative designs, which affect dispersion of the thermal plume: • Relative locations on the Nile bed (which control potential re-circulation (re-entrainment) of warm water into the intake); • Design (flow rate, flow velocity, height above seabed orientation, .. etc).	The cooling water intake and outfall infrastructure is located such that there will be no effects on the operation of the power plant through re-circulation (re-entrainment)of warm water from the cooling water discharge into the intake structure. The orientations, flow rates and flow velocities of the intake and outfall are designed to avoid scour of the Nile bed and change to sedimentation. The height of the intake and outfall above the seabed are designed to avoid any potential interference with Nile navigation. The intake orientation, flow rate and velocity are designed to minimize entrainment of fish and other marine organisms. Fish screens are also fitted to the intake.

Item	Summary of Alternatives	Se[illegible]ted Design
Source of Potable Water Supply	There are three alternatives for providing potable water to the power plant: • local potable water network of the Helwan Governorate, which could be extended to the site of the power plant; • treated water in the power plant; and • provided potable water in jerry cans.	Tr[illegible] plant water will pr[illegible] water for human uses in [illegible] power plant, including drinking.
Effluent Treatment and Disposal(*)	There is a range of technologies which may be used to treat effluent from the power plant. The main effluent characteristics of concern are pH, suspended solid material and oil/grease residues. These characteristics may be treated by: • pH adjustment by acid/alkali addition; • filtration of suspended solids; • interception of surface oily substances; Due to the development programs in the area surrounding the site, available options for disposal of the plant's treated effluent are to a mains sewer, an existing wastewater treatment plant, or a local watercourse. Otherwise, the only available discharge route will be direct to Nile. The plant includes a wastewater treatment facility.	The treatment system consists of modules for treating wastewater streams generated by the power plant. This is achieved by selectively combining some of these waste streams and providing treatment as required prior to routing to the disposal system. Effluent treatment systems will ensure compliance with the Egyptian EEAA and World Bank discharge standards for power plants.

Use of Water Treatment Chemicals	There is a range of proprietary water treatment chemicals available for use in power plants. The approach to the use of water treatment chemicals is determined by the quality of the raw feedwater, requirements of the power systems to operate safely and efficiently and management of the power plant. The use of water treatment chemicals is inherent in the operation of the power plant, although how the chemicals are used can be controlled.	The use of water treatment chemicals will be reduced to the minimum required to achieve safe and efficient operation of the power plant. The control of the use of water treatment chemicals will include consideration of the type of chemical used (Chlorine will be added to the cooling water system to control bacterial and algal growth instead of sodium hypochlorite), dosing regime and control of residual concentrations in the process effluent and cooling water discharge.

Note:
(*) Processed waste water will be used for irrigation. Wastewater is monitored for pH prior to use.

3.4 ALTERNATIVE SITES

The site location has been allocated to the Upper Egypt Electricity Production Company (UEEPC), an affiliated company to the Egyptian Electricity Holding Company (EEHC) by the Egyptian Government (Presidential Decree no. 43 of the year 2010, issued on 14 February 2010).

3.4.1 Identification of Candidate Sites

Three sites were considered for the proposed project, namely Safaga, Sharm esh-Sheikh and Helwan South. Relatively, the Helwan South was preferred to Safaga and Sharm esh-Sheikh sites mainly because of the higher cost for connection to cooling water, make-up water and the gas network, in addition to the electricity grid due to the greater distance to the load centers.

The key criteria used in the evaluation of the alternative sites by the EEHC/ UEEPC were as follows:

- *Economic factors*:
  - capital costs;
  - operation and maintenance costs;
  - requirement for natural gas;
  - requirement for cooling water;
  - demand loads for electricity; and
  - requirement for electricity transmission lines/sub-stations.

- *non-economic factors:*
  - potential environmental impacts; and
  - site development.

Potential environmental impacts have been examined for all sites. Screening level assessment during feasibility study indicated that the level of environmental impacts will be relatively constant for all the three sites.

According to the Investment Map and Land-use Map of Egypt, the South Helwan/ Kureimat has been designated since 1999 to industrial development. Some of the land around has already been developed with industry facilities. As a result, the Helwan South on the Nile River area has been identified as the centre of load for current and future electricity demand in the region.

Compared to other alternative sites, the Helwan South on the Nile River site was found to be the most effective site for the following reasons:

- Minimal additional infrastructure requirements are needed.
- A workers colony is not required during construction as the power plant will use the local workforce from Helwan Governorate and the surrounding towns and villages.
- Desirable benefits for development of the site area.

In addition, the power plant will be constructed and operated on a land originally allocated for power generation activity, thus it will not include any land take. Also, the power plant site will bring socio-economic benefits to the wider Helwan Region, through employment opportunities, supply contracts and the effects of project expenditure within the local economy.

The key findings of the consideration of alternative sites are summarized in *Table 3-4*. The consideration of alternative sites by the UEEPC/EEHC indicated that Helwan South has no significant disadvantages and has several beneficial aspects for other developments in the Helwan and Atfieh / Kureimat area, and desirable site development characteristics. Therefore, Helwan South was selected as the preferred site for the power plant.

Table 3-4
Key Findings of the Consideration of Alternative Sites

Site	Key Findings
Safaga	Remote, "greenfield" site, hence a new colony for workers would be required with potential socio-economic conflicts. Extensive infrastructure requirements needed, resulting in higher costs and potential environmental impacts.
Sharm esh-Sheikh	Relative to Helwan South site, significant infrastructure requirements needed, resulting in higher costs and potential environmental impacts.
Helwan South	Minimal additional infrastructure would be required. Cost-effective site for development (first lowest of the three alternative sites). A workers colony is NOT required as the project will use the local workforce from wider Helwan area.

4. DESCRIPTION OF THE PROPOSED PROJECT AND THE EXISTING FACILITY

4.1 PROJECT INFRASTRUCTURE

The Helwan South facility will consist of three units, supercritical steam electric generating station firing natural gas as the primary fuel and mazout (heavy fuel oil) as an emergency fuel. In addition, Sollar oil will be used as a start-up/warm-up fuel. The development of Helwan South Power Plant will consist of the infrastructure presented in *Table 4-1 and Table 4-2*. The proposed site of the power plant and the easements for the associated infrastructure are shown in *Figure 4-1*.

Table 4-l

Main Infrastructure for Helwan South Power Plant

Infrastructure	Brief Description	Comment
Power plant	1950 MWe power plant comprising three Steam Turbine units each of 650 MWe capacity, using natural gas as the main fuel and mazout (oil no. 6) to be used in emergency situations for limited hours.	Power plant is the subject of this ESIA report.
Cooling water supply	Abstraction and return of cooling water from/to the Nile River through intake and discharge structures.	Cooling water supply is required and subject of this ESIA.
Fuel supply	Natural gas supply via a new gas pipeline routing and the emergency fuel mazout oil to be transported by trucks from Musturod (Cairo) or Suez oil refineries) to the power plant site. Light fuel oil supply, also by trucks.	Gas pipeline is the subject of a separate ESIA by GASCo. A gas reducing station will be used for the new units. Supply of emergency and start up fuels (heavy and light fuel oils) by trucks are included in this review.
Power evacuation	Direct connection by overhead transmission line into the new 500 kV switchyard and 500kV OHTL network.	New off - site transmission line is required to evacuate power generated and included in this review.
Potable water supply	Potable water will be obtained from the new power plant water supply system.	No separate ESIA report is necessary.
Sewer Line	The power plant has its own sewage treatment plant. Treated wastewater will be used for plantation program of landscaping the power plant site.	Plant sewer treatment system is the subject of this ESIA report. Therefore no separate ESIA report is necessary.
Site access road	Access via an existing road.	No new road is required.

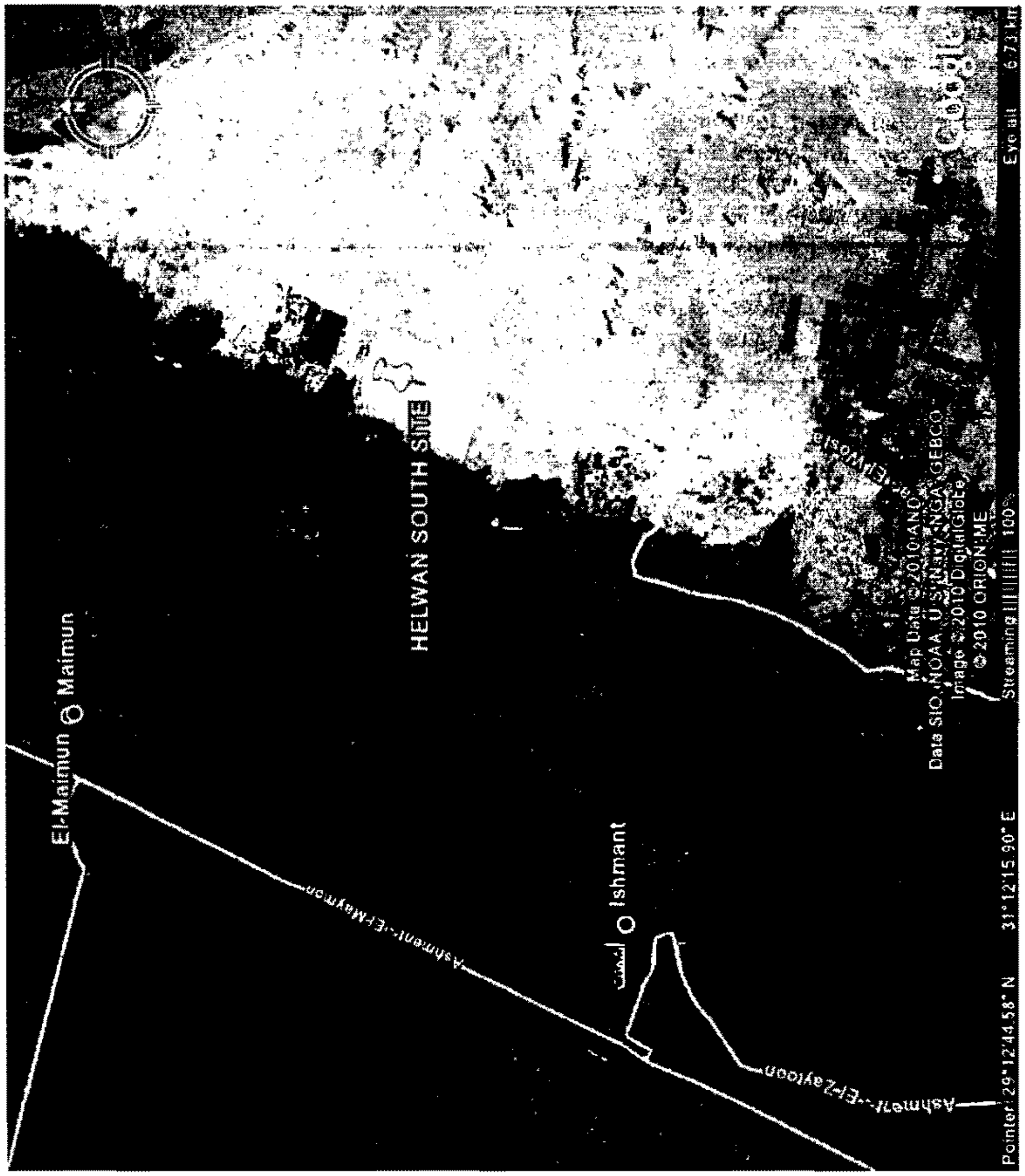
Table 4-2

Supporting Infrastructure

Infrastructure Type and Brief Description
• Logistic buildings, including administration building, offices, workshop, warehouse, laboratory and gate house. • Gas handling facilities, for metering and control of gas delivery. • Fuel feeding system for both natural gas and alternate fuel. • Handling system needed for the periodic maintenance of the equipment. • Fire fighting facilities including emergency supply. • GIS switchgear with 500 kV outgoing feeder lines. • Ventilation and air conditioning. • Chemical laboratory. • Communication system. • Site drainage, site lighting and perimeter wall (3 m height) .

Figure 4-1

Proposed Site of the Helwan South Power Plant and its Easements



4.2 DESIGN OF THE HELWAN SOUTH POWER PLANT

4.2.1 Overview of Helwan South Power Plant

The preliminary design, layout and engineering aspects of the proposed power plant are being developed by the Consultant on behalf of EEHC/ UEEPC.

The design of the plant is based on high quality electric utility standards and uses proven technology and equipment. The plant has been designed to produce low cost power without compromising quality, reliability or availability.

The plant will consist of the infrastructure presented in *Tables 4-1 and 4-2.*

The project will include the following main components:

- Supercritical steam power plant, comprising three generating units primarily fired by natural gas, at approximately 9-11 bar gauge at the interface, but also designed to run on mazout (heavy fuel oil) in emergency situations as a secondary fuel. Each unit will consist of one outdoor supercritical steam generator for steam generation and one supercritical steam turbine generator (STG) providing 650 MWe (nominal) electrical generation capacity per unit at the 100% of the STG output case. Each STG will be fed by steam from the respective steam generator (boiler);

- Circulating water system, with the main pumps and associated piping, the intake and discharge structures, the screening system, the chlorination system and the cathodic protection system;

- Heavy fuel oil and light fuel oil storage tanks;

- Intermediate water storage, the demineralization plant and the make up water system; and

- Power will be generated at the manufacturer's standard voltage and stepped up through main transformers to be connected to the new 500kV GIS switchgear.

Provisional layout drawing of the proposed power plant is provided in *Figure 4-2*. The final layout of the power plant and detailed design will be completed by the Consultant and Upper Egypt Electricity Production Company's (UEEPC's) Contractors who will construct the power plant. However, main components illustrated in the provisional layout drawing include the following:

- Boiler Unit 1 A.
- Boiler Unit 1 B.
- Boile Unit 1C.
- Auxiliary Boiler.
- Steam Turbines Units 1 A, 1B&1C.
- Elec. Bldg. ,all units.
- Elec. Control Bldg. ,all units.
- Main Transformers Unit 1 A.
- Main Transformers Unit 1 B.
- Main Transformers Unit 1C.
- Aux. Transformers Unit 1 A.
- Aux. Transformers Unit 1 B.
- Aux. Transformers Unit 1C.
- Switchyard Area.
- Diesel Generator.

- Switchgear Control Room.
- Stacks Module 1.
- Fuel Gas Receiving/Reducing Station.
- Mazout Fuel Oil Unloading Pumps.
- Sollar Oil Unloading Pumps.
- Mazout Fuel Storage Tank 1.
- Mazout Fuel Storage Tank 2.
- Sollar Oil Unloading Pumps.
- Mazout Oil Heaters/Transfer Pumps.
- Sollar oil Storage Tank.
- Water Treatment Area.
- Circulating Water fire Water Pump House.
- Circulating Water Electrical Equipment Bldg.
- Chlorine Tank/Pump.
- Condensate Water Tank.
- Condensate Water Discharge Structure.
- Condensate Water Nile I Well.
- Demineralized Water Storage Tank.
- Waste Water Treatment Plant.
- Administration Building.
- Warehouse/Work Shops.
- Security office.
- Fire Station.
- Hydrogen Generation Building.
- Bottled Gas Storage/Gen. Area.
- Foam Equipment.
- Black Start Facility.

The power plant is designed to operate as a base load unit with the STG operating in sliding pressure mode up to approximately 60% load and at fixed pressure for higher loads.

Key features of the power plant design may be summarized as follows:

- The conventional Steam Turbine Generator power plant will have the capability to be fired by dual fuel, using either natural gas or mazout in case of emergency.
- The power plant will operate by a once-through cooling system. Supply and return cooling water will be from/to the Nile River.
- Nile water will be utilized in the steam generation system after it has been filtered and demineralized.

4.2.2 Design and Layout of the Power Plant

The proposed design and layout are being developed with regard to the following factors and considerations:

- Technical requirements for construction, operation and maintenance.
- Design of a safe power plant taking into account the relative locations of equipment and the relationship of the overall plant to the environment, particularly sensitive receptors to environmental impacts.
- Compliance with regulatory requirements.
- Presence of existing services.

- Provisions and mitigation measures to avoid or minimize any potential environmental impacts.

- Primary access and secondary roads to operate the power plant.

In general, the site can be split into three main components, namely:

- main power production area, approximately in the central east part of the site which incorporates the Steam Turbine Generators, Boilers, stacks and the power transformers;

- fuel handling and fuel gas reducing station area on the northern part of the site, which includes storage tanks for the mazout and Sollar oils, and ancillary management facilities (including loading/unloading area, fuel heating and pumping units);

- main cooling water intake and outlet pipelines, demineralization unit and pump house on the western side of the site.

The outline design and layout used as the basis for the assessment incorporates all of the key features of the power plant. Where appropriate, conservative assumptions have been made to ensure that all potential environmental impacts are considered and evaluated.

4.3 PROCESS DESCRIPTION

4.3.1 Electricity Generating Process

The steps in the generating process, typical for each power generating unit, at the power plant are illustrated in *Figure 4-3* and the key features are as follows:

- The key inputs to the generating process are natural gas or mazout oil, which will be delivered to the site via underground pipelines (gas or mazout), together with air and water.
- Natural gas (or mazout oil when natural gas is unavailable) will be mixed with air and combusted to generate steam from demineralized water to drive two turbines serving electrical generators. The combustion of the fuel is supported by injection of air. The process results in the generation of electricity and also produces hot exhaust gases.
- The steam is cycled from the boilers through the turbines to condensers. The condensers are cooled by a direct cooling system, abstracting water from, and discharging the used effluent to, the Nile River. The condensate is then returned for recirculation within the boilers.
- The final exhaust gases will be discharged to the atmosphere via a *flue housed in a single stack of 150 m height, (at minimum, may be more elongated) for each unit in accordance with emission standards set by the EEAA.* The main by-products from combustion of natural gas are carbon dioxide (CO2), water vapour, carbon monoxide (CO) and nitrogen oxides (NOx). Sulfur dioxide (SO2) and particulates, which are typically associated with coal and oil combustion, will not be produced other than in trace quantities during natural gas firing. When mazout oil is used instead of natural gas (in emergency situations for only less than 2% of the total operating hours), SO2 and particulates will also be key emissions from the power plant.

4.3.2 Operating Modes

Under normal operating conditions, the pswer plant will run according to one of the following modes:

- two steam turbines at full load, two boilers firing natural gas;
- three steam turbines at full load, three boilers firing natural gas; or
- boiler start up: under black start conditions light fuel oil may be fired.

In emergency circumstances (when gas is unavailable), the plant will operate as described above but using heavy fuel oil (mazout) in place of gas. Emergency operation using heavy fuel oil will occur for no more than 7 continuous days, i.e. 170 hours per year and only if gas is unavailable.

In case of a total blackout, the power plant will operate as follows:

- emergency diesel engines will supply power to the auxiliaries.

4.3.3 Grid Connection

The electricity produced by the unit generator will be fed into a step up main transformer. The output is delivered into the 500 kV GIS switchyard by means of 500 kV GIB bus for connection with the Egyptian Electricity Transmission Company (EETC) power transmission system. Electricity will be evacuated off site by high voltage transmission line (500kV). The interconnection point is the transmission line terminal to the gantry of the 500 kV GIS switchyard. EETC will construct and operate single circuit 500kV transmission line between the plant and the national network.

Figure 4-2

Provisional Layout Drawing of the Helwan South Power Plant

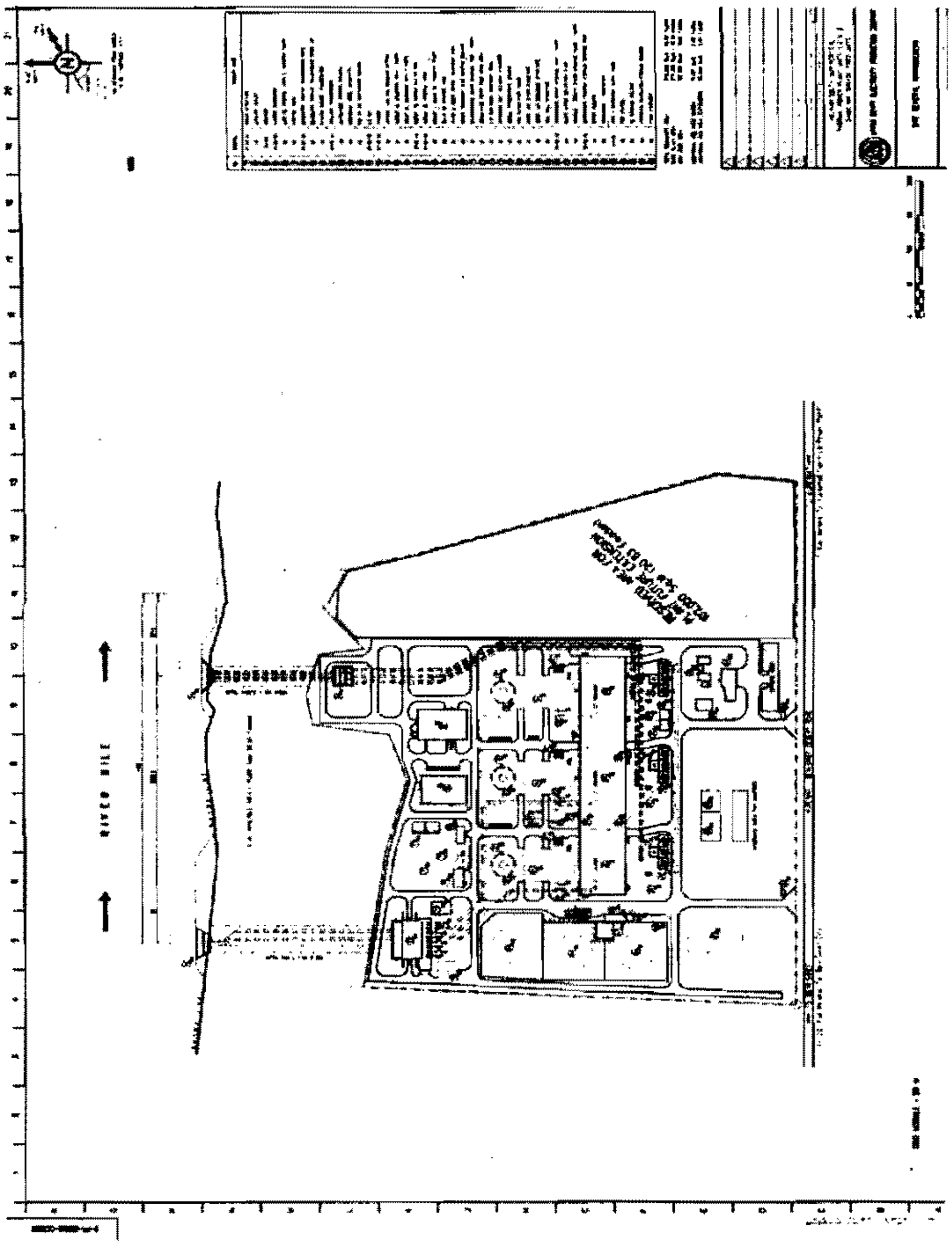
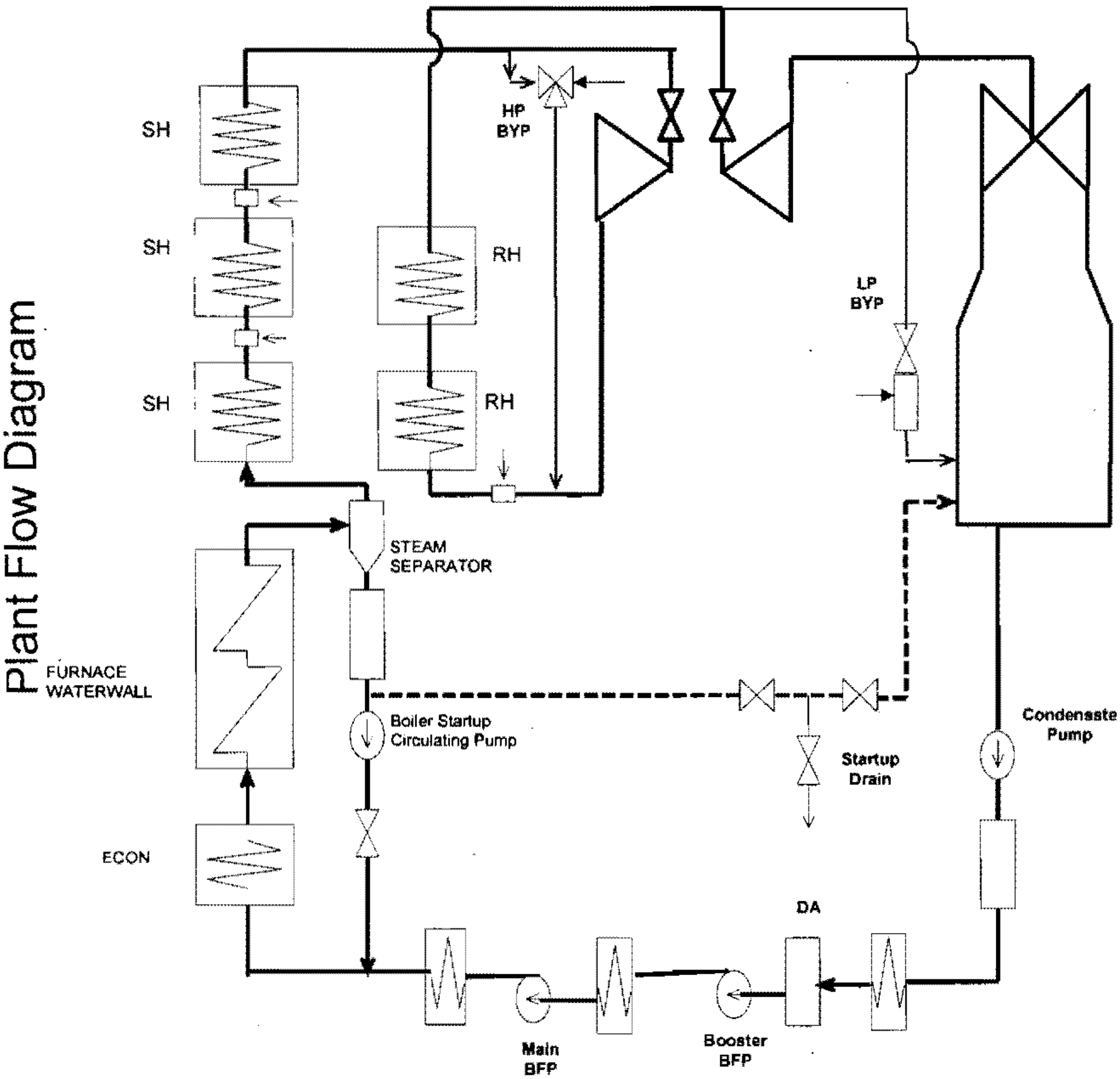


Figure 4-3

Helwan South Power Plant Flow Diagram
(Steps of the Generating Process)



4.3.4 Fuels

Natural Gas

Natural gas will be transported to the site via a gas pipeline operated by "City Gas". At the outlet of the reducing gas station, the gas pressure is 7 bar. The average gas consumption is estimated as about 99 kg/sec. for three units. The design characteristics of the natural gas are given in *Table 4-3(a)* below.

Fuel Oil

The heavy fuel oil will be delivered to the site via trucks from tank yard area of Musturod or Suez Petroleum refinery to the power plant site. Hence, mazout is supplied to the tanks at the tank yard area of the power plant.

Heavy and light fuel oils will be stored (for all units of Helwan South power plant) on site in:

- two, 45,000m^3 tanks for heavy fuel oil,
- one, 2,000m^3 tank for light fuel oil.

The heavy and light fuel oil tanks are situated in two separate retention areas designed to retain 110% of the storage capacity.

It should be noted that Sollar oil may also be used to fuel the emergency generator. However, the use of this fuel will be very limited: Sollar oil will only be used in the event of an emergency requiring the operation of the emergency generator or as a stand-by alternative to natural gas for start up using the auxiliary boiler. Therefore, the use of Sollar oil is not considered in the EIA.

The characteristics of the fuel oil which will be used by the power plant as a back up fuel are summarized in *Table 4-3(b)*.

Table 4-3 (a)

Characteristics of the Fuel Gas to be Used by the Power Plant (Minimum Specifications of the EEHC)

Composition	Percent by Volume	Percent by Weight
Nitrogen	0.385	0.62
Carbon Dioxide	0.688	1.72
Methane	92.766	84.49
Ethane	4.117	7.03
Propane	1.211	3.03
Butane	0.529	1.74
Pentanes	0.165	0.68
Hexanes	0.138	0.67
Heptanes Plus	0.001	0.02

Parameter	Value
Molecular weight	17.57
Density gm/liter (lb/ft3) @ 60 F and 14.696 psia	0.742 (0.0046)
Higher heating value:	
kcal/kg (Btu/lb)	12,809 (23,056)
Kcal/kg (Btu/ft3) @ 60 F and 14.696 psia	9545 (1072.6)
Sulfur content, ppm (max)	10,060 (18,103)

Table 4-3 (b)

Characteristics of the Fuel Mazout Oil to be Used by the Power Plant (Minimum Specifications of the EEHC)

Parameter	Value
Specific weight @ 15°C (59°F) kg/m3	945 (59)
Moisture content, % vol.	1.0
Ash content, % wt.	0.3
Sulfur content, % wt.	3.0
Carbon content, % wt.	85.0
Hydrogen content, % wt.	10.7
Vanadium content, % ppm	0.002 to 0.003
Lower heating value (LHV), kcal/kg	9500 (17.096)
Higher heating value (HHV), kcal/kg	10,060 (18,103)

Table 4-3 (c)

Characteristics of the Fuel Sollar Oil (Oil No. 2) to be Used by the Power Plant (Minimum Specification of the EEHC)

Parameter	Value
Density @ 15°C, gm/ml	0.82 – 0.85
Flash Point P.M.C., °C min	55.0
Viscosity	
Kinematic @ 40°C, centistokes	1.9 – 4.1
R1 @ 40°C	30.0 – 36.0
Pour Point, °C max.	4.5
Water & Sediment, % vol max.	0.10
Conradson Carbon, % wt. max.	0.10
ASH Content, % wt. max.	0.01
Total Sulfer, % wt. max.	1.0
Copper Strip @ 100°C (3HRS), max.	DIV.1
Distillation	
90% distelled @, °C	350.0
Residue After Dist, @ 370°C % vol.	2.50
Sodium & Potasium Content, ppm max.	2.0
Calcium Content, ppm max.	2.0
Vanadium Content, ppm max.	1.0
Lead Content, ppm max.	1.0

All fuel which is stored on-site will be stored in dedicated tanks within bunded areas with controlled drainage facilities (as described above).

4.3.5 Operational Use of Raw Materials

Water Consumption

The water balance for the power plant is outlined in *Figure 4-4* at 100% load.

Water from the Nile River will be used for the main condenser circulating water cooling system and as the heat sink for the auxiliary equipment closed cooling water system. The Nile water will also be used as the source for the water treatment plant which will provide makeup water to the main cycle closed loop cooling system. Potable water will be obtained from the plant water system.

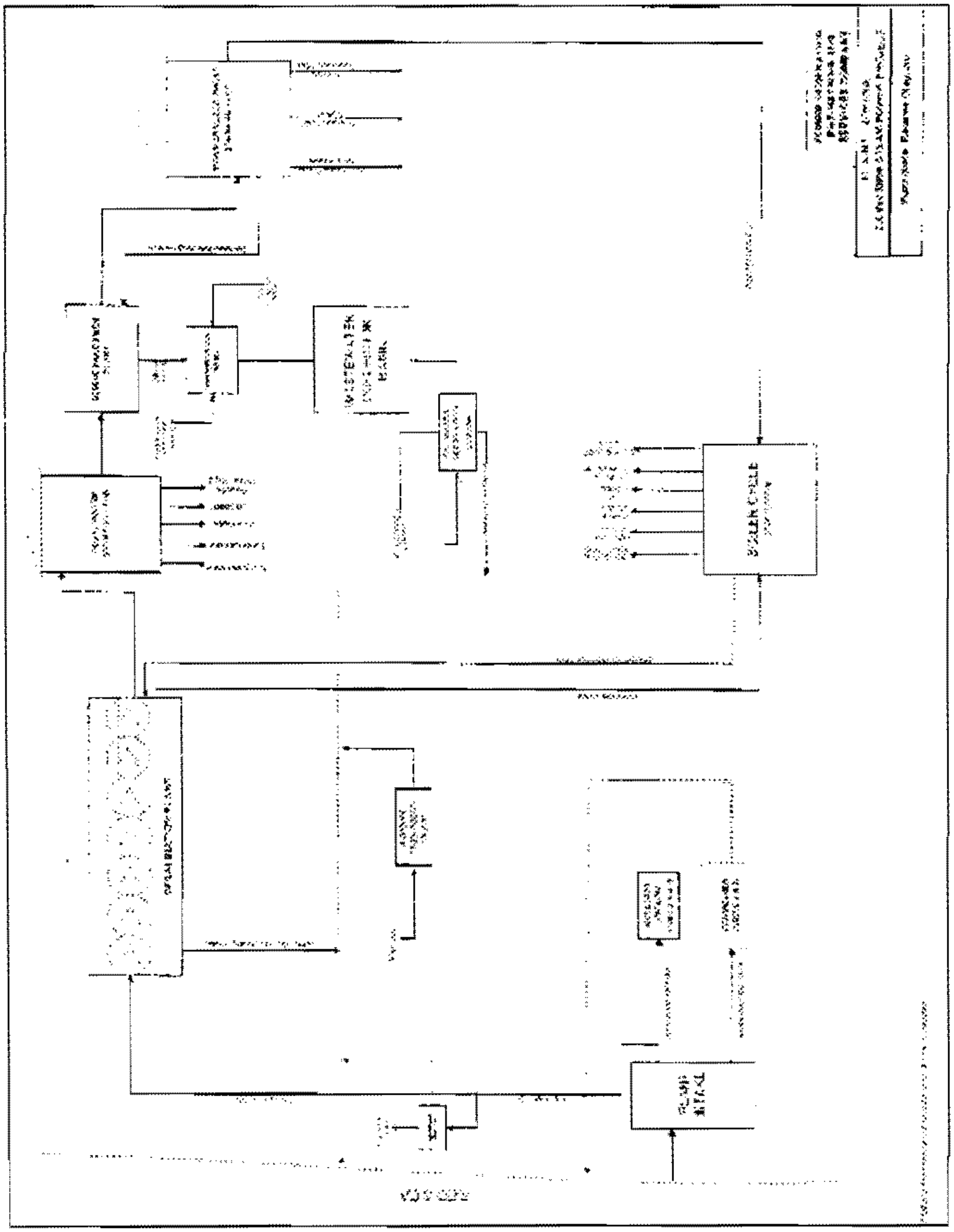
Plant Water Requirements per One Unit are as follows:

- Service water[(1)]: 30.0m3/hr
- (11.11% consumed[(2)]= 3.34 m^3/hr and 88.89%
- recycled[(3)] = 26.67 m^3/hr)
- Boiler make – up water : 31.25 m^3/hr
- (totally recycled)
- Cooling water : 82,800 m^3/hr
- (0.07% consumed = 57.96 m^3/hr and 99.93%
- recycled = 82,742.04 m3/hr)
- Total water usage : 82,861.25 m^3/hr
- (consumed = 61.295 m^3/hr, recycled = 82,799.955 m^3/hr)
- Cooling water abstracted from the Nile River (23 m^3/sec. per unit, i.e. 82,800 m^3/hr.) is returned totally back to it. Actual water consumption is around 0.07% of the abstracted water.
- No disturbance to the Nile flow is expected either upstream or downstream.
- Hydrological/hydraulic study is carried out and the study revealed that no impact is expected and the mixing zone is limited to 50-70m distance with 5oC above ambient, which is diluted to 3oC at a distance between 100 and 150 m with full compliance with Egyptian Law 48/1982 and WB regulations.
- All waste water is treated. Water treated directly into waterbody: 120-220 m3/hr.
- MWRI is in full agreement with EEHC regarding its plan for water abstraction.
- Average seasonal flow of water in the Nile River is as follows:
- Minimum flow (Winter time): 60 million m3/day at a MSL of 21.28m (6.63% of the Nile total).
- Dominant flow (Average time): 90 million m3/day at a MSL of 23.63m (4.42% of the Nile total).
- Maximum flow (Summer time): 250 million m3/day at a MSL of 24.36m (1.59% of the Nile total).

(4) "Service Water" includes water for utilities (toilets; floor cleaning; sanitary)
(5) Consumption = predominantly consumptive use.
(6) Recycling = predominantly non-consumptive use; returned to the original source.

Figure 4-4

Water Balance of the Helwan South Power Plant



The total volume of water used in each process is shown in *Figure 4-4*. The water will be abstracted from the Nile River to meet the power plant cooling water and process requirements.

Consumption of Process Chemicals

Table 4-4 provides a list of process chemicals which will be used by the power plant. The main use of process chemicals at the power plant will be for pretreatment of Nile water, control of pH and oxygen scavenging in the Steam Generators system and prevention of biofouling in the intake water pipes and the condenser cooling system.

In addition, a range of oils, detergents and solvents will also be used at the power plant in small quantities for general plant operation and maintenance, e.g. lubricating oil, hydraulic control fluid, detergent and paints and solvents.

All chemicals will be stored in suitable containers, tanks or vessels and in bunded areas with controlled drainage facilities.

4.3.6 Cooling System

Cooling Water Abstraction and Discharge

The power plant will utilize once through cooling system using water abstracted from the Nile

The key features of cooling system are as follows:

- Raw water will be taken from the Nile River through the future intake basin and treated and screened by a trash rack and travelling screens system to remove solid materials prior to use. The water will then be transferred to the power plant by four 2.5 meter diameter pipes. Four 2.5 meter diameter discharge pipes will return the water from the power plant to the Nile River through a Nile I well and outfall basin.
- The future outfall structure will be positioned and designed to avoid re-circulation of warm effluent cooling water from the discharge into the intake for Helwan South Power Plant.
- The existing outfall is designed to provide optimum velocity discharge into the Nile in order to create efficient mixing and reduce the potential for a thermal plume of water at elevated temperature compared to ambient Nile water. At the exit of the outfall, the temperature of the used cooling waters will be elevated by approximately 8 °C above the ambient water temperature; however the cooling water temperature rapidly decreases due to mixing and will always be within the allowable temperature rise (8°C).

Table 4-4

Provisional Inventory of Process Chemicals[1] to be Used at the Power Plant

Substance	Rate of Use (kg per hour)	On-site Inventory and Storage
Circulating Water Chemical Feed System		
Chlorine	5500	100 m^3 50x2-m^3 tanks
Boiler Water Pretreatment System		
Coagulant (aluminum sulfate or equivalent)	4.0	8.0 m^3 solution 40x25 kg bags
Polyelectrolyte	0.1	6 m^3 solution 40x25 kg bags or 4 m^3 2x2m^3 portable totes
Boiler Water and Feedwater Chemical Feed System		
Ammonium Hydroxide ($28\%NH_4OH$ or equivalent)	50.0	10 m^3 bulk storage tank
Oxygen scavenger ($35\%N_2H_2$ or equivalent)	5.0	1.5 m^3 dry tank
Sodium phosphate compounds (di-or tri-phosphate or equivalent)	0.4	8 m^3 tank
Demineralization System		
50% sodium hydroxide (caustic soda)	1000 (infrequent once per day)	30m^3 tank
98% sulfuric acid	7000 (infrequent once per day)	30m^3 tank
Condensate Polisher		
40-50% sodium hydroxide (caustic soda)	1500 (infrequent once per day)	0.8 m^3 tank
93-96% sulfuric acid	1500 (infrequent once per day)	0.8 m^3 tank
Closed Cooling Water System		
Corrosion inhibitors (sodium nitrite, molybdate-based or equivalent)	Infrequent 5kg every 3 months	6x2081 drums or 4m^3 2x2m^3 portable totes
Wastewater Treatment System		
40-50% sodium hydroxide (caustic soda)	0.3	0.25 m^3 day tank *plus* bulk storage with demineralization system
93-96% sulfuric acid	0.2	0.25 m^3 day tank *plus* bulk storage with demineralization system
Coagulant (aluminum sulfate or equivalent)	1.4	0.25 m^3 day tank *plus* bulk storage with demineralization system

Notes:
(1) All process chemicals will be sourced by local licensed dealers and will be handled according to instructions and precautions described in the Safety Data Sheets.

Abstraction and Discharge Technology

Cooling of the power plant will be based on a pipeline Nile water cooling system, with a total flow of approximately 69 m^3/sec (i.e. 248,400m^3/hr). Outside the limits of the plant, the cooling water structures consist of the following:

- Bankline Crossing between the power plant fence and the Nile River, the bankline will be crossed by four underground pipes. These will be entirely buried so that access to the bankline is not impaired.

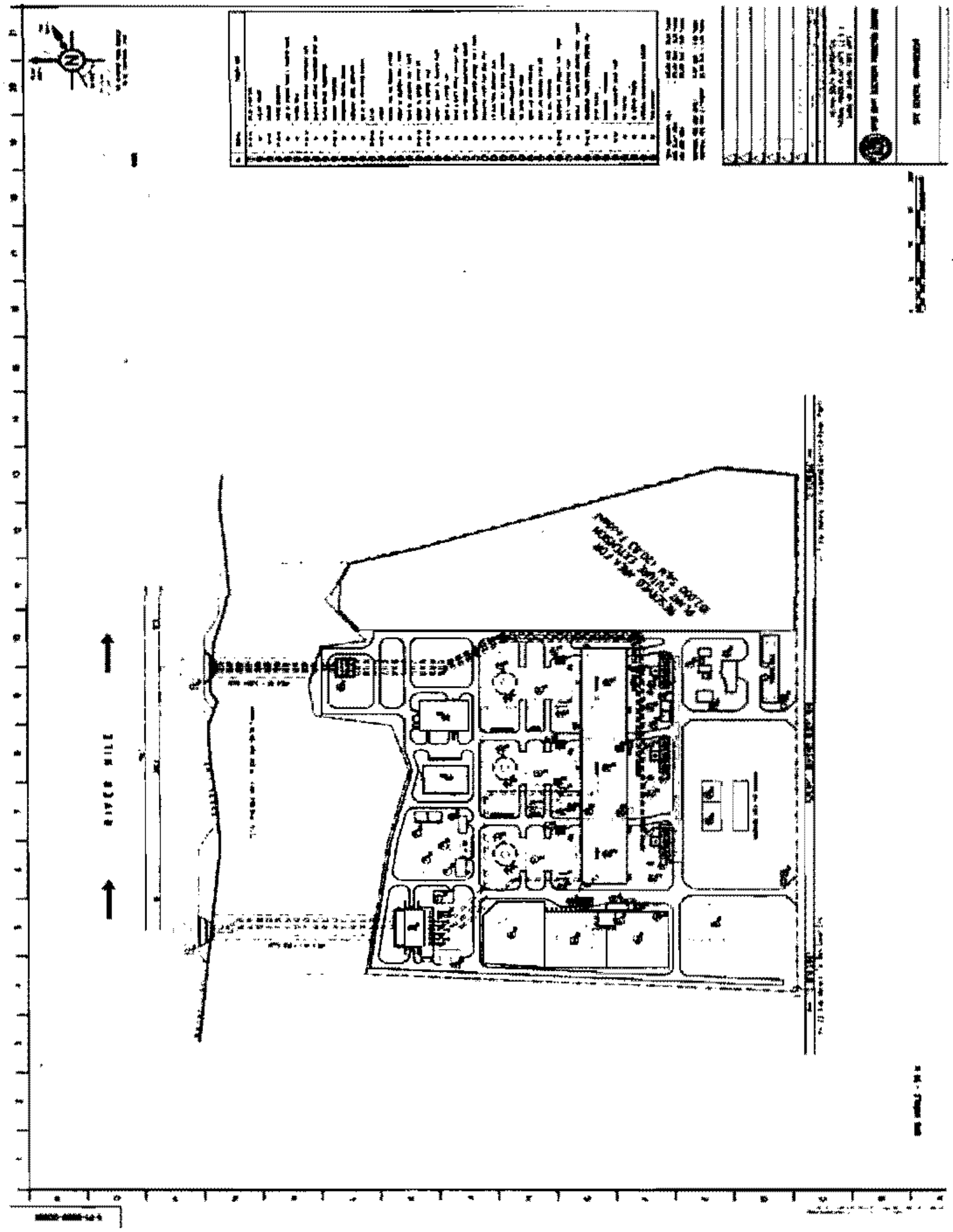
Inlet and Outlet Structures

The location and form of the cooling water piping (intake/discharge and associated pumping station) is shown in *Figure 4-5*.

The design of the cooling system will take into account the results of the analytical and physical models to assess the dispersion of the discharge of used cooling water in the River Nile. In particular, the location, orientation and flow rate of the outfall will be designed to ensure that the increased temperature of the discharge will not have any significant thermal effects on the Nile and that there will be no increase in temperature at the intake to the cooling system for Helwan South Power Plant (and, therefore, will not affect the operation of its cooling system and, consequently, will give satisfactory results for the *"Law for the Environment" (Law 4/1994.)* and the *"Law for Protection of the Nile River" (Law 48/1982)*.

Figure 4-5

Cooling Water Intake and Discharge Infrastructure



4.3.7 Water Treatment Equipment

Water needed for plant operation will come directly from the Nile. Before use it has to be treated. Liquid effluent is also treated prior to discharge. The water treatment facilities located on site include the following:

- clean water production plant;
- desalination equipment (plant and water storage tanks);
- demineralization plant and condenser make up system;
- chlorination equipment for water storage;
- demineralized water storage;
- waste water treatment equipment; and
- sewage treatment system.

Clean Water Production

The Nile water cleaning plant supplies clean, filtered Nile River water to the oncethrough cooling water circuit, circulating water to the condenser, closed circuit heat exchangers, and the electrochlorination and desalination plant.

Desalination System

The desalination system is an Ejecto compression process. The plant is organized in two independent lines of 50 m3/h net capacity each (59m3/h gross capacity). Suspended and dissolved solids contained in Nile water are removed, in order to produce desalinated water. Desalinated water is stored in two tanks, each with a capacity of 4,000 m3.

Demineralization Plant and Make up Condenser

The demineralization system consists of injecting soda or acid into the water according to a function of pH level and provides:

- make up water of required quality to satisfy boiler and turbine requirements;
- high purity water to the laboratories, sampling and analysis system, closed cooling water, and any other system where dissolved salt and gas contamination is unacceptable; and
- high purity water required during the pre-operational period (cleaning, testing, etc.).

Waste Water Equipment

The waste water treatment system treats the liquid wastes from the power plant and produces an effluent suitable for discharge into the outlet structure and the Nile . The waste water produced by the power plant will be limited. The treated effluents will comply with Egyptian environmental regulations and World Bank guidelines. All the oily wastes are collected in a separate network and sent to an oil separator. The oil reservoir is fitted with a slipover weir to allow skimming of the separated oil layer at the desired depth. The oil collected in the reservoir flows by gravity to an integral oil holding tank and taken off site by a licensed contractor.

The effluent from the demineralisation plant (acid and soda) will be released to the environment after neutralisation.

Sewage Treatment System

Sewage treatment plant will treat sanitary wastes. All sanitary water will be directed after treatment to the plantation irrigation network and residual sludge will be collected in septic tanks and taken off site by licensed contractors. There will be no direct release to the environment.

Clean Water Source

Clean water of the Kureimat Power Complex will be used for construction activities and sanitary use and will serve plant uses during construction.

Water requirements during operation will be supplied by the desalination plant on site. All drinking water will be supplied by the plant water system.

4.3.8 Supporting Infrastructure

In addition to main items of plant and equipment used to generate electricity and to the cooling water system, the following supporting infrastructure will form part of the power plant:

- Gas handling facilities, for the metering and control of gas delivery.
- Electrical connection GIS to the Helwan South Power Plant 500kV switchyard.
- Storage tanks for mazout and Sollar oils.
- Raw water treatment system for boiler feedwater make-up.
- Wastewater treatment.
- Site services.
- Security visitor gate house.
- Administrative building.
- Lighting.
- Workshops and stors.

4.3.9 Life Expectancy of the Power Plant

The design life for the power plant and the associated infrastructure is 30 years.

With careful maintenance and replacement and refitting of equipment within the power plant as required, the life expectancy of the power plant may be safely extended beyond 30 years if required (eg to 35-40 years).

4.3.10 Off-site Information Requirements

The development of the Helwan South power plant design will include the provision of its own cooling system using water abstracted from the Nile River, which is considered within this EIA report.

The power plant may also require the provision of the following infrastructure:

- gas pipeline;
- potable water pipeline; and
- sewer pipeline.

The only other off-site infrastructure required to serve the power plant is the electricity transmission system, which will be available from the development of interconnection network of the power plant. The development of the power plant will include transformer and GIS connection to the 500 kV switchyard, which is considered within this EIA report.

4.4 OPERATIONAL RELEASES TO THE ENVIRONMENT

4.4.1 Pollution Control Systems and Abatement Technology

The power plant will include a range of measures designed to avoid or minimize releases to the air, water or land (solid wastes). These measures are summarized in *Table 4-5*.

Table 4-5
Summary of Pollution Control and Abatement Systems

Release	Pollution Control/Abatement System
Air Emissions	Under normal operating conditions, the plant will fire natural gas which is the cleanest fossil fuel available. Heavy fuel oil (mazout) will only be used as an emergency fuel (for max. of 170 hours per year) and light fuel oil will only be used during start-up. 150 m high stack which is in excess of Good Engineering Practice. The boiler is fitted out with "Low NOx" burners for gas and fuel oil operation, in order to reduce NOx emissions. The stack height has been designed in order to optimize the pollutant dispersion.
Noise Emissions	The steam turbine generator set will be enclosed in a building. All the outdoor equipment will be designed for 90 dB (A) at 1 meter.
Emissions to Water	Oil effluents will be collected and treated in an oil/water separator before discharging. Sewage effluent will be collected and treated in a sewage treatment system before disposal outside the plant. Water used in the main water cooling system (open system) is not polluted by chemicals. The circulating water temperature increase will not exceed 9.6°C higher than the Nile River water under normal conditions. The auxiliary cooled water system is designed as a closed cooling system and no water will be discharged from it. The residual heat of the auxiliaries (diesel, generator stator, etc.) will be transferred to the main water cooling system (open system).
Generation and Disposal of Solid Wastes	A natural gas power plant does not produce significant amounts of waste. All solid wastes will be stored on-site before being evacuated by a licensed contractor.

4.4.2 Operational Releases from the Power Plant

During operation, the key releases into the environment from the power plant will be comprised of the following:

- During natural gas firing the exhaust gases will normally be comprised of nitrogen oxides (NOx), CO_2 and traces of CO. In the case of mazout firing, SO_2 and particulates (PM_{10}[1] and TSP[2]) will also be emitted. The emission limits are set out in Table 4-6;
- The power plant may also use Sollar oil to fuel an emergency generator and during startup (intermittent and very low frequency). Hence, the potential emissions from the use of Sollar oil will be low.
- noise emissions from the plant equipment;

(1) PM_{10} : Thoracic Particulate Matter (size < 10 μm).
(2) TSP : Total Suspended Particulates.

- liquid effluent, including cooling water, sewage water, waste and rain water as set out in Table 4-7;
- solid wastes, including solids removed from the cooling water system, sludge from tanks and interceptors, boiler sludge, waste water treatment, and general office and canteen waste, as set out in Table 4-8, all of which will be disposed of at suitably licensed waste disposal sites.

Materials Handing

During normal plant operation, a range of products will be delivered to the power plant. Bulk materials (such as natural gas and heavy fuel oil) will be imported via pipelines and others (such as machinery, diesel, lubrication oil, chemicals, spare parts) will be delivered by road in shipments of drums, packages or road tankers. These shipments will be logged and appropriately stored as required under Egyptian and World Bank requirements and guidelines.

Table 4-6

Principle Boiler Emissions to Air (mg/Nm^3)
[Ceiling Values of both the Egyptian & the W.B. Standards]

Emission Type	Emission Concentrations(1)			
	World Bank Standards		Egyptian Standards	
	Natural Gas	Fuel Oil	Natural Gas	Fuel Oil
NO_x	240	400	300(2)	300(2)
SO_2	Not Specified	850	Not Specified	3600
TSP	Not Specified	50	Not Specified	150

Notes:
(1) Values taken at 3% O_2 in dry fumes and for 100% load.
(2) 300 mg/m^3 at 3% of O_2 in fumes.

It should be noted that in Table 4-6, all parameters for World Bank standards are normalized to standard conditions: 273°K, 101.3 kPa, 3% oxygen, dry gas emission rates are presented for 100% load as a worst case on a per unit basis. It has been assumed that there will be 1000 hours per year of forced outage, 7590 hours of natural gas firing, and 170 hours of mazout firing.

Table 4-7

Inventory of Liquid Effluents Generated by the Power Plant (One Unit - Conceptual)

Release	**Source**	**Maximum Flow Rate at 100% Load**	**Discharge Route**
Cooling water	Direct cooling system	82,800 m^3 per hour	Via circulating water discharge structure (CWDS)
Boiler blowdown	Boiler system	20 m^3 per hour	To wastewater basin and then to discharge system(1) after treatment
Backwash from boiler water filtration	2nd stage filtration system for boiler Feed	9.3m^3 per hour	To wastewater basin and then to discharge system(1) after treatment
Oil/water interceptor effluent	Oil/water interceptor system	10m^3 per hour	To wastewater basin and then to discharge system(1) after treatment
Domestic sewage(2)	Domestic system associated with offices, canteen, washrooms, etc.	3m^3 per day	Sewage treatment plant and then to the plantation irrigation network
Wastewater neutralization effluent(2)	Wastewater neutralization tank of demineralization system	2m^3 per hour	To wastewater basin and then to discharge system(1) after treatment
Operational site(2) drainage	Hardstanding areas of operational plant, bunded areas, transformer compound and fuel oil handling areas	Intermittent	To wastewater basin and then to discharge system(1) after treatment
Rainwater run-off(2)	All other areas, via storm sewer and stormwater balancing pond	Intermittent	To wastewater basin and then to discharge system(1) after treatment

Notes:
(1) Discharge system for industrial effluents includes water treatment and then discharge to the Nile River.
(2) These effluents could be directed to the Ettaqa sewer network when extended to the site of the power plant.

Table 4-8

Inventory of Solid Wastes Generated by the Power Plant (Conceptual)

Solid Waste	Source	Maximum Generation (ton per year)	Discharge Route
Wastewater basin sludge	Build-up of solid residues in wastewater treatment system	Very low (<1 ton per year), requiring disposal once every 5 years	Licensed dump site (1)
Sewage sludge	Sludge produced by sewage treatment plant	Very low (<1 ton per year), requiring disposal once every 3 months	Licensed contractor to the city sewer system or dump site (1)
Tank sludge	Solid residues which build-up in fuel and process chemical storage tanks	Negligible	Licensed dump site(1)
Interceptor sludge	Drainage interceptors used to remove solids and oils and grease from effluent	Very low (<1 ton per year), requiring disposal once every 6 months	Licensed dump site(1)
Boiler sludge	Solid residues which Build up in the boiler system	300-400 kg per year	Licensed dump site(1)
Commercial waste	Offices, canteen and staff facilities	Negligible	Licensed contractors
Trash Rack and Travelling Screen Wash	Trash rack and travelling screen	Variable	Sanitary landfill site

Notes:
(1) Dewatering and pressing processes will be applied to all wastewater sludges before disposal.

4.5 OPERATIONAL MANAGEMENT AND STAFFING

4.5.1 Process Control

The power plant will be controlled from a central control room, which will contain all the process control computing facilities. All main plant variables will be displayed on "mimic displays", which will reflect the current operational status of the plant.

Safety measures, controls and instrumentation will be provided through distributed control system (DCS), which will continuously monitor operating conditions and be capable of automatically initiating shutdown if required. Hence, process control will have a high integrity and operator intervention will not be required to guarantee the safety of the power plant.

4.5.2 Operational Organization

The Operation and Maintenance (O&M) of the power plant will be performed by the Project Company, UEEPC. There will be personnel dedicated to the Operation and Maintenance services for the power plant.

The organization of the plant is headed by a management group, including a Plant Manager and one assistant in charge of environment, safety and quality control.

Plant Manager

The Plant Manager will be responsible for the general management of the O&M activities of the plant. His duties will include the obligation to ensure that the plant is satisfactorily operated and maintained.

Assistant Plant Manager

The Assistant Plant Manager is in charge of environment, safety and quality assurance, specifically:

- for environment and safety, he is responsible for the formulation and implementation of fire fighting, safety and environmental and social management policy; and
- for quality assurance, he is responsible for ensuring that all operating procedures and standards are correctly applied for the day-to-day operation and maintenance of the plant. He will also develop and produce standards, policies and procedures.

Operations Manager

The Operations Manager is responsible for the operation of the plant. The Operation Department is responsible for:

- receipt, preparation and handling of fuel;
- management of the water system including water supply, water treatment and cooling water, general purpose water and wastewater treatment;
- laboratory operations;
- steam and power generation;
- grid liaison;
- emission control equipment; and
- environmental monitoring.

Maintenance Manager

The Maintenance Manager is responsible for the maintenance of the power plant and his department is responsible for providing maintenance service for the power station equipment and structures.

4.5.3 Staffing

The power plant will employ approximately 400-500 people.

The power plant will be manned for 24 hours per day, 7 days per week. During a normal working day, 330-400 employees will be on-site. During night-time and holidays, 60-72 employees will be on-site.

In addition, specialist contractors will be employed for specific tasks, such as modifications to the plant, equipment overhauls, etc.

4.5.4 Staff Facilities

The power plant will include facilities for its staff in a multiple stories building adjacent to the main power plant buildings. These facilities will comprise office accommodation, lavatories, a prayer room and conference rooms.

4.5.5 Staff Training

All staff will undergo integrated training in the following:

- general operation of the power plant;
- specific job roles and procedures;
- occupational health and safety; and
- contingency plans and emergency procedures.

The staff training will comprise:

- induction training on appointment;
- specialist training (as required for the prescribed job role); and
- refresher training as required (typically annually).

The training program will be designed to ensure that appropriate skilled staff are available to operate the power plant at all times.

4.5.6 Operational Expenditure

The typical annual operational expenditure at the power plant will be around US$4 million (as a 20-year average), although during periods when major maintenance is carried out the expenditure could rise to over US$7 million in a particular year. It is expected that 70% of the operational expenditure will be spent locally, on labor, consumables, equipment repair, general maintenance, etc. The payroll (including benefits and overtime) is expected to be approximately US$ 1.9 million per year.

4.6 OPERATIONAL ENVIRONMENTAL HEALTH AND SAFETY

The environmental, health and safety (EHS) plan for the operation of the power plant is described in *Section 8*.

The design, construction and operation of the power plant will comply with the applicable requirements of Egyptian and World Bank guidelines related to environment, health and safety (*see Section 2*). The health and safety of the workforce and the local population and protection of the environment are of paramount importance in the design and operation of the power plant.

As part of the procedures which will be implemented, personnel shall receive training in safety procedures and awareness. Appropriate safety measures shall be observed for all operations. Where appropriate, the necessary protective clothing shall be provided.

A detailed record will be kept of any injuries and accidents and a monthly report will be prepared with the aim of undertaking corrective action to prevent them from reoccurring.

Routine inspections shall be carried out on particular items of equipment according to specified schedules. Only approved equipment will be used. The plant will be maintained in a state of safe operation and repair such that it is in accordance with all relevant statutory regulations and environmental requirements. This will include staff training plans, shut down plans, emergency response plans, emergency contacts etc. which will be adopted during both the construction and operation of the plant.

The operational environment, health and safety plan will include provisions to monitor compliance with the key provisions of the Egyptian and World Bank guidelines listed in *Table 4-9*.

Table 4-9
Key Components of the Operational Environmental, Health and Safety (EHS) Plan

Issue	Provisions within the Operational Environmental, Health and Safety Plan
Atmospheric emissions and ambient air quality	• Ambient air quality standards. • Emission limits. • Specific conditions for fuel use.
Liquid effluent discharges	• Discharge limits. • Specific conditions for development on the Nile bankline.
Noise emissions and ambient noise levels	• Noise emission limits applicable to land use zone.
Solid and hazardous waste management	• Specific conditions on storage and handling of hazardous waste.
Occupational environmental management and health and safety	• Ambient air quality standards for the workplace. • Ambient temperature standards for the workplace. • Noise limits for the workplace. • Specific conditions on electrical safety in the workplace. • Specific conditions on working in confined spaces. • General conditions on health and safety. • Specific conditions on personnel training. • Specific conditions on record-keeping and reporting.
Use of chemical compounds	• Specific conditions on the use of related chemicals.

4.7 CONSTRUCTION ACTIVITIES AND PROGRAM

4.7.1 Construction Program and Schedule

The construction program is planned to be completed within 45 months (from site mobilization till start reliability run of the first unit). *Figure 4-5* gives the milestone summary schedule of the Helwan South power project.

The key phases and activities within the construction program are shown in *Table 4-10*. The normal hours of working for construction are shown in *Table 4-11*.

4.7.2 Construction Materials

Preliminary estimates of the main construction materials which will be required to construct the power plant, excluding specialist plant and equipment, are set out in *Table 4-12*.

Figure 4-6

Milestone Summary Schedule of the Helwan South Thermal Power Plant (3 x 650 MWe) Supercritical

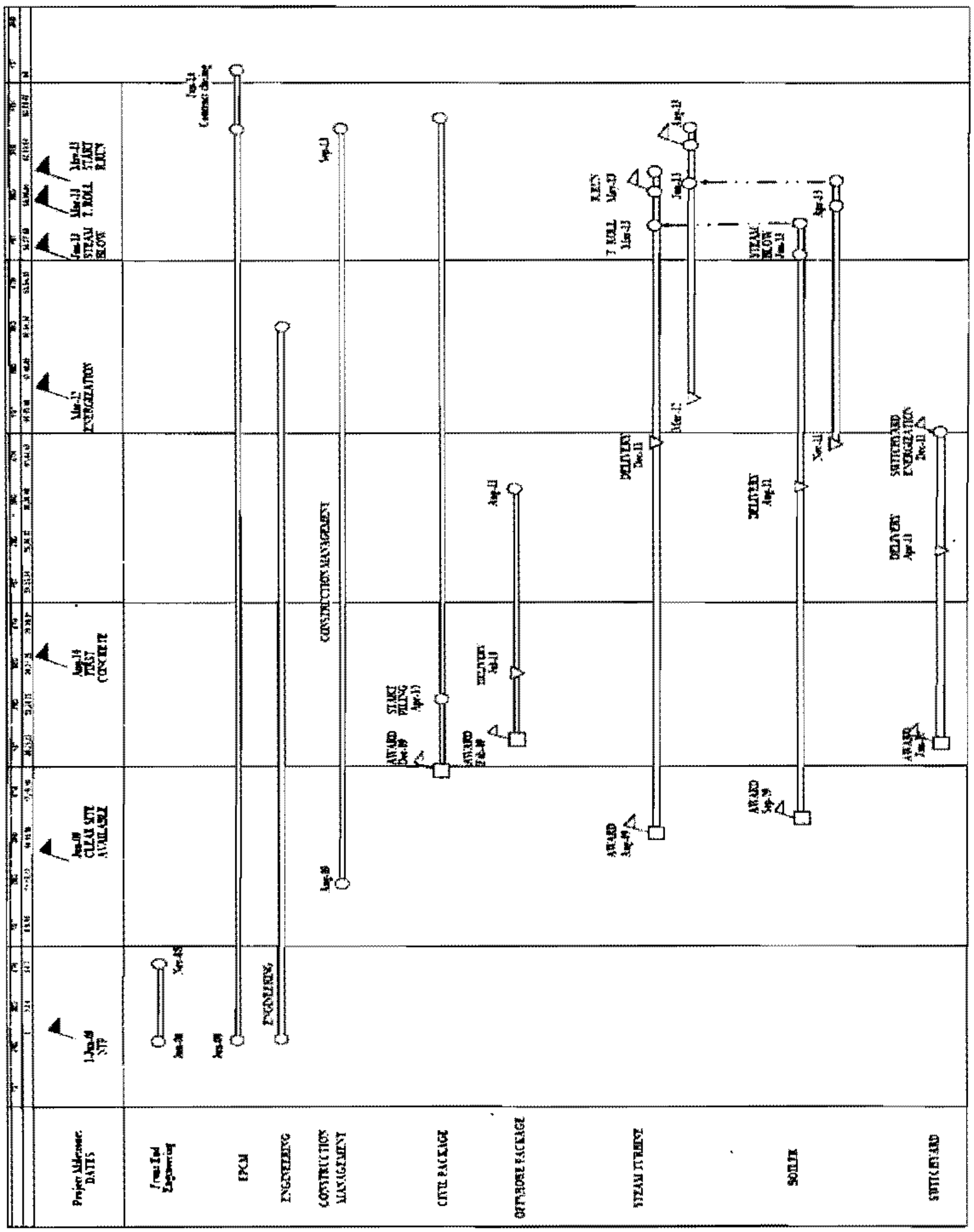


Table 4-10

Summary of Construction Activities

Activity	Description of Activities	Indicative Timing from Mobilization
Construction Start and Site Set-up	Mobilization, establishment of temporary site offices, installation of temporary utilities, site survey.	Months 1-4
Preliminary Works	Establishment of temporary facilities, topsoil stripping, excavation, construction of site roads access, drainage, services, fencing.	Months 1-7
Earthworks, Piling and Foundations	Piling, establishment of base slabs, footings, pits and foundations.	Months 8-20
Steel work	Construction of steel frames for buildings and support of plant.	Months 15-23
Major Plant Installation	Installation of boilers, steam turbine generators, etc.	Months 25-44
Cooling Water System	Trenching and laying of on-land pipelines (Circulating water pipes).	Months 11-19
Mechanical and Electrical nstallation	Installation of pipework, pumps, compressors, cooling water ducts, power cabling and switchgear process controls, HVAC, pumps, motors, fans heat exchangers.	Months 20-40
Auxiliaries	Installation of switchgear, transformers, gas transfer facilities, water treatment plant.	Months 22-32

Table 4-11

Normal Hours of Working for Construction

Day of Week	Hours of Normal Working
Saturday-Thursday	07:00-03:00 hours (1)
Friday	No work
Holy Days and Holidays (2)	No work

No
(1) ... Days and Holidays include Christmas Day, Eid-El-Fitr, Sham El Nessim, Sinai Day, Labor Day, Eid-El-...a, Moslem New Year, Revolution Day, Prophet's Birthday (El-Mawled El-Nabawy), Armed Forces Day.
(2) Construction work between Saturday and Thursday will be undertaken in two 10 hour shifts.

Table 4-12

Preliminary Estimates of Construction Materials

Construction Material	Quantity (tonnes, unless otherwise stated) (preliminary)
Cement powder	20,000
Fine aggregates [(1)]	26,300
Coarse aggregates [(2)]	39,500
Reinforcing steel	5,000
Structural steel	4,200
Potable water	220,000m^3
Raw water	30,000m^3

Notes:
(1), (2) Sourced by licensed contractors from designated quarries.

4.7.3 Construction Workers

the Consultant / UEEPC will seek to utilize qualified contractors with demonstrated performance in the construction of power plants and of construction projects in the region. Wherever practicable, local employment opportunities will be maximized.

The construction workforce is anticipated to be typically 1200-1500 people, rising to 2000-2500 people during the peak construction periods.

Most fabrication will take place prior to delivery to the site and all erection of structures and installation of equipment will use local craft labor, including the following professions:

- engineers;
- boiler makers and installers;
- carpenters;
- cement masons;
- electricians;
- iron workers;
- millrights;
- pipefitters;
- teamsters;
- laborers; and
- welders.

It is likely that the majority of the craft labour will be employed from Helwan and Beni-Suweif, with approximately 10-15% originating from close to the proposed site.

4.7.4 Construction Traffic

Construction activities will generate heavy traffic. Construction work will be carried out in two shifts: 07:00-17:00 hours and 17:00-07:00 hours.

In the first stage of construction, the main traffic generated will be from civil works activities (concrete materials, reinforcement, earth moving equipment, construction materials, paint, steel structure, concrete pipes etc.).

In the second stage, heavy equipment will be transported on site. Oversize transport will also be used for the transport of special equipment such as turbines, stator alternators and condenser bundles.

The anticipated levels of construction traffic accessing the Helwan South Site are summarized in *Table 4-13* and the section below.

Table 4-13

Summary of Traffic Generated During Peak Construction

Vehicle Type	Day Shift (07:00-17:00 hours)		Night Shift (07:00-17:00 hours)	
	Hourly	Daily	Hourly	Daily
HGV[1]	10	100	5	20
Car/LGV[2]	43	86	23	46
Minibus	39	78	21	42
Abnormal Load[3]	2	4	0	0
Total	94	268	44	88

Notes:

(1) Assume that all HGVs travel to and from the site during the daytime shift.

(2) Assume that 75% of the construction workers wil1 travel by contract bus at an occupancy rate of 10 per vehicle. The remaining 25% of the work force will travel to and from the site by car at an occupancy rate of 3 per car.

(3) The timing of deliveries of abnormal loads will be agreed with the Competent Authority; however, it is assumed that these deliveries will occur during the night shift to minimize road congestion. There will be approximately 35 abnormal loads during construction.

Heavy Goods Vehicles (HGVs)

The volume of HGVs traffic will vary throughout the construction period. During peak HGV activity, it is expected that there will be approximately 100 HGV loads, i.e. 200 HGV movements, each day. Throughout the whole construction period, the average number of HGVs traveling to and from the site is expected to be 10-30 HGV loads or a maximum of 60 HGV movements on the road network each day.

In addition to these, approximately 35 abnormal loads are anticipated to arrive at the plant over the construction period. It is unlikely that any more than two such loads (i.e. four individual movements) would be necessary on any day during the construction of the power plant.

4.7.5 Construction Safety

The Contractors will be required to develop and implement a construction Quality Control Program. A key part of the Quality Control Program will be a Health and Safety Plan, which the construction contractor(s) will be required to comply with as a condition of contract.

4.7.6 Fire Protection

The site fire protection system will be to NFPA (National Fire Protection Association, the American Standard) codes.

The fire protection water supply and storage system provides water under pressure to the site protection system, which then supplies water to the fire hydrants, hose stations and fixed water suppression systems within buildings.

Water for fire fighting will be supplied by the on-site water feed unit and stored in the water tanks. Systems will be fitted to ensure that this reserve is maintained. Two pumps will then provide water to the following major components of the fire protection system:

- underground yard piping and valves;
- fire hydrants and accessories; and
- hydrant hose reels.

Fire protection equipment will include fixed water suppression systems, standpipes and hose stations, portable water and CO_2 extinguishers, independent fire detection systems, and fixed foam suppression systems (for light fuel oil tank and transformers).

4.7.7 Environmental Management During Construction

The Project Company recognizes that construction activities need to be well-managed and controlled to avoid potential environmental impacts from noise, dust, odor, effluent, traffic and other forms of disturbance by construction workers and fixed or mobile plant.

Each subcontractor who operates on site will be responsible for the tidiness of its own working areas as well as for the transport and correct disposal of all its waste, scrap and spills, in accordance with all local laws and regulations.

The construction activities will incorporate a range of mitigation measures to minimize the potential for environmental impacts to occur *(see Section 7 of this ESIA report)*.

5. DESCRIPTION OF THE ENVIRONMENT

5.1 GENERAL SETTING OF THE SITE

The Helwan South site is located within a bare sandy area of uncultivated land. It is entirely situated on approximately more than 37 hectare rectangle- shaped piece of land located in a rural/desert area approximately 10 km south of the village of Kureimat, in the Helwan Governorate (was back to Giza Governorate after political events of 11 Feb. 2011) on the east bank of the Nile river. The site of the new Helwan South 1950 MWe power plant facility is an area of about 276,000 m^2 within the existed allocated site. The site locus is approximately 100 km south of Cairo and 23 km north of Beni-sueif. Two physiographic zones occupy this area: a floodplain adjacent to the Nile, and a rocky desert plateau east of the floodplain. The site of the existing land is 450 meters wide and has an average length of 800 meters; in all the site encompasses 378,000 square meters (*see Figure 5-1 (G)*)

On the north side of the site is the Kureimat Power Complex (2x600 MWe+ 2x750 MWe), at around 7.5 km and the Kureimat village (about 10 km) and the Helwan South irrigation pumping station (about 9 km). The site is about 700 m south of the Dayr al-Maymoun village. On both of the south and the east sides of the site is a wide-extended desert land. On the east side, and across the power plant site is a two-lane road running paralle to the Nile river.

On the western side of the site is an agricultural stripland parallel to the Nile river where the power plant's cooling water intake and discharge structures will be located.

The nearest town of importance is Es-saff, Markaz Es-saff, about 38 km along the road in the north direction. Towns of importance in the wide vicinity of the power plant site are Atfieh, Helwan, Giza, Imbaba, 15th of May, Beni-sueif and El-Wasta. The general site location is shown in *Figure 5-1 (A through G)*.

The site entirely consists of approximately flat land, which is owned by the Upper Egypt Electricity Production Company (UEEPC). Localized map of the proposed site is shown in *Figure 5-2*.

The land is identified by boundary lines determinec the coordinates of the proposed site. Key points are given in *Figure 5-3(A)*, which indicates the following coordinates:

	North (N)	East (E)
1.	723619,80	636394,86
2.	723831,95	635925,12
3.	723187,29	635612,19
4.	722918,38	636072,77

More determining coordinates are presented in *Figure 5-3(B)*.

The Helwan South site is located on the western edge of the North Galala Plateue, a desert environment ranging in elevation from 330 to 1,275 meters above sea level. Wadis drain into the Nile river from the west slope of the plateau. The development of the site did not affect the drainage in adjacent areas. The river bank in this reach of the Nile (El- Wasta to Beni-sueif) is generally steep, consisting of small floodplain areas on the east bank; however, more extensive agricultural lands occur on the west bank. Flat desert lands above the east bank (*Figure 5-5(B)*) extend some 35 km inland to the Galala Plateau ridge. This area is not irrigated, but sporadic grazing occurs throughout the plateau.

The power plant site is located immediately above a river floodplain and just upstream and downstream of Helwan South Island, away from the cultivated area. Small oases occur about 1 km south of the site, and immediately to the north of the site. These oases are located on wadis at their confluences with the Nile flood-plain. The oases and adjacent floodplain are used to grow a variety of fruit, vegetable, and forage crops and to graze livestock. The natural growth of palm trees and shrubs, combined with fig trees and other cultivated woody plants, provides habitat for a variety of songbirds and some shorebirds.

Natural stream bank vegetation forms a narrow border to the river and consists of Scirpus, Juncus, Phragmities, Typha, and other emergent species. Snails are abundant along the shoreline, as are nematodes and other bottom worms in shallow water. The shoreline also shows evidence of high siltation and periphytic growth. The shoreline is already stabilitized as a part of the existing project. The elevation is on average not changed in the cultivated area but all areas are of uniform elevation.

Above the floodplain the topography of the site consists of an abrupt slope followed by a flat plateau some 300 meters to the east. The elevation difference from the Nile at summer flow levels to this plateau is approximately 20 meters. The site's eastern most boundary extends along the main north-south highway and includes a major wadi. The flow through this wadi during storm periods would be blocked east of the highway's elevated road bed.

The Helwan South site is within the Atfieh local governing unit, with the city of El-Saff as the governing center of the district. No villages or individual residences are located on the site. Agricultural workers who farm the floodplain live in nearby villages. Kureimat village is located some 10 km to the north of the site and *Figure 5-5(C)* shows the view of the nearest part of the village from the road to the site.

The site is located within a totally rural landscape with some small scattered residential communities.

Supply to the site is possible via railroad, road and barge from Alexandria, El-Dekheila, Damietta, Suez-Gulf or others. The power plant location can be reached by previously mentioned two-lane road which branches off the agricultural road connecting Alexandria with Cairo. This access road has a width of about 12 m starting from Helwan. The part of this access road which passes the Helwan South site is paved but is full of asphalt pocket.

The project area lies within the hyperarid climatic province of Egypt characterized by a mild winter and hot summer.

Vegetation cover types within the site boundaries and in surrounding areas consist of three categories: emergent marsh wetlands adjacent to the Nile river, cultivated areas on the historical river floodplain, and barren desert on the eastern plateau.

Agricultural crops have been cultivated on the higher floodplain and at the mouth of several small wadis at the project site between the 23 m and 28 m elevations.

At least two different crops are planted annually on the lower areas, and in August, corn and peanuts are the predominant crops. Winter wheat is to be planted after the corn is harvested. Orchard and perennial crops included grapes, melons, guava, lemon, Indian fig (Opuntia ficusindica) and castor bean.

Generally, the project area is an agricultural-desert landscape. In the vicinity of the project site, almost no human settlements of any significant size occurs.

There is a typical rural housing with many small villages. The nearest villiage to the site is at about 1 km. No housing, except the existing plant's colony, occurs in the immediate vicinity of the site which is totally surrounded by desert, agricultural and farm lands. The satellite image taken recently *(Figures 5-1(D, E and F))* shows that these lands are as described.

There are no significant habitats within the project's area of influence.

The primary wildlife species observed onsite during the November 2010 field reconnaissance were birds. Within the wetlands, the cattle egret (Bubulcus ibis), moorhen (Gallinula chloropus), common swallow (Hirundo Rustics), and graceful warbler (Prinia gracilis) were commonly observed in the Scirpus – Juncus marshes. Most of the avian activity, however, was centered in the agricultural areas. Swallows were observed foraging the fields. Cattle egrets, spur-winged plovers (Hoploterus spinosus), crested larks (Galerida cristata), and Senegal stone curlews (Burhinus senegalensis) foraged on the ground in the fields. Palm doves (Streptopelia senegalensis) were commonly observed foraging on the ground as well as resting in the trees. No birds were observed in the desert on the site.

In addition, the field surveys have indicated that non-of the floral and faunal communities and/or species are of conservation value (rare or threatened). Meanwhile, no natural protectorates exist near the vicinity of the proposed site.

No industry, other than the existing Kureimat power complex, is present near the site. Thus, the air in the background atmosphere is of appropriate quality.

No archaeological resources are known in this zone. During February 1991 and before the construction of the existing Kureimat power plant, Kathryn A. Bard and Ricardo J. Elia of the Office of Public Archaeology, Boston University have conducted Preliminary Archaeological Assessment for the Kureiamt, Egypt Feasibility study. Also, the local archaeological authorities have surveyed the whole area around the site and they all proved that no historical resources exist.

Two water sources are available near the site, i.e. the Nile river and the underplaying aquifer. The quality of both surface water and groundwater in the Helwan South reach of the Nile is generally good. Only in localized sectors where there are concentrated sources of contaminants, such as irrigation drainage return waters, would water quality degradation be expected to occur.

The groundwater basin, which lies both beneath and closely adjacent to the Nile Valley from Cairo to Aswan, includes an area of about 2 million feddans. Water storage in this linear basin has been estimated at approximately 27 billion m^3. However, because the hydrologic balance of the Nile Valley alluvial aquifer is directly connected with Nile surface flows, production from the aquifer is nominally the same as withdrawing water from the river. In essence, the valley aquifer is a transmission medium for river surface resurces.

The proposed site lies within the administrative boundary of the Helwan Governorate, which was formed as a distinct Governorate, separated mainly from Cairo and Giza Governorates, where most of its Kisms / Marakez / Districts/ Cities were basically affiliated to Cairo and Giza Governorates **and were back to both of them after political events of 11 Feb. 2011.** The Government Egypt has prepared an Urgent Development Plan (UDP) for land-use management and planning, in which it sets out its policy to control development in the the Helwan South region up to 2017 and beyond.

The Helwan Zone Master Scheme, 2009 is shown in *Figures 5-6(A) & (B)*. The proposed land uses around the project site include new urbanized and residential development areas, which discussed in more detail in *Section 5.8*.

Figure 5-1(A)

Location Map of the Proposed Site within the Egyptian Context

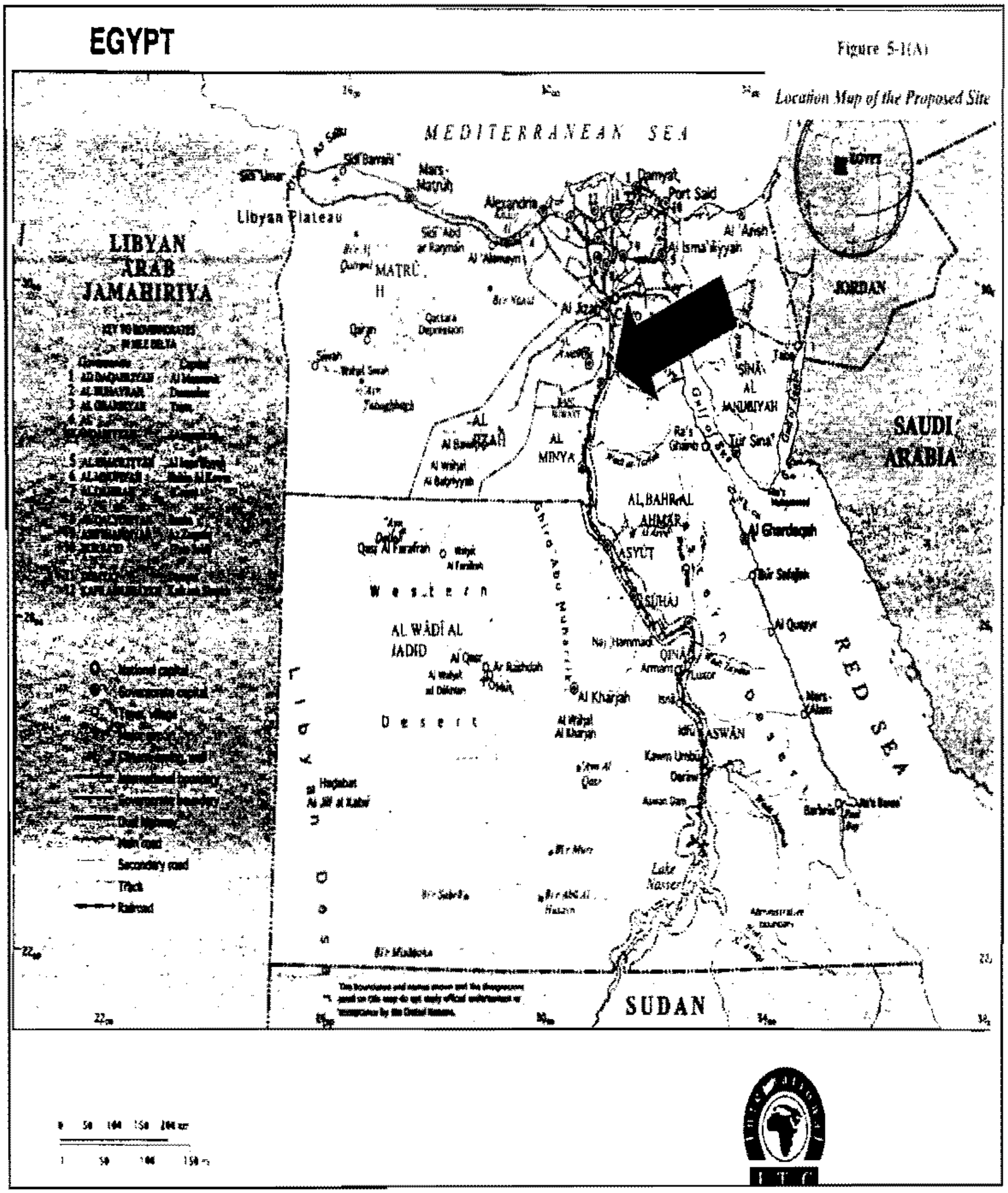
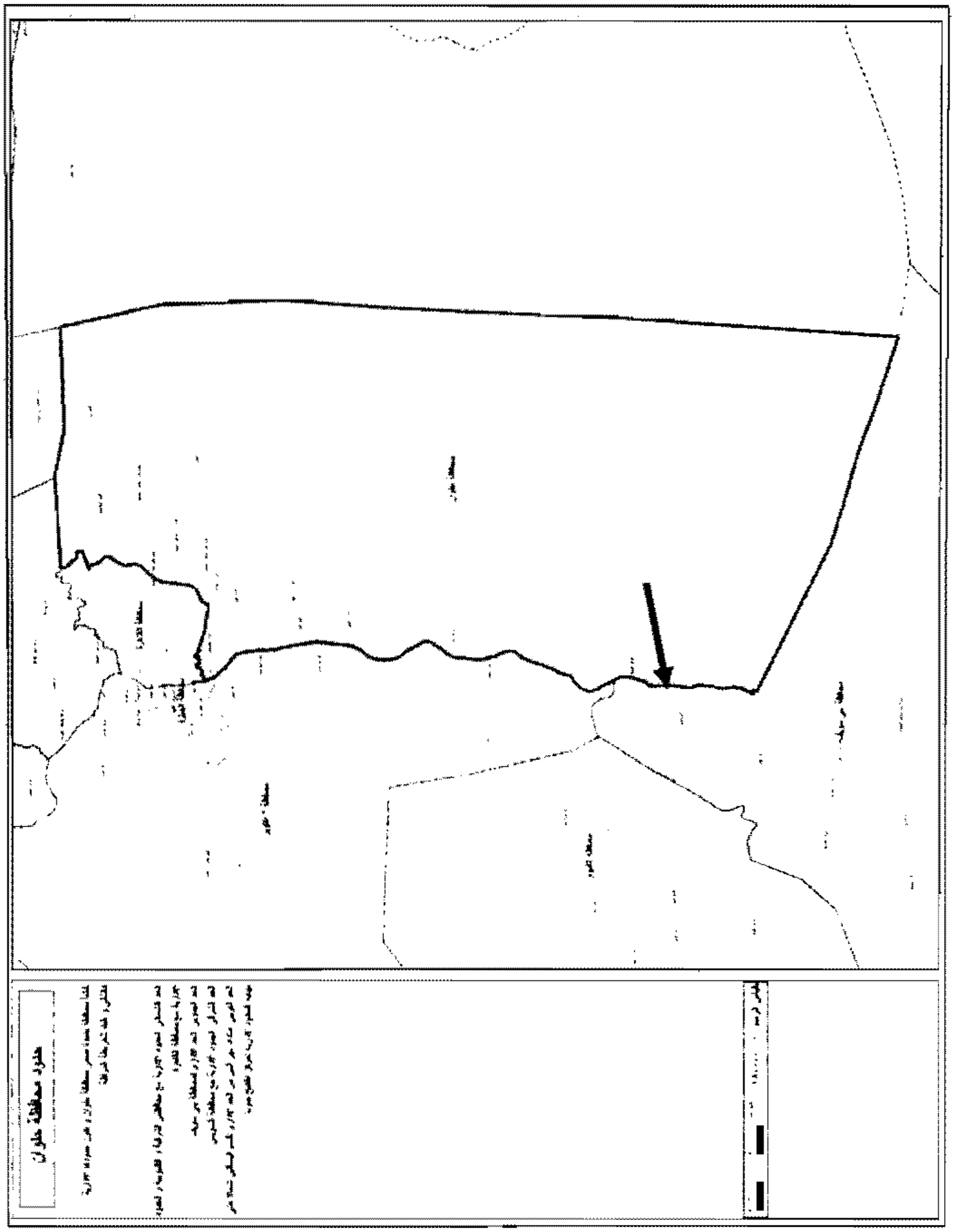


Figure 5-1 (AA)

Part of Landsat TM Mosaic Covering the Project Area

Figure 5-1 (B)

Location Map of the Proposed Site within the Ex-Helwan Governorate Context



Source: Arab Republic of Egypt-The Cabinet Information & Decision Support Center: Egypt's Description by Information 2010, Helwan Governorate.

Figure 5-1 (C)

The Proposed Site within the Ex-Helwan Governorate and Surrounding Governorates

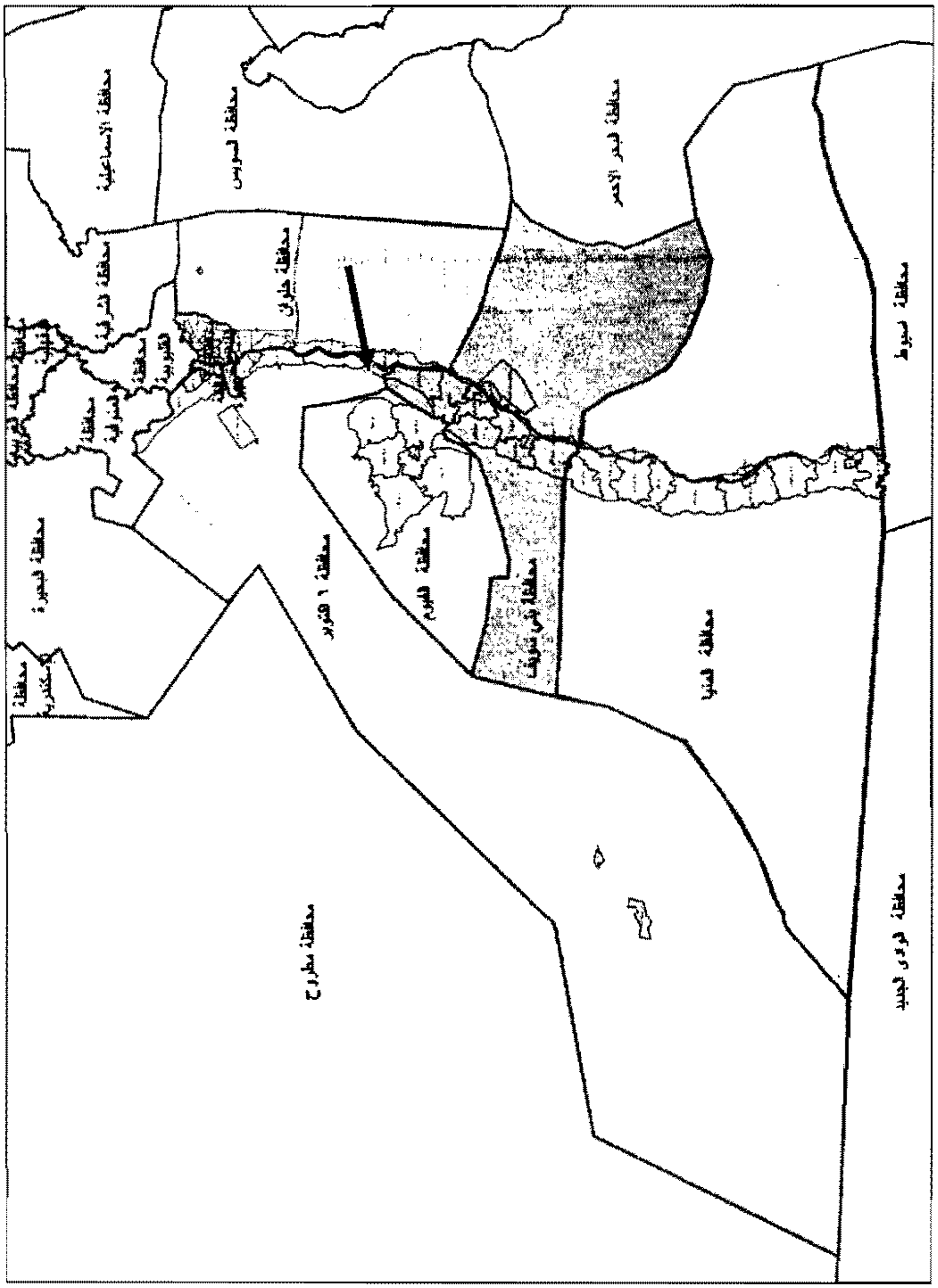


Figure 5-1 (D)

Landsat Image of the Wider South Helwan Area
Showing the Proposed Site of the Helwan South Power Plant

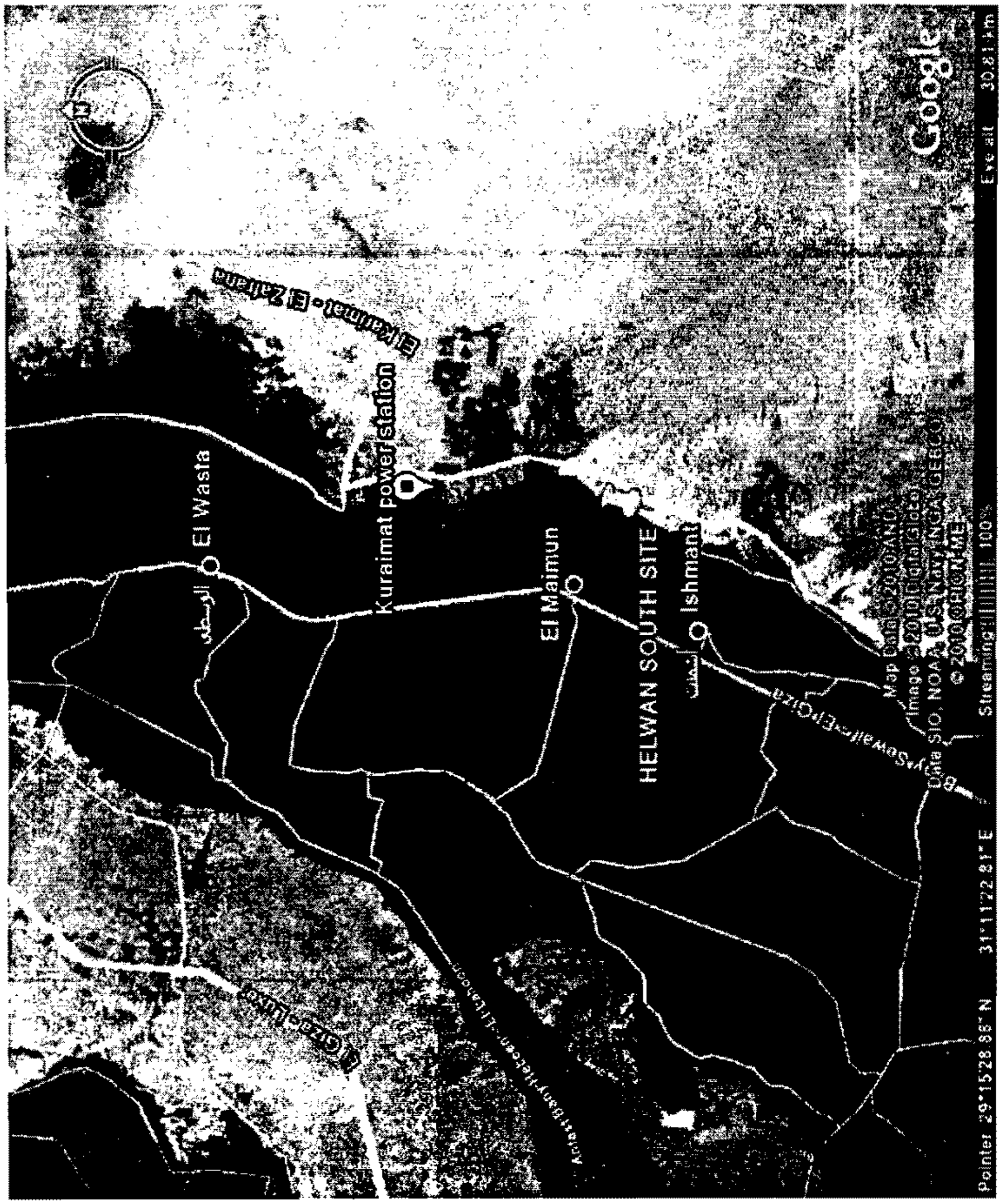


Figure 5-1 (E)

Landsat Image of the Wider Kureimat Area
Showing the Proposed Site of the Helwan South Power Plant

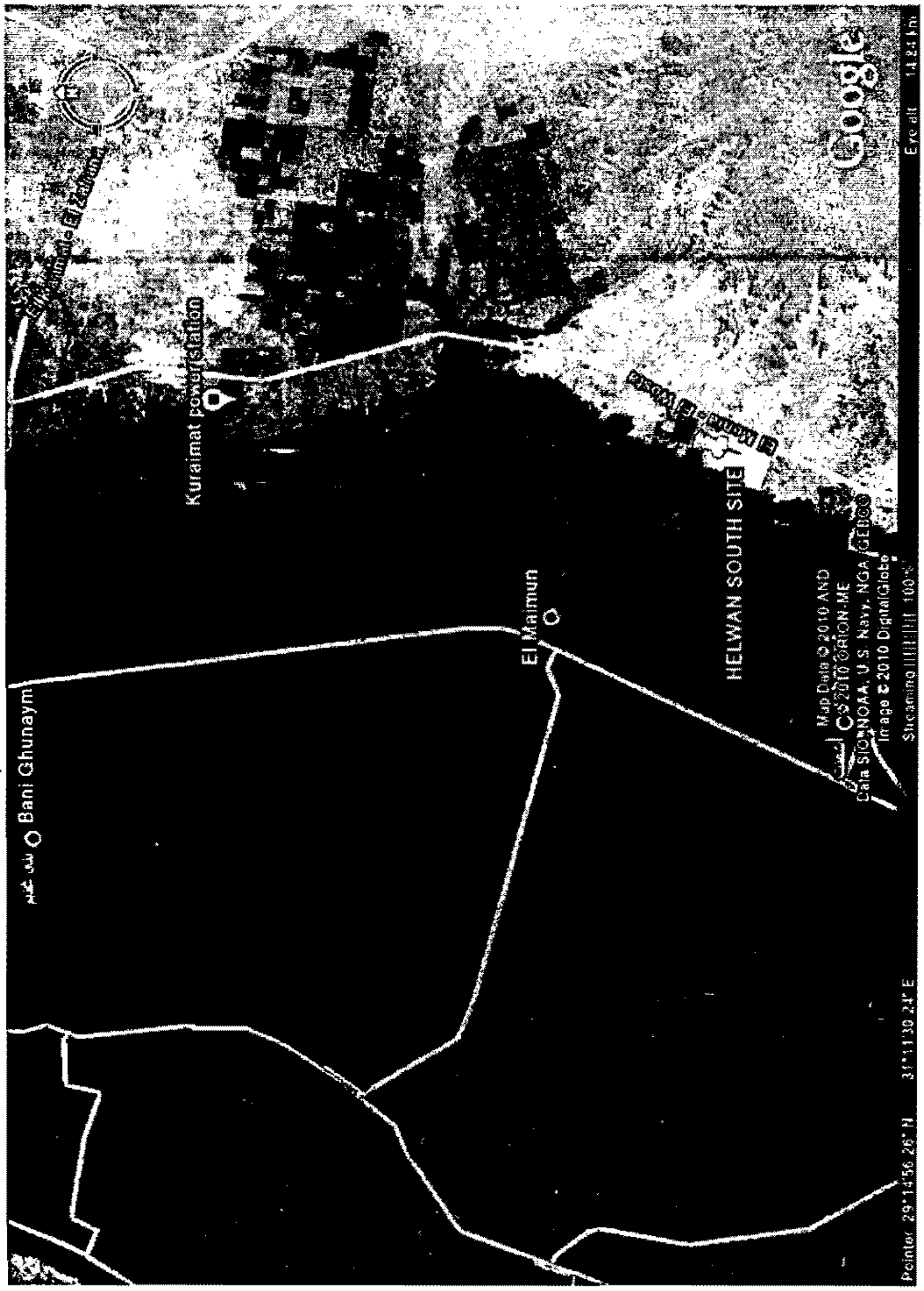


Figure 5-1 (F)

Enlargement of the Helwan South Power Plant Area

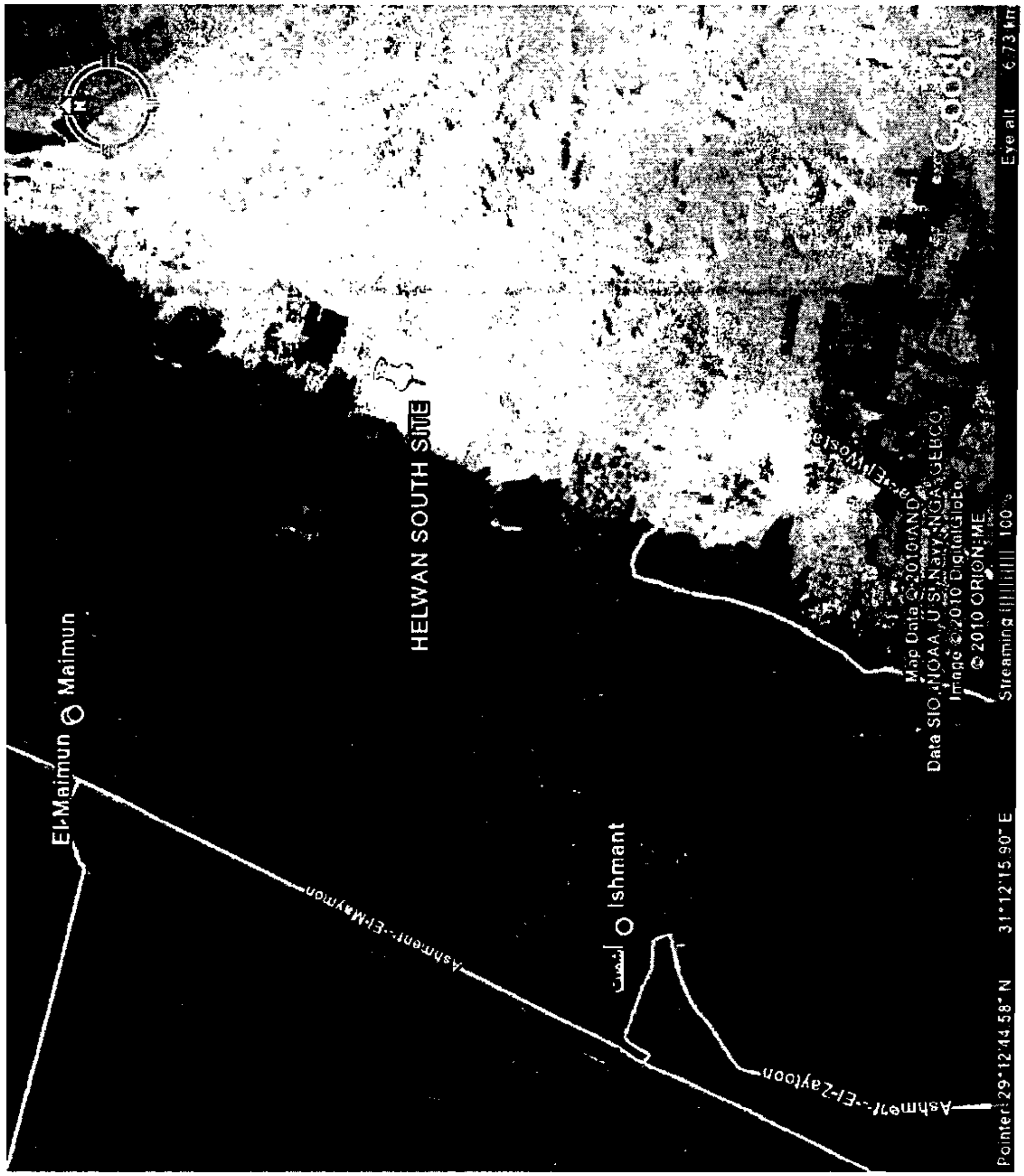


Figure 5-1 (FF)

Enlargement of the Helwan South Power Plant Area

Figure 5-1 (G)

Schematic Layout Drawing of the Helwan South Power Project

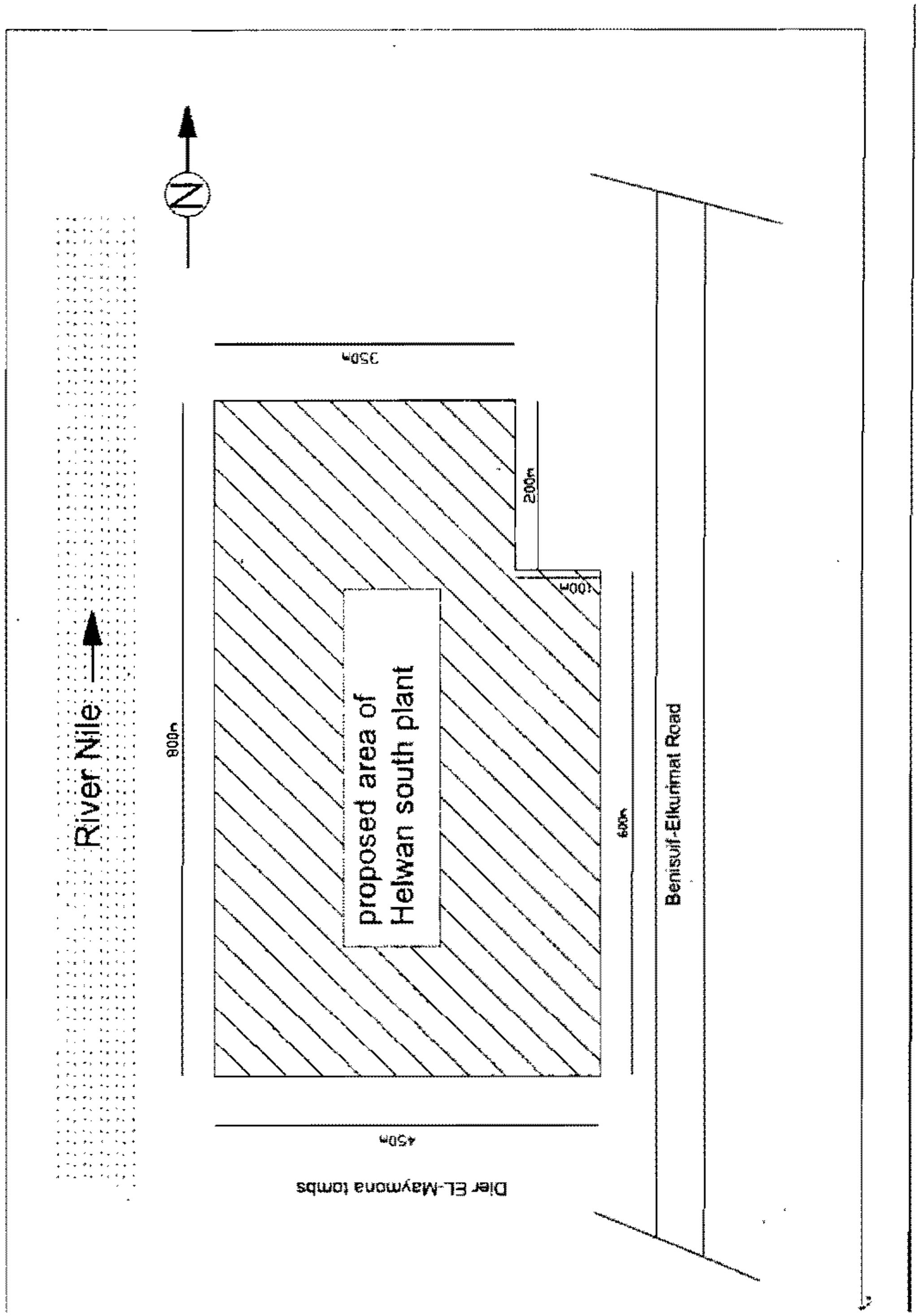


Figure 5-2

Localized Map of the Proposed Site

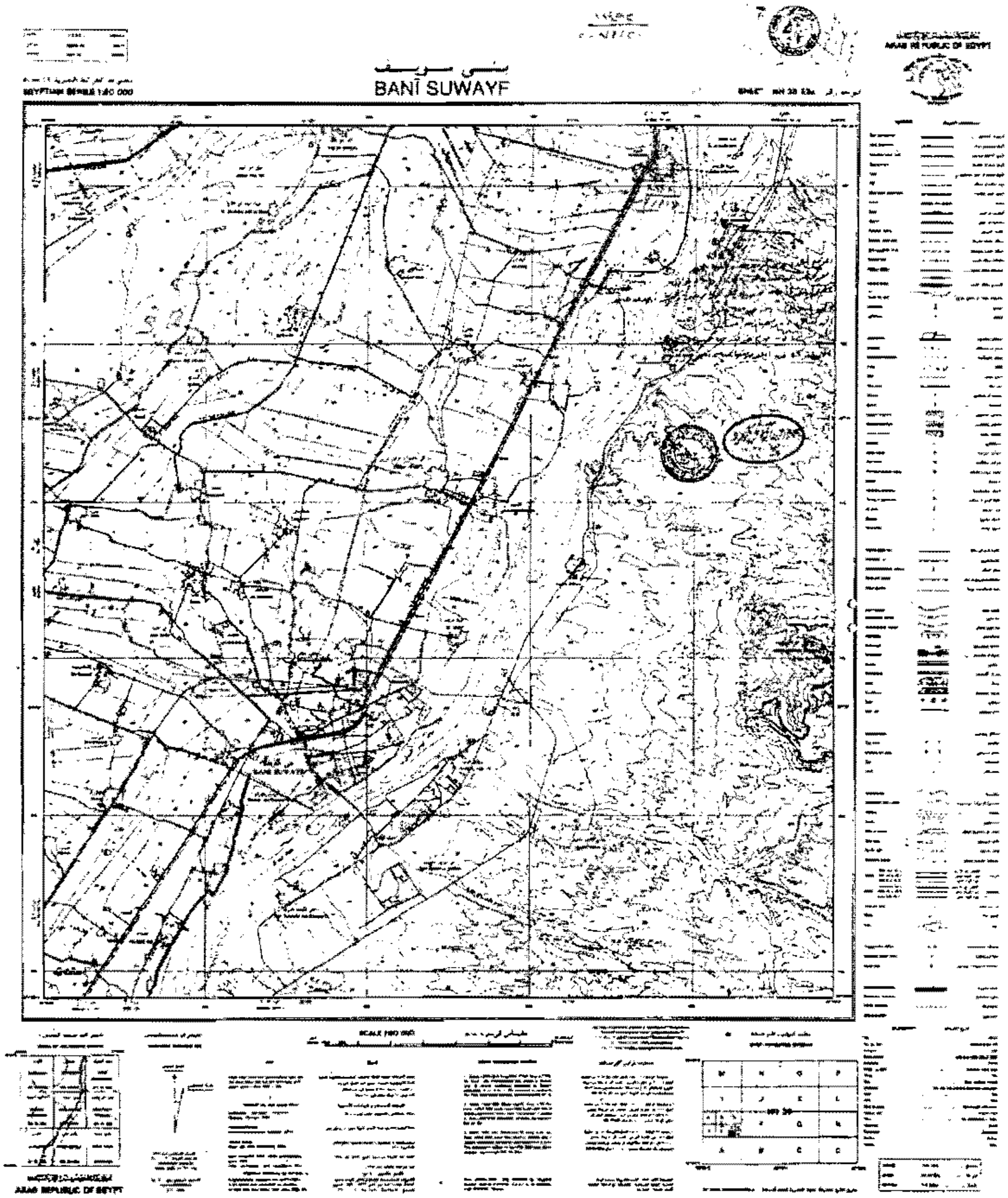
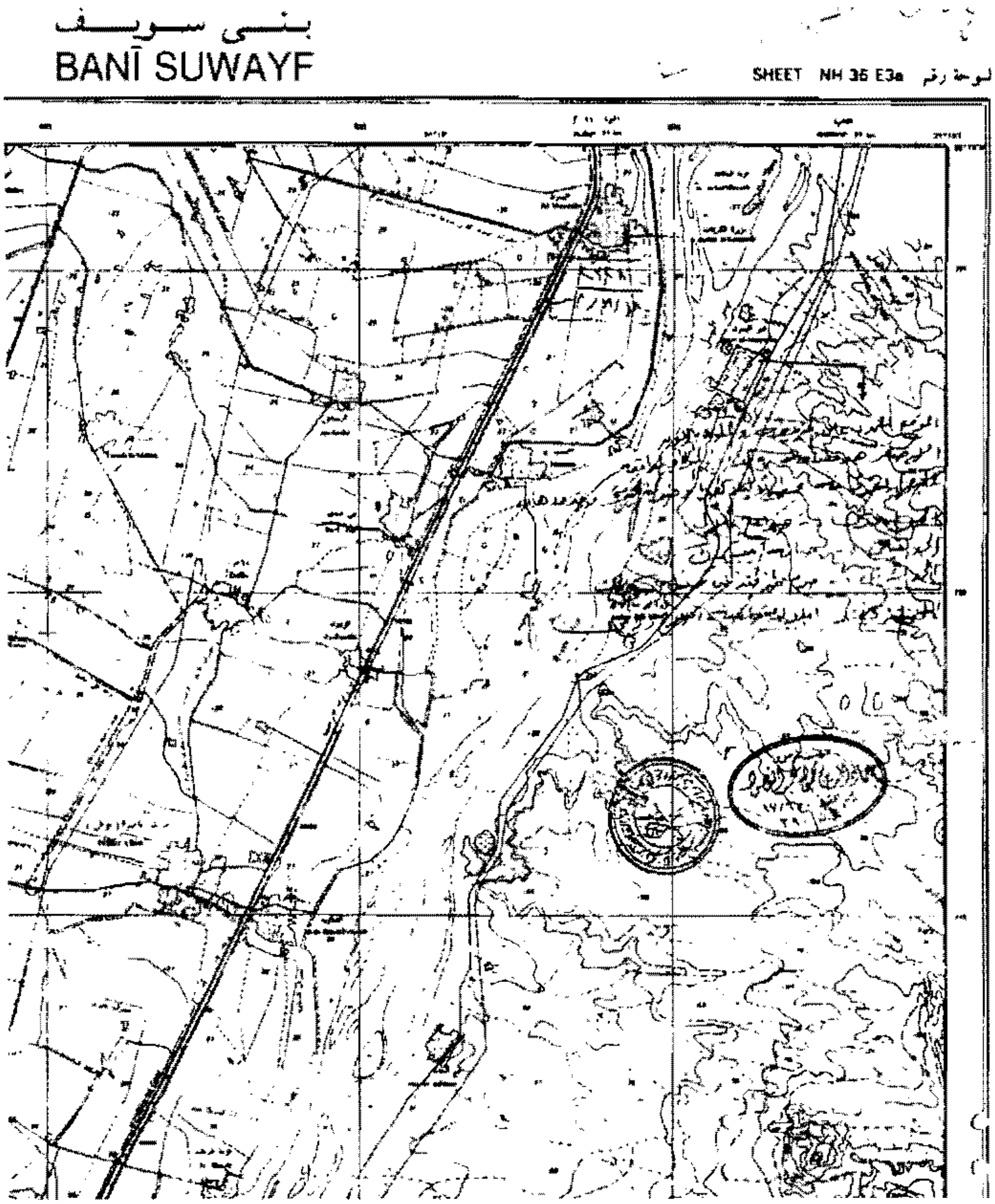


Figure 5-3 (A)

General Area Map of the Helwan South Power Plant with Locations of Permanent Control Points



	North (N)	East (E)
1.	723619,80	636394,86
2.	723831,95	635925,12
3.	723187,29	635612,19
4.	722918,38	636072,77

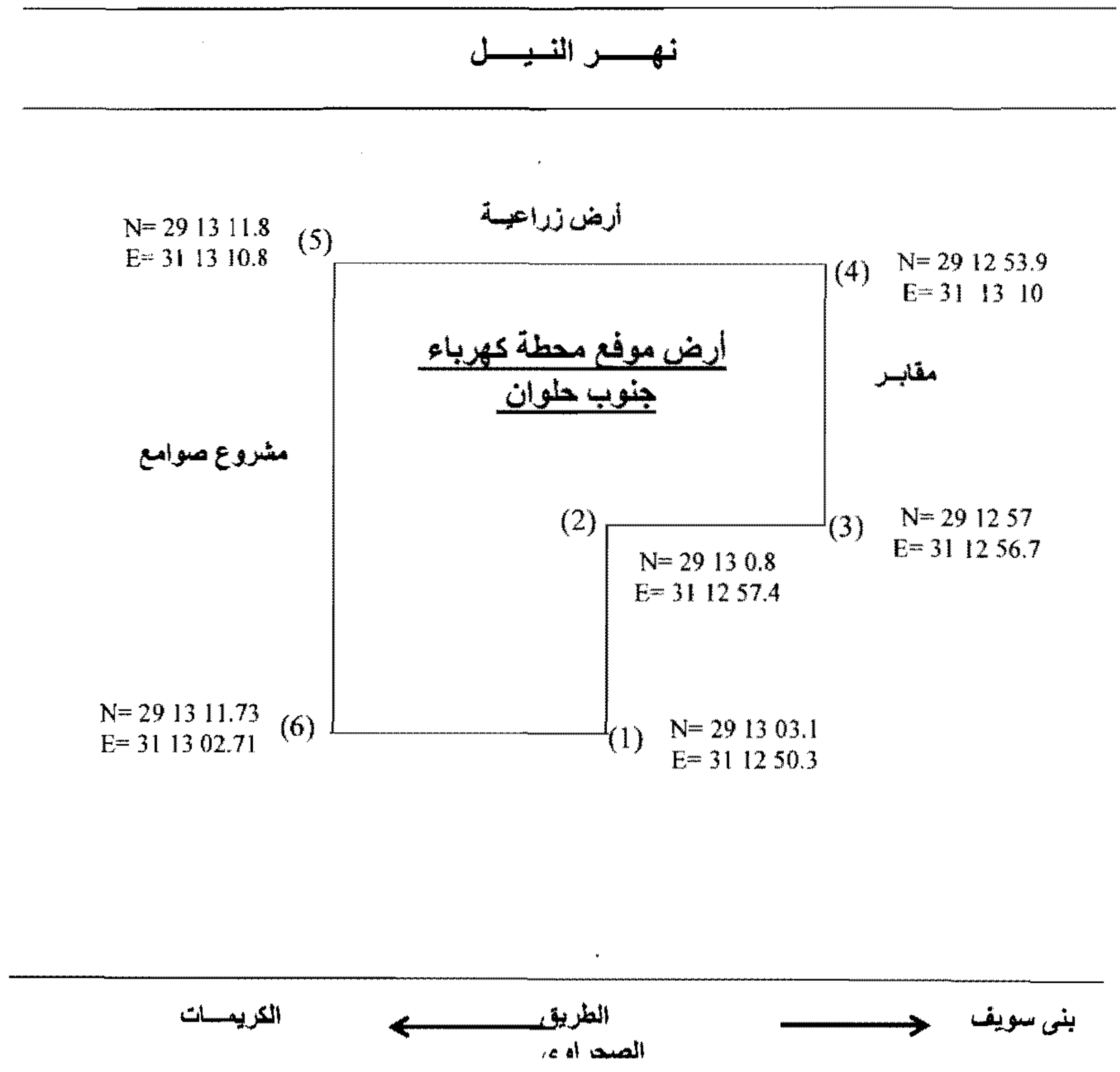


Figure 5-3 (B)

Exact Coordinates of the Project Site

Figure 5-3 (C)

General Layout Drawing of the Helwan South Power Plant and its Easments

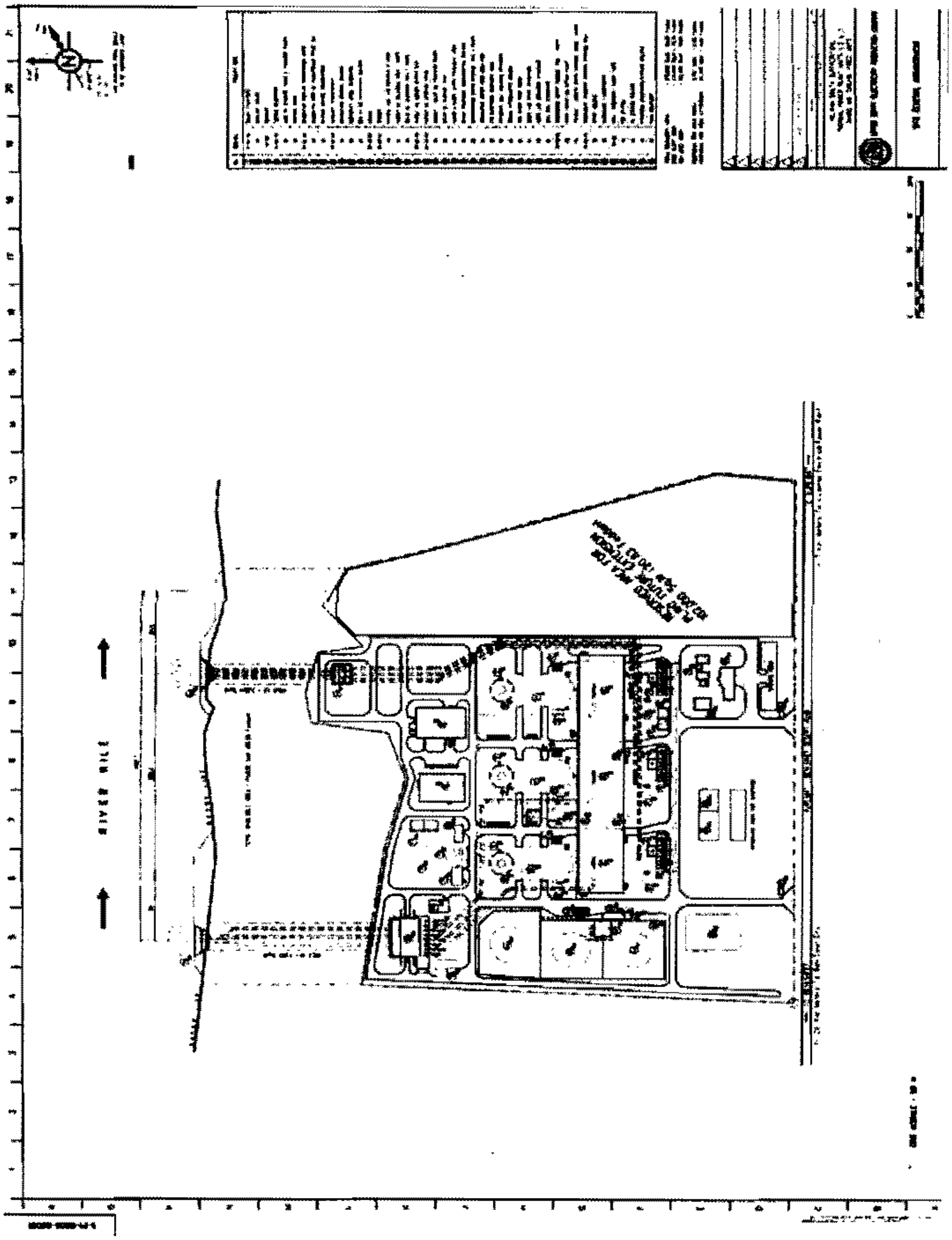


Figure 5-4 (A)

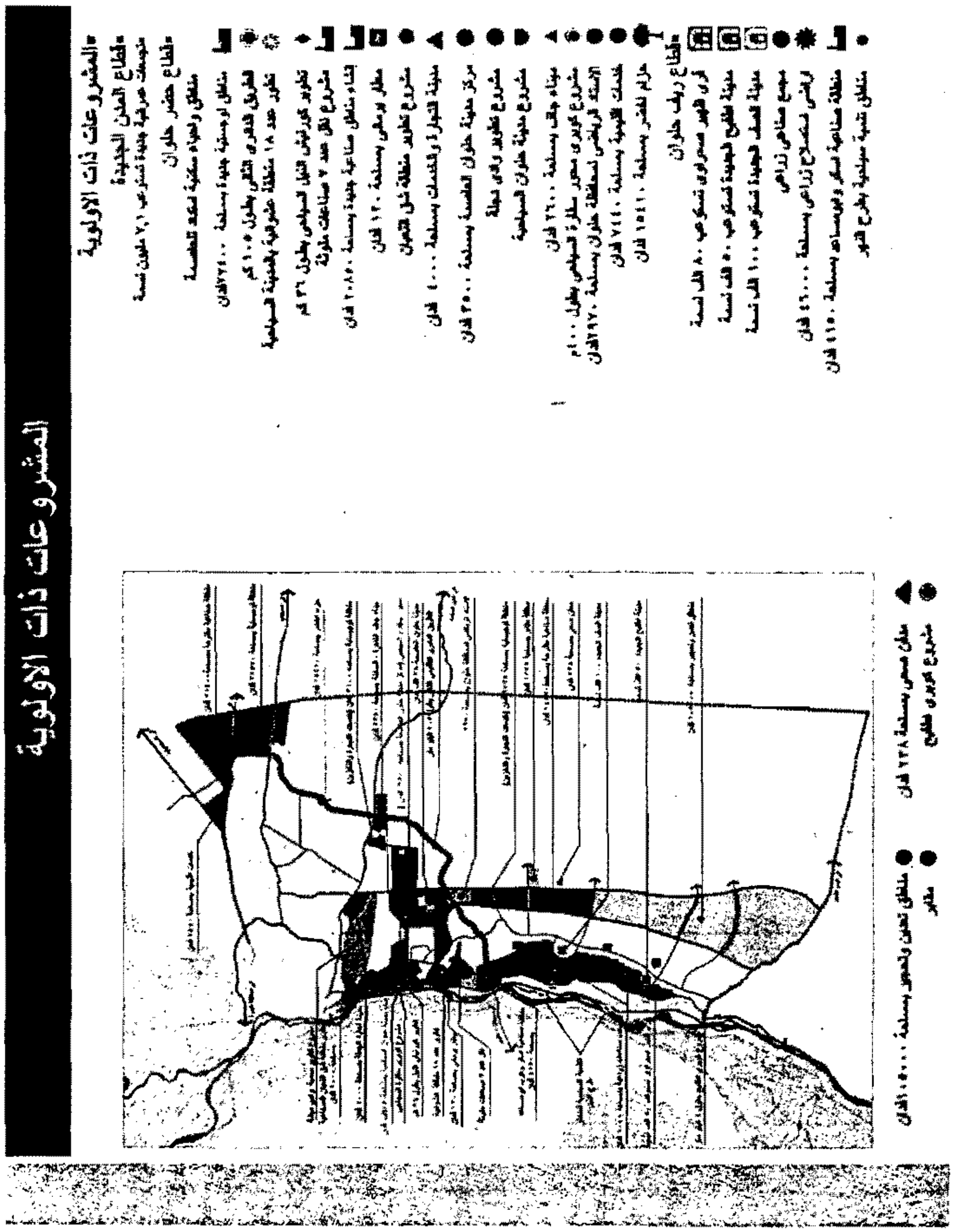
Some Photos for the Site Area

Figure 5-4 (B)

Some Photos for the Power Plant Site

Figure 5-6 (B)

Urban Development Plan for the Helwan Region, including El-Kureimat Zone, 2009



5.2 SOILS, GEOLOGY, HYDROGEOLOGY, TOPOGRAPHY AND SEISMICITY

5.2.1 Introduction

Information on soils, geology, hydrogeology and topography was obtained from the following sources:

- review of the 1:50,000 scale and 1:500,000 scale as well as both 1:25,000 scale and 1:5000 scale Geological and Geographical Maps; produced by the Egyptian Military Survey Authority and the Egyptian Geological Survey and Mining Authority (EGSMA);
- discussions with the Department of Natural Sciences, College of Sciences and the Institute of Environmental Studies and Research, Ain Shams University;
- discussions with the National Authority for Remote Sensing and Space Sciences (NARSS), Ministry of State for Scientific Research and Technology;
- review of the Hydrogeological Map of Egypt;
- observations made during the site visits, by ECG and their sub-Consultants in November 2010; and
- baseline Study on the "Physical Environmental and Geological Setting of the Helwan South Proposed Steam Power Plant, Helwan Governorate, Egypt", conducted by "Commercial Services Corporation (CSC) ", November 2010.

The general topography of the area is shown in *Figure 5-7(A & B).*

Figure 5-7 (A)

General Topography of the Project Area

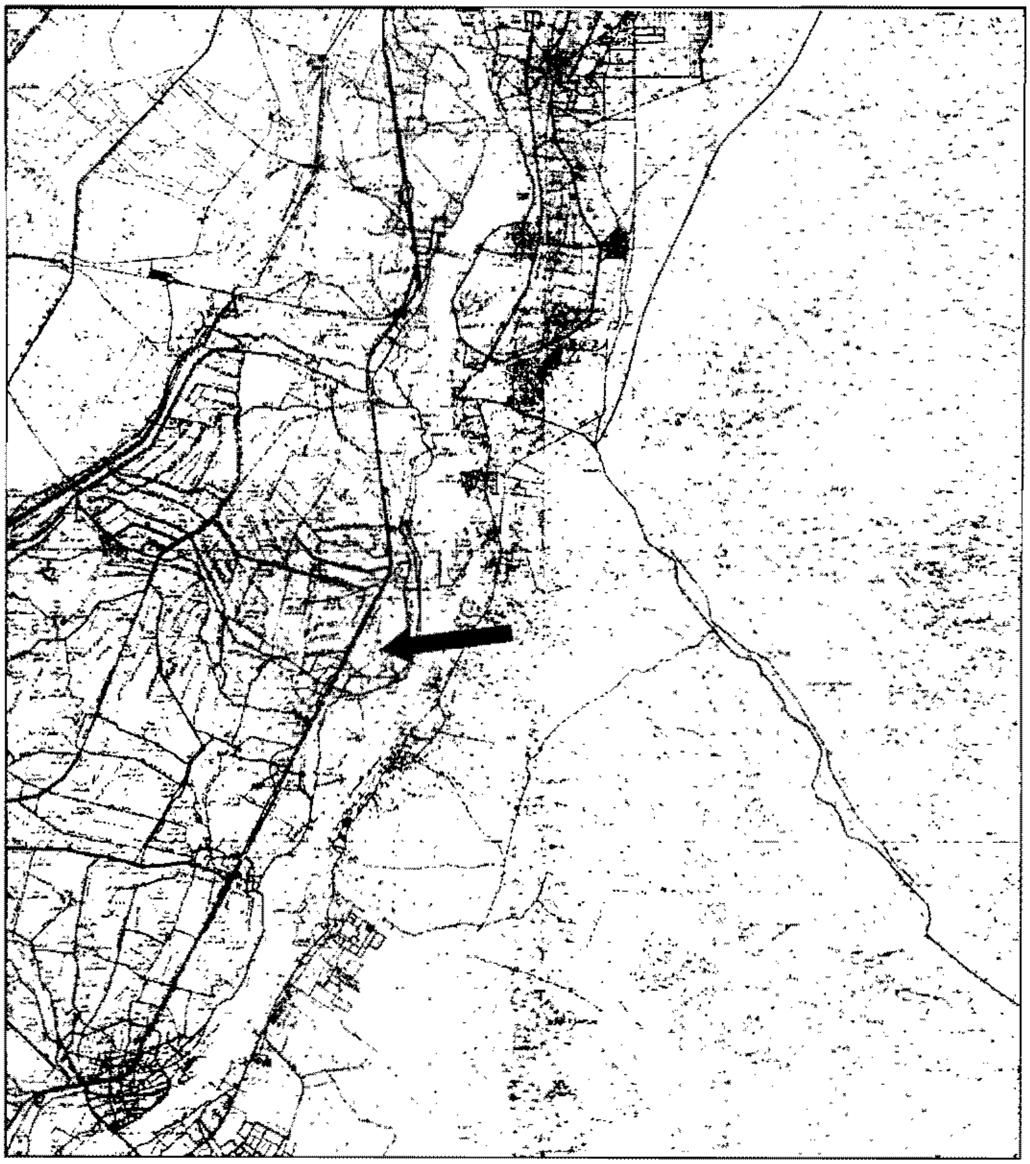


Figure 5-7 (AA)

General Topography of the Project Area

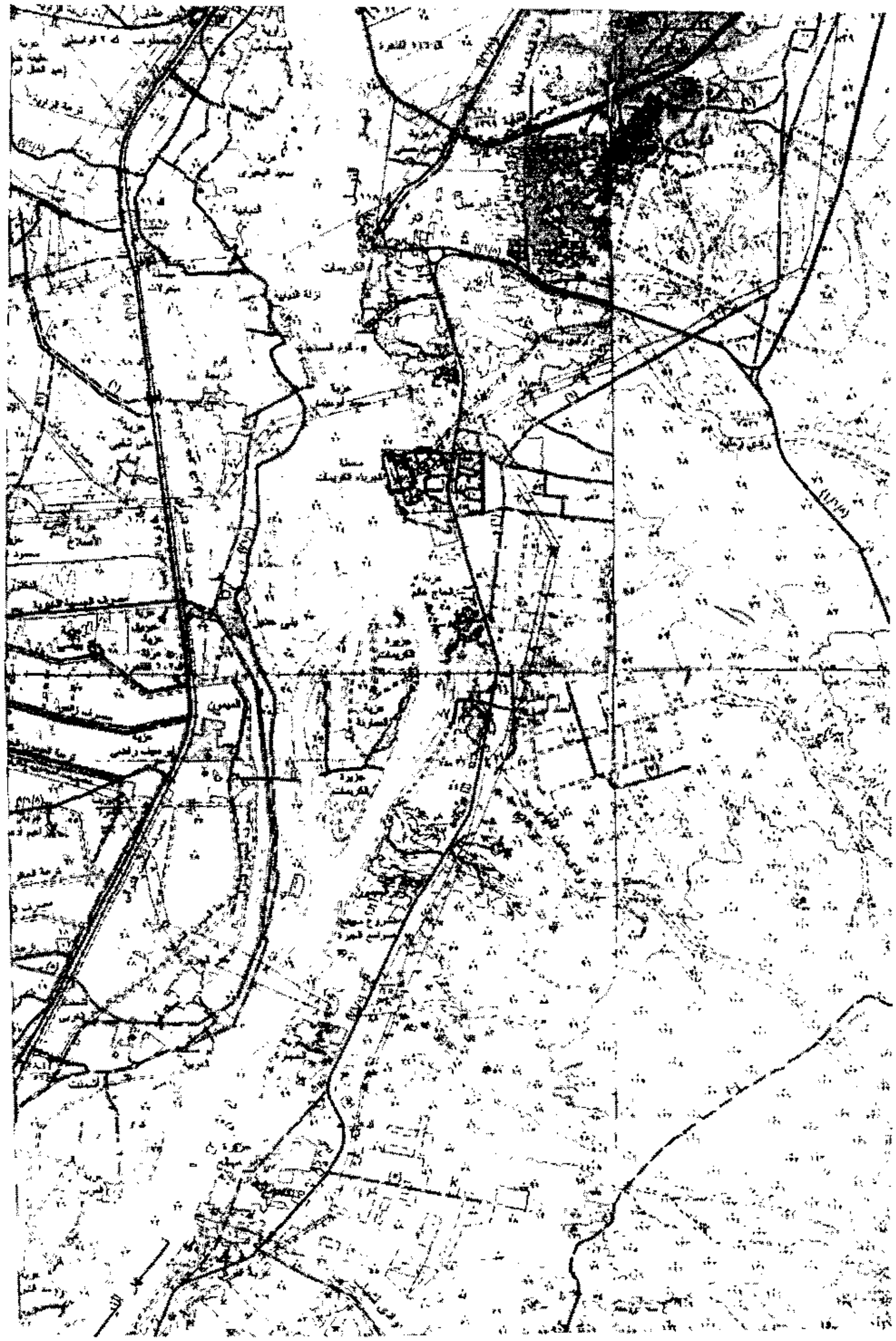


Figure 5-7 (B)

Satellite Image Showing the Topography of the Area Surrounding the Proposed Site

5.2.2 Geomorphic Features

The area can be classified into 3 main distinct geomorphic units (Figure 5-8) namely:1- DissectedPlateau 2&PedimemS&3 Playa (Nile terraces and Fan-glomerates).

1. Dissected Plateau

This plateau overlooks the Nile to the east assuming a relief of 305 m. over the pediments to thewest. The plateau is very irregular in outline and striking, generally in a north- south trend. Severalembayment's' and their corresponding promontories distinguish the rim of the plateau. Theembayment may cut back in the plateau surface for a distance of 3 km. the most important of theseembayment's is occupied by Wadi Abu Tarefei which runs west northwest-east southeast for a distanceof 3.5 km. Northwards, another major embayment is distinguished which is occupied by WadiSoraka.Enclosed in between these two embayment a major promontory, known as Gebel HormretSheiboun, and is located. This promontory stretches westward towards the Nile and is separated from itsbank by only 7.5 km.Gebel HomretShaiboun has the highest altitude in the area, 334 m above sea level and has a relief of171 m. in over the pediment surface (the upper pediment). South of Gebel HomretShaiboun, the plateaurecesses back, eastward, and has a smooth outline displayed as a major are. This arc terminates nearly atthe southern limit of the area mapped where WadiSanur is located. Many wadis drain the plateausurface and run along the scarp face crossing the pediments to the Nile, The general trend of these wadisis east-west and the drainage system is parallel to subparallel. The plateau is covered by marl andlimestone beds, assuming 177 m. in thickness, exposed both over the pediment surface and at the scarpface (Figure 5-8).

2. Pediments

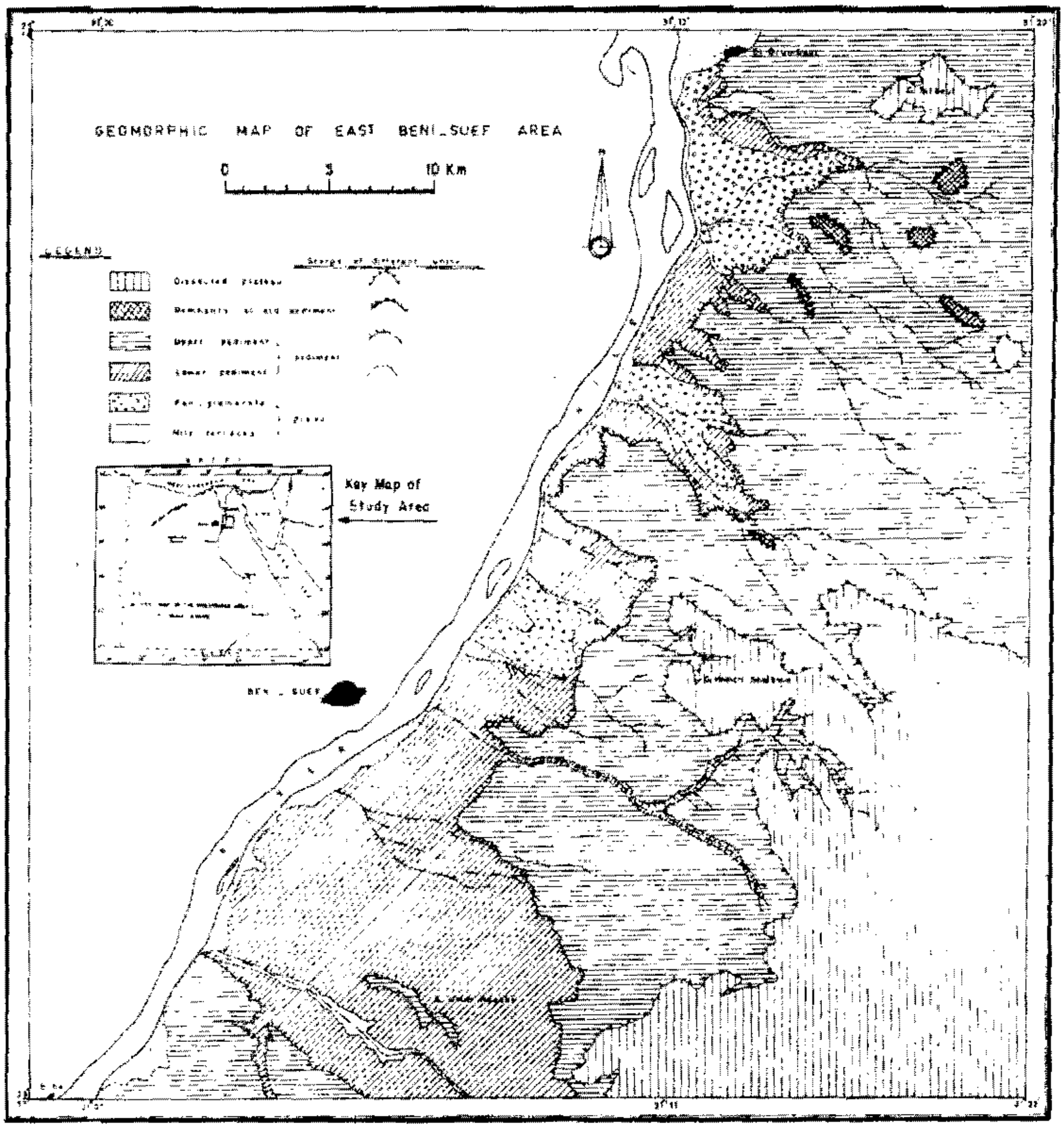
Two main rock-cut pediments are distinguished in the area namely, the upper and the lowerpediments.

a. The Upper Pediment stretches parallel to the scarp face bounding the plateau. The pediment's surface is a barren white limestone with clay intercalations, stretching 3 to I0 km east till it abuts againstthe scarp face ofthe dissected plateau. To the west it overhangs the lower pediment, with a relief of 30 m. The western outline of the pediment is very irregular, running in a zigzag line displaying a number ofspurs, points, alcoves and indentations. The pediment covers an area of 547.50 km. and opens outconsiderably to the north, outside the mapped area. To the south, the pediment surface has an altitudeof 9I m above sea level.

Figure 5-8

The Main Geomorphic Features in the Study Area
(After E. A. Zaghloul,1978)

Figure - 2



In the area of WadiMetein el Bahari,the lower and the upper pediments coalesce forming one surface.This surface stretches southward in the form of a limestone cliff 63 m. above the Nile terraces. In placeswithin this stretch, this limestone cliff may form two steps corresponding to the lower and upperpediments. Over the surface of the upper pediment, several limestone mesas and buttes are encountered.These represent remnants of the surface of a limestone pediment which once was present above theupper pediment surface. These features rise 72m. above the pediment surface and increase generally in a number and area towards the north east, formed mainly of limestone beds.Several east-west wadis dissect this surface. The most important of these are WadiLeshiab in thenorth and WadiBayad in the south. The wadis incise their channels deeply in the limestone surface andin places the incision may reach up to 30 m.

b. The Lower Pediment runs nearly parallel to the upper pediment and overlooks the Nile terraces tothe west. In few places along its stretch, the pediment forms a scarp of 44 m. high above the Nile terraces.The surface of this pediment is covered by limestone beds which make a flat surface extending towardsthe Nile. The western side of this pediment is smooth in outline, only where fan-glomerates are present,the outline is irregular. This surface is 13 km wide and rises 72 m above sea level.The main wadi crossing this surface to the Nile is WadiLeshiab which incised its channels 6 in on the average.

3. *Playa*

The Playa in the area investigated is classified into:a. Fan-glomerate and b -Nile terraces.

a. Fan-glomerat: These are found in 3 places in the mapped area, the northern fan is irregular in outline,covering 23.7 km^2.This fans has been formed by the coalescence of several wadis which fan out in thisarea depositing their loads before reaching the Nile. The sediments covering the fan are mainlyconglomerates and loose sands.

   In this aspect this fan-glomerate may represent the bajada surface of the zone of deposition (Sparks,1960). The thickness of these deposits varies from few centimeters along the edge of this fan to 7 m. near its centre and rises 50 m. above sea level and only 10 m. above the Nile terraces.

   The middle fan is oval in outline; covering I0.1km2.This fan has been formed by the coalescence ofsome wadi fans depositing their loads, in this area which are mainly conglomerate and loose sands. Thethickness of these deposits varies from few centimeters along the edge of the fan to several meters near itscentre. This fan rises 47 m. above sea level and only 10 m. above the Nile terraces.

   The southern fan is irregular in outline, covering an area of I0km2. This fan is covered byconglomerate and 100m. sands. Its altitude is 66 m a.s.l. whereas it stands about 5 m. above the Nileterraces to the east.

b. Nile Terraces: These make a thin strip along the Nile, 0.5 to I km. wide. Most parts of these terracesare now cultivated and only very limited rocky places are desert. Nile mud and silt of variablethicknesses are recorded by drilling in these terraces. Attia (1954) described a section, 11, 0 m. thick, westof Beni-Suef. The section is made of alluvial deposits, clays, sandy clays and sands unconformablyoverlying Pliocene sediment in the east and Pleistocene gravels in the west.

4. *Cultivated Lands*

The site is situated in the edge of the cultivated lands at the eastern bank of the River Nile. It formsthe flat area which is a part from the Nile Valley. Many small villages (Ezzab / Kafr) are littered around the area such as AL-brimbul , Al-Maumun and others .

5.2.3 Geological Setting

The present geological studies resulted in establishing the stratigraphic setting of the sedimentary sequence in the area under consideration and the structural elements that affected the area during the geological history.

Stratigraphy

The present geological studies resulted in establishing the stratigraphic setting of the sedimentary sequence in the area under the consideration and the structural elements that affected the area during the geological history.

The exposed rocks in the area investigated fall into the following stratigraphic rock units (*Figure 5-9*).

- Invertedwad's.Quaternary
- Fan-glomerate
- Umm Raqaba Formation Pliocene,
- Wadi Hof Formation Upper Eocene
- The Qurn Formation
- Moqattam Formation Middle Eocene

1. **Moqattam Formation**
   This name was first introduced by (Zittel, 1883) to describe the limestone and clastic beds at GebelMoqattamEast of Cairo; Zittel subdivided the section exposed at Gebel Moqattam into LowerMoqattam; comprising the limestone beds at the base of the hill making the main scarp face of theGebel, while to the upper limestone and clastic intercalations he designated the term Upper Moqattam.Farag and Ismail 1959 divided the Lower Moqattam of Zittel into two units: Gebel Hof Series atbase and the Observatory Series at top. Later, Said, 1962restricted the term Moqattam Formation to themain limestone beds exposed at Gebel Moqattm which, werenamed by Zittel, Lower Moqattam. The UpperMoqattam was given a new name (Maadi Formation). In the area studied, this unit covers the two pediments at the foot slopes of the main plateau boundingthe area to the east, The formation covers an area of approximately 642.90 km^2 . On the eastern bank ofthe Nile, the Moqattam Formation consists of limestone with thin shale and clay intercalations. The limestone is white, hard fine-grained, forming a low scarp which is quarried in many places for buildingpurposes, this quarried part ofthe section is equivalent to the Building Stone Horizon of Hume (1965).The following is a stratigraphic section measured at WadiMetein El-Qibli.

Wadi Metein E1-Qibli Section

At WadiMetein E1 Qibli, the Moqattam Formation includes more clayey bands. The thickness ofthis unit, in this area is residual, the base is not exposed.The following section represents the Moqattam Formation as exposed in the flat pediments west ofthe main plateau.

Top : Thickness(m)

Limestone, greyish white, hard, sandy at base, with Nummulites spp.and Operctmino sp.	1.50 m
– Clay, brown, compact, salilerous..................................	0.50m
– Limestone, greyish white to yellow, hard, massive, crystalline in parts	5.00m
– Clay, brown, hard, saliferous..	0.50m

- Limestone, white, chalky, hard, with clay thin bands 3.00m
- Marl, yellowish brown, loliated, hard, salty......................... 0.70m
- Limestone, yellowish white, sandy, withNummulitesspp....... 1.10m
- Clay, brown, saliferous.. 0.10m
- Limestone, yellowish white, hard, sandy at base, including shell debris.. 1.00m
- Clay, brown, compact, saliferous.................................. 0.30m
- Limestone, white, hard, massive.................................... 1.50m
- Clay, yellowish brown, saliferous................................ 0.30m
- Limestone, chalky to yellow, hard and jointed................... 1.40m
- Clay, brown, compact, highly saliferous.......................... 0.45m
- Limestone, chalky, white, hard, jointed, nummulitic............ 4.80m
- Clay, earthy yellow, hard, saliferous.............................. 0.50m
- Limestone, chalky, yellow, hard, forming a ledge................ 0.70m
- Clay, green,gypseous and saliferous, hard........................ 0.30m
- Limestone, yellowish white to chalky, hard....................... 1.20m
- Clay, greyish borwn, hard, saliferous.............................. 0.50m
- Limestone, greyish white, hard. Jointed, crystalline at top with Nummulite sp.and fish teeth................................. 1.40m
- Marl, grey, hard, foliated, containing shell fragments............ 0.30m
- Clay, yellowish brown, compact, gypseous....................... 0.40m
- Limestone, chalky to yellow, hard, forming the base ofthe section andthe floor ofthe wadi, including Lucinaphamonis Ball, and Nummulitessp 0.50m

Base: unexposed Total thickness = 35.90 m

The above mentioned sections represent the horizon from which many building stones are quarried in the area under consideration. Most probably, Wadi Metein El-Qibliand Gebel HomretShaibounsections are partly equivalent to theObservatory Series of Farag and Ismail (1959)and to the Building Stone Horizon of Cairo.(Hume1965)On the other hand, theGuishi Formation and the Qurn Formation as belonging to the Upper Eocene. Farag and Ismail(1959) regarded the Qurn Formation as wholly of Upper Eocene age. Thus the Guishi Formation iscertainly an upper member of the Moqattam Formation, i.e. Middle Eocene, and most probablycorrelated with the Observatory Seriesof Farag and Ismail (1959).

2. Qurn Formation

This name was given by Farag and Ismail (1959), to a chalky limestone, sandy marl, and marly limestone, succession at Wadi Hof area near Helwan. Zaghloul1978 , classified the Upper Moqattam ofZittel (1883) into three units,the Qurn at the base, WadiGarawi in the middle and Wadi Hof at top.Said (1962) lumped these units under one lithobiostratigraphic unit; Maadi Formation.

In the area studied, we are able to divide the section above the Moqattam Formation into two units which differ considerably in their lithological characteristics. The lowerunit can be correlated with the Qurn Formation of Farag and Ismail, while the upper unit is equivalent,most probably, to the Wadi Hof Formation.The conglomerate band recognized in the area under the present study, separates both units and along this hiatus,the middle unit of Farag and Isamil (1959); WadiGarawi Formation, is missing. The names introduced by Farag and Ismail are given here to the units in the area studied, while the MaddiFormation is considered invalid because of priority in naming rock units (American Commission onStratigraphic Nonienoclature; Articles nos. 3.10 and 17. 1971).

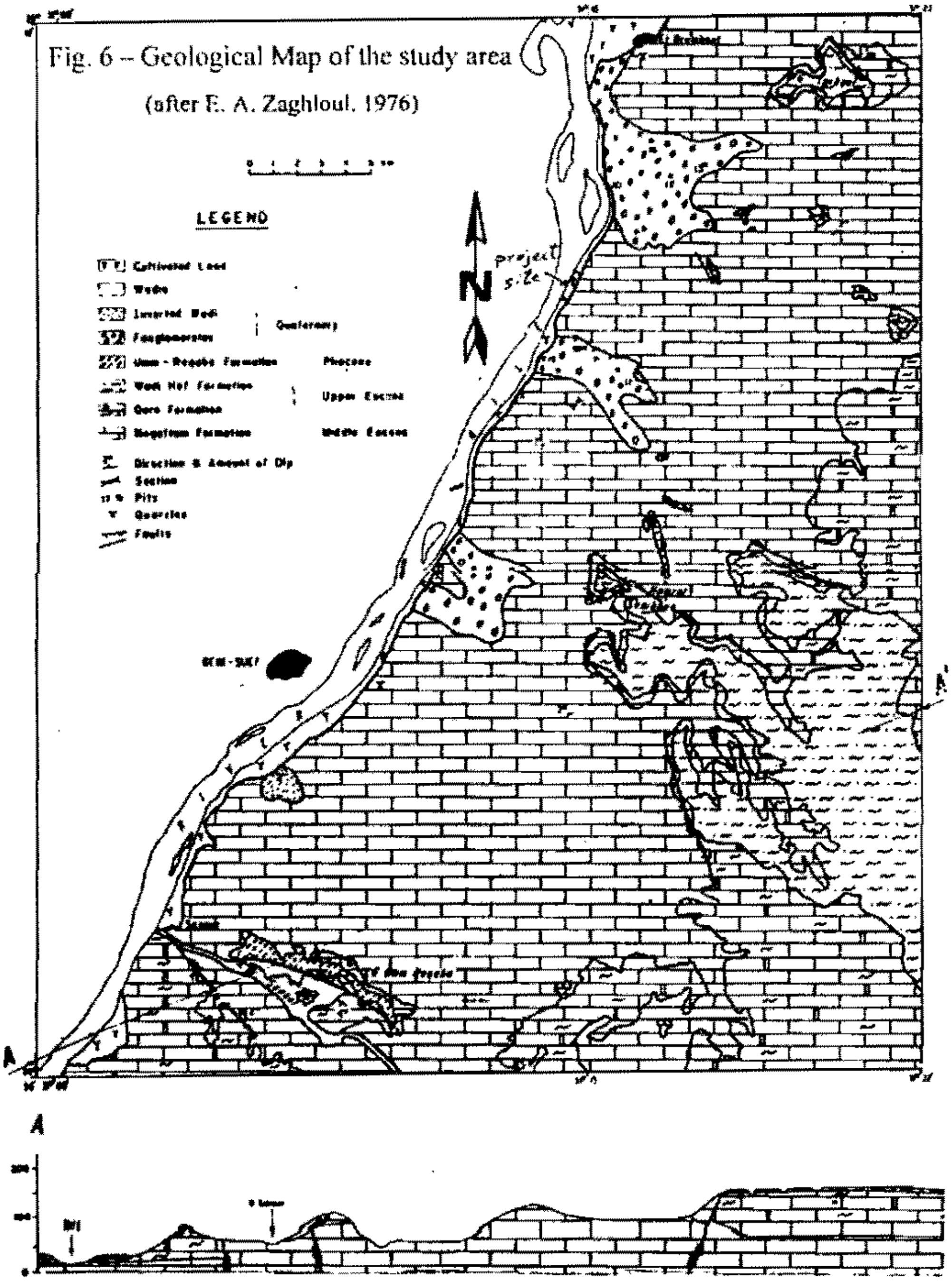
In the area studied the Qurn Formation makes the slope of the eastern scarp and some patchyhillocks scattered over the pediment surface at the northeastern part of the area. The formation isformed of a succession of shale, marl and limestone, covering an area of 174.30 km2. The following is the section measured at GebelTarboul.

Gebel Turboul Section

At the area of Gebel Tarboul, the Qurn Formation is separated from the upper unit,Wadi Hof Formationby a conglomerate band, 22 cm thick, which is well noted in Gebel Tarboul section. TheQurn Formation attains a thickness of 53.60 m and is composed of a succession of marls and shale,while its base is unexposed.

Figure 5-9

Geological Map of the Study Area
(after E. A. Zaghloul, 1976)



3. Wadi Hof Formation

This is the third and topmost unit of Farag and Ismail (1959), given by them to a series of marl andsandy limestone at Helwan area, south east of Cairo.At the area studied, Wadi Hof Formation makes the upper slopes and the top of the north easternplateau. The formation is made of a succession of chalky limestone, sandy limestone and shale, where itcovers an area of 147.20 km^2.

Gebel Tarboul Section

At the area of Gebel Tarboul, the Wadi Hof Formation unconformably overlies the QurnFormation. The unconformity is well marked by a bed of conglomerate 22 cm thick. This conglomeratebed separates both the Qurn Formation at base and the Wadi Hof Formation at top. The section ofGebel Tarboul consists of at white chalky limestone and shale beds assuming a thickness of 66.50 m.The following is a description of Gebel Tarboul section:

Top Thickness (m)

4. Limestone, yellowish white, sandy in places, with Ostreaclot-beyi, Nummulitesbeaumontid'Archiac and Heime. Nummulites sub-Beaumonti andOperculinasp.. 8.0
3. Limestone, greyish white, hard, jointed, with gypsum veinlets, including Nummulitesbeaumontid'Archiac and Haime, Assiline sp., Milionllaoblonga (Montagu), Miliolaa prism d'Orbigny,valves of Ostracoda and shell fragments 39.0
2. Limestone, yellow, sandy, hard, forming a wall, containing dwarfed gastropods, bone debris, shell fragments, Nummulitesbeaumontid'Archiac and Haime, Nurmmulites sub-beaumonti, Miliolapriscad'Orbigny and Operculina sp...13.5
1. Shale, yellow to yellowish brown, fissile, including Nonionellaspissa Cushman, Miliolapriscad'Orbigny, Loxostomumteretum Cushmanand Buliminajacksonensis Cushman 6.0

Base: Conglomerate, yellowish white to dark brown highly ferruginous,saliferous, with calcareous sandstone, forming a ledge, containing rarebadly preserved Operculinasp., Nummulites spp., and other shellfragments..0.22

4. Umm Raqaba Formation

This unit makes nearly the whole of Gebel Umm Raqaba which is a conspicuous butte at thesouthern part of the area covering an extension of 4.70 km^2. The formation is made of alternatingconglomerate and sandstone beds unconformably overlying the Qurn Formation. The conglomerateconsists of limestone, chert and quartz sand grains bounded together by a clayey matrix.The Umm Raqaba Formation is fossiliferous and the fossils are mainly found at two horizons, bestdeveloped at the western part of the area. The contact with the underlying Qurn Formation is clear inthe field by virtue of lithological and colour differences between both units, the yellowish brown clasticsection of Umm Raqaba overlies a greyish white carbonate Qurn succession. The thickness ofthe Umm Raqaba Formation at its type section is 23.85 m, decreases to the westwhere it attains 10.90m. The thickness of this formation is residual since no younger sediments were recorded at its top.The fossils collected, from the sections assign this unit to the Pliocene. Among the collectedfossils, reworked Middle and Upper Eocene species are common. However, this does not alter the ageassigned to the Umm Raqaba Formation since the fossils are reworked and the lithologicalcharacteristics of Umm Raqaba show that conglomerate is a common lithotope. The conglomerate isnot doubt, derived from the surrounding Eocene scarps. This age assignment was first mentioned in thework of Blanckenhorn (1921) while describing the geology of this area. The Pliocene section knownfrom this area, most probably represents the most southerly marine Pliocene transgression in Egypt, during thisepoch.The Pliocene sediments are known from many small and patchy occurrences in different parts ofEgypt. At the Red Sea Coast, Beadnell (1924), Cox (1929), Souaya (1963), El-Akkad and Dardir (1966)and Issawi etal. (1971) describe a clastic section with reefal carbonate interbeds which was believed to beof Pliocene age.

The marine Pliocene exposure around Cairo area occurs as a strip along the cultivation edge. It isespecially well developed between Abu Sir and Gizeh on the western bank of the river.

The succession ofthe Pliocene strata at Kom El-Shelul is also worked out by Sandford and Arkell(1939). The Pliocene fauna are similar to the fauna of the Nile Valley exposures. To the east of the Nile, at the foot of Gebel Moqattam in Kait Bay as well as to the south of Cairo at Helwan, similar Pliocene exposures bound the cultivation and rest, with depositional dip on the MiddleEocene limestone cliff.

The Pliocene sediments are recorded only from Gebel UmmRaqaba and covering an isolatedfaulted patch at WadiSannur. The Umm Raqaba Formation overlies unconformably the QurnFormation. The contact between both units is marked by a change in litliology and a disconformablerelationship. The section is residual since no younger sediments were seen overlying this unit. It seemsthat the Umm Raqaba Formation is lithologically correlative with the upper part of the Pliocene sectionexposed at Kom-El Shelul area.

The following is a tentative correlation chart between different units exposed at the twobasins.

5. Quaternary Deposits

The Quaternary geology was given little importance in Egypt since the pioneering work of Sandfordand Arkell(1933) on the Nile basin and of Caron-Thompson (1932) on Kharga Oasis. In the last twodecades and as a result of the building of the Aswan High Dam, Unisco has launched an activeprogram to study the anthropology and archeology of the area to be covered by water south of Aswan.This entails a detailed work on the Quaternary geology of this area. The findings of different scholarsfrom different parts of the world in Nubia area help to establish a tentative chronological sequence ofevents during this time. This encouraged many workers to expand their researches north ofthe HighDam. Important discoveries on the Quaternary geology of south Egypt are revealed in the publicationsof Wendorfet. al. (1965, 1968) and of Butzer and Hansen (1968) which make a study of the Quaternarydeposits of any area a must to complete its geological picture. In the area studied different exposures belonging to the Quaternary were recognized. These units areclassified into the following sequence:

- Inverted Wadis.
- Fan-glomerate.

A description of each of these units is given below.

Inverted Wadis

An outcrop of interbedded loose coarse quartz sandstone and rubble made of boulders, cobbles and pebbles of a wide variety of rocks including basement and sedimentaries were recorded. The basement rocks have similarity to the Eastern Desert igneous and metamorphic complex which no doubt is the source of this rubble. Partly, the loose component of the rubble is cemented giving a hard and well indurated conglomerate. The cementing material is silica at the basal 90 cm. while the upper 3.0 m. are cemented by iron oxides. The thickness of this unit is about 6 m. The relative elevation of this unit is 35 m. above sea level, which represents the lowest sediments in the area.

Fanglomerates

Several patches located very near to the present cultivation edge were found to be covered byrelatively thick conglomerate and loose sand deposits. These were derived from the Eastern Desertscarps and mountains as they include both sedimentary and rolled igneous pebbles and cobbles. Thefanglomerates were formed by the coalescence of several wadi fans depositing their loads into shallowdepressions formed within the basal Eocene surface. The thickness of these deposits, in general, variesfrom few centimeters along the edge of these fans, to several meters near the centre.

Structures

Generally, the Egyptian platform may be subdivided, from south to north into the following four units (*Figures 5-10 and 5-11*), Craton and Stable Shelf in the south, Unstable Shelf in the north and the Hinge Zone at the coastal area .The hing zone is located between the mobile shelf and the miogeosynclinal area.

The general structural outlook of the area isone of a flat surface with very gentle dips (1-2) atvariable directions. Though the area is located on the north western flank of the Red Sea basement hillsand also just south of the uplifted arch which extends from Bahariya in the southwest to Abu Roash,Ataqa and Maghara in the northeast, it is surprisingly scarcely touched by these stresses. Mostprobably the only echo of these stresses is a number of small faults which cut through the area.The expected direction of dip of different units is towards the north with a slight deviation to the eastor the west. Contrary to this expectation several measurements show directions to the southeast. This isprobably due to a main fracture line along the Nile with a northeast-southwest direction.Youssef (1968) recorded a major fault along the Nile at this area which he assumed to have the Gulfof Aqaba trend, i.e. N l5° E. Zaghloulet. al. (1976) work substantiates Youssef's concept.Tertiary sediments which make the table land west of the Red Sea hills were supposed to be dippingaway from these uplifted basement hills.

In other words the Qurn and WadiHofFormations (UpperEocene) exposed at the eastern part of the area studied with a gentle angle of dip 2° to the west weresupposed to lie below their present outcrops west of the Nile (*Figure 5-12*). Most probably a fault (or several faults) is located near the present Nile channelculminating in the upthrown of the western side. Youssef (1968) indicated that the stresses leading tothis faulting movement are parallel to N l0° W, S 10° E. The fault is probably a wrench fault withvertical displacement accompanying a strike-slip movement.The effect of these stresses on the area under consideration lies in the change of the general northerly direction of dip to a southern component. The downthrown block, in the studied area, was draggeddown hence the changes in the direction of dip.Several other faults were mapped from the area, a brief description of the most important of these is given below.

Gebel Turboul Faults

This group of faults comprises three faults. A-A, B-B and C-C (*Figure 5-12*). Faults A-A' and B-B run in a northwest- southeast direction N, 15 W. and N.63° W. for distancesof 1.7 and 1.0 km respectively. Both faults are of the normal, gravity, strike and longitudinal type. Thedownthrown of each fault is ca 20 m.These two faults A- A' and B-B' are traced along the slope face of Gebel Tarboul. Two other faultswere mapped from the area at southwest of GeblelTarboul. The first fault has a length of 20 km andtrending N. 50° W,, while the second fault has a trend N° 32° W, and a length of 1.7 km.Fault C-C', has a trend N° 33° W. and a length of 2.0 km. The fault is ofthe normal, gravity, strikeand longitudinal type. The thrown of this fault is towards the south with an amount of 15 m.

Figure 5-10

Sketch Map of the Structural Aspects of the Nubian – Arabian Shield Margin in Northern Egypt (afterSchlumberjer,1984)

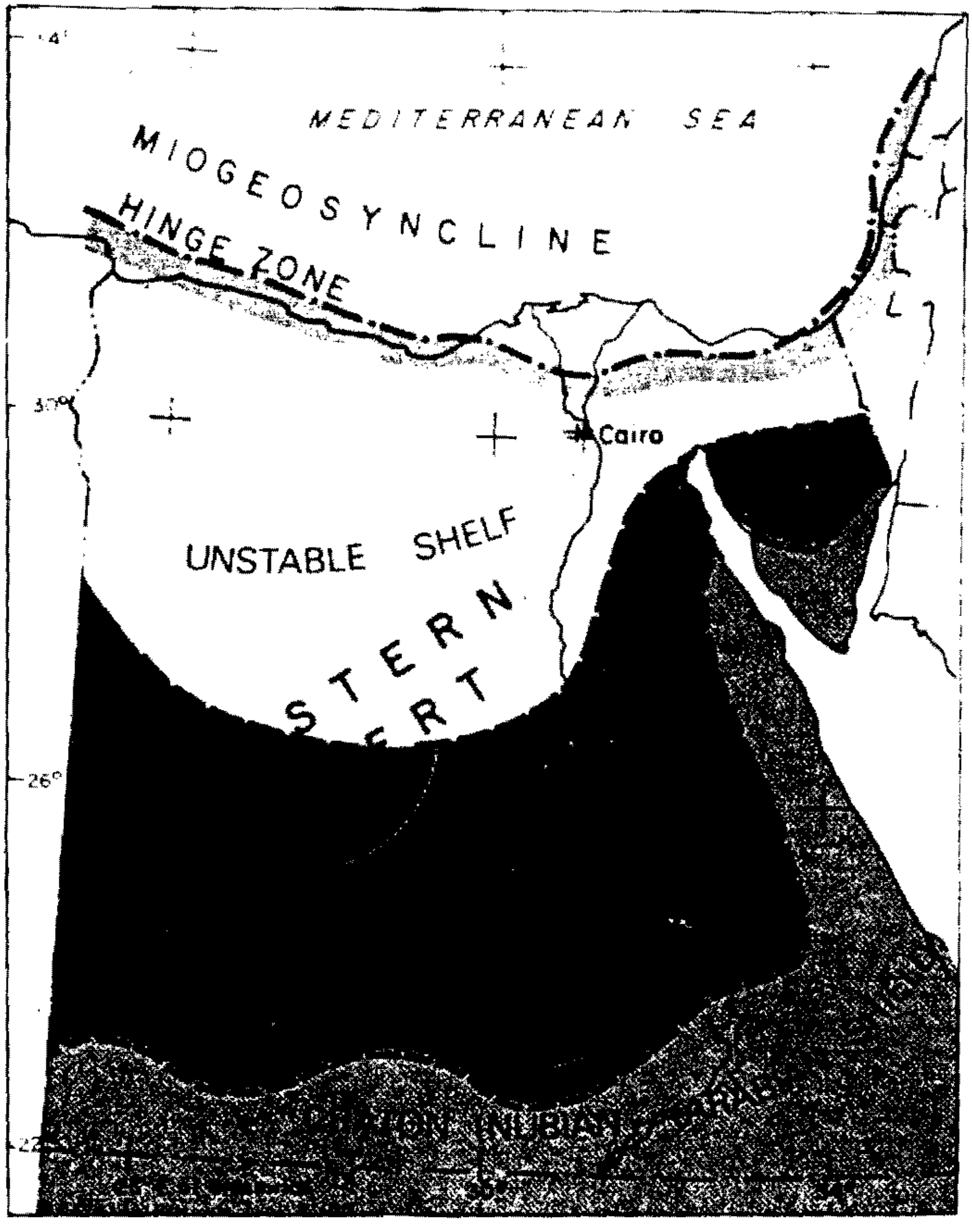


Figure 5-11

Schematic Map showing Major Tectonic Elements in Northern Egypt

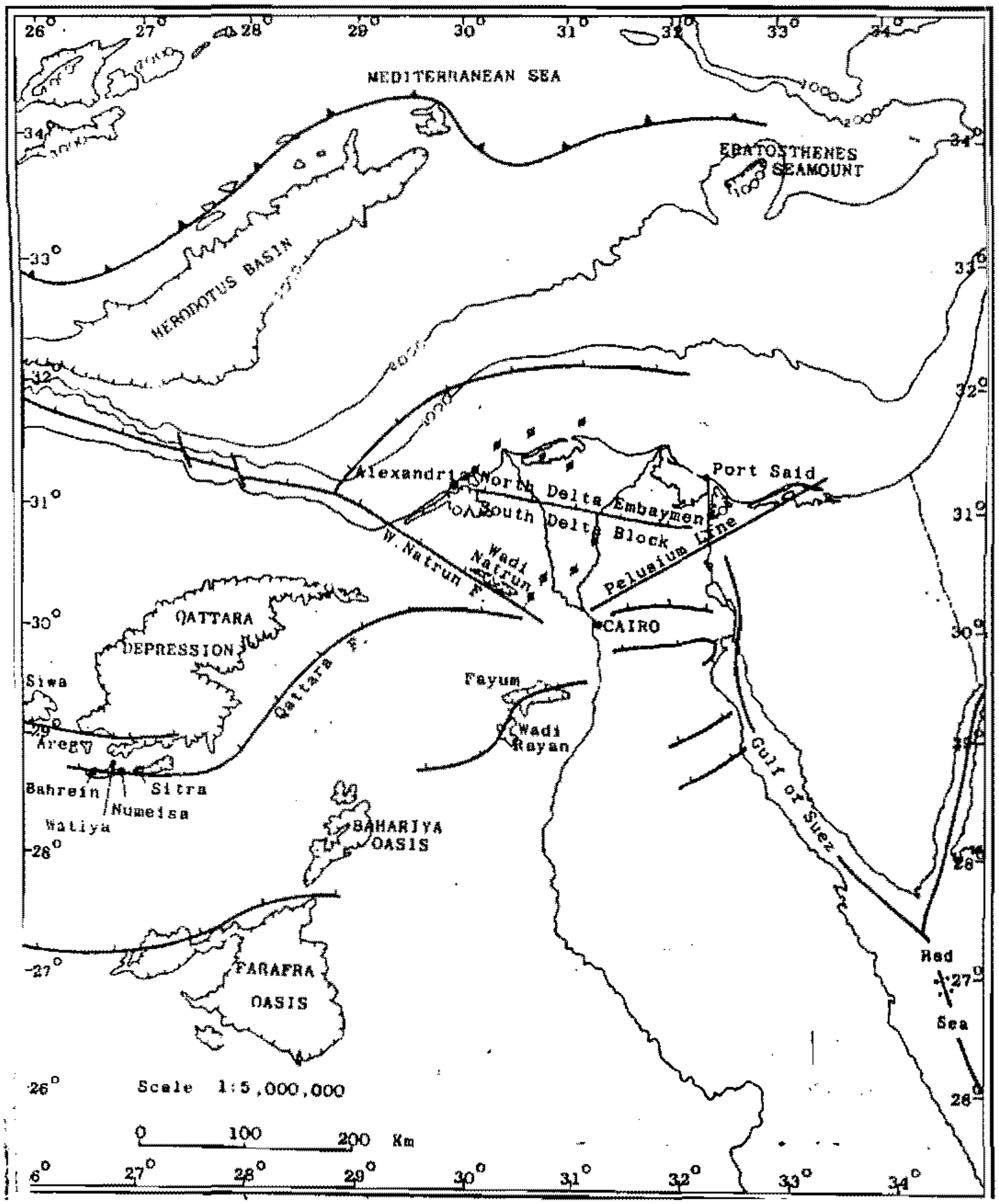


Figure 5-12

Fault Pattern in the Area from Kureimat to Beni – Suweif
(after E. A. Zaghloul, 1976)

5.2.4 Natural Resources

The main natural resources in the area under consideration are the building stone materials and materials used for the Cement Industry.

The reserve of the main materials is as following:-

Materials	Reserves \ m^3
Limestone	27.500 m3
Sands	18.000 m3
Gypsum	70.000 m3
Soil	45000 m3

5.2.5 Water Resources

Hydrology

Due to the continuity of the water bearing formation, there is aeast-west groundwater flow from the new reclaimed area to the flood plain aquifer. Little of this flow is intercepted by the drains, so the flood plain aquifer is continuously recharged. This cause upward leakage and water logging of the original Nile Valley land (AncientLand).

The main irrigation station is Al-Kureimat which irrigates about 22966 Feddan with total water budget in the range of 198.92 m.m3| year.

Groundwater

Referring to the Hydrogeological Map of Egypt (see *Figure 5-13*), the groundwater conditions and the aquifer geometry can be summarizing as in the following:

1. ***The Nilotic aquifer system*** (Qena Formation)of semi-confined type is underlain by thick clay beds (Pliocene rock unit) which act as aquiclude. It consists mainly from sands, gravels and silt.

2. ***The Quaternary fluviatile and fluvio-marine*** sand and gravel with interbeds of clay and having a thickness of about Most of the shallow water wells are restricted to the top most part of thisaquifer.

3. ***Fissured Carbonate Aquifer System***: This aquifer is mainly consists of thick fractured limestone and dolomite of the Lower and Middle Eocene rock units. The depth to the water bearing beds ranging from 100 – 150 m. from the ground surface while the water level 1s about 90 m. from the level of the ground surface.

Groundwater Quality

The groundwater quality within the new reclaimed area east of the site differs considerably from one location to another, but is more or less constant in the old flood plain(300 – 500 ppm.).

On the other hand, the quality (salinity) of the groundwater in the fissured carbonate aquifer ranges from 2000 – 3000 ppm.

Geoelectrical Survey (Resistivity)

According to El-Shayeb,1999, the geoelectric measurements and interpretation undertaken in Al-Saff area lead to conclude the following:

1. Three geoelectric units can be differentiated as follows:
   a) A top sandy and gravelly unit, characterized by relatively higherohmic values and forms a potentially zone for the groundwater accumulation
   b) A sand clay unit underlying the sandy gravel unit and characterized by relatively low ohmic values
   c) A base clay unit characterized by relatively very low ohmic values (<10 ohmic). Both the sandy clay units are not considered suitable for getting groundwater.

Accordingly, the study area bears reasonable potentialities for theprobable accumulation of groundwater due to the presence of sandy-gravel unit having a suitable thickness up to 80 m. The annual precipitation of rain within the study area is very poor and this leads to expect that the main source of the groundwater within the studied area is the seepage from the Nile. Moreover, the geoelectrical result shows that the clay layer occurred at the shallower depth in the central part of the study area forming a domal structure which can play a very important part as a cap layer.

Water Uses

1. Irrigation: The irrigation water is free of charge and readily available for almost all lands that officially declared as agriculture land. The irrigation system in the study area is combined to the gravity and water lifting system. Some wells were located in the new cultivated areas

2. Drinking and domestic: All water for drinking and domestic purposes are processed and treated Nile water.

Figure 5-13

Hydrogeological Map of the Study Area

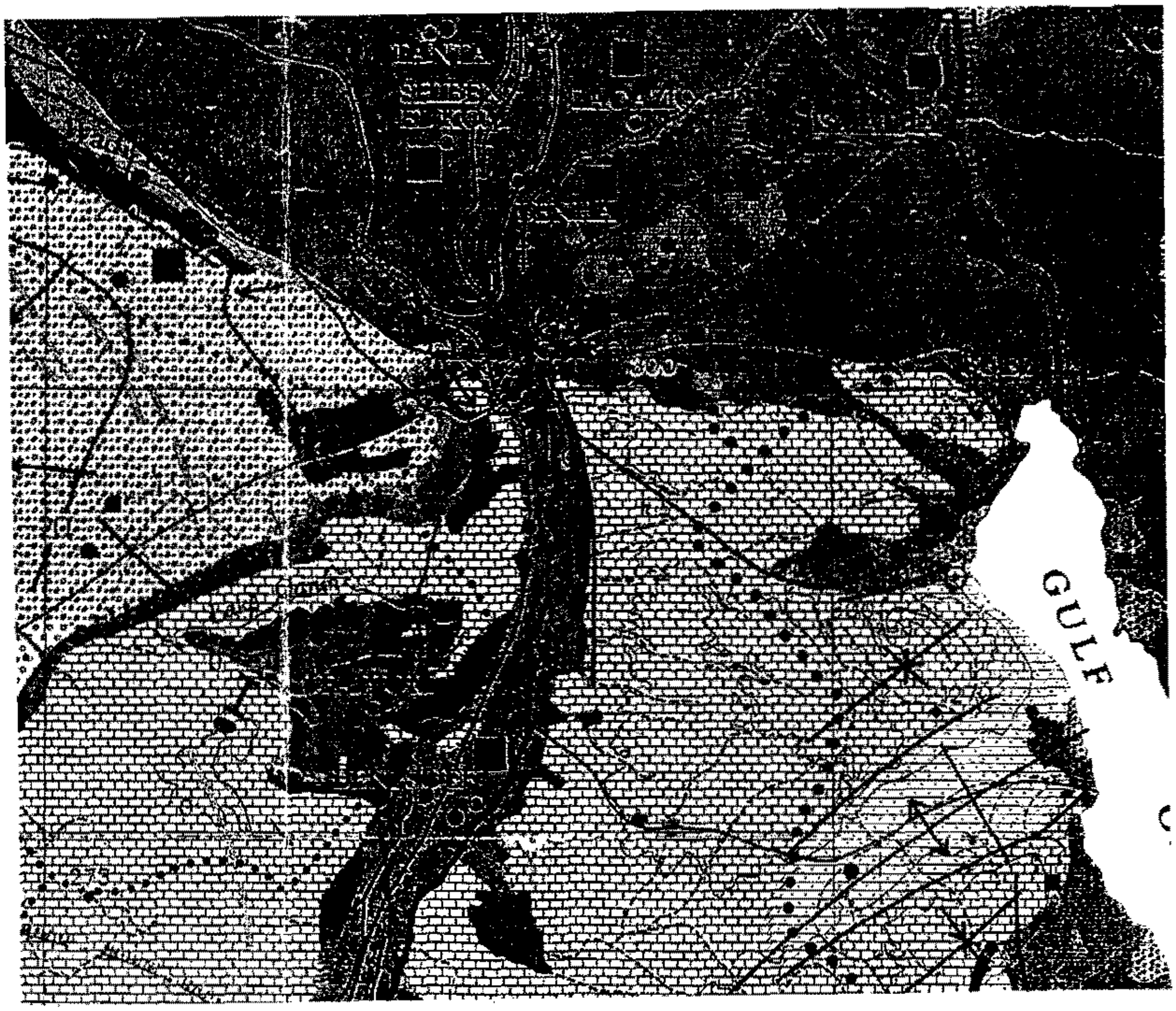


Figure 5-13 *(Contd.)*

Hydrogeological Map of the Study Area

LEGEND

I GROUNDWATER AND ROCKS

INTERGRANULAR AQUIFERS

Exten... and highly productive aquifer

Extensive or local, generally moderately productive aquifer

FISSURED AQUIFERS, INCLUDING KARSTIFIED ROCKS

Extensive or local, generally moderately productive aquifer

REGIONAL MIXED INTERGRANULAR AND/OR FISSURED AQUIFERS (NUBIAN COMPLEX)

Extensive, moderately to low productive aquifer

ROCKS WITH LIMITED GROUNDWATER RESOURCES

Extensive or local, low productive aquifer

Hard rocks (igneous or metamorphic rocks), local groundwater occurrence in fissured and weathered zones

NON AQUIFERS

IV MAN-MADE FEATURES

Main irrigation canal

Main irrigation canal (under construc

Main drain

Main navigation canal containing saim

Pipeline for water supply from surface

Surface water pumping station

Barrage or dam

Syphon or tunnel

Sluice or lock

GROUNDWATER EXTRACTIC DISCHARGE IN 1991 IN m^3/yea

Extraction per district

Less than 10 million m^3/year

10 to 50 million m^3/year

More than 50 million m^3/year, amour indicated in million m^3/year

Extraction in desert areas

Figure 5-13 *(Contd.)*

Hydrogeological Map of the Study Area

II LITHOLOGY

QUATERNARY

TERTIARY

MESOZOIC

MESOZOIC-PALEOZOIC

III SURFACE WATER FEATURES

V GROUNDWATER FEATURES

WELLS AND BOREHOLES

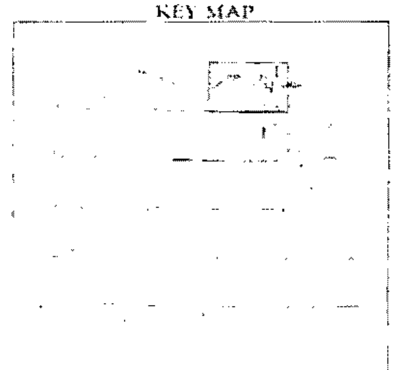
INTERPRETATION NOTES

VI TOPOGRAPHICAL AND GEOLOGI INFORMATION

A — A'

VII ADDITIONAL SYMBOLS FOR THE CROSS-SECTIONS

KEY MAP



5.2.6 Natural Hazards

Earthquake

Generally, the distribution of the earthquake epicenters in Egypt is mainly located along the main three trends (systems) as shown in (*Figures 5-14 and 5-15*). These trends are:

- Gulf of Aqaba – Dead Sea (Levant) trend ,
- Red Sea , Gulf of Suez , Cairo – Alexandria trend and
- Fayum – Cairo – Pelusium trend.

In fact, the area under the consideration is located in the intersection between the Gulf of Suez and Cairo-Fayum main trends (*Figures 5-16, 5-17 and 5-18*). The area is characterized by the occurrence of shallow, micro, small moderated and large earthquakes. The activities are mainly attributed to the Red Sea– Gulf of Suez and Cairo – Fayum systems.

After the ***Dahshour earthquake (1992),*** the following features were observed:

a- Liquefaction

It is very pronounced at Atfeih,Menyet Al-Saff and other areas, the water level increased about one meter over some cultivated lands. The trend of cracks 70 and 90 was also observed on the eastern side of the Nile valley.

b- Fracturing

Kebeasy, 1990, reported that the NW trend is the major active trend in Egypt. He also mentioned that the activities along this trend increased in recent years. Seismicity records show that the area is vulnerable to seismic activities that may reach 4 – 5 on Richter scale.

Hamdan, 1999 reported the extension of the NW faults which affect the Middle Eocene rocks in the area of 15 May City further north.

The study area is vulnerable to earthquakes in the magnitude of 3 – 4 on Richter Scale . This should be taken in consideration during the design and the foundation of the station from the engineering point of view.

Flash Flood

The Atfeih area subjected to the occurrence of flash floods after occasional rainfall showers. Three spillways are located around the study area, these spillways are:

- Al-Dessimy Spillway
- Atfeih Spillway
- Al-Kureimat Spillway

Figure 5-14

Epicenters Distribution of Instrumental Earthquakes' in the Northern Egypt (1900–1997) Modified to Show the Active Seismic Trends
(After Al-Ibiary, 2001)

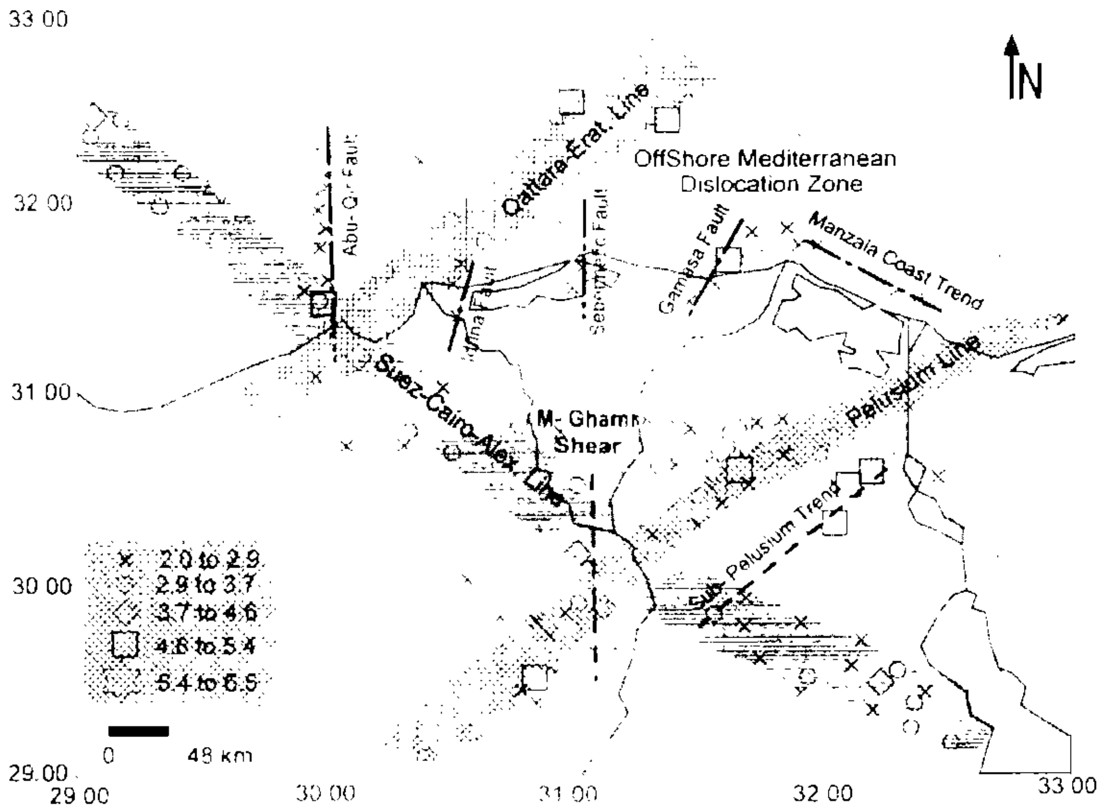


Figure 5-15

Seismicity Map of Egupt
(after Sieberg)

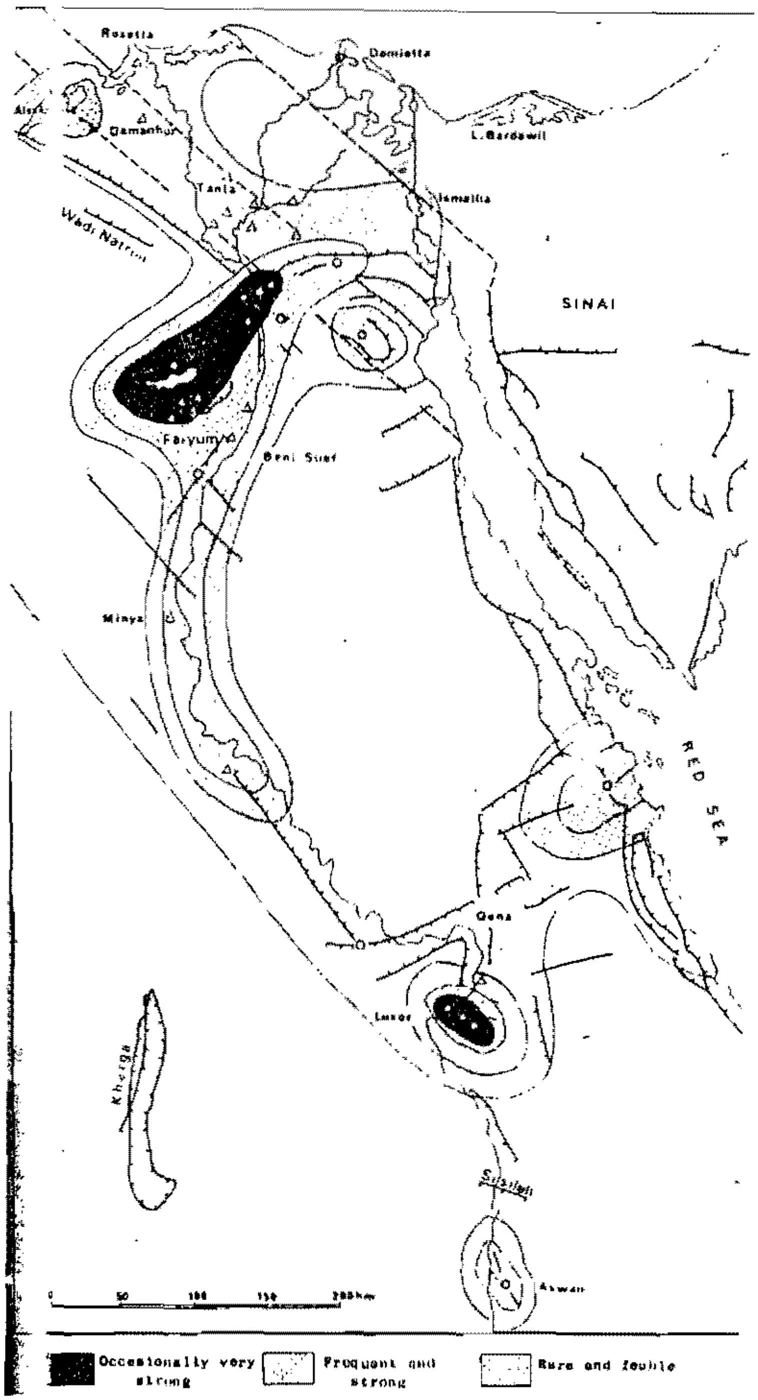


Figure 5-16

Seismicity Map of Egypt and Surrounding Areas during the Period from 1900–1996
(compiled from different authors)

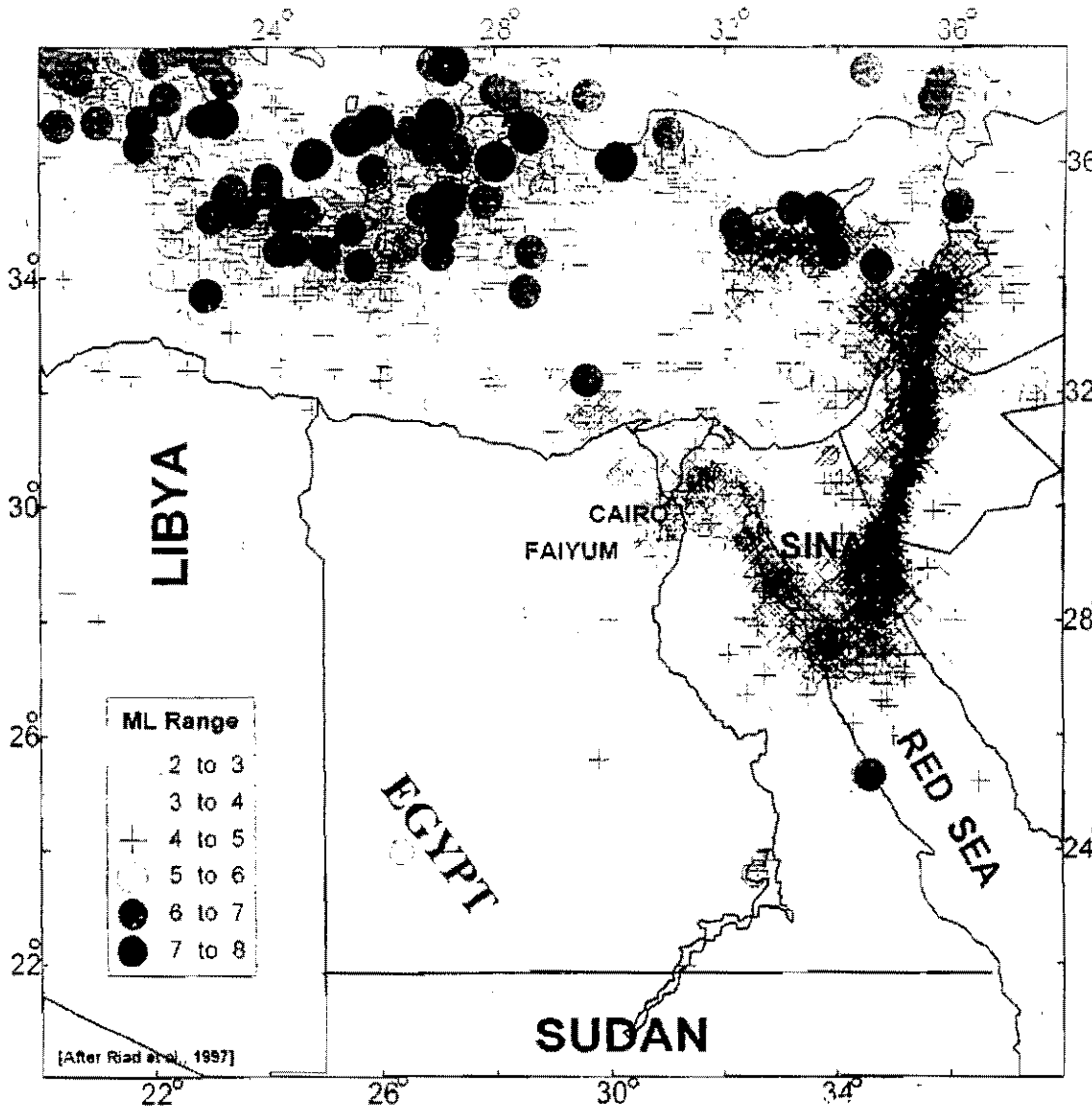


Figure 5-17

Epicenter Distribution of Varying Magnitude Earthquake Focal Mechanism of Principle Earthquakes and Active Seismic Trends
(A, B, C and D after Kebeasy1990)

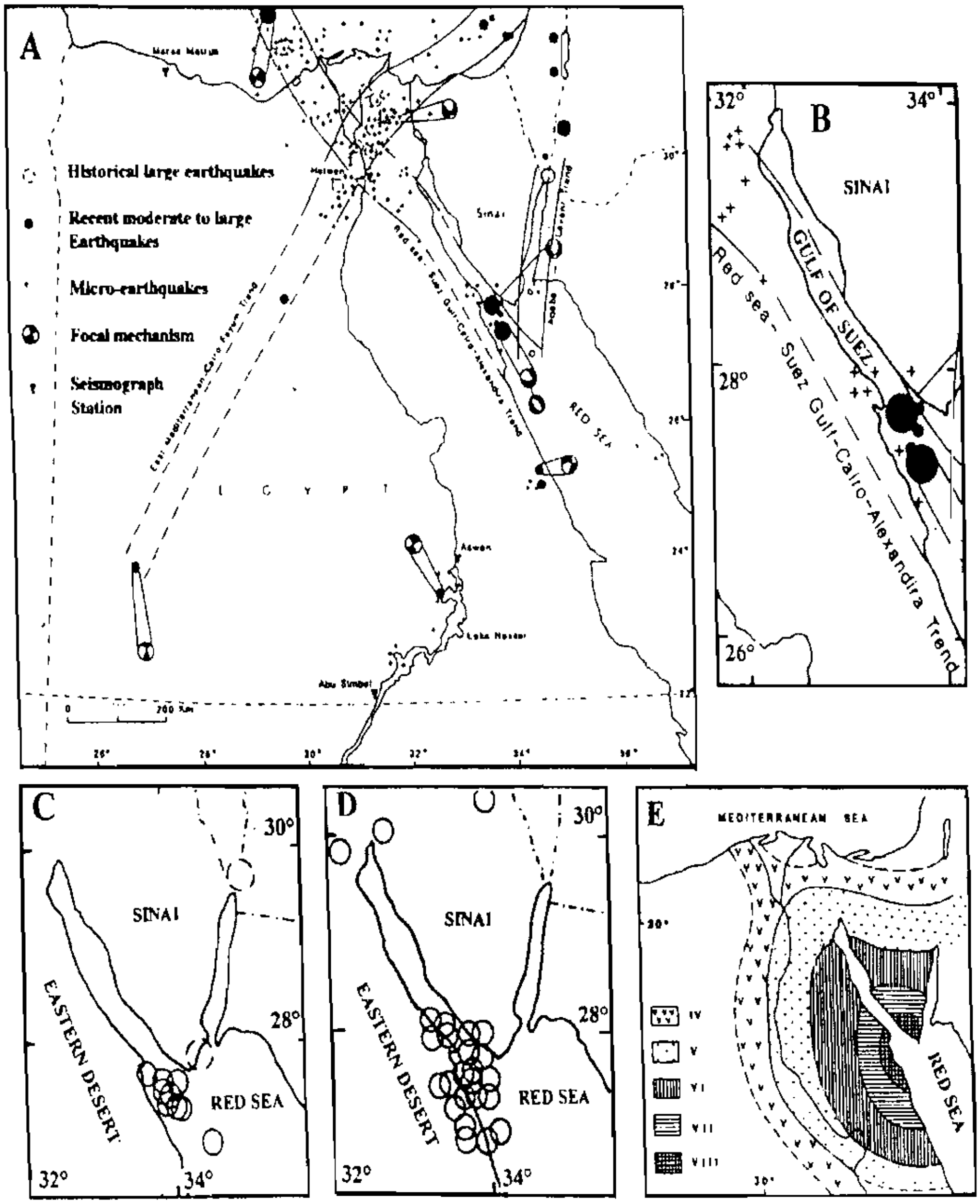
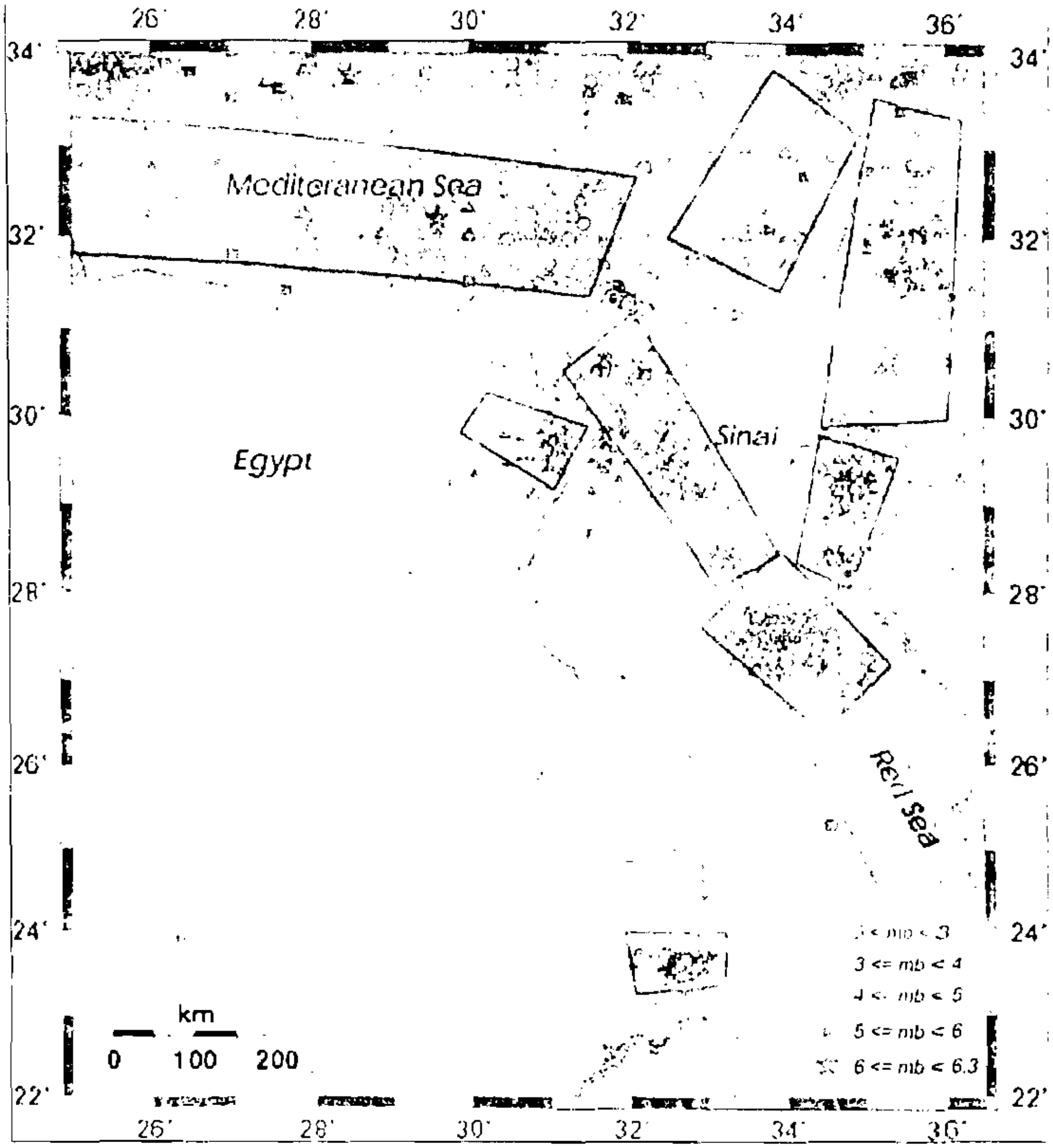


Figure 5-18

Seismic Activity Map of Egypt from 1900 to 2000
Based on Data from NRIAG with the Proposed Seismic Zones
(after Mahmoud 2003)



5.2.7 Man-Induced Hazards

As pollution issues become a problem in several cities all over the world, industrial estates were developed to house a number of industries in one place usually on land peripheral to a city or in its suburbs. Some of these industries pose a sustainable threat to the environment if not well managed.

Smoke

The daily mean concentration of smoke from the industrial areas should not exceed the recommended WHO guide line of 125g/m.

Suspended Particles

The suspended particulates are due to the dust emitted from the limestone quarries in the eastern part of the study area. However, the concentration should not exceed the WHO guide line of 60 – 90 g / m.

Siltation

Siltation in the River Nile near the water intake should be monitored routinely to avoid clogging or capacity reduction. Periodic mechanical removal of silt by drag-line type shovels may need to be carried out to the site. To avoid possible slope failure of the river banks near the intake tunnel and the outlet discharge tunnel, stone lining of the banks, in the conventional manner, need to be considered.

High – Tension Power Lines

High tension power lines that extend away from the power station should be sited to avoid human settlements and other ancillary human activities. The electromagnetic field encircling these lines isknown to have a negative effect on health and communications. Human activities should be kept at a distance from these lines calculated according to conventional standards.

Water Hyacinth

The excessive growth of ***Water Hyacinth (Ward Al-Nile)*** is a problem of national dimension because of the nutritive – nature of the Nile water due to the extensive fertilization of the agricultural land. Mechanical collection of Water Hyacinth and its disposal on land is the common national remedial practice. The water intake tunnel should be protected from the invasion of the floating plant.

5.3 CLIMATE AND METEOROLOGY

5.3.1 Introduction

Both local and regional climatic characteristics play an important role in the dispersal of pollutants in the atmosphere. To understand the potential impacts from a given industrial source, both local and regional climatic conditions and short and long term meteorological factors must be considered. The principal meteorological parameters, which affect the dispersal of airborne pollutants, are the following:

- wind speed, direction and temporal distribution;
- atmospheric stability;
- mixing height (the height below which there is significant mixing within the atmosphere); and
- precipitation (which affects the deposition of the pollutants).

Both micro and macro meteorological factors affecting the general climatic conditions in the region of the proposed site have been examined in this assessment.

5.3.2 Regional Climatic Conditions

This section describes regional climatic conditions in the Helwan South area. *Tables 5-1, 5-2 and 5-3* summarize climatic information available for the area using 35 year monthly rates data.

Climate Characterization

The climate of the Helwan South site is one of the mildest in the Mediterranean sea. Winter temperatures are higher than in any other part of the Mediterranean coast. Generally, this climate, however, gradually changes as one moves south and at about 40 to 50 km inland, it merges into Mediterranean saharian climate. As far the area occupies a portion of the Mediterranean zone, it has a special climate which differs from the inland areas. It is characterized by a comparatively high humidity, frequent dew formation and small diurnal temperature variations.

The climate of the region is caused primarily by the sub-tropical high pressure belt that is prevalent in this area, leading to clear skies for most of the time. The prevailing winds are northerly and can become strong during the winter. The northerly winds are caused by a sub-tropical high pressure cell in the western desert of Egypt during the winter months and by the western edge of a huge Asiatic low pressure cell over northwestern India during the summer. The sparse rainfall in this area usually falls in the form of showers during the cold season (December, January, February) while under the influence of cold upper level troughs to the north. The highest temperature generally occurs in June through August when tropical continental air masses arrive from western Syria and Iraq on northeast winds while the lowest temperatures are recorded in January and February as polar continental air masses to the north are dragged down in the rear of winter Mediterranean depressions. Relative humidities remain low for most of the year reaching a maximum in November and December or January and a minimum in April and May or June.

Summaries of climatic variables for the site region are available from meteorological data collected at Helwan. The Helwan data furnish wind speed, wind direction, temperature, pressure, precipitation and relative humidity information that are considered to be representative of the Helwan site. Atmospheric stability information is also available from the

Helwan meterorolgical station and Shoubrah El-Kheima monitoring program Phase II Report based on data collected at Shoubrah El-Kheima power plant site.

Wind Profile

A 35-year Helwan data base (1974-2009) indicates a prevailing northerly wind at the site (35 percent from North quadrant) with a secondary maximum of winds from the North quadrant (32 percent) followed by North-North-eastrly winds (23 percent) and winds from the North-North-West quadrant (18 percent) and then westerly-southerly winds and other directions (8.4 percent). Calm and variable winds occur approximately 18.6 percent of the time. Wind speeds and directions measured for 2009 are shown on the Wind Rose in *Figure 5-19*. Wind speeds are generally light to moderate with an annual-average speed of approximately 4.23 meters per second and rarely exceed 5.0m/sec. (*Table 5-2*).

Temperatare

The temperature data collected at Helwan for a 35 year period indicate a maximum daily-average temperature of 34.9°C in July and a minimum daily-average temperature of 7.5°C in December. Summertime high temperatures average 34.1°C while winter lows reach 8.6°C. The annual-average temperatures is 21.6°C with record highest and lowest temperatures of 47.5 and 7.5°C, respectively.

Pressure

Air pressure in the Helwan area remains generally high throughout the year. The mean atmospheric pressure value decreases gradually from December (1019.1 mbar) to July (1008.6 mbar) before rising again to reach 1019.1 mbar during December.

Rainfall

The annual rainfall precipitation does not exceed 25 mm. Rain falls showers and varies considerably from year to year. Generally, the rainfall is scarce over most of the year and occurs occasionally in the form of sudden and short signals associated with the northwest wind.

Relative Humidity

Annual mean of relative humidity is about 46% with maximum value of 69% in November and minimum value of 46% in May. Relative humidity does not vary greatly through the year, staying between 46-58% at none and between 59-69% in the morning and in the evining.

Evaporation

Natural evaporation rate ranges from 3.9 mm/d in January to 5.8 mm/d in May. It means that the evaporation rate is high from March to October and is low in winter season.

Atmospheric Stability

The atmosphere stability information derived from the Shoubrah El-Kheima Phase II Report indicates that unstable and neutral conditions occur more frequently (65 percent) than stable conditions (35 percent). However, very stable conditions (Class 7) occur most frequently of the seven stability classes at a frequency of 23 percent. These data alongwith the climatic information points toward generally poor dispersion conditions prevailing during the night-time hours.

Sources of Air Pollutants

The general absence of rainfall minimizes washout, normally an important mechanism for removing air pollution from the atmosphere. Stable atmospheric conditions also reduce dispersion. As a result, air pollutants in Helwan South's atmosphere for long periods, building up and increasing the potential for human exposure and formation of secondary pollutants such as ozone. Air pollutants that fall from the atmosphere through dry deposition (e.g. particulates) are not washed from the ground by rainfall and can be readily re-entrained by winds. There is an air quality monitoring station in the area northern the site, at around 7.5 km within the Kureimat Power Complex boundary from which a background air quality characterization can be made. Site observations throughout the year 2009 have demonstrated that there are no major sources of air pollutants in the area. Therefore, the availability of background data is not critical to this assessment. Based on the existence of some industrialization in the wider area and the fact that the Helwan South and other zones of the Helwan Governorate wider area are identified as Helwan South's zones, it is assumed that the air quality of this location is characteristic of a rural setting with low anthopogenic sources of air pollution. Preconstruction ambient air monitoring, which would be conducted during the next phase of project development, would present guidance on the background air quality characteristics.

Table 5-1

Temperature, Humidity and Rainfall Information for the Proposed Site (35-year monthly rates)

(Base[illegible] Weather Monitoring at the Helwan Station)(*)

Month	Temperature (°C)				Humidity	Rainfall (mm/day)	
	Av. Daily Max.	Av. Daily Min.	Highest Daily Max.	Lowest Daily Min.	Relative Humidity (%)	Total Monthly	Max. in Single Day
January	18.4	8.4	31.1	8.4	60	3.7	13.4
February	20.1	9.8	34.1	9.8	54	3.7	19.5
March	23.7	12.1	39.5	12.1	50	2.5	11.9
April	28.1	14.3	43.1	14.3	42	0.8	10.4
May	32.4	17.8	46.7	17.8	41	1.6	27.5
June	32.8	19.9	47.5	19.9	44	0.02	1.4
July	34.8	21.3	45.3	21.3	52	0.0	0.0
August	34.9	21.6	43.8	21.6	55	0.0	0.0
September	32.7	20.3	42.4	20.3	55	0.0	0.0
October	29.9	18.3	42.6	18.3	55	0.7	21.7
November	26.2	14.4	37.4	14.4	59	2.6	23.8
December	19.8	7.5	35.0	7.5	60	5.0	32.7
Annual-average	27.81	15.48			59.9	20.62	

Notes:

(*) This data is extracted from Helwan meteorological station Records, and it covers area of 50 km.

Table 5-2

Wind Speed Information for the Proposed Site (Knots)
(35-year monthly rates)
(Based on Weather Monitoring at the Helwan Meterorological Station)[1]

Month	Av. Monthly Speed (Knots[2])	Highest Hourly Av. (Speed/ Direction)[3]	Date of Occurrence (Day/Year)	Highest Sudden Plast of Wind [3] (Speed/Direction)	Date of Occurrence (Day/Year)
January	6	26/220	17/81	45/240	17/18
February	7	30/190	18/81	50/220	3/92
March	8	28/190	22/85	50/180	22/85
April	10	32/200	16/81	49/340	12/71
May	10	28/280	2/97	54/290	2/97
June	10	20/360	5/77	35/240	13/71
July	9	16/030	3/78	27/010	9/84
August	8	14/010	24/77	23/360	29/69
September	9	20/070	29/77	33/020	11/71
October	9	33/240	9/89	33/240	23/76
November	8	22/240	28/69	38/220	24/76
December	7	25/260	14/77	45/260	14/77
Annual-average	8.42				

Notes:

(1) This data is extracted from Helwan meteorological station Records, and it covers area of 50 km.
(2) Knot = 1.85 km/hr.
(3) Highest hourly average and highest sudden plast of wind are provided based on weather monitoring at the Bahtim (northeast Cairo) meteorological station.

Table 5-3

Fog, Mist and Storms Information for the Proposed Site (days/month), (35-year monthly rates)

(Based on Weather Monitoring at the Helwan Meteorological Station)(*)

Month	Fog (no. of Days)	Mist (no of days)	Stirred up Sands/ Duststorms (No. of days)	Thunderstorms (No. of days)	Gales (No. of days)
January	0.3	0.3	0.8	0.02	0.02
February	0.1	0.1	0.4	0.02	0.1
March	0.1	0.1	1.0	0.1	0.2
April	0.0	0.1	1.1	0.04	0.2
May	0.02	0.1	0.6	0.0	0.2
June	0.0	0.0	0.1	0.0	0.0
July	0.0	0.0	0.0	0.0	0.0
August	0.0	0.02	0.1	0.0	0.0
September	0.0	0.0	0.1	0.0	0.0
October	0.1	0.1	0.2	0.04	0.0
November	0.1	0.2	0.1	0.2	0.02
December	0.2	0.2	0.2	0.02	0.02

Notes:

(*) This data is extracted from Helwan meteorological station Records, and it covers area of 50 km.

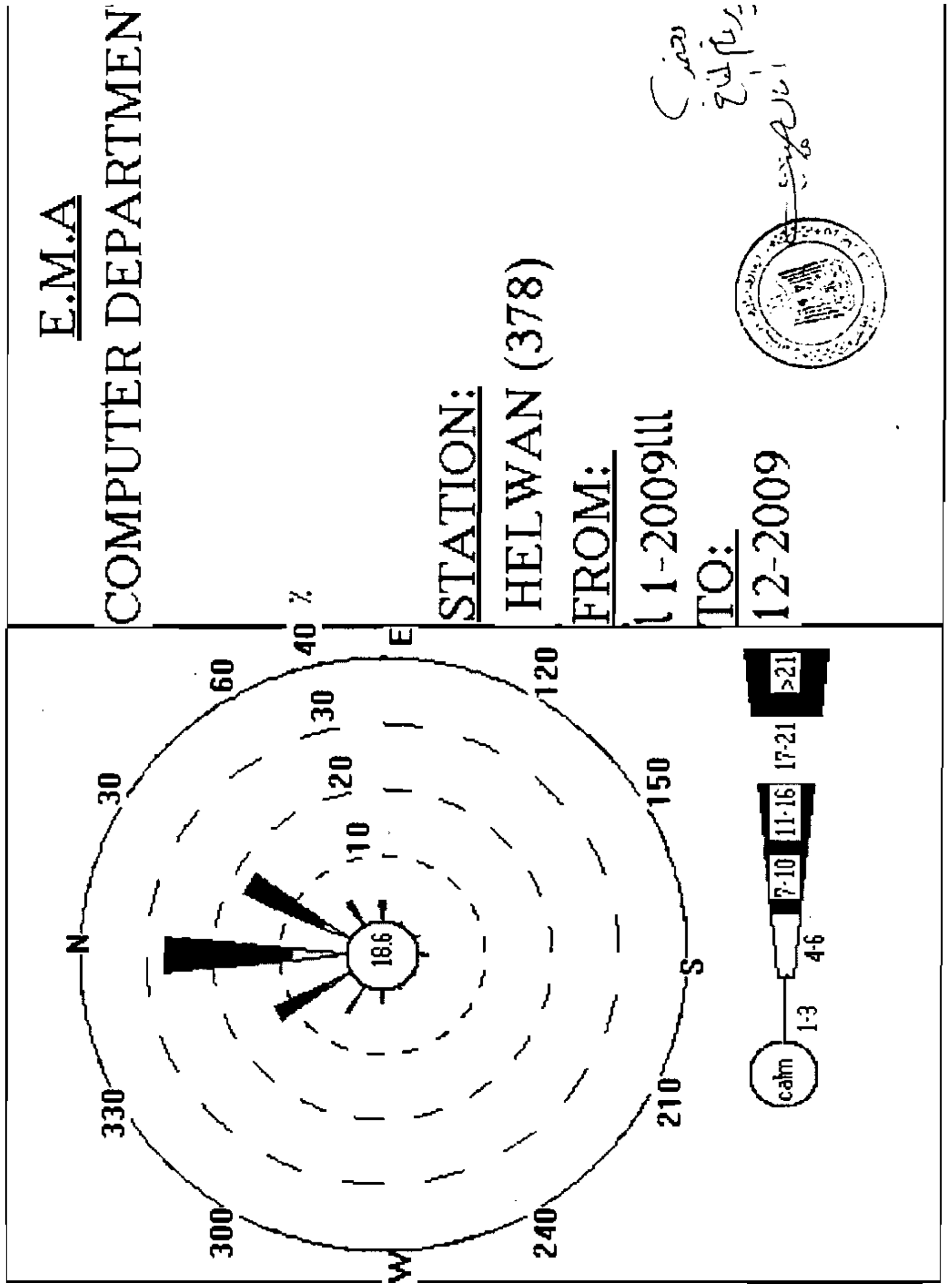
Table 5-4

Summary of the Seasonal Storms (Nawat)

No.	Local Storm name	Expected Date of Occurrence	Approximate Duration
1.	Nawat El-Saliba	September - 27	3 days
2.	Nawat El-Saliba	October - 21	3 days
3.	Nawat El- Maknassa	November- 26	3 days
4.	Nawat Kassem	December- 4	3 days
5.	Nawat El-Fida	December- 26	2 days
6.	Nawat El-Ghatas	January - 11	3 days
7.	Nawat El- Fida El-Kabira	January - 19	5 days
8.	Nawat El-Karam	January - 29	2 days
9.	Nawat El-Shams	Febrewary - 8	5 days
10.	Nawat El-Hosoum	March - 10	8 days
11.	Nawat El- Shams El-Kabira	March - 20	2 days
12.	Nawat El- Aowa	March - 25	6 days
13.	Nawat El-Khamassin	April - 30	-----
14.	Nawat El-Nokta	July - 18	-----

Figure 5-19

Wind Rose of Helwan South
(Helwan Meteorological Station, 2009)



5.4 AMBIENT AIR QUALITY

5.4.1 Ambient Air Quality Data

Introduction

Concentrations of ambient pollutants vary according to both time and location. They are affected by many factors, the most significant being the size, number and location of emission sources and the prevailing weather.

Nitrogen dioxide is the only significant pollutant emitted to the atmosphere from a gas fired power plant, with respect to human health effects. The other combustion products of natural gas are CO_2 and H_2O. When fuel oil is burnt, SO_2 and particulate matter become significant emissions of concern.

Monitoring at the Site

Air quality monitoring at the proposed site was undertaken by the Air Pollution Preclusion Department, National Research Center during October 2010 on behalf of the UEEPC/EEHC. Monitoring took place at five monitoring points located at the center of the proposed site and the boundary four points at the four geographical directions as shown in *Figure 5-20.*

Continuous measurements, over a period of 24 hours, were taken for nitrogen oxides (NOx), carbon monoxide (CO), carbon dioxide (CO_2), sulfur dioxide (SO_2), aldehydes (HCHO), hydrogen sulfide (H_2S), smoke and total suspended particulates (TSP). The results of this monitoring are shown in *Table 5-5 and Table 5-6* below. Comparison with Egyptian Threshold Limit Values (TLVs) (as stipulated in *Law 4/1994 and Law 9/2009*) show that the concentrations of gaseous pollutants in ambient air at the proposed site are within the TLVs for 24 hour averages.

Figure 5-22

Helwan South Site Plan and the Selected Monitoring Locations

Table 5-5

Mean Concentrations of Gaseous Air Pollutants at the Proposed Project Site
(Measured by the National Research Center (NRC) for 24 hour average)

Site No.	CO (mg/m^3)	CO_2 (mg/m^3)	SO_2 ($\mu g/m^3$)	NO_2 ($\mu g/m^3$)	HCHO ($\mu g/m^3$)	H_2S ($\mu g/m^3$)
1 (Center)	1.18	199.41	10.15	15.90	29.43	9.13
2 (North)	1.15	108.22	6.49	11.25	19.13	1.65
3 (South)	1.17	182.93	8.36	10.30	31.28	13.04
4 (East)	1.15	180.08	7.19	11.13	26.12	15.18
5 (West)	1.17	176.75	7.07	11.89	28.05	18.53
Mean	**1.16**	**169.48**	**7.85**	**12.09**	**26.80**	**11.51**
EEAA TLV(1)	**10(2)**	-	**150**	**150**	-	-

Notes:
(1) Egyptian Standard for Threshold Limit Value for Ambient Air Quality(24 hour means)as stipulated in Law 4/1994 and its amendment (Law 9/2009).
(2) 8 hours mean.

Table 5-6

Mean Concentration of Non-Gaseous Air Pollutants at the Proposed Project Site
(Measured by the National Research Center (NRC) for 24 hour average)

Site No.	TSP ($\mu g/m^3$)	Smoke ($\mu g/m^3$)
1 (Center)	309.39	139.32
2 (North)	427.47	75.92
3 (South)	449.44	195.41
4 (East)	352.12	92.26
5 (West)	360.06	57.47
Mean	**379.70**	**112.08**
EEAA TLV*	**230**	**150**

Notes:
* Stipulated by the Law 4/1994 and its amendment (Law 9/2009).

The levels of particulate matter, which ranged between 309.39 and 449.44 $\mu g/m^3$, exceeded Egyptian standards for maximum 24 hour mean concentrations at all measurement sites on some occasions. Exceedences are likely to be due to emissions of particles from dry surfaces, vehicle exhausts and industrial processes. These levels are likely to decrease as future Helwan air improvements and mitigation programs achieve progress.

The level of smoke at measurement points are likely to be due to machinery used in various activities (agriculture-type machinery uses to the west of the site) and traffic, especially heavy trucks, passing east of the proposed site.

Whatever reasons are for the high dust level, it should be noted that the contribution of the power project activities during construction phase (mainly due to movement of vehivles and humans, including construction operations) will be neglected relative to the existing background, especially in the presence of all mitigation measures (see Section 8).
During operation, the contribution of the power plant will be less than 1.3% of the existing background level, because dust emissions generated by natural gas combustion are traces.

The power plant monitoring program (see Section 8) will give a clear evidence that the continued violation of air quality is not attributed to the project.

5.4.2 Existing Sources of Atmospheric Pollutants

The key existing sources of atmospheric pollution in the project area comprise the following:

- operations at the various machinery uses with agriculture-type and small industries-type facilities to the west and north of the proposed site (resulting in elevated levels of particulate matter and smoke); and
- vehicles using the major arterial road along the eastern edge of the proposed site.

On the basis of the monitoring data available for the proposed site and from observations made at the site, the air shed around the project site is likely to have the general characteristics of South Helwan area air shed. Air pollution in Helwan results from automobile exhaust and several types of industrial emissions. Washout by rain, an important mechanism for removing air pollution from the atmosphere is not effective in clearing Helwan's atmosphere because of the area's very limited annual rainfall. Air pollutants that fall from the atmosphere through dry deposition are not washed from the ground by rain and therefore can be readily re-entrained by winds.

As a result, air pollution in Helwan exceeds health standards, in terms of partuclate and smoke pollutants.

Ambient concentrations of TSP and PM_{10} are likely to exceed WB guidelines for determining air sheds of moderate quality. Short term monitoring of ambient air quality at the site (and as given in *Table 5-5*), suggests that ambient concentrations of all other pollutants are well below WB moderately degraded air shed guidelines.

5.4.3 Particulate Matter Constituents

For providing an adequate data base on this information, an analytical study was undertaken for the Helwan South site during October 2010 by the National Research Center. The main outcomes of this study are summarized as below.

Smoke

Samples of smoke were collected throughout the 24 hours during the period of 11-12 October, 2010 at five locations: center of the selected area of the station and the surrounding 4 locations at the 4 geographic directions.

The smoke-particle size ranges on the average between 0.07 µm and 0.1 µm at the 5 study locations.

Due to the small size of its particles, smoke behaves in many ways like a gas and has the same penetration power of a gas. At the same time, smoke does not remain in the atmosphere for long time. The average time for which smoke particles remain in suspension has been estimated as 1-2 days.

Suspended Dust

Samples of fine suspended dust ≤ 0.2 µm in size and those of sizes ranging between 0.2 µm and 10 µm were collected throughout the 24 hours during the period of 11-12 October.,2010 at the five locations. The concentrations of the two fractions of suspended dust were measured, then the percentage of each fraction was calculated as shown in *Table* 5-7. The samples were chemically analyzed and the percentages of their chemical constituents were calculated and listed in Tables 5-8.

Through examining the available results, it can be seen that:
(First) The ≤ 0.2 µm suspended dust percentage reaches on the average 41.50 which is high when taking into consideration the limited size range of this fraction which lies between 0.2 µm and 0.1 µm. The lesser sizes are those of smoke particulates. On the other hand, the suspended particulates ranging in size between 0.2 µm and 10 µm have an average percentage of 58.50, which is low due to the wide range of such fraction.

(Second) The percentages of chlorides, sulphates, ammonium, nitrates, nitrites organic matter and combustible matter increase on the average in ≤ 0.2 µm fine suspended dust.

(Third) The ash is the only exception of the previous finding. The average percentage of this constituent is 53.38 in the 0.2 µm – 10 µm suspended dust and 50.10 in the ≤ 0.2 µm fine suspended dust at the study area. This reflects the high content of 0.2 µm – 10 µm suspended dust of natural dust

when compared with the ≤ 0.2 µm suspended dust. Most of natural dust residue is contained in the ash component.

However, dust resulting from man-made activities, particularly transportation activities taking place near the site still the principal constituent of suspended dust in the area selected for the construction of South Helwan Steam Power Station. This is confirmed by the clear trend of percentages of all chemical constituents of suspended dust (with the exception of ash) to increase – on average–in fine suspended dust ≤0.2 µm when compared with those of 0.2–10µm suspended dust.

Metals in Suspended Dust

Table 5-9 shows the percentages of calcium, sodium, potassium, lead, iron and cadmium in ≤ 0.2 µm and 2-10 µm suspended dust.

Through examining the results, it can be shown that:
There is a clear relationship between the metal concentrations and the difference in the particle size of suspended dust, since the six analysed metals increase –on average- in their concentrations in fine suspended dust less than 0.2 µm when compared with the average concentrations of the six metals in 0.2-10 µm suspended dust.

This phenomenon is expected in such study, since the elemental content of particulates is surface area dependent. The ratio of surface area to volume is inversely proportional to the mean particle size, i.e. as the diameter becomes small, the surface area becomes large. Therefore, the elemental content increases with decreasing in particle sizes.

Table 5-7

Average Concentration ($\mu g/m^3$) and Percentage of Suspended Dust at the Proposed Site

Dust Size	Concentration ($\mu g/m^3$)	Percentage (%)
≤ 0.2 μm	155.97	41.50
0.2-10μm	223.73	58.50

Table 5-8

Water-Soluble and Insoluble Chemical Constituents of Suspended Dust at the Proposed Site, Percentage

Dust Size	Water-Soluble Matter (%)					Water-Insoluble Matter (%)		
	Chlorides	Sulfates	Ammonium	Nitrate	Nitrite	Org.M.*	Comb.M*	Ash
≤ 0.2 μm	0.84	1.96	0.21	0.29	0.09	1.76	33.64	50.10
0.2-10μm	0.45	1.31	0.15	0.14	0.02	0.57	27.37	53.38

Notes:
(*) Org. M. = Organic Matter, Comb. M.=Combustible Matter.

Table 5-9

Metals in Suspended Dust, Percentage

Dust Size	Calcium (Ca)	Sodium (Na)	Potassium (K)	Lead (Pb)	Iron (Fe)	Cadmium (Cd)
≤ 0.2 μm	3.16	1.52	0.39	0.02	1.27	0.002
0.2-10μm	2.72	1.39	0.34	0.01	1.24	0.001

Notes:
(*) N/D = Not Detected.

Dustfalls

Two samples of dustfall were collected throughout 30 days at each of the 5 locations. The rate of dustfall at each of the 5 locations was measured. Then the 2 samples collected at each location were composited and distributed into 5 sizes:
≥ 90 μm, 90-80 μm, 80-63 μm ,63-45 μm and ≤ 45 μm. The frequency percentage of each size in each sample was then calculated as shown in *Table 5-10*. Each size was also chemically analysed and the chemical constituents were calculated into percentages (*Tables 5-11*).

Through examining available results, it can be seen that:
(First) The dustfall of smaller sizes (63 μm – 45 μm & ≤ 45 μm) reaches on average percentage of 62.98 and highly decreases the dustfall of bigger sizes (≥ 90 μm & 90 μm - 80 μm) with an average percentage of 27.06, whereas the dustfall of medium sizes (80 μm –

63 µm) has an average percentage of 9.96. This means that the dustfall at the study area contains both small and big sizes with highly different percentages, and hence it should be treated as dust of small sizes of high percentages and medium and big sizes of less percentages.

(Second) The average percentages of chemical constituents of dustfall indicate a clear trend for increasing with decreasing of particle size. This finding reflects that no interaction between natural dust of big particle sizes and dust of small particle sizes resulting from man-made activities, particularly transportation ones taking place near the site as a source of dustfall in the area selected for construction of South Helwan Steam Power Station.

Metals in Dustfalls

Table 5-12 show the percentages of calcium, sodium, potassium, lead, iron and cadmium in ≥ 90 µm, 90-80 µm, 80-63 µm, 63-45 µm and ≤ 45 µm dustfall size fractions.

Through examining the results, it can be shown that:
There is a clear relationship between the ncentrations of the elements and the difference n particle size of dustfall, all measured ents show a clear trend or increasing with ecreasing of dustfall particle size.

This finding indicates that no in action between natural dust carried by wind and the local dust resulting from the human activities, particularly the transportation ones had occurred. An important factor had contributed in reaching this finding is the long period of the dustfall sampling (30 days). Generally, it can be said that the natural dust has an important role in polluting the atmosphere of the study area.

It should be noted that the dustfall originates from suspended dust which remains in the atmosphere for a periods differ with particle size before it deposits on the earth's surface. Through this time, suspended dust particles are exposed to physical and chemical changes due to the prevailing meteorological conditions and chemical reactions occur for them in atmosphere.

Table 5-10

Average Rate of Dustfall (in gm/m²/month) and Percentages of Different Sizes (in μm) at the Proposed Site

Average Dustfall Rate (gm/m²/month)	Dustfall Size (%)				
	≥ 90	90-80	80-63	63-45	≤ 45
10.87	11.43	15.63	9.96	16.36	46.62

Table 5-11

Water-Soluble and Insoluble Chemical Constituents of Dustfall at the Proposed Site, Percentage

Dustfall Size (μm)	Water-Soluble Matter (%)					Water-Insoluble Matter (%)		
	Chlorides	Sulfates	Ammonium	Nitrate	Nitrite	Org.M.*	Comb.M.*	Ash
≥ 90	2.12	2.45	0.19	0.62	0.01	2.87	6.06	47.06
90-80	2.68	2.69	0.23	0.75	0.01	3.31	6.17	50.09
80-63	2.98	3.29	0.34	0.80	0.02	4.97	8.94	50.08
63-45	3.27	4.56	0.50	0.93	0.05	5.48	9.10	53.66
≤ 45	3.41	5.72	0.58	1.12	0.05	10.16	10.09	57.69

Notes:
(*) Org. M. = Organic Matter, Comb. M.=Combustible Matter.

Table 5-12

Metals in Dustfall, Percentage

Dustfall Size (μm)	Calcium (Ca)	Sodium (Na)	Potassium (K)	Lead (Pb)	Iron (Fe)	Cadmium (Cd)

≥ 90	2.85	1.33	0.48	0.01	1.28	0.001
90-80	2.96	1.42	0.48	0.01	1.32	0.002
80-63	3.12	1.42	0.56	0.02	1.40	0.002
63-45	3.53	1.44	0.59	0.03	1.47	0.002
≤ 45	4.41	1.63	0.66	0.04	1.63	0.003

Summary

It can be extracted from the present study of the solid air pollutants analysis in selected area for construction of 2 x 650 M.W. South Helwan Steam Power Station that:

1. Smoke particulates ranges in size between 0.07 and 0.1 µm on average.
2. The ≤ 0.2 µm suspended dust reaches on average 41.50 % which is high when taking into consideration its limited size range which lies between 0.2 and 0.1 µm.
3. Dustfall contains both small and big sizes with highly different percentages, more distribution of small sizes and less distribution of medium and large sizes
4. The concentrations of chlorides, sulphates, ammonium, nitrates, nitrites, organic matter and combustible matter increase in ≤ 0.2 µm fine suspended dust.
5. The concentration of ash increases in 0.2-10 µm suspended dust.
6. The concentrations of water–soluble and insoluble constituents of dustfall indicate a clear trend for increasing with decreasing of particle size.
7. There is a clear relationship between the concentrations of calcium, sodium, potassium, lead, iron and cadmium and the difference in size of suspended dust. The concentrations of the six metals increase with decreasing in particle size.
8. There is a clear trend for increasing of the metal content with decreasing of dustfall particle size.

5.5 AQUATIC ENVIRONMENT

5.5.1 Introduction

The data on the existing aquatic environment has been assimilated from discussions with the Hydraulics Research Institute, the National Research Center, the Institute of Environmental Studies & Reaeach-Ain Shams University and a review of relevant literature, which comprised:

- Prof. Dr. Khaled Abdel-Hai Ramadan, Dr. Ahmed Amin, Prof. Dr. Fathi El-Gamal, Eng. Fahmy S. Fahmy Abdel Halim (October 2010); ***Field Investigation and Hydrogaphic Survey at the Site of the New Helwan South Power Plant Project, 2x650 MWe,*** Hydraulics Research Institute;
- Prof. Dr. Khaled Abdel-Hay, Eng. Ibrahim A. El-Desouky, Dr. Ahmed Amin and Prof. Dr. Fathi El-Gamal (February 2011 and May 2011); ***Helwan South Power Plant-Hydrothermal Numerical Model Study,*** Hydraulics Research Institute; and
- Prof. Dr. Mohamed A. El-Dib and others (December 2010); ***Assessment of Water Quality along Selected Site for the Construction of Electricity Generation Station at Helwan South, Helwan Governorate,*** National Research Center.

The site of the new Helwan South power plant, 3x650 MWe Super Critical Project is locted at km 7.5 upstream El-Kureimat Power Complex on the right hand side of the main road from Cairo to Beni-Sueif. It will use River Nile's water for its once-through cooling water of the supercritical plant, steam turbine generator. Water for cooling will be withdrawn from the River Nile through the intake. The plant cooling water will be discharged back to River Nile through discharge pipe to the outfall structure. *Figure 5-21* depicts a general layout of the plant location.

The water used by the plant includes circulating water for cooling the steam turbine condensers and plant service water. The max design flow for the intake and discharge structures is around 46 m^3/s.

5.5.2 Field Measurements

Field investigation works consist of three item as given below.

Bathymetric Survey

Bathymetric survey was carried out in the vicinity of the project area as can be seen in *Figure 5-22*.

Figure 5-21

Layout of the Location of New Helwan South Power Plant

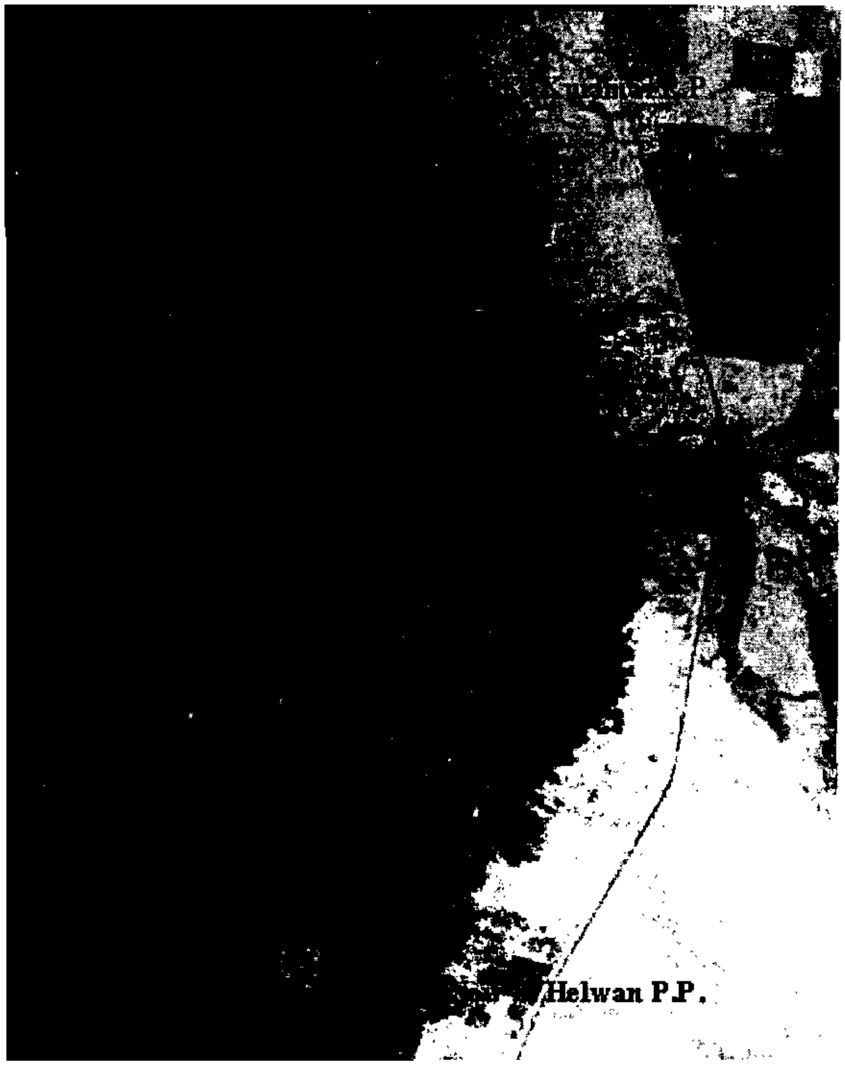
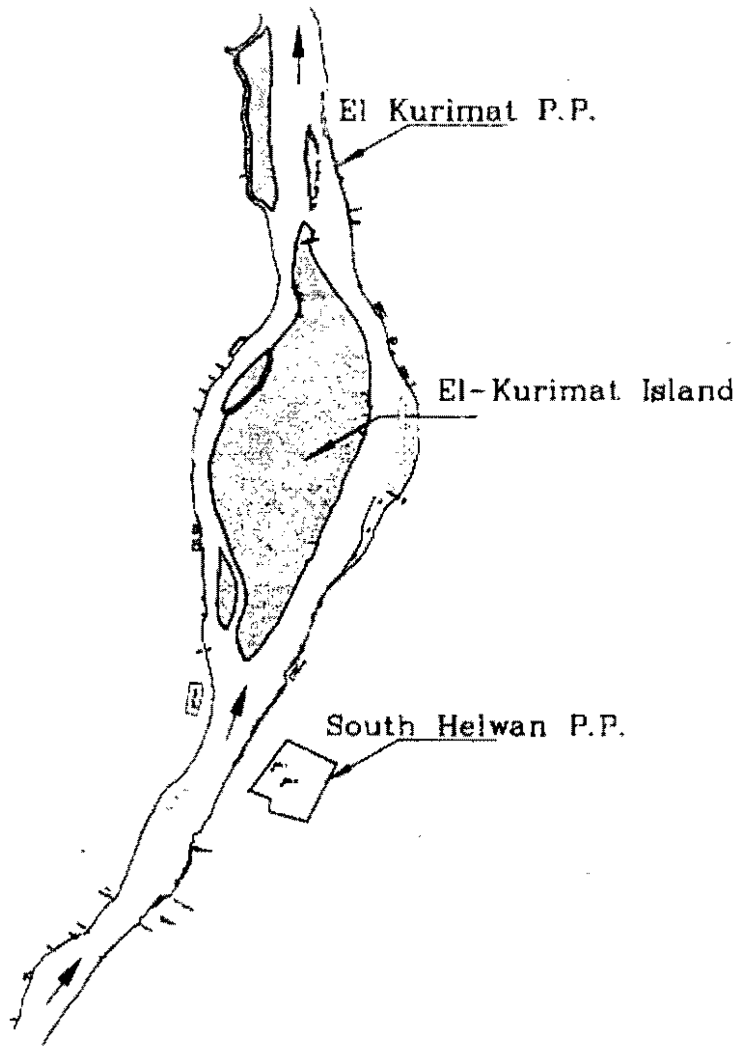


Figure 5-22

Layout of the Surveyed Area



Bathymetric survey provided the following measurements :

- Detailed contour map for the study area.
- Bathymetry of cross sections every 20-50 m apart in the study area.

Hydrometric Survey

Hydrometric survey provided the following data:

- Flow velocity measurements at selected cross sections in the project site
- Water level measurements at the cross sections where the velocity measurements were carried out
- Discharge flow computations based on the flow measurements and cross section profiles.

Bed Material Sampling

Bed material sampling were carried out at the measuring velocity cross sections. Three bed samples were carried out at each cross section. The samples were analysed to obtain the grain size distribution of the bed materials.

5.5.3 Equipment Used for Measurements

The equipment and instruments that were used for field investigation are as follows:

- Two surveying boat, (Rubber Boat).
- Five Geographical Positioning System (GPS) unites, (Lecia and Trimble).
- Total Station, (LEIKA, TS 1700, SWISS).
- Two levelling instruments with micrometer units, (Lecia).
- Two Echo sounder units, (TAMAYA TDM-9000 and Bathy-500MF).
- Two units of Multi cell Doppler Profiler, (SONTEK AND ARGONAUT, USA).
- Meteorological Station, (TAMS 9600).

  - GEOGRAPHICAL POSITIONING SYSTEM (GPS)

Manufacturer : LEICA, Swiz
Model : GPS 500, 1200 and Viva
Number of units: 6 units

Accuracy
Rapid static (phase)
Static mode after initialization
Horizontal: 5 mm + 0.5 ppm (rms)
Vertical: 10 mm + 0.5 ppm (rms)

Kinematic (phase)
Moving mode after initialization
Horizontal: 10 mm + 1 ppm (rms) Vertical: 20 mm + 1 ppm (rms)

  - TOTAL STATION

Manufacturer : LEICA, Swiz **Model** : TC 1700
Number of units: 1 unit

<u>**Accuracy**</u>
Angle accuracy 1.5"
Distance accuracy+/-2mm / 2 ppm on prism
Magnification 30 x Shortest focusing 1.7 m Range1 Prism 3.5 Km

- <u>LEVELING INSTRUMENT</u>

Manufacturer : LEICA, Swiz
Model : NA2
Number of units: 2 unit
<u>**Specifications**</u>

- <u>TAMAYA TDM-9000 ECHO SOUNDER</u>

Manufacturer : TAMAYA TECHNICS INC., JAPAN.
Model : TDM-9000
Number of units : 1 unit
Measurement Range : 0.65m-50m (1/100), 0.65m-100m (1/200)

<u>**Accuracy**</u> : ±2cm±water depth x 1/1000
Transducer Frequency : 200KHz±3KHz
Direction Angle of Transducer: Half value half angle, about 3 °

- <u>BATHY-500MF</u>

Manufacturer : SYQWEST., USA
Model : Bathy-500MF
Number of units : 1 unit
Measurement Range: 0-300 Meters

<u>**Accuracy**</u> : 0-40m (2.5cm), 40-200m (5.0cm), >200m (10cm)
Transducer Frequency : (33-200) KHz
Direction Angle of Transducer: Half value half angle, about 3 °

- <u>BOATS USED FOR BATHYMETRIC SURVEYS:</u>

1) <u>Fiber Rubber boats</u>
Different boats will be used in the bathymetric survey with capacity up to 7 persons, and 55 HP outboard motors.

The dimensions of the big boats are:
Length : 4.7 m
Width : 1.9 m
Draft : 0.25 m
Capacity: 0.7 ton
Motor : 55HP

The dimensions of the small boat are:
Length : 3.96 m
Width : 1.68 m
Draft : 0.20 m
Capacity: 0.5 ton
Motor : 40HP

5.5.4 Methodology

The methodology used to construct the bench marks, carry out the bathymetric and hydrographic survey and bed sampling are explained as follows:

Horizontal and Vertical control

- Constructing two temporary Benchmarks, (BMS) that consist of a concrete block; top area about 0.40 x 0.40 m, and 0.5 m height. The benchmarks were clearly identified by a durable identification tag securely fixed on top.
- Differential Geographical Positioning System (DGPS) was used to measure the global coordinate of two constructed Benchmarks, (BMS). GPS units were placed on these BMS before starting the survey works with sufficient period for accurate determination of their positions
- The vertical control was accurately made with reference to the mean sea level. This was done by leveling between the constructed bench marks (BM1 and BM2) and the existing bench mark of El Kurimat Power Plant.

Table 5-13 presents the coordinates and levels of the constructed BMS.

Table 5-13

Coordinates of the Constructed Bench Marks

Point	UTM		WGS84		Z
	Easting	Northing	Latitude	Longitude	(+MS
BM 1	326600.37	3233607.49	29° 13' 09.705" N	31° 12' 57.914" E	29.11
BM 2	326679.71	3233463.77	29° 13' 05.076" N	31° 13' 00.933" E	36.99

Bathymetric and Topographic Survey

- Topographic survey covered a distance of 10 km of the River Nile at the project area, see Figure 2. The topographic survey was carried out using a hand held units of the GPS. The location of the all land facilities, (roads, structures... etc), were surveyed and attached to the contour maps.
- Bathymetric survey of the Nile River at the project area, (10 km), was carried out by Sounding using Echo sounder that installed on a rubber boat, (for water depth measurements), attached to a GPS unit, (for position measurements).
- The surveyed area was carried out by surveying 199 cross sections perpendicular to the main river flow. The distance between the cross sections was ranged between 20-50 m.
- Intensive bathymetric survey around the existing structures within the surveyed area (groins, intakes or outfalls structures, islands, etc) was implemented.

The measured data is used to develop a contour map using SURFUR software. The facilities within the surveyed area were identified in the contour maps. The developed contour map was produced with UTM coordinate system and 0.5 m contour step and finalized by the AUTOCAD software. The developed contour map is shown in Figure 5-23 (Measured cross-sections are provided in a separate album).

Hydrometric Survey

Flow Velocities and Discharges

Propeller current meters were used for measuring the velocity distribution at 10 cross-sections covering the surveyed area. The hydrometric survey is summarized as follows:

- Velocity measurements were carried out at 10 cross-sections distributed along the surveyed area.
- The locations of the cross-sections are shown in *Figure 5-24*. These cross sections were selected based on the requirements of the models calibrations.
- Number of verticals in each cross section ranged between 9 to17 verticals were specified, depending on the shape and the width of the each cross section.
- The flow velocity was measured at three measuring points for each vertical, (0.2, 0.5, and 0.8 of the local water depth).

Table 5-14 shows the computed discharges at the selected cross-sections based on the velocity measurements. In the table Q is the discharge in m^3/s and WL is the water level with respect to the mean sea level. The measured flow velocity at the measuring cross-sections are presented in *Tables 5-15 through 5-18.*

Figure 5-23

Bathymetry of the Nile River at the Helwan South Segment along the Western Side of the Proposed Site

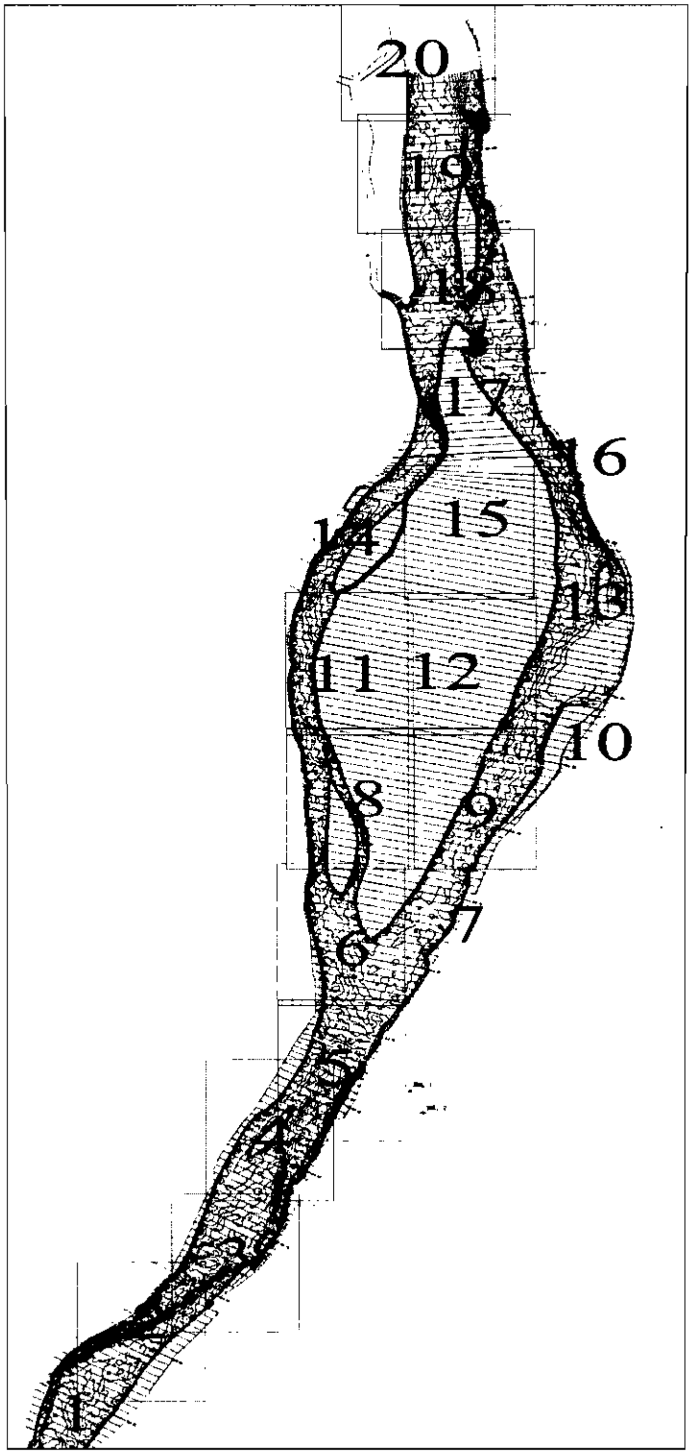

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Figure 5-24

Locations of the Cross Sections Velocity Measurements

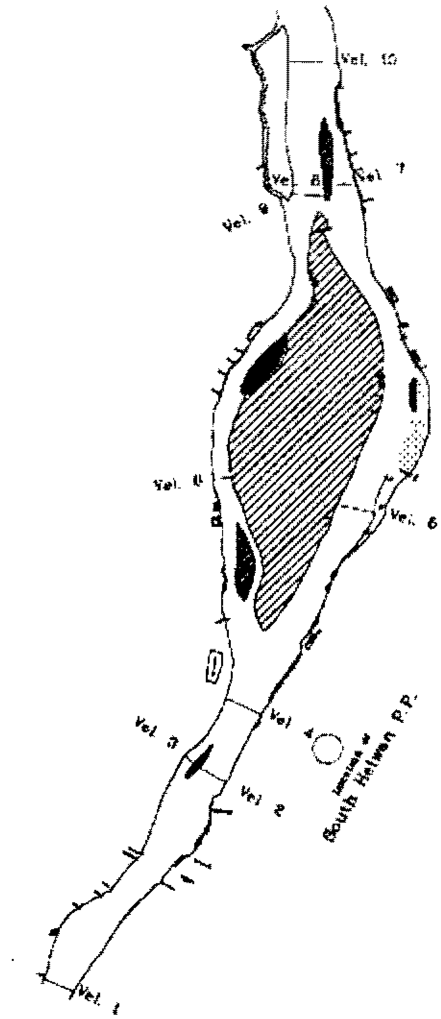


Table 5-14

Computed Discharges at the Selected Cross Sections

Location	Date	Q	WL	Left Bank (m)		Right Bank (m)	
		m^3/s	m+MSL	E	N	E	N
Vel.1	7/11/2010	1126.88	22.40	324240.3	3231210.2	324530.38	3231083.9
Vel.2	7/11/2010	1006.90	22.19	325744.6	3233284.5	325990.00	3233128.0
Vel.3	7/11/2010	117.26	22.19	325687.4	3233394.9	3233319.0	3233319.0
Vel.4	8 /11/2010	1123.09	22.14	325992.9	3233970.1	326333.54	3233804.2
Vel.5	8 /11/2010	549.45	21.94	327054.4	3235849.8	327421.78	3235775.9
Vel.6	8 /11/2010	571.82	21.94	325869.7	3236094.3	326044.10	3236117.1
Vel.7	8 /11/2010	493.83	21.69	326990.2	3238949.0	327234.54	3238975.5
Vel.8	8 /11/2010	569.82	21.69	326606.5	3238866.8	326941.12	3238850.6
Vel.9	8 /11/2010	57.94	21.69	326500.3	3238825.9	326539.51	3238849.3
Vel.10	8 /11/2010	1061.96	21.59	326576.5	3240165.0	327057.12	3240142.0

Surface Currents

The surface current pattern was observed using floats that were released from the boat in several locations within the surveyed area. The float positions were recorded using the positioning system to track the float that determined the direction of the surface current. The results of the surface current are shown in *Figure 5-25*.

Figure 5-25

Direction of Surface Currents

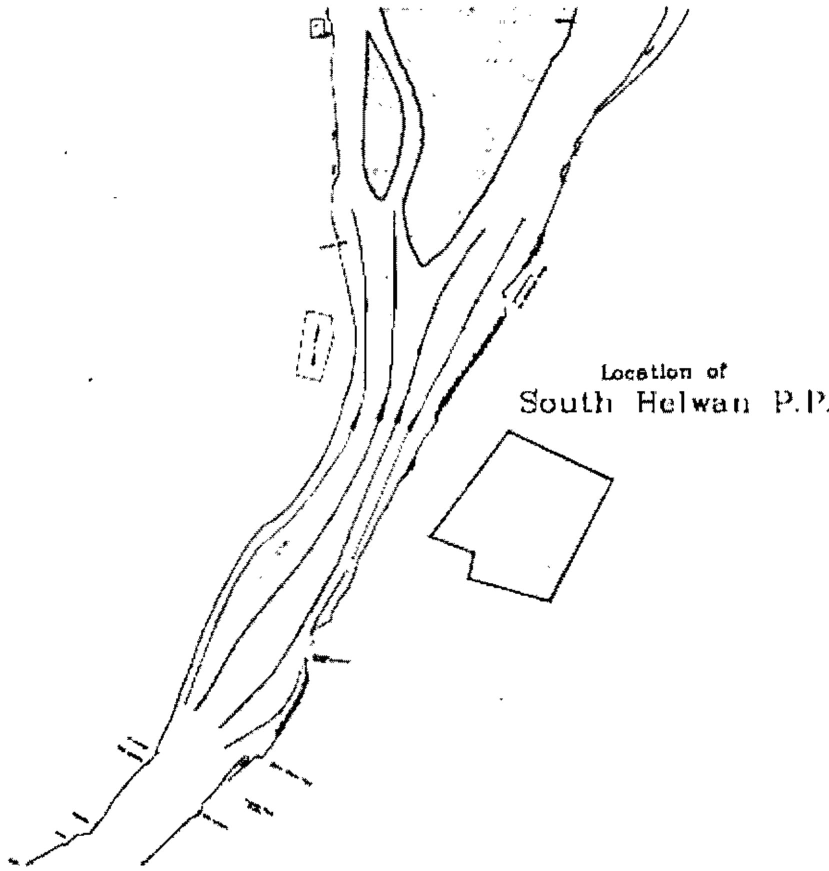


Table 5-15

Velocity Distribution at Vel. 1

Dist. from L.B.	Depth	Point Depth	Point Vel.	AverageVel.	Discharge
m	m	m	m/s	m/s	m^3/s
15	4	0.8	0.328	0.297	33.83
		2.0	0.288		
		3.2	0.283		
38	4	0.8	0.490	0.438	47.46
		2.0	0.437		
		3.2	0.389		
59	4.8	1.0	0.637	0.589	86.73
		2.4	0.589		
		3.8	0.541		
83	6	1.2	0.799	0.750	101.29
		3.0	0.770		
		4.8	0.661		
104	6	1.2	0.951	0.858	111.51
		3.0	0.863		
		4.8	0.756		
126	5.8	1.2	0.953	0.860	85.17
		2.9	0.879		
		4.6	0.730		
143	5.8	1.2	0.990	0.867	84.54
		2.9	0.865		
		4.6	0.748		
160	5.6	1.1	0.961	0.877	114.76
		2.8	0.908		
		4.5	0.732		
183	5.6	1.1	0.964	0.905	95.41
		2.8	0.913		
		4.5	0.828		
202	5.6	1.1	0.969	0.889	94.87
		2.8	0.887		
		4.5	0.812		
222	5.2	1.0	1.054	0.868	64.71
		2.6	0.831		
		4.2	0.756		
237	4.8	1.0	1.006	0.857	97.41
		2.4	0.834		
		3.8	0.756		
263	4	0.8	0.948	0.845	45.93
		2.0	0.839		
		3.2	0.756		
277	3.8	0.8	0.908	0.837	56.11
		1.9	0.834		
		3.0	0.772		
300	3	0.6	0.594	0.598	7.18
		1.5	0.626		
		2.4	0.546		

Table 5-16

Velocity Distribution at Vel. 2

Dist. from L.B.	Depth	Point Depth	Point Vel.	AverageVel.	Discharge
m	m	m	m/s	m/s	m^3/s
18	3.15	0.6	0.804	0.724	82.57
		1.6	0.778		
		2.5	0.538		
53	3.18	0.6	0.868	0.766	56.45
		1.6	0.786		
		2.5	0.626		
76	3.2	0.6	0.834	0.772	58.18
		1.6	0.778		
		2.6	0.701		
97	3.8	0.8	0.927	0.811	129.95
		1.9	0.820		
		3.0	0.677		
130	5.6	1.1	0.961	0.865	169.15
		2.8	0.881		
		4.5	0.735		
163	5.6	1.1	1.030	0.966	133.98
		2.8	0.993		
		4.5	0.847		
187	6	1.2	1.046	0.959	154.23
		3.0	1.006		
		4.8	0.778		
214	5.8	1.2	1.078	0.977	137.88
		2.9	1.009		
		4.6	0.812		
240	5.2	1.0	1.014	0.951	76.70
		2.6	0.974		
		4.2	0.841		
267	3	0.6	0.546	0.435	7.82
		1.5	0.456		
		2.4	0.280		

Table 5-17

Velocity Distribution at Vel. 3

Dist. from L.B.	Depth	Point Depth	Point Vel.	AverageVel.	Discharge
m	m	m	m/s	m/s	m^3/s
15	2.2	0.4	0.799	0.725	25.63
		1.1	0.703		
		1.8	0.695		
32	2.1	0.4	0.770	0.677	36.37
		1.1	0.698		
		1.7	0.544		
56	2.4	0.5	0.722	0.670	31.70
		1.2	0.669		
		1.9	0.621		
77	2.2	0.4	0.727	0.643	21.66
		1.1	0.663		
		1.8	0.517		
101	1.25	0.3	0.328	0.404	1.89
		0.6	0.442		
		1.0	0.403		

Table 5-18

Velocity Distribution at Vel. 4

Dist. from L.B.	Depth	Point Depth	Point Vel.	AverageVel.	Discharge
m	m	m	m/s	m/s	m^3/s
19	2.15	0.4	0.352	0.248	14.03
		1.1	0.227		
		1.7	0.187		
42	2.2	0.4	0.315	0.313	21.07
		1.1	0.328		
		1.8	0.280		
62	3.6	0.7	0.363	0.414	48.01
		1.8	0.445		
		2.9	0.403		
85	3.8	0.8	0.711	0.714	36.15
		1.9	0.724		
		3.0	0.698		
97	4.4	0.9	0.818	0.755	51.08
		2.2	0.788		
		3.5	0.626		
112	4.4	0.9	0.863	0.793	91.50
		2.2	0.807		
		3.5	0.695		
136	4.8	1.0	0.948	0.865	96.06
		2.4	0.865		
		3.8	0.780		
160	4.4	0.9	1.012	0.875	81.84
		2.2	0.839		
		3.5	0.812		
181	4.4	0.9	1.012	0.896	130.64
		2.2	0.871		
		3.5	0.831		
214	4.6	0.9	0.993	0.863	98.61
		2.3	0.823		
		3.7	0.815		
239	4.6	0.9	0.980	0.851	121.65
		2.3	0.820		
		3.7	0.786		
270	4.6	0.9	0.945	0.855	148.33
		2.3	0.831		
		3.7	0.812		
304	5.6	1.1	0.943	0.856	70.81
		2.8	0.857		
		4.5	0.767		
320	4.8	1.0	0.943	0.846	90.06
		2.4	0.841		
		3.8	0.759		
346	4.4	0.9	0.677	0.660	23.23
		2.2	0.682		
		3.5	0.599		

Bed Material Sampling

A Van Veen grab sampler was used to collect the bed material samples. The bed material samples were collected at the same locations of the velocity measurements (three samples per cross-section). Analysis of samples included grain size distribution and specific weight of bed materials are shown in *Table 5-19*.

Table 5-19

Characteristics of Bed Sediments

Sample No.	Total Sample Weight (grm)	Geometric Mean Diameter (mm)	Geometric Standard Deviation (δg)	Uniformity Coefficient	Sorting Coefficient	Curvature Coefficient	Mean Diameter of the Sample (mm)
1	345.18	0.224	1.279	1.385	0.850	0.986	0.239
2	466.54	0.437	1.416	1.786	0.812	1.122	0.443
3	456.82	0.519	1.540	2.158	0.742	1.007	0.514
4	513.12	0.310	1.585	1.925	0.707	0.812	0.323
5	379.06	0.190	1.399	1.837	0.785	1.007	0.217
6	586.93	0.355	1.551	1.776	0.727	0.893	0.419
7	623.81	0.381	1.446	1.864	0.778	1.010	0.388
8	651.04	0.382	1.686	2.315	0.696	0.948	0.402
9	596.23	0.338	1.540	2.007	0.740	0.964	0.350
10	299.12	0.545	1.337	1.778	0.819	1.110	0.505
11	463.010	0.647	1.239	1.531	0.851	1.013	0.641
12	446.65	0.437	1.516	1.839	0.749	0.982	0.423
13	406.87	0.290	1.456	1.750	0.784	1.012	0.305
14	585.35	0.571	1.473	2.330	0.786	1.394	0.553
15	754.07	0.423	1.467	1.755	0.771	0.994	0.430

5.5.5 Water Quality Measurements

Water quality measurements as well as sediment sampling and analysis are available for the project location from surveys undertaken at five sample locations along the River Nile segment at the Helwan South site by the "Environmental Consultation & Water Quality Unit, National Research Center.

The sample locations are determined such as Sample No. 1: In front of the proposed intake of the electric generation station (shore line), Sample No. 2: 100 meter upstream the intake of the electric generation station, Sample No. 3: 100 meter downstream the proposed intake of the plant (5 meter off shore), Sample No. 4: between the proposed intake and the outlet, and Sample No. 5: 50 meter downstream the outlet of the electric generation station, whilst relevant data are presented in *Table 5-20 through Table 5-26*. Water and sediment samples were taken on 17^{th} November 2010. The results of water quality determination included chemical analysis of water samples (physico-chemical parameters, concentration of heavy metals and identification of organic content), microbiological analysis (bacteriological examination and algal counts) and chemical analysis of sediment.

Water Characteristics and Quality

- Physico-chemical Parameters

Table 5-20 presents the results of physico-chemical analysis of water samples. The values of most parameter match the general trend of Nile River water quality. The values of water turbidity, transparency and total suspended solids are low and indicate that water is clear. Meanwhile, the values of pH, and alkalinity were almost approaching each other at all investigated sites indicating that there is no variation in the water quality of the studied water along the studied areas. On the other hand, Results of total dissolved solids and electrical conductivity indicated significant variation between sites especially in sites 2 and 5. In addition results of analysis indicated that there is no significant variation between the concentrations of chlorides, sulfates, nitrates, sodium, potassium, and magnesium at all tested sites. Such values represent the typical unpolluted Nile River water.

- Organic Content of Water Samples

Results presented in *Table 5-21* reveal that the values of the COD and BOD indicated that there are no sources of organic pollution discharged at this area. Water samples collected at all sites were free from polychlorinated biphenyl and chlorinated hydrocarbons. All other organic pollutants such as phenol, oil & grease, polycyclic aromatic hydrocarbons were recorded in low concentration while, site 2 recorded the maximum organic pollution.

In general, available results revealed that the studied water samples at the studied area were clean.

- Heavy Metals Content

Table 5-22 shows the concentrations of heavy metals in water samples from the selected sites. The level of iron ranged between 0.0074 and 0.066 mg/l. Cadmium, chromium, lead, manganese and nickel were not detected in any of all water samples. The concentration of zinc in water samples was 0.02 mg/l..

- Bacteriological Examination

Results of bacteriological examination of water samples are given in *Table 5-23*. Bacteriological indicators for of faecal pollution were detected in all water samples. Total Coliform ranged between 1.3 x 10^2 and 2.5 x 10^4 MPN/100 cm^3 while, faecal Coliform ranged between 5.0x10^1 and 7.9 x 10^2. In general, the presence of both total coliforms and faecal coliforms in the water samples indicates bacteriological source of pollution.

It should be noted that the Nile River water is treated via water treatment stations, purified and disinfected prior to using as a potable water distributed to the potable water networks.

It is important to note, too, that this water, when abstracted by the power plant for the plant uses will be treated via plant water treatment facility, and if used as potable water, will be purified and disinfected first.

- Algal Counts

The general distribution of algae and their counts in water samples are given in *Table 5-24*.

Total algal counts in water samples were ranged between 6372 and 8562 organism / ml. Diatoms represented the most dominant algal groups followed by green algae and blue green algae. That distribution of algal groups matches the general trend to be found in Nile River water.

Sediment Characteristics

- Organic Content

Results given in *Table 5-25* reveal that the contents of oil and grease ranged between 296 (site 2) and 415 (site 1) mg/kg. Where, the concentration of total hydrocarbons amounted between 48.8 mg/kg at site 2 and 80.1 mg/kg at site 1 which in convent with oil and grease content. On the other hand chlorinated hydrocarbons were recorded in all sites in low concentration. Polychlorinated biphenyls (PCBs) were not detectable in all sites.

- Heavy Metals Content

The concentrations of Zn, Cd, Cr, Pb, and Ni in sediment samples are shown in *Table 5-26*.

Available results reveal that copper and nickel were present at the higher concentrations at all sites compared with chromium and lead. The concentration of copper ranged between 24 mg/kg - 26 mg/kg. Cadmium was less than the detection limit in all samples.

Table 5-20

Water Quality at the Project Location
Physico-chemical Analysis of Water Samples at the Project Location
(Samples Delivery Date: 17^{th} November 2010)

Parameters	Unit	Concentration				
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
pH	-	8.2	8.2	8.3	8.4	8.4
Turbidity	NTU	3.6	2.7	2.8	3.0	3.1
Electrical Conductivity	µmho/cm	450	694	340	355	540
Transparency	cm	50	60	60	60	60
Total Solids	mg/l	286	438	216	224	336

Total Dissolved Solids	mg/l	246	421	198	214	304
Suspended Solids	mg/l	40	17	18	10	32
Total Alkalinity ($CaCO_3$)	mg/l	134	134	132	134	126
Calcium	mg/l	31.2	46.9	28.8	30.1	38.0
Magnesium	mg/l	10.7	12.1	11.0	10.7	13.1
Sodium	mg/l	15	18	16	17	15
Potassium	mg/l	5	5	6	5	5
Chloride	mg/l	18	22	19	20	16
Sulfate	mg/l	8	9	8	12	12
Nitrate (NO_3-N)	mg/l	0.01	0.01	0.02	0.015	0.021

Notes:

Site (1): Infront of the proposed intake.
Site (2): 100 meter upstream the proposed intake.
Site (3): 100 meter downstream the proposed intake.
Site (4): between the proposed intake and the outlet.
Site (5): 50 meter downstream the proposed outlet.

Table 5-21

Water Quality at the Project Location
Organic Analysis of Water Samples at the Project Location (1)
(Samples Delivery Date: 17th November 2010)

Parameters	Unit	Concentration				
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
COD	mgO_2/l	21	39	8	9	30
BOD	mgO_2/l	11.9	28.4	4.2	4.6	17.7
Oil& Grease	mg/l	3.2	1.0	2.3	3.1	2.6
Phenol	mg/l	0.01	0.01	0.01	0.01	0.01
Total Hydrocarbons	μg/l	26.13	33.23	19.02	30.15	17.88
Polycyclic Aromatic Hydrocarbons	μg/l	18.43	24.14	10.2	21.28	9.41
Chlorinated Hydrocarbons	μg/l	N.D	N.D	N.D	N.D	N.D
Polychlorinated Biphenyles (PCBs)	μg/l	N.D	N.D	N.D	N.D	N.D

Notes:
(1) The same sampling points as indicated in Notes of Table 5-20.
(2) ND = Not Detected.

Table 5-22

Heavy Metals Analysis of Water Samples (1)
(Samples Delivery Date: 17th November 2010)

Parameters	Unit	Concentration				
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
Iron	mg/l	0.048	0.066	0.0074	0.013	0.0154
Manafanese	mg/l	N.D	N.D	N.D	N.D	N.D
Zinc	mg/l	0.02	0.02	0.02	0.02	0.02
Cadmium	mg/l	N.D	N.D	N.D	N.D	N.D
Chromium	mg/l	N.D	N.D	N.D	N.D	N.D
Lead	mg/l	N.D	N.D	N.D	N.D	N.D
Nickel	mg/l	N.D	N.D	N.D	N.D	N.D

Notes:
(1) The same sampling points as indicated in Notes of Table 5-20.
(2) ND = Not Detected.

Table 5-23

Microbiological Analysis of Water Samples[(1)]
(Samples Delivery Date: 17th November 2010)

Site No.	Total Bacterial Counts, Cell/cm³		Most Probable Number Index/100ml	
	At 22°C	At 37°C	Total Coliform	Faecal Coliform
Site (1)	6.4×10^3	8.6×10^3	1.6×10^3	5.0×10^2
Site (2)	1.4×10^3	1.4×10^3	2.5×10^4	7.9×10^2
Site (3)	4.6×10^2	4.6×10^2	4.0×10^2	1.0×10^2
Site (4)	9.8×10^2	8.3×10^2	6.0×10^2	1.0×10^2
Site (5)	1.2×10^2	6.3×10^2	1.3×10^2	5.0×10^1

Notes:

(1) The same sampling points as indicated in Notes of Table 5-20.
(2) N/D = Not Detected.

Table 5-24

Algal Counts of Water Samples [(*)]
(Samples Delivery Date: 17th November 2010)

Parameters	Count (Organisms/ml)				
	Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
Diatoms	7486	7543	6205	5763	5454
Green Algae	627	643	595	629	666
Blue-Green Algae	304	376	255	221	252
Total Algal Counts	**8417**	**8562**	**7055**	**6613**	**6372**

Notes:
(*) The same sampling points as indicated in Notes of Table 5-20.

Table 5-25

Organic Analysis of Sediment Samples (1)

(Samples Delivery Date: 17th November 2010)

Parameters	Unit	Concentration				
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
Oil & Grease	mg/kg	415	296	330	400	342
Total Hydrocarbons	µg/kg	80.1	48.8	60.2	77.2	65.8
Polycylic Aromatic Hydrocarbons	µg/kg	122	134	155	166	177
Chlorinated Hydrocarbons	µg/kg	11.9	3.2	7.1	4.7	5.7
Polychlorinated Biphenyles (PCBs)	µg/kg	N.D	N.D	N.D	N.D	N.D

Notes:
(1) The same sampling points as indicated in Notes of Table 5-20.
(2) ND = Not Detected.

Table 5-26

Heavy Metals Analysis of Sediment Samples (*)

(Samples Delivery Date: 17th November 2010)

Parameters	Unit	Concentration				
		Site (1)	Site (2)	Site (3)	Site (4)	Site (5)
Copper	mg/kg	24	25	26	26	26
Cadmium	mg/kg	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Chromium	mg/kg	15	14	15	14	13
Lead	mg/kg	0.6	0.5	0.5	0.6	0.5
Nickel	mg/kg	23	22	22	23	22

Notes:
(*) The same sampling points as indicated in Notes of Table 5-20.

5.6 AQUATIC ECOLOGY

5.6.1 Introduction

The river Nile is an old river whose basin is dominating feature of the northern quarter of the continent of Africa with extent length about 6740 km. It follows from the south at Ethiopia plateau to Egypt. The river Nile constitutes over 80 % of the fresh water resources available to Egypt; represent 55.5 million m^3 per year coming from the south according to the international agreement for the distribution of water resources of river Nile between countries of Nile basin. Moreover, other 8.5 million m^3 can be supplied from ground water and 3.7 million m^3 reused drainage water. Such quantities will not surely satisfy the increasing demand of water in different activities. At the north of Cairo delta barrage, the river Nile bifurcates into two branches namely Damietta and Rosetta and four Rayyahs (canals) namely El-Nassery, El-Behreiy, El- Menofy and El-Toufeky.

The major sector of the studied site is located in the Kureimat region close to the River Nile; which is, consists essentially of an intensively dissected sedimentary limestone plateaus.

The River Nile is one of the world's largest rivers with a total length exceeding 6625 km and its flora and fauna are part of global biodiversity. The river in Egypt has been considerably changed physically and chemically by the construction of the Aswan High Dam in 1970 and this is believed to have changed the conditions for aquatic organisms.

Helwan region lies about 30km south Cairo. At this region there are many factories which discharge their wastes in the Nile water leading to a continuous change in water quality.

The main objective of the aquatic ecology study is to investigate the water ecology characteristics of the River Nile before the use of its water for cooling of the proposed electrical power station and expected the impact of this process on the water ecosystem.

5.6.2 General Field Observations

The field observations that describe the general conditions of the River Nile banks investigated area are as follow:

- It was noticed that large pipes established in front of the Power Station which permit inlet and outlet of water to the River Nile used in turbines cooling system are extended for just about 10 m off the water. These pipe effluent influences the natural movement of the currents in the area, which in turn negatively affect the distribution and abundance of the aquatic organisms in the area.

- This River Nile bank is divided into three habitats; the slope, the water-edge and open-water of the Nile. Each of these habitats has its specific flora.

- The bank region is biologically deteriorated with very poor biodiversity and no sensitive ecosystems.

- Very limited commercial fishing occurs in the vicinity of the project.

- No protected areas for their conservation value are located on, or in the vicinity of the project area.

5.6.3 Methodology

The aquatic ecology of the project hinterland was generally described. This was gathered from the team previous experience in this area as well as scientific literature.

The aquatic ecological baseline data of the site of the proposed extension of Power Plant were then gathered through field investigations. These include bottom surveys of the bank, visual inspection and counting of fish species with fishermen, and collection of phyto- and zooplankton biota for laboratory examination.

Water samples of 1 liter were collected and preserved immediately in Lugol's Iodine solution (APHA, 1992) in a 1: 100 ratio. The samples were examined using inverted microscope. The drop method was applied for counting and identification of different algal species (APHA 1992).

Plankton samples were examined in the laboratory separately in a counting Sedgwick rafter cell. All samples were examined under the ordinary binocular microscope Identification and classification of plankton was carried out with the aid of standard monographs and publications.

Benthic organisms were collected by Ekman dredge and dip net and have been recorded and identified to species or generic levels. Fish species going around has also been registered (*see Figures 5-26 and 5-27*).

5.6.4 Wild Life

Plants and Vegetation

The macrophytes are widely distributed in the River Nile, and this distribution is mainly controlled by the water level and the degree of currents. The emergent macrophytes are widely spread on shallow areas of the River banks, and the boundaries of the islands as a result of the High Dam construction. However, the submerged macrophytes cover the River margins and extend to a depth of about 2 meters, such as Ceratophyllum demersum, Myrophyllum spicatum, Potamogaton pectinatus and P. crispus. The floating plant of the genus Eichhornia the most dominant in I River Nile.

Figure 5-26

Collection of Samples

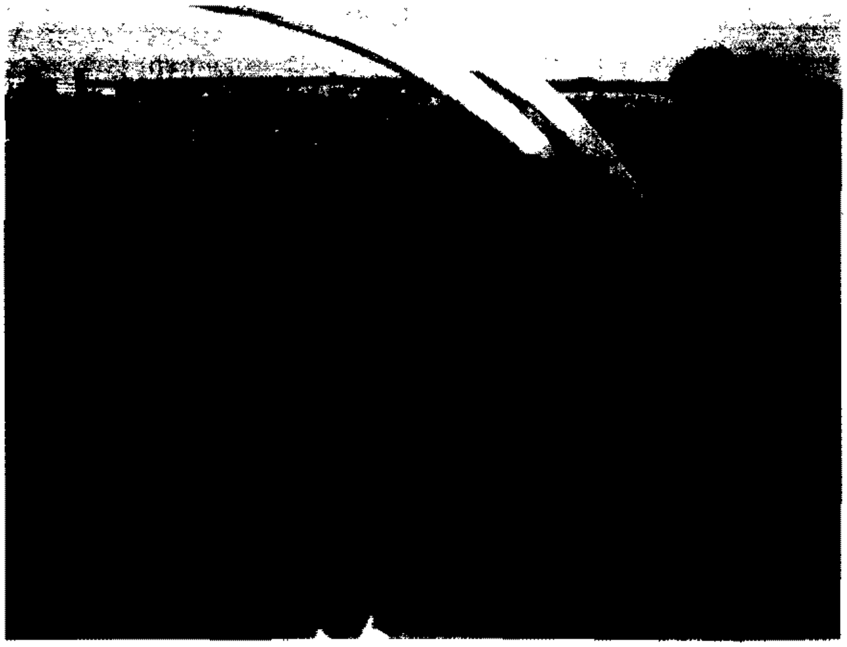


Figure 5-27

Collection of Samples

River Nile bank ecosystem is usually divided into 3 habitats; slope, water-edge and open-water of the Nile. Each of this habitat has its specific flora (*see Table 5-27 and Figures 5-28 and 5-29*).

Slopes of the Nile

Many species were recorded in this habitat; annuals andperennials. The unique species are: *Plantago major, Amaranthus hybridus, Coriandrum sativum, Gnaphalium luteo-album, Lathyrus marmoratus, Phalaris paradoxa, Sisymbrium irio, Sonchus macrocarpus* and *Trifolium resupinatum.* The common species are: *Phragmites australis, Arthrocnemum macrostachyum, Sarcocornia fruticosa, Suaeda vera, Salsola kali, Senecio glaucus* subsp. *coronopifolius* and *Sonchus oleraceus.* The rare species are: *Paspalidium geminatum, Atriplex halimus, Ipomoea carnea, Ranunculus sceleratus, Cichorium endivia* subsp. *pumilum, Hordeum marinum, Medicago polymorpha* and *Anagallis arvensis.*

Water-edges of the Nile Bank

The unique species are: *Clerodendrum acerbianum, Sida alba, Medicago intertexa* var. *ciliaris, Rorippa palustris, Setaria verticillata* and *Setaria viridis.* The common species are: *Phragmites australis, Sarcocornia fruticosa* and *Azolla filiculoides.* The rare species are: *Halocnemum strobilaceum, Inula crithmoides, Cynanchum acutum, Suaeda maritima, Centaurea calcitrapa, Sphaeranthus suaveolens, Tamarix tetragyna* and *Ammi visnaga.*

Open-water of the River Nile

A total of 14 species were recorded in this habitat. The common species are: *Phragmites australis, Eichhornia crassipes, Ceratophyllum demersum, Azolla filiculoides* and *Echinochloa stagnina.* The rare species are: *Arthrocnemum macrostachyum, Sarcocornia fruticosa, Lemna perpusilla, Potamogeton crispus* and *Salsola kali.*

Among the noteworthy species along the Nile banks are two species that cause severe infestation to the water ditches of Egypt:

1. ***Phragmites australis.*** An emergent aquatic that is a boon and bane to man. It causes severe infestations to the water bodies that hinders the navigation and lead to the fragmentation of the water body. It plays also an important role in increasing the silting process in shallow drains. On the other hand, the plant had a long history of use by man as building material for houses and rafts (e.g. Egypt), as thatching (e.g. England), fodder (e.g. Egypt and other countries). It can be used also as paper pulp and source of bioenergy. Australian and German scientists found this plant to be an effective biological filter for wastewater renovation. The plant also is a source of organic matter and safe refuge for the fish and rests for the birds particularly during winter.
2. ***Potamogeton pectinatus.*** It is the most dominant submerged plant along the Nile bank, tolerant to wide ecological parameter variations but with a tendency or better growth in slightly brackish water .It is also a common aquatic plant in inland waters of Egypt, where it inhabits both stagnant and running waters .This plant usually dies off in autumn, leaving the rhizomes and winter turions to persist in mud till the next spring when new plants start to sprout.

Table 5-27

Plants and Vegetation

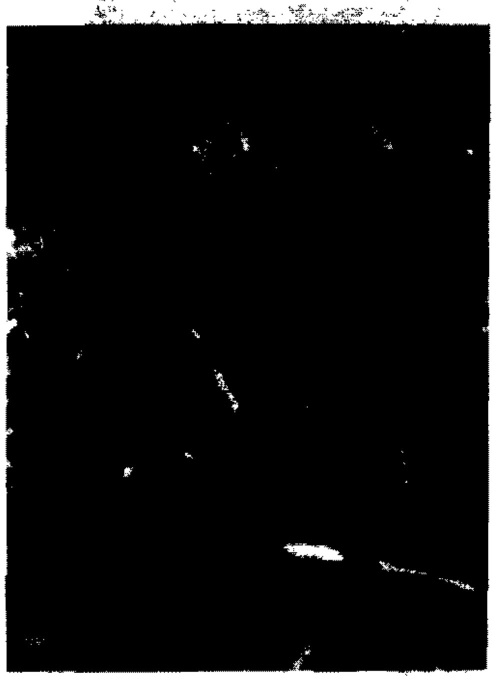
Species
Echinochloa colona
Anagallis arvensis
Chenopodium murale
Malva parviflora
Polypogon monspeliensis
Reichardia tingitana
Sonchus oleraceus
Frankenia pulverulenta
Avena fatua
Hordeum murinum subsp. *leporinum*
Melilotus indicus
Schismus barbatus
Eruca sativa
Lolium perenne
Senecio glaucus subsp. *coronopifolius*
Setaria verticillata
Sisymbrium irio
Brassica tournefortii
Calendula aegyptiaca
Conyza bonariensis
Emex spinosa
Gnaphalium luteo-album
Trigonella laciniata
Urospermum picroides
Beta vulgaris
Carex divisa
Cyperus difformis
Echinochloa crusgalli
Hordeum marinum
Juncus bufonius
Lolium multiflorum
Portulaca oleracea
Rumex dentatus
Trifolium alexandrinum
Trifolium resupinatum
Orobanche crenata
Chenopodium album
Chenopodium ambrosioides
Cichorium endivia subsp. *pumilum*
Spergularia marina
Chrysanthemum coronarium
Eclipta alba
Amaranthus viridis
Ranunculus sceleratus
Lotus arabicus
Amaranthus hybridus

Species
Anethum graveolens

Figure 5-28

Plants and Vegetation

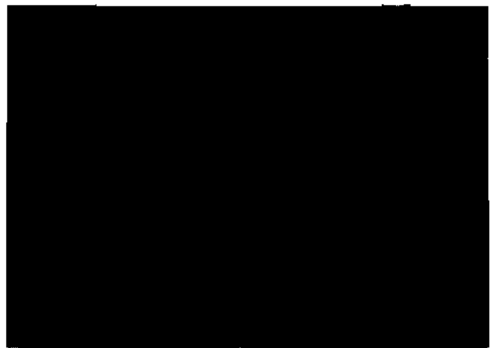
Mentha longifolia **نعنع**



Sonchus oleraceus **جعضيض**

Figure 5-29

Plants and Vegetation



Saccharum spontaneum هيش

Imperata cylindrica حلفا

Lemna gibba عدس المية

Phytoplankton

Early studies carried out in the River Nile had investigated phytoplankton at different regions and pointed out that diatoms were the main component of the River Nile. Many ecologists reported that Bacillariophyta is the most dominant group before and after the impoundment and represented mainly by the genera Melosira, Synedra and Cyclotella. Studies of the phytoplankton in the River Nile at four segments (Assuit, Cairo, Rosetta Branch and Damietta Branch) revealed that the main phytoplanktonic groups were Bacillariophyta, Cyanophyta and Chlorophyta. Bacillariophyta was dominant during most seasons especially at Cairo segment (*see Figures 5-30 (A through D)*).

Zooplankton

Zooplankton community is an important trophic level both in grazing and nutrient regeneration of phytoplankton and as food for juvenile and adult fishes. The study of zooplankton distribution is also useful for the general monitoring of certain aspects of the environment such as hydrographic events, pollution, eutrophication, warming trends and long-term changes which are signs of environmental disturbance. *Table 5-28* shows the diversity of zooplankton in the River Nile side that is dominated with rotifers (*see Figures 5-31 (A through D)*).

Table 5-28

Checklist of Zooplankton Species Recorded along the River Nile Bank

Rotifera
Anuraeopsis fissa (Gosse)
Asplanchna girodi De Guerne
Asplanchna priodonta Gosse
Asplanchna sieboldi Leydig
Brachionus angularis Gosse
Brachionus budapestinensis Daday
Brachionus calyciflorus Pallas
Brachionus caudatus (Barrois &Daday)
Brachionus falcatus Zacharias
Brachionus plicatilis (Müller)
Brachionus quadridentatus Hermann
Brachionus rubens Ehr.
Brachionus urceolaris (Müller)
Cephalodella gibba Ehr.
Colurella adriatica Carlin
Colurella obtusa Haver
Filinia longiseta Ehr.
Harringia rouseleti Beauchamp.
Hexarthra oxyuris Hudson
Keratella cochlearis Gosse
Keratella quadrata Müller
Keratella tropica Apstein
Keratella vulga Ehr.
Lecane arcula Harring
Lecane bulla Gosse
Lecane closterocera Schmarda
Lecane luna Müller
Lecane lunaris Ehr.
Philodina roseola Ehr.
Polyarthra ramata Skorikow
Polyarthra vulgaris Carlin
Proalides sp.
Rotatoria sp.
Synchaeta oblonga Ehr.
Synchaeta pectinata Ehr.
Testudinella patina Hermann
Trichocerca cylindrica Imhof
Trichocerca gracilis Tessin
Trichocerca pusilla Jennings
Trichocerca inermis Linder

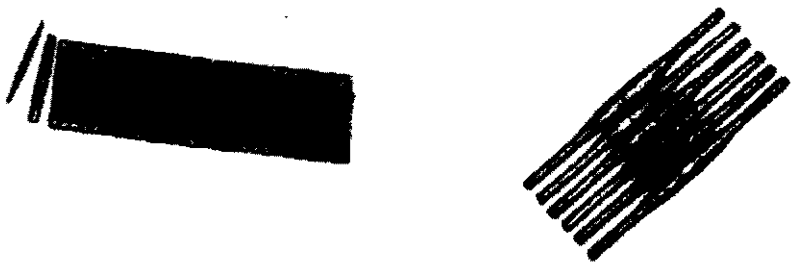
Table 5-28 *(Contd.)*

Checklist of Zooplankton Species Recorded along the River Nile Bank

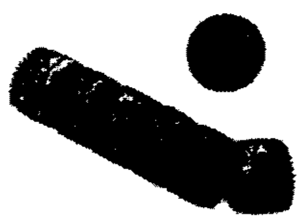
Copepoda
Acanthocyclops americanus March
Acanthocyclops exilis Coker
Acanthocyclops vernalis Fischer
Apocyclops panamensis March
Schizopera nilotica
Tachidius descipes Geisb
Thermocyclops crassus Fischer
Thermocyclops decipinis Kieker
Thermocyclops neglectus Sars
Nauplius larvae
Copepodid stages
Cladocera
Alona intermedia Sars
Alonella nana Baird
Bosmina longirostris Muller
Ceriodaphnia reticulata Jurine
Chydorus ovalis Kurz
Chydorus sphaericus Muller
Daphnia similis Claus
Diaphanosoma brachynrum Lieven
Diaphanosoma mongolianum

Figure 5-30 (A)

Common Phytoplankton

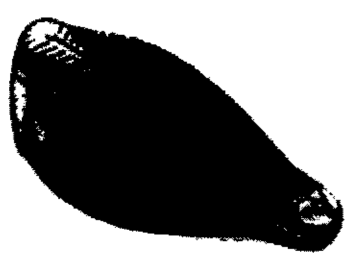


Fragilaria

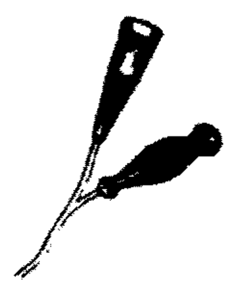


Stephanodiscus

Achnanthes



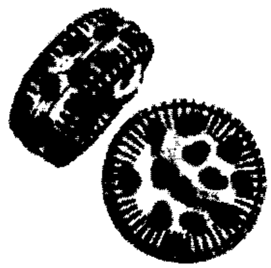
Gomphonema parvulum



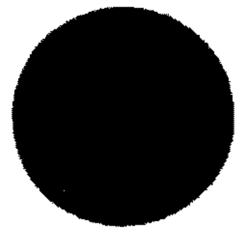
Gomphonema

Figure 5-30 (B)

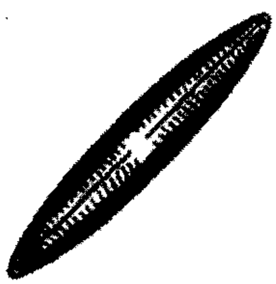
Common Phytoplankton



Cyclotella meneghiniana

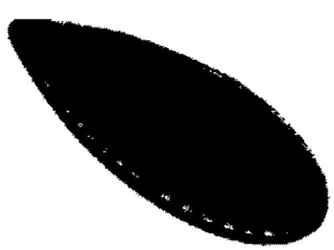


Cyclotella



Navicula

Pinnularia

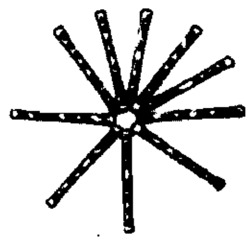


Surirella

Stauroneis

Figure 5-30 (C)

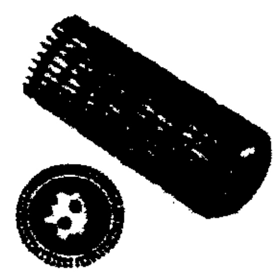
Common Phytoplankton



Asterionella

Asterionella japonica

Asterionella



Melosira

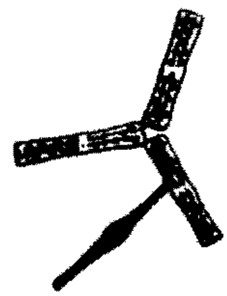
Nitzschia closterium

Nitzschia palea

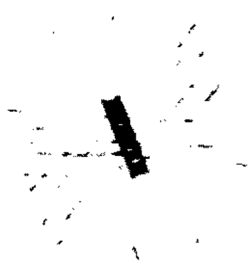
Figure 5-30 (D)

Common Phytoplankton

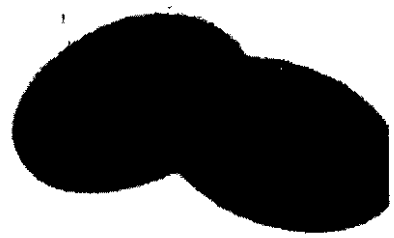
Tabellaria flocculosa



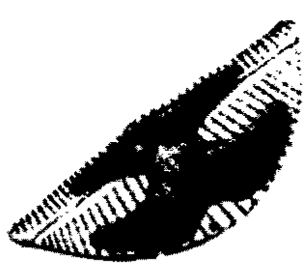
Tabellaria

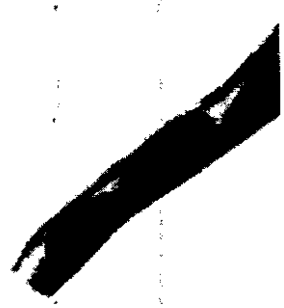


Chaetoceros



Cocconeis placentula

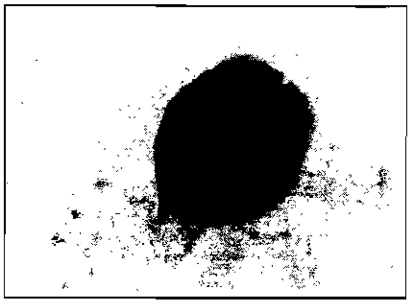




Cymbella

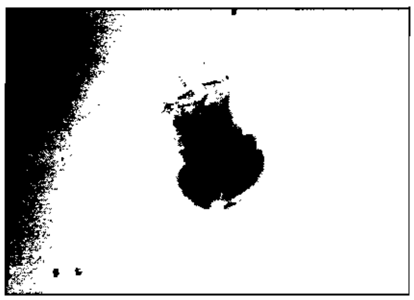
Figure 5-31 (A)

Common Zooplankton

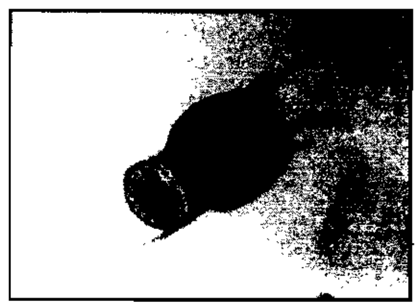


Brachionus angularis

Brachionus caudatus



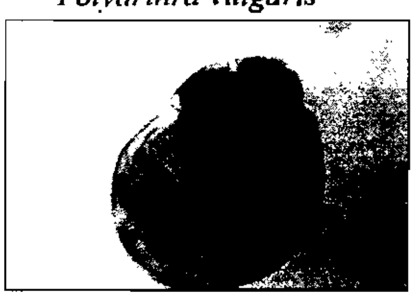
Brachionus calyciflorus



Brachionus falcatus

Polyarthra vulgaris

Hexarthra oxuris



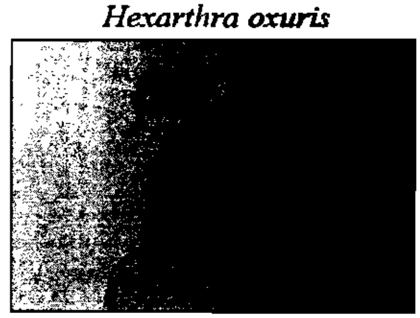


Figure 5-31 (B)

Common Zooplankton

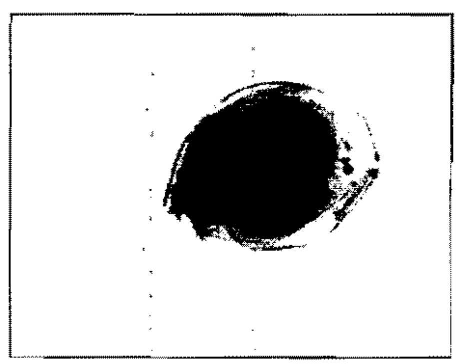

Adult female


Postabdomen

Moina micrura


Adult female


Postabdomen



Diaphanosoma exesium

Chydorus sphearicus

Figure 5-31 (C)

Common Zooplankton

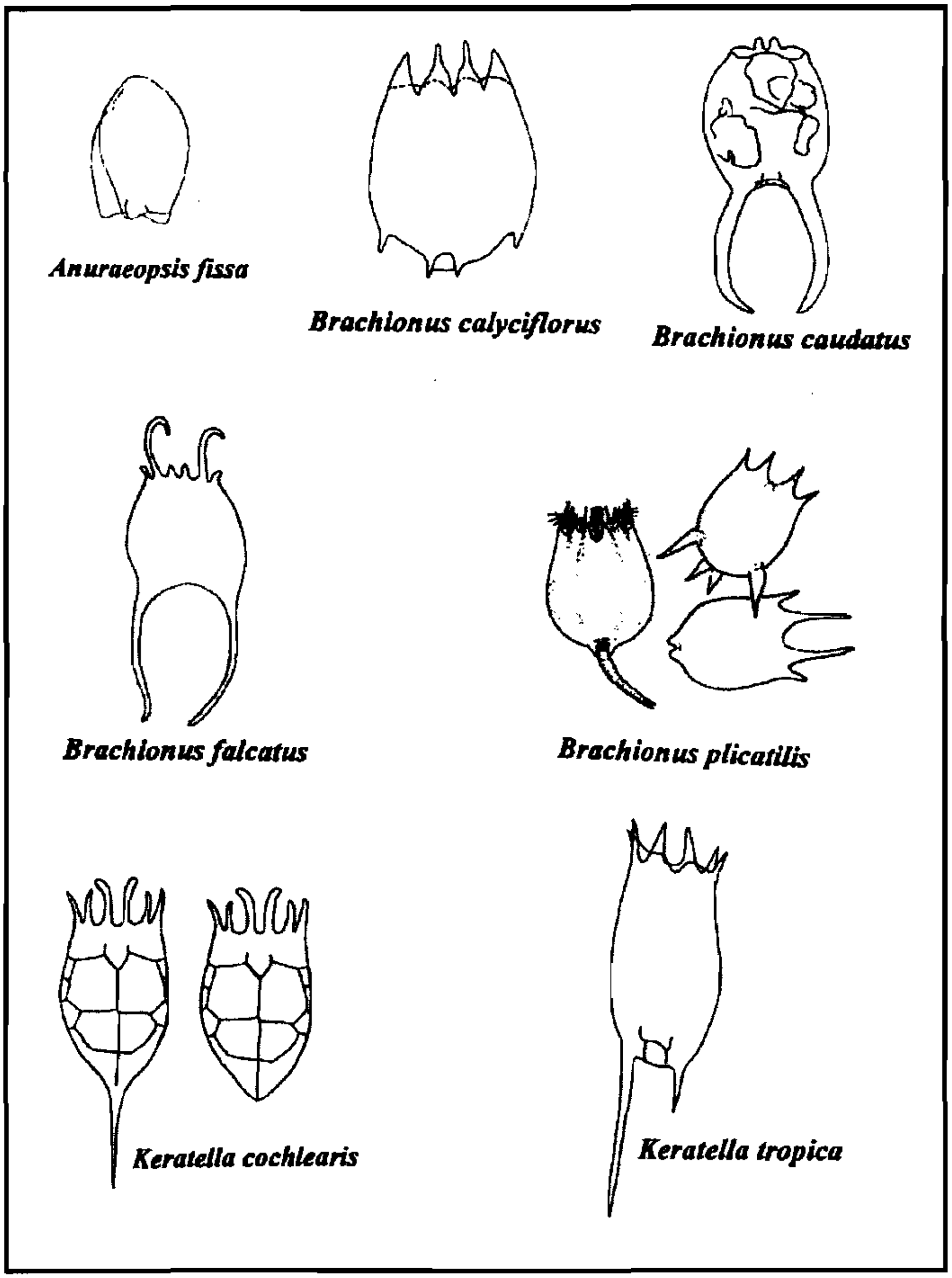
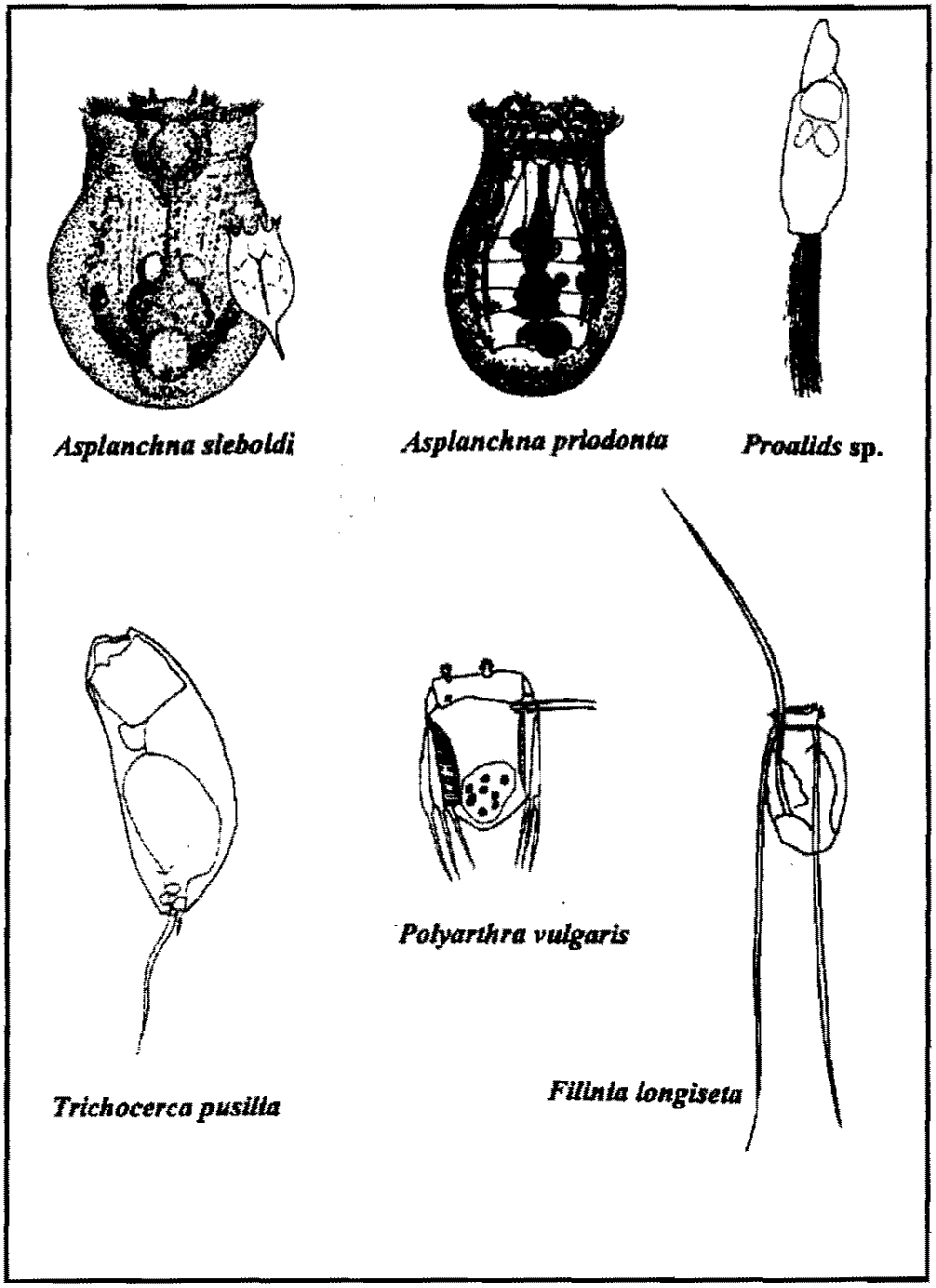


Figure 5-31 (D)

Common Zooplankton



Asplanchna sieboldi *Asplanchna priodonta* *Proalids* sp.

Polyarthra vulgaris

Trichocerca pusilla *Filinia longiseta*

Benthic Fauna

The benthic invertebrates in aquatic ecosystems play an important role in the transformation of the organic matter sediment on the bottom to its base elements and subsequently contribute to the basic nutrition of fish. The composition of the benthic fauna has largely been considered as a good indicator of water quality because, unlike planktonic species, they form relatively stable communities in the sediments which do not change over long time intervals and reflect characteristics of both sediments and upper water layer.

The most common species recorded in the River Nile are the molluscan group, especially pulmonates including Biomphalaria, Bulinus, as well as Bellamya, Physa. Also, there are many of arthropods and annelids (*Table 5-29*).

On the othe hand, Meiobenthic species are a good indication of water quality changes, because they have a short life cycle, a fast metabolism and quick reaction to changes in their environment and they are also more specialized regarding their food sources .Meiofauna in fresh water comprises different groups in relation to various types of freshwater biotopes.

Table 5-29

Checklist of Benthos Species Recorded along the River Nile Bank

Species
Arthropoda
Corophium orientale (Schellenberg)
Gammarus lacustris (Fabricius)
Gammarus aequicauda
Gammarus orinicornis
Mesanthura sp.
Palaemon elegans
Tandipos tentans (Meigen)
Nymph of *Neurocordula* sp.
Nymph of *Ischneura* sp. (Pinhey)
Nymph of *Enallaga vansomerni*
Micronecta plicata (Costa)
Lethocerus niloticus (Stal)
Sternolophus solieri (Lapouge)
Aquatic spiders
Annelida
Branchiura sowerbyi (Beddard)
Limnodrilus hoffmeisteri (Claparede)
Limnodrilus udekemianus (Claparede)
Limnodrilus claparedeianus (Ratzel)
Potamothrix hammoniensis (Mich)
Chaetogaster limnaei (K. Von Beak)
Helobdella conifera (Moore)
Salifa perspicax (Blanchard)
Glossiphonia sp.
Mollusca
Melanoides tuberculata (Müller)
Theodoxus niloticus (Reeve)

Buliuns truncatus (Audouin)
Gyraulus ehrenbergi (Beck)
Physa acuta (Draparanud)
Cleopatra bulimoides (Olivier)
Bellamya unicolor (Olivier)
Lanistes carinatus (Olivier)
Biomphalaria alexandrina (Ehr.)
Hydrobia ventrosa (Montagu)
Succinea cleopatra (Pallary)
Corbicula consobrina (Cailliaud)
Corbicula fluminalis (Müller)

Fisheries

The average total fish production of the River Nile is about 120,000 tons that contributes by about 10%of the total production of the Egyptian fisheries. Tilapia species represents about 70% of the Egyptian total catch in the River Nile , while African Catfish represents about 15% of the catch. The rest of the catch consists of Mullet species, Eels and others.

Oreochromis niloticus is widely distributed along the River Nile; while *Tilapia zillii* is the second common species of cichlids as well as *Clarias gariepinus Sarotherodon galilaeus*. The introduced species *Gambusia affinis* shows a similar wide distribution (*see Figures 5-32 "A & B"*).

Fishermen use usually traps to catch fish in the River Nile , which are set among aquatic vegetation, such as *Phragmites, Potamogeton* and *Ceratophyllum* beds. In open water free from vegetation, the traps are either fixed to the bottom by bamboo sticks or in rows among an artificially made barrier. The barrier is usually made from bamboo sticks with gaps at intervals into which the traps are placed. The most common fish species in the site are present in *Table 5-30*.

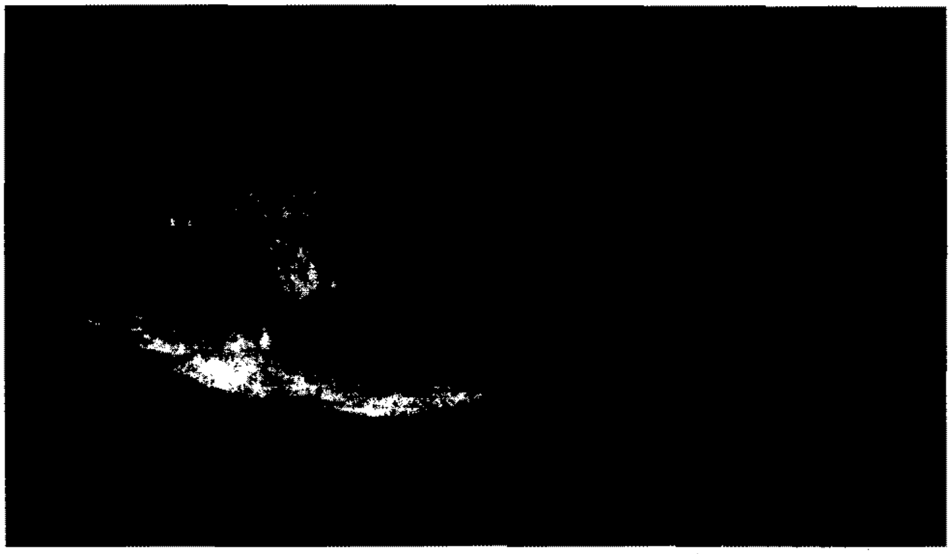
Table 5-30

Fish Species in the Nile River at the Study Site

Family	Species	
Cyprinodontidae	*Aphanius fasciatus* (Valenciennes, 1821)	بطريق
Poecilidae	*Gambusia affinis* (Baird & Girard , 1853)	جامبوزيا
Atherirudae	*Atherina mochon* Cuvier, 1829	بساريا
Mugilidae	*Mugil cephalus* Linnaeus, 1758	بورى
	Liza ramada (Risso, 1826)	طوبارة
Cichlidae	*Hemichromis bimaculatus* Gill , 1862	هيمكروس مخطط
	Haplochromis bloyeti (Sauvage,1883)	هابلوكروس قزم
	Tilapia zillii (Gervais, l848)	بلطى اخضر
	Oreochromis niloticus (L.,1757)	بلطى نيلى
	Oreochromis aureus (Steindachner,1864)	بلطى ازرق
Gobiidae	*Pomatoschistus minutus* (Pallas ,1767)	ابو كرش

Figure 5-32 (A)

Common Fish Species

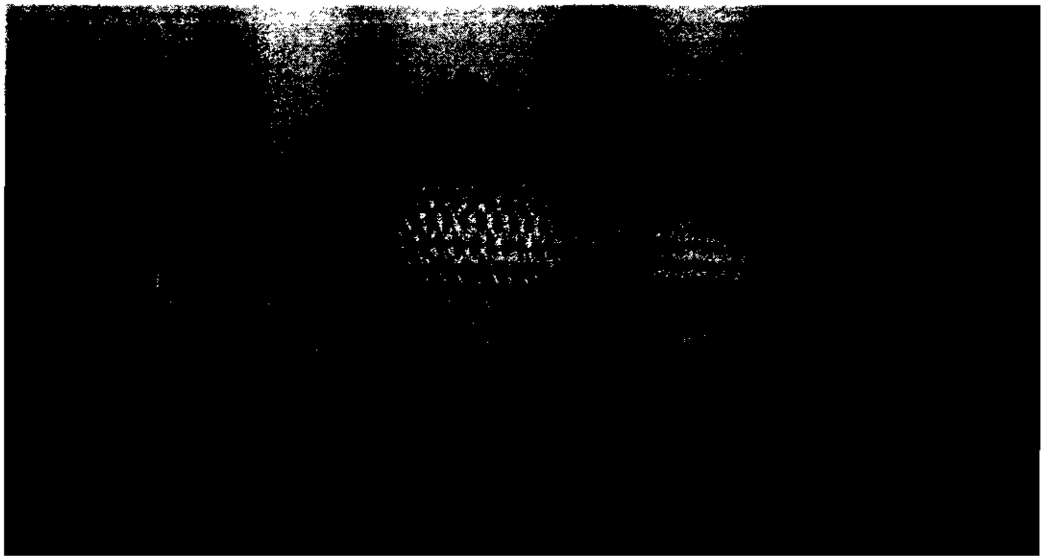


Tilapia zillii بلطي أخضر

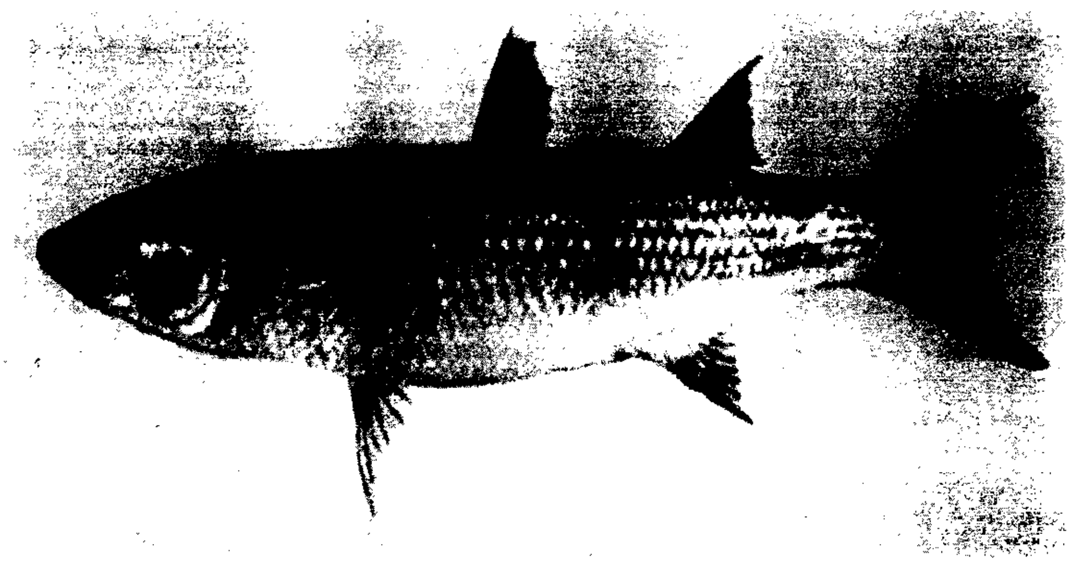
Oreochromis niloticus بلطي نيلي

Figure 5-32 (B)

Common Fish Species



Mugil cephalus بوري



Liza ramada ة طوبار

Amphibians and Reptiles

Many species of amphibians and reptiles are known from the area along the River Nile at the bank sides. Characteristic amphibians include Bufo regularis, Ptychadena mascareniensis and Rana ridibunda (*see Figures 5-33 "A & B"*).

Common reptiles include Hemidactylus turcicus, Chalcides ocelltus, Natrix tessellata, Ptychadena masareniensis and psammophis sibilans (*Table 5-31*).

Table 5-31

Reptiles and Amphibians Recorded at the Study Area

Latin name	English name	Arabic name
Bufo regularis	Egyptian Toad	ضفدع نيلى
Bufo viridis	Green Toad	ضفدع أخضر
Chalcides ocellatus	Ocellated Skink	سحلية دفانة
Eryx jaculus	Javelin Sand Boa	دساس بلدى
Hemidactylus turcicus	Turkish Gecko	برص منزلى
Malpolon monspessulana	Montpelier's Snake	ثعبان خضارى
Natrix tessellata	Diced Water Snake	ثعبان الماء
Psammophis sibilans	African Beauty Snake	ابو السيور
Ptychadena mascareniensis	Mascarene Frog	جزاع ابو خطين
Rana ridibunda	Lake Frog	جزاع اخضر

Mammals

Rodents form the largest mammalian group of the area (*Table 5-32*), being represented by many species and the most common species – besides of course the normal cats and dogs- are the Field Rat *Arvicanthis niloticus* and the Black Rat *Rattus rattus*, which are nocturnal and feed on vegetables and seeds. Burrows are shallow and usually under shrubs (*see Figure 5-34*).

Many Foxes were recorded in areas around the River shore. Individuals and their tracks were seen throughout the area, where it seems to inhabit date and fruit groves, cultivated areas and suburban gardens, commonly seen during daylight hours. It feeds on birds, rodents and insects. It is widespread around drains of Nile banks and Valley. However, wild carnivores have suffered a great deal of decline in the recent years as a result of secondary poisoning with pesticides widely used to control *Arvicanthis niloticus* and other rodent pests.

The Giant Musk Shrew; *Crocidura flavescens deltae*, was also recorded in many areas around the lake shore.

Table 5-32

List of the Mammals Recorded on the River Nile Bank

Order	Family	Species	English name	Arabic name
Insectivora	Soricidae	*Crocidura flavescens*	Giant musk shrew	عرسة
Rodentia	Cricetidae	*Gerbillus andersoni*	Anderson's Gerbil	بيوضى
		Psammomys obesus	Fat sand rat	جرذ

	Muridae	*Arvicanthis niloticus*	Nile or field rat	فار الغيط
		Rattus rattus	Black rat	جرذ اسود
		Rattus norvegicus	Brown rat	جرذ المجارى
		Mus musculus	House mouse	سيسى - فار
		Acomys cahirinus	Cairo spiny mouse	عرسة

Figure 5-33 (A)

Common Herpetofauna

Bufo regularis ضفدع نيلي

Natrix tessellate ثعبان الماء

Figure 5-33 (B)

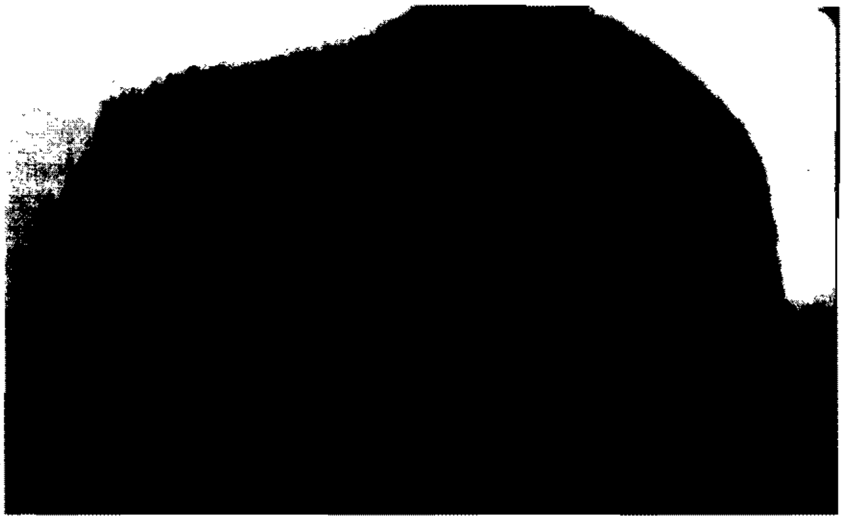
Common Herpetofauna

Rana ridibunda جزاع لخضر

Hemidactylus turcicus برص منزلي

Figure 5-34

Common Mammals



Arvicanthis niloticus **فأر الغيط**

Mustela nivalis **ابن عرس (عرسة)**

5.7 TERRESTRIAL ECOLOGY

5.7.1 Introduction

The major sector of the studied site is located in the Qarimate Desert close to the River Nile; which is, consists essentially of an intensively dissected sedimentary limestone plateaus. The formations of these limestone plateaux are mainly Upper Eocene (Bartonian) and Middle Eocene (Lutetian). The former includes a series of sands, marls, clays and marly limestone which are softer, more easily eroded, and contain larger amounts of gypsiferous and ochreous materials. The Middle Eocene formations include various types of limestone which are more solid and contain a number of hard dolomitic bands. They form the main bulk of the northern limestone plateau of the Eastern Desert. This Eocene desert adjoins on its north border sand and gravel formations of the Oligocene.

Palaeodeposits formed in situ cover extensive areas of the sandstone plateaux in this area. These deposits form erosion pavements described by Kassas (1953b) and Kassas and Girgis (1964), hamada desert, and rocky erosion surfaces. The sand and gravel desert that extends east of the Nile to the Suez Canal is composed of fluviatile palaeodeposits which belong to the Oligocene, non-marine Miocene or Pliocene (Shukri, 1953; Shukri and Akmal, 1953).

The most pronounced geomorphological feature of the whole Eastern Desert of Egypt is its dissection by valleys and ravines. While eastward drainage of highlands to the Red Sea is by numerous independent wadis, channels of the westward drainage to the Nile Valley mostly coalesce into a relatively small number of extensive wadis.

The main plain is covered by a series of silts, sands and gravel of fluviatile origin, often with a stony surface. In places, this stony surface is hurried under blown sand or washed silt. Mobile dunes of the barkhan type are sterile.

The Recent deposits rest upon Plio-Pleistocene beds of limestone, shales, marls, clays, grits, conglomerates and gypsum; the Pli-Pleistocene beds form low flat-topped hills projecting through the recent deposits. These beds rest uncomfortably upon the basement complex rocks. Along the western margin of the plain, hills of Archean rocks have been reduced to plain level by erosion and are now marked by residual fragments of the underlying rock type. This forms locally a desert surface of the hamada type as distinguished from the gravel desert of the plain and the erosion pavements .

The geology of the area was outlined by Abdel-Daiem (1971). Quaternary strata cover the major part of the area which have a maximum thickness of about 240 m, and are developed into aeolian sands as well as into fluviatile sands and gravels.

Tertiary- strata occupy much of the area; they are essentially developed into lime facies with thin intercalations of clayey sand, and are formed under shallow marine conditions. Pliocene strata are exposed at the fringe of the Nile Valley and are referred to as marine Pliocene composed of sandy limestone and marl packed with ***Ostrea cucullata*** with a rich foraminiferal content.

According to this sequence, it is postulated that arms of the Pliocene gulf that occupied the Nile Valley penetrated into erosional valleys of the main wadis, which were originally formed towards the end of the Miocene. At the end of the Pliocene and in the Early Pleistocene continued rising of the land surface in the south and the flow of fresh water into the Pliocene gulf filled this gulf with ferruginous material. Pleistocene to Holocene times was marked by continual building of the Delta, the piedmont plains and eventually the flood plains. With the advent of aridity the landscape took most of its present shape.

A variety of habitat types are found in this extensive desert area. These include the sand dunes, extensive area of gravel desert, and the low reaches of numerous west-flowing wadis draining the limestone.

5.7.2 General Field Observations

The field observations that describe the general conditions of the terrestrial investigated area are as follow:

- The terrestrial investigated area is generally characterized by low vegetation and some desert wild plants, while most of the area was planted by many crops (*see Figure 5-35*).
- Most of habitats in the region are biologically deteriorated with very poor biodiversity and no sensitive ecosystems (*see Figures 5-36, 5-37 and 5-38*).
- No protected areas for their conservation value are located on, or in the vicinity of the project area.

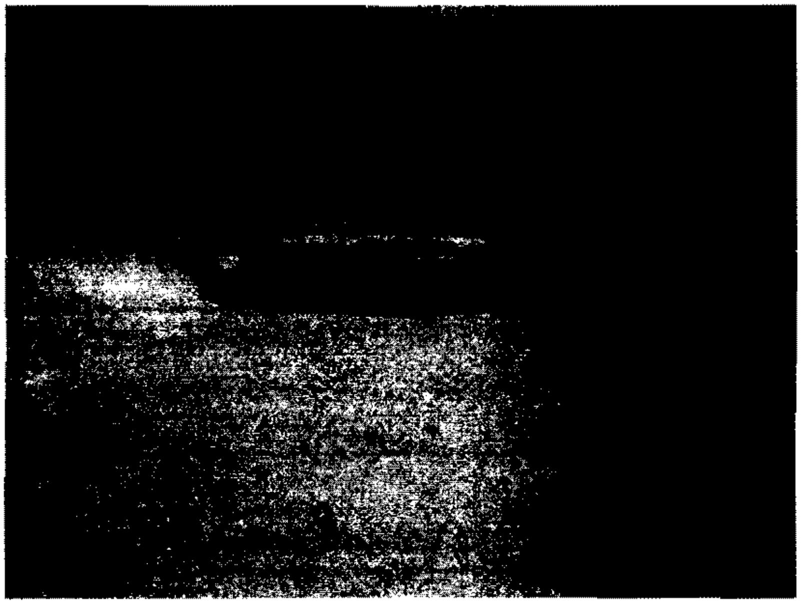
5.7.3 Methodology

The terrestrial ecology of the project hinterland was generally described. This was gathered from the team previous experience in this area as well as scientific literature.

The terrestrial ecological baseline data of the site of the proposed extension of Power Plant were then gathered through field investigations. These include habitats surveys, visual inspection and counting of fish species with fishermen, and collection of phyto- and zooplankton biota for laboratory examination.

Figire 5-35

Desert Environment around the Power Plant

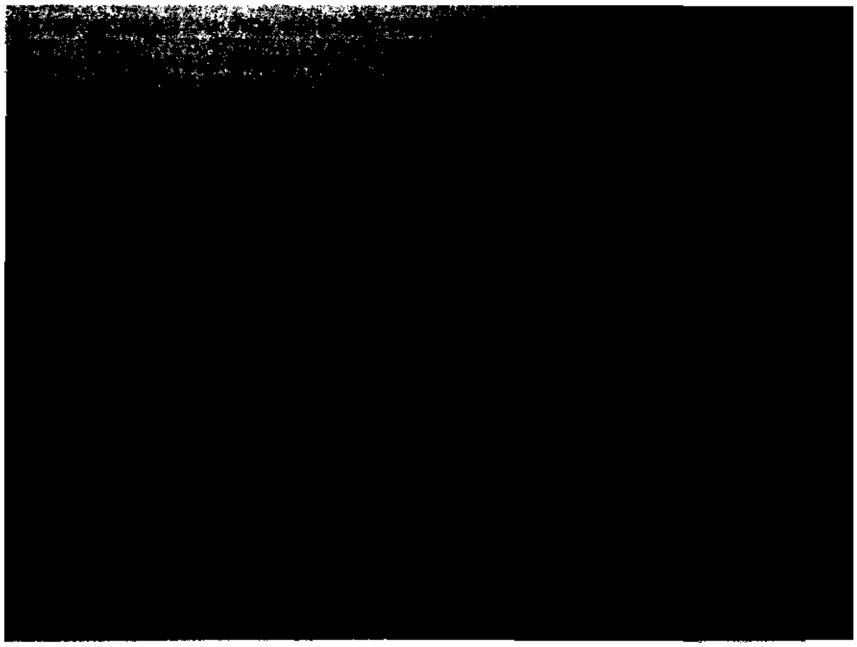


Figire 5-36

Vegetation in the Studyt Area

Figire 5-37

Different Terrestrial Habitat



Figire 5-38

Plants and Vegetation in the Study Area

5.7.4 Wild Life

Plants and Vegetation

The area of the study is generally characterized by low vegetation and some desert wild plants, while most of the area was planted by many crops.

Several plant communities were recognized. The dominant species include: *Acacia racldiana, Tamarix aphylla, Retama (Lygos) raetam, Leptadenia pyrotechnics, Launaea spinosa, Hammada elegans, Anabasis articulata, Panicum turgidum, Artemisia judaica, Zilla spinosa and Zygophyllum coccineum.*

Several species seem to have an eastern affinity and are confined to the eastern margins of the area. These include: *Launaea spinosa, Blepharis edulis Convolvulus hystrix, Barleria acanthoides, Iphiona scabra, Taverniera aegyptiaca, etc. (see Figures 5-39 and 5-40).*

Reptiles

Many reptilian species are known to occur in this area. In the relatively flat, sand or gravel desert around the studied site, Saber (1989) listed 30 desert dwelling reptilian species. Most abundant of these were *Acanthodactylus scutellatus, A. boskianus, Trapelus flavimaculatus, Scincus scincus, Chamaeleo chamaeleon, Varanus griseus, Psammophis schokari, Spalerosophis diadema* and *Cerastes viper a.* In wadis draining the limestone plateau in the northern sector of this desert, common reptiles include *Ptyodactylus guttatus, Acanthodactylus boskianus, Uromastyx aegyptius, Chamaeleo camaeleon, Coluber rhodorhachis, Walterinnesia aegyptia* and *Cerastes cerastes* .In the southern part of this inland desert *Ptyodactylus hasselquistii, Pseudotrapelus sinaitus, Trapelus flavimaculatus, Uromastyx ocellatus, Mesalina guttulata, M. rubropunctata* and *Cerastes cerastes* are the characteristic reptiles (*Table 5-33 and Figures 5-41 through 5-46*).

Table 5-33

Reptiles Recorded at the Study Area

Latin name	English name	Arabic name
Acanthodactylus boskianus	Bosc's Fringe-toed Lizard	سقنقر خشن
Acanthodactylus scutellatus	Nidua Fringe-toed Lizard	سقنقر الرمل الكبير
Acanthodactylus schreiberi		
Chalcides ocellatus	Ocellated Skink	سحلية نفقة
Chamaeleo africanus	African Chameleon	حرباء افريقيا
Chamaeleo chamaeleon	Common Chameleon	حرباء
Eryx jaculus	Javelin Sand Boa	تمساح بلدى
Hemidactylus turcicus	Turkish Gecko	برص منزلي
Mabuya quinquetaeniata	Bean Skink	سحلية جراية
Mabuya vittata	Bridled Skink	سحلية جراية مخططة
Malpolon monspessulana	Montpelier's Snake	ثعبان خضارى
Naja haje	Egyptian Cobra	كوبرا مصرى
Psammophis sibilans	African Beauty Snake	ابو السيور
Sphenops sepsoides	Audouin's Skink	سحلية نعامة

Birds

Many birds of resident avifauna of this desert is composed of y species of 'true desert birds (Baha el Din and Saleh, 1983) *, such as Hirundo rustica savignii, Motacilla flava pygmaea, Galerida cristata maculate, Lanius collurio collurio, Acrocephalus arundinaceus arundinaceus, Prinia gracilis gracilis, Phylloscopus sibiatrix, Sylvia curruca curruca, Ficedula parva parva, Oenanthe oenanthe oenanthe Cursorius cursor, Pterocles coronattus, P. senegallus, Ammomanes cincturus, A. deserti, Alaemon alaudipes, Oenanthe lugens, O. leucopyga, Scotocerca inquieta, Corvus ruficollis, Bucanetes githa-gineus and Emberiza striolata (Tabl.e 5-34 and Figures 5-47 and 5-48).*

Table 5-34

List of Bird Species Recorded at the Study Area

[(*) Denotes the endemic species, b: breeding species]

Scientific name	Family	English name
Tachybaptus ruficollis ruficollis[b]	Podicipediae	Little Grebe
Ardea cinerea cinerea	Ardeidae	Grey Heron
Ardeola ralloides	Ardeidae	Squacco Heron
Nycticorax nycticorax nycticorax	Ardeidae	Night Heron
Ixobruchus minutus minutus[b]	Ardeidae	Little Bittern
Egretta alba alba	Ardeidae	Great White Egret
Egretta ibis ibis	Ardeidae	Cattle Egret
Egretta garzetta garzetta	Ardeidae	Little Egret
Anas penelope	Anatidae	European Wigeon
Anas clypeata	Anatidae	Shoveler
Anas querquedula	*Anatidae*	*Garganey*
Aythya ferina	*Anatidae*	*Pochard*
Aytha nyroca	*Anatidae*	*Ferruginous Duck*
Elanus caeruleus caeruleus	*Accipitridae*	*Black-Shouldered Kite*
Circus aeruginosus aeruginosus	*Accipitridae*	*Marsh Harrier*
Falco tinnuniculus tinnuniculus	*Falconidae*	*Kestrel*
Porphyrio porphyrio madagascariensisb	*Rallidae*	*Purple Gallinule*
Fulica atra atra	*Rallidae*	*Coot*
Charadrius hiaticola tundrae	*Charadriidae*	*Ringed Plover*
Charadrius alexandrinus alexandrinusb	*Charadriidae*	*Kentish Plover*
Hoplopterus spinosusb	*Charadriidae*	*Spur-Winged Plover*
Calidris minuta	*Scolopacidae*	*Little Stint*
Calidris alpina alpina	*Scolopacidae*	*Dunlin*
Philomachus pugnax	*Scolopacidae*	*Ruff*
Lymnocryptes minimus	*Scolopacidae*	*Jack Snipe*
Tringa totanus totanus	*Scolopacidae*	*Redshank*
Actitis hypoleucos	*Scolopacidae*	*Common Sandpiper*
Larus ridibundus	*Laridae*	*Black-Headed Gull*
Larus genei	*Laridae*	*Slender-Billed Gull*
Larus fuscus fuscus	*Laridae*	*Lesser Black-Racked Gull*
Larus argentatus cachinnans	*Laridae*	*Yellow-Legged Gull*
Chlidonias hybrida hybrida	*Laridae*	*Whiskered Tern*

Table 5-34 *(Contd.)*

List of Bird Species Recorded at the Study Area

[(*) Denotes the endemic species, b: breeding species]

Scientific name	Family	English name
Chlidonias leucoptera	*Laridae*	*White-winged Black Tern*

Scientific name	Family	English name
Sterna albifrons albifronsb	*Laridae*	*Little Tern*
*Streptopelia senegalensis aegyptiaca**	*Columbidae*	*Palm Dove*
Streptopelia decaoclo decaoclo	*Columbidae*	*Coilered Turtle Dove*
*Centropus senegalensis aegyptius*b*	*Cuculidae*	*Senegal Coucal*
Cuculus canorus canorus	*Cuculidae*	*Cuckoo*
Ceryle rudis rudisb	*Alcedinidae*	*Pied Kingfisher*
Merops orientalis cleopatra	*Meropidae*	*Little Green Bee-eater*
Upupa epops epops	*Upupidae*	*Hoopoe*
Hirundo rustica rustica	*Hirundinidae*	*Swallow*
Riparia riparia riparia	*Hirundinidae*	*Sand Martin*
*Calandrella rufescens nicolli*b*	*Alaudidae*	*Lesser Short Toed Lark*
*Galerida cristata nigricans**	*Alaudidae*	*Crested Lark*
Anthus cervinus	*Motacillidae*	*Red-Throated Pipit*
*Motacilla flava pygmaea**	*Motacillidae*	*Egyptian Wagtail*
Motacilla flava flavissima	*Motacillidae*	*Yellow Wagtail*
Motacilla cinerea cinarea	*Motacillidae*	*Grey Pied Wagtail*
Lanius collurio collurio	*Laniidae*	*Red-backed Shrike*
Sturnus vulgaris vulgaris	*Sturnidae*	*Starling*
Corvus corone cornix	*Corvidae*	*Hooded Crow*
*Prinia gracilis deltae*b*	*Sylviidae*	*Graceful Warbler*
Scotocerca inquieta inquieta	*Sylviidae*	*Scrub Warbler*
Passer domesticus niloticus	*Passeridae*	*House Sparrow*
Emberiza calandra calandra	*Emberizidae*	*Corn Bunting*
Emberiza shoeniclus intermedia	*Emberizidae*	*Reed Warbler*
Milvus migrans		

Mammals

Rodents form the largest mammalian group of the area (*Table 5-35*), being represented by many species and the most common species – besides of course the normal cats and dogs- are the Field Rat *Arvicanthis niloticus* and the Black Rat *Rattus rattus*, which are nocturnal and feed on vegetables and seeds. Burrows are shallow and usually under shrubs.

Many Foxes were recorded in areas around the River shore. Individuals and their tracks were seen throughout the area, where it seems to inhabit date and fruit groves, cultivated areas and suburban gardens, commonly seen during daylight hours. It feeds on birds, rodents and insects. It is widespread around drains of Nile banks and Valley. However, wild carnivores have suffered a great deal of decline in the recent years as a result of secondary poisoning with pesticides widely used to control *Arvicanthis niloticus* and other rodent pests.

The Giant Musk Shrew; *Crocidura flavescens deltae* , was also recorded in many areas around the lake shore (see *Figures 5-49 through 5-53*).

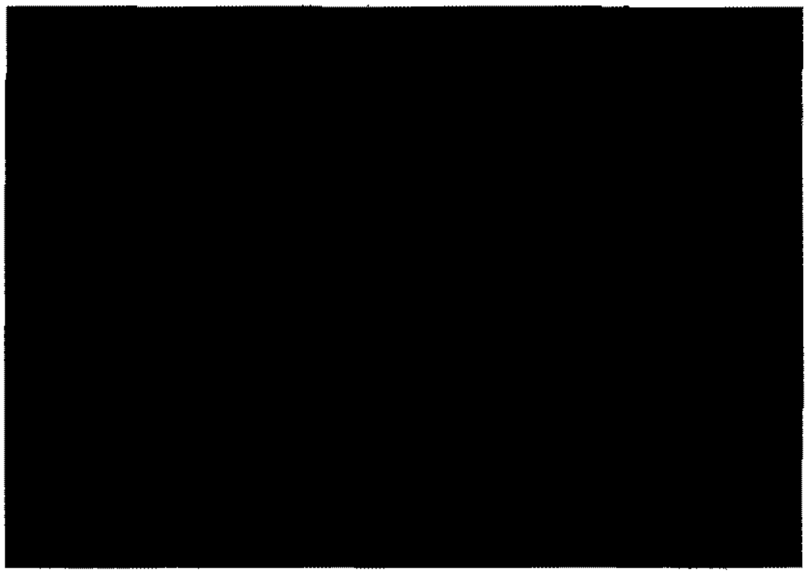
Table 5-35

List of the Mammals Recorded at the Study Area

Order	Family	Species	English name	Arabic name
Insectivora	Erinaceidae	*Hemiechinus auritus*	Long eared hedgehog	قنفذ
	Soricidae	*Crocidura flavescens*	Giant musk shrew	عرسة
Rodentia	Cricetidae	*Gerbillus andersoni*	Anderson's Gerbil	بيوضي
		Psammomys obesus	Fat sand rat	جرذ
	Muridae	*Arvicanthis niloticus*	Nile or field rat	فار الغيط
		Rattus rattus	Black rat	جرذ اسود
		Rattus norvegicus	Brown rat	جرذ المجارى
		Mus musculus	House mouse	سيسي - فار
		Acomys cahirinus	Cairo spiny mouse	عرسة
Carnivora	Mustelidae	*Mustela nivalis*	Weasel	ابن عرس
	Viverridae	*Herpestes ichnaumon*	Egyptian mongoose	نمس

Figure 5-39

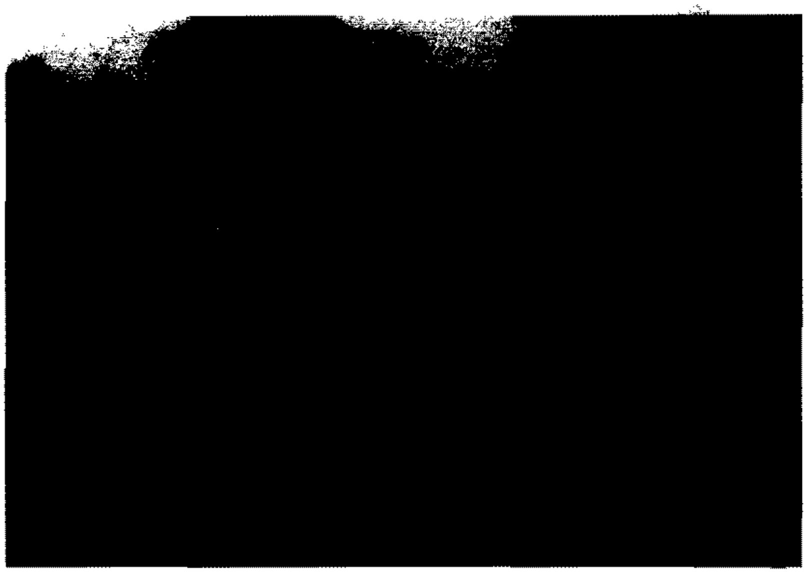
Plants and Vegetation



Saccharum spontaneum **هيش**

Figure 5-40

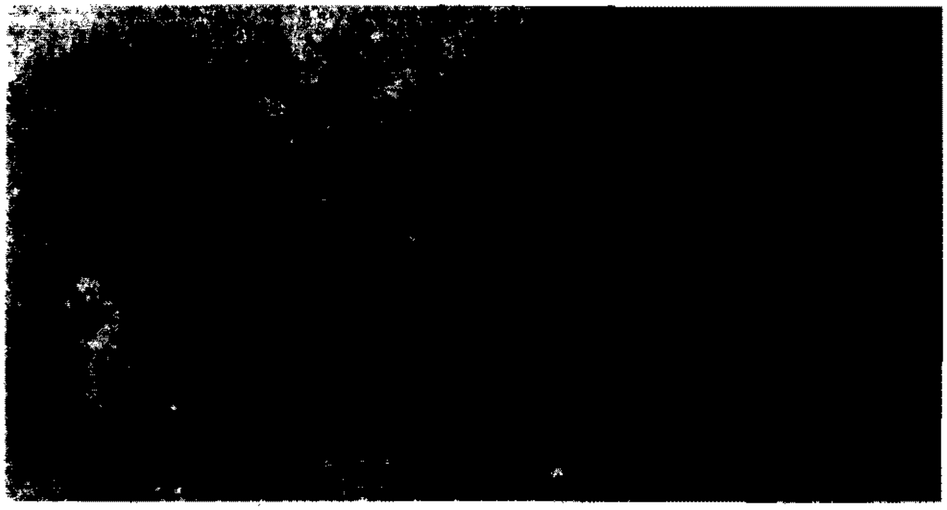
Plants and Vegetation



Imperata cylindrica **حلفا**

Figure 5-41

Common Herpetofauna



Hemidactylus turcicus turcicus **برص منزلي**

Ptyodactylus hasselquistii **برص أبو كف**

Figure 5-42

Common Herpetofauna

Stenodactylus petrii برص واسع العين

Stenodactylus sthenodactylus برص واسع العين

Figure 5-43

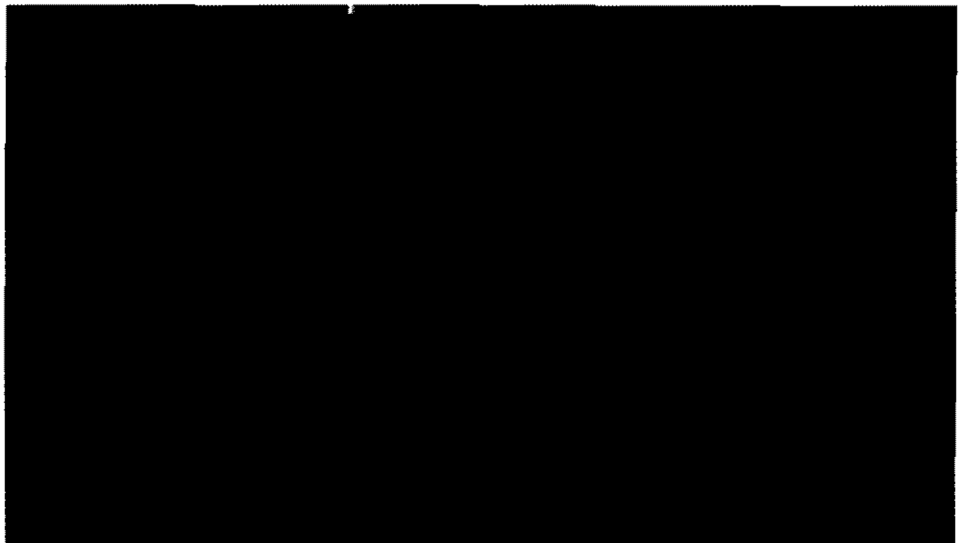
Common Herpetofauna

Acanthodactylus boskianus سقنقر خشن

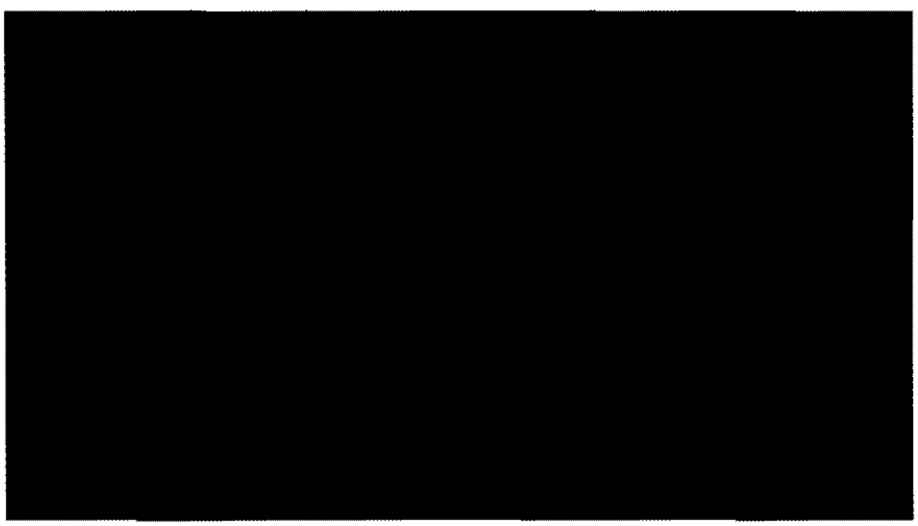
Acanthodactylus scutellatus سقنقر الرمل الكبير

Figure 5-44

Common Herpetofauna



Chalcides ocellatus **سحلية دفانة**



Scincus scincus سقنقور

Figure 5-45

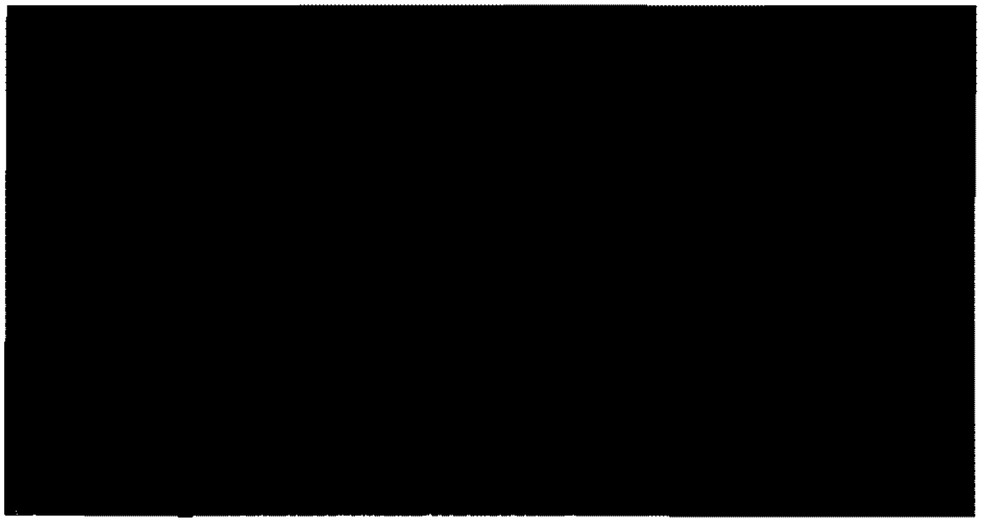
Common Herpetofauna

Sphenops sepsoides سحلية نعامة

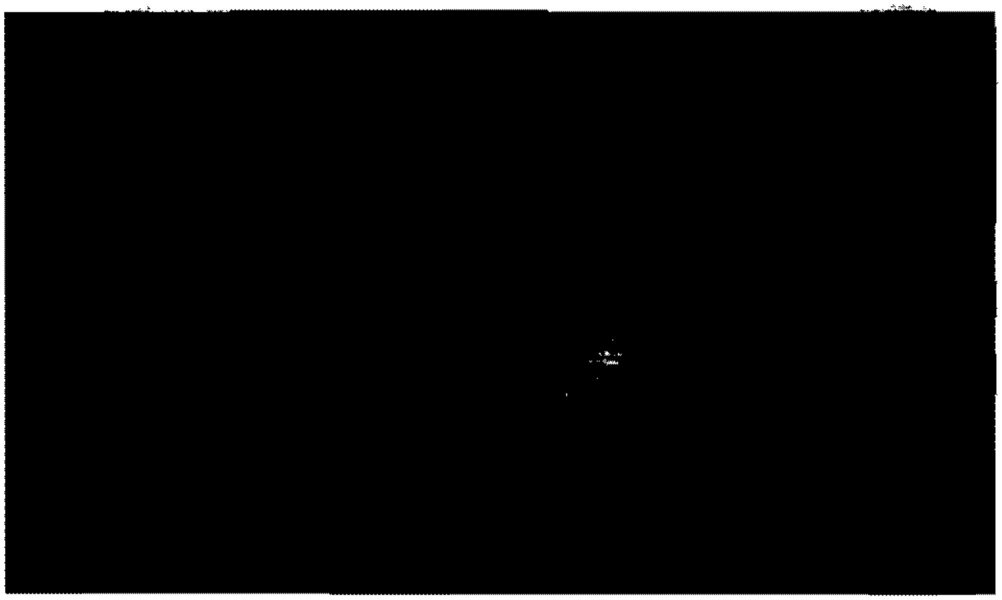
Chamaeleo chamaeleon حرباء

Figure 5-46

Common Herpetofauna



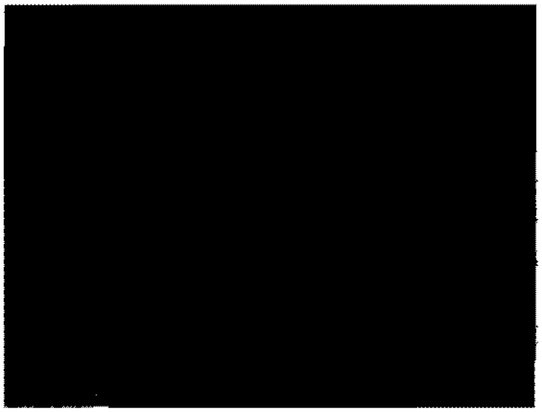
Varanus griseus ورل صحراوى



Lytorhynchus diadema يسباس

Figure 5-47

Common Birds



Motacilla flava

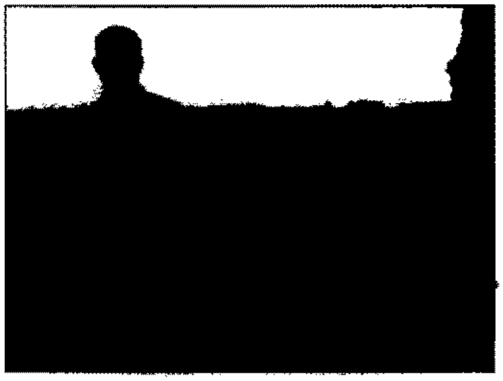
Prina gracilis

Hirundo rustica

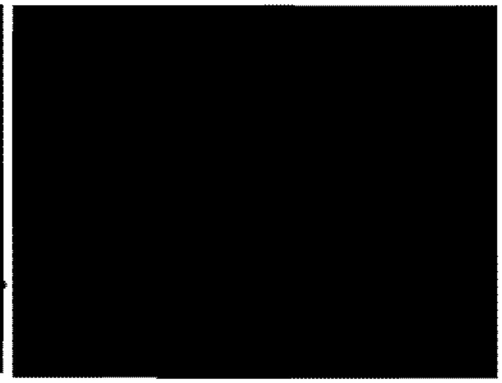
Gallinula chloropus

Figure 5-48

Common Birds



Falco tinnunculus

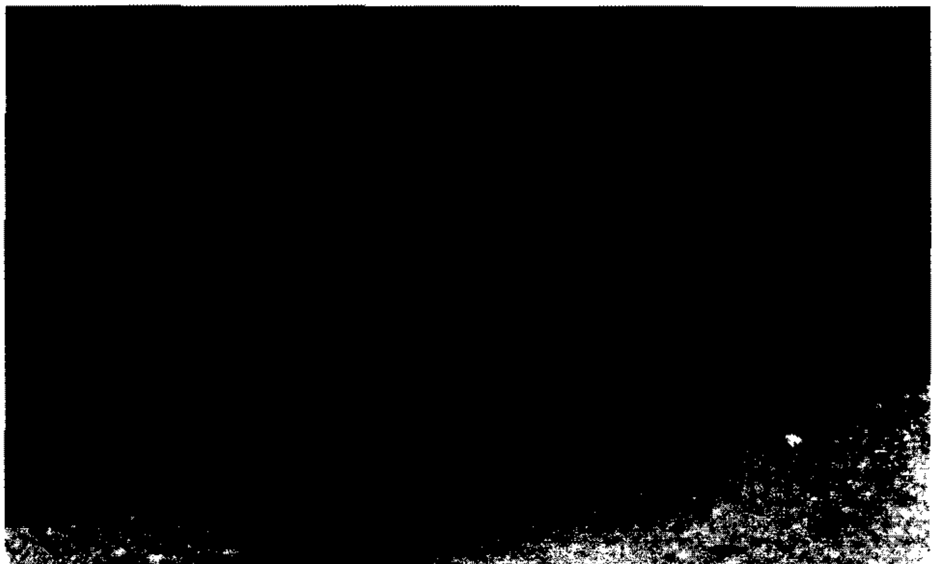


Elanus caeruleus

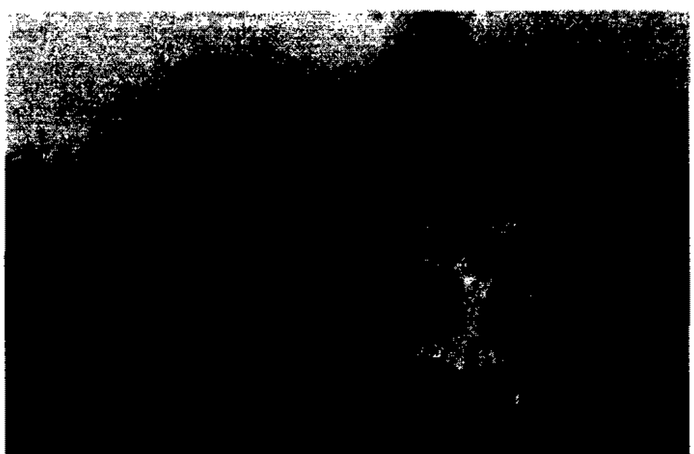
Alcedo atthis

Figure 5-49

Common Mammals



Hemiechinus auritus القنفذ طويل الأذن



Gerbillus pyramidum الدمسي

Figure 5-50

Common Mammals

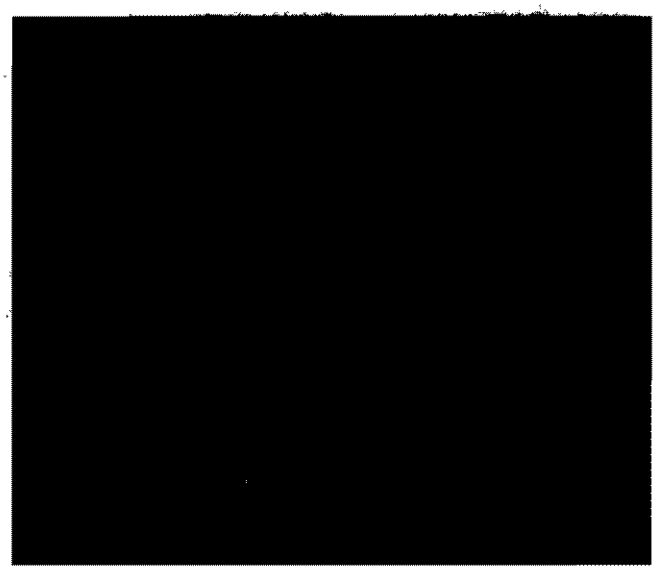
Gerbillus andersoni **جربيل اندرسون**

Gerbillus gerbillus **البيوضي**

Figure 5-51

Common Mammals

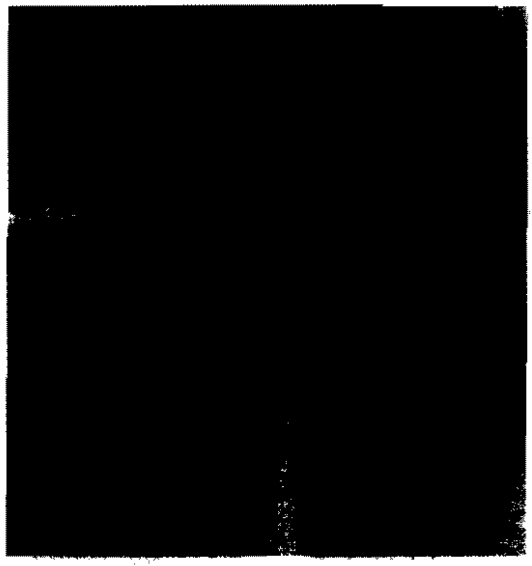
***Meriones* carssus** مريونز كراسوس



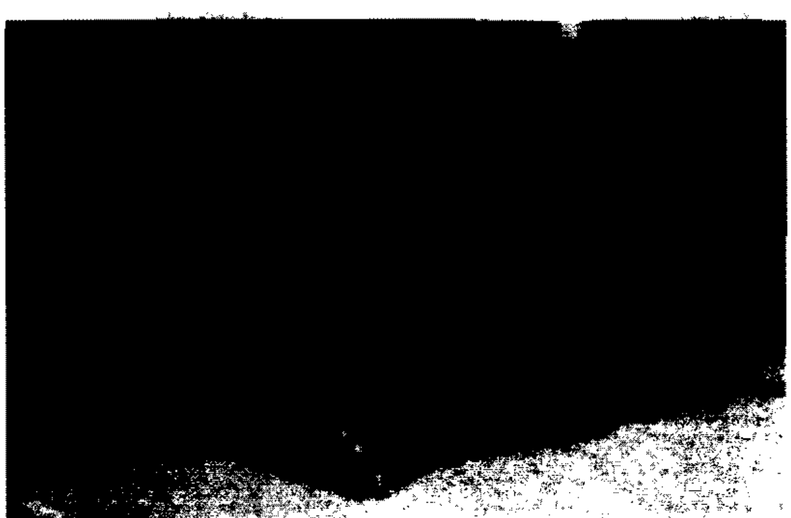
sanmomys obesus جرذ

Figure 5-52

Common Mammals



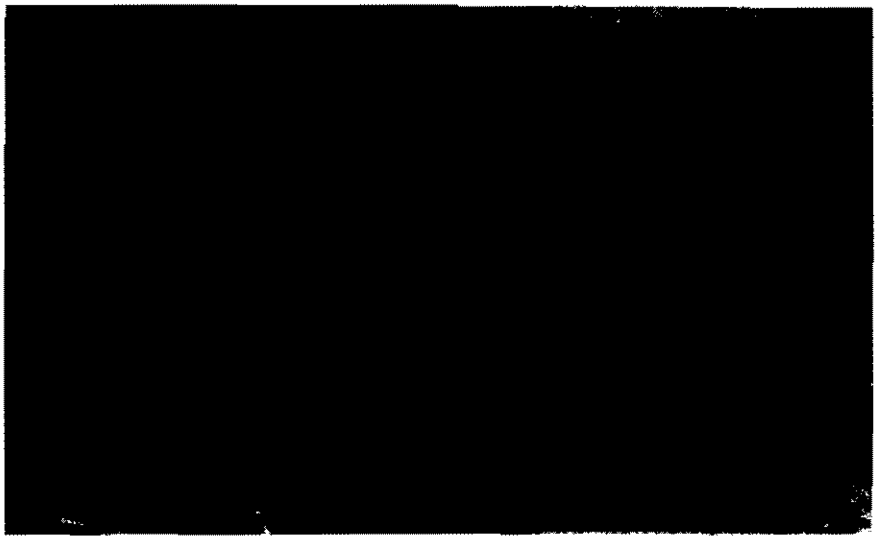
Rattus rattus **جرذ أسود**



Mus musculus فأر المنزل

Figure 5-53

Common Mammals



Jaculus orientalis القرفتي

Jaculus jaculus يربوع حر

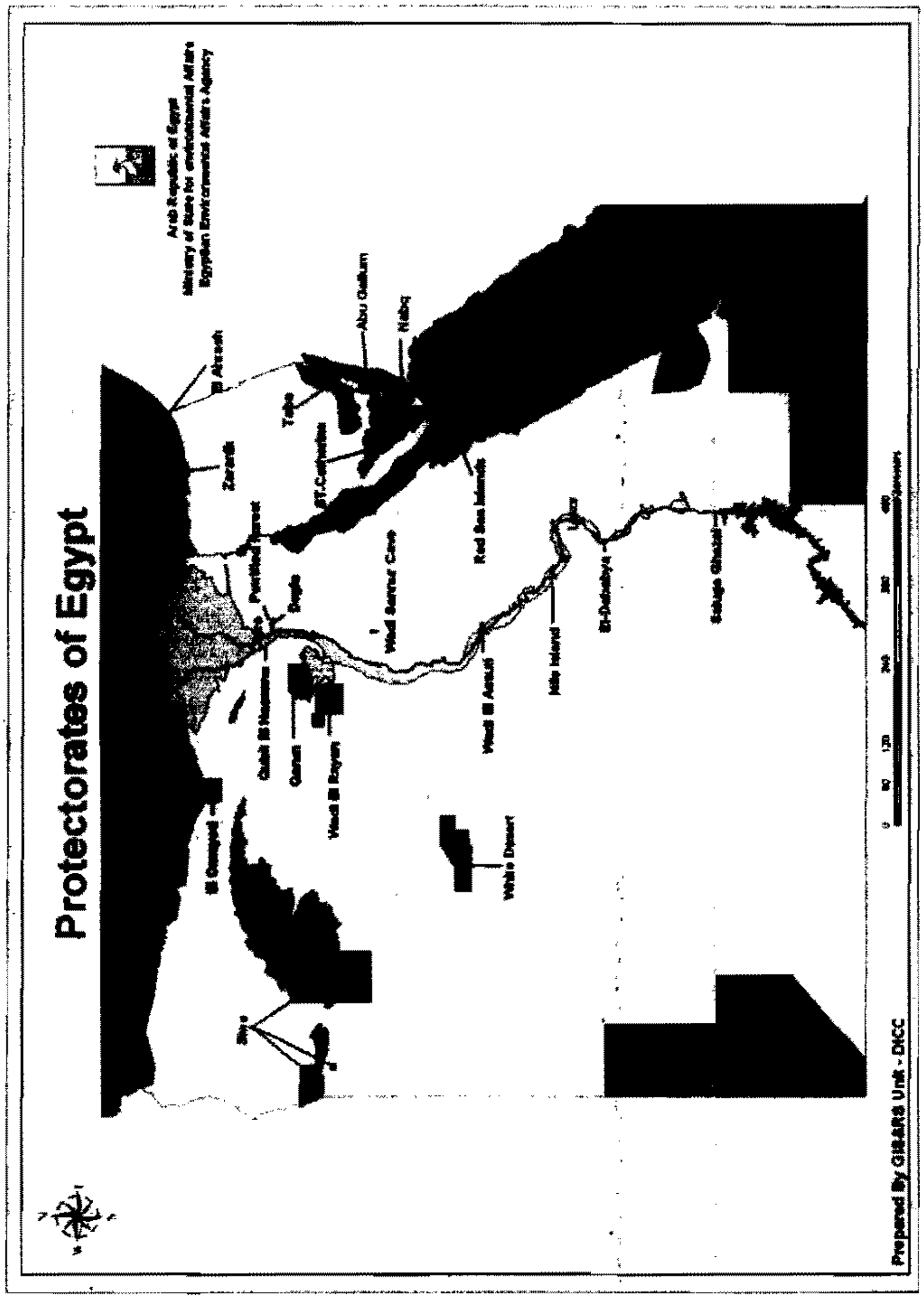
5.7.5 Natural Protectorates

The site is not located at a natural protectorate area. *Figure 5-54* presents the map of natural protectorates in Egypt.

The nearest Protectorate to the site is the Hassana Dome (Kobbet El-Hassana) scientific protectorate in the Giza Governorate, which is more than 90 km far north from the proposed Helwan South power project site.

Figure 5-54

Natural Protectorates of Egypt



5.8 LAND USE AND LANDSCAPE CHARACTER

5.8.1 Introduction

Due to increased developmental activities in Egypt, it was necessary to monitor and follow up the changes in water use; land use, consequently a number of periodical monitoring programs were developed to measure indicators of water and land quality: natural, chemical and microbiological indicators. In these programs, surface water quality is assessed through monitoring water resources found closed to the development projects over Egypt.

Due to limited water resources vis-à-vis the national development project demand caused by government increase and industrial, agricultural and other developmental activity boom, it was necessary to have an Egyptian water policy that employs integrated water management methodologies. This policy focuses on providing water in the amounts that should meet various developing needs, besides maintaining water quality against pollution, following scientific methods to rationalize water consumption in all developmental domains, and raising citizens' awareness at all levels on this end (to protect water against pollution and rationalize consumption). Moreover, all stakeholders would participate in the implementation of the integrated water management policy to ensure sustainability.

Recording land use/ land cover change over time is perhaps one of the most important applications of digital remote sensing data (Christensen et al., 1988). For example, the conversion of land to industrial activity land use can be detected using a temporal comparison of spatial change determined from multi-dates satellite data. The value of utilizing remotely sensed data for change detection studies is limited only by the imagination of the investigators and potential users.

The using of change detection technique is to measure the changes in spatial distribution of land, vegetation, water areas in South Helwan Steam Power Plant (3x650) Mw, Helwan Governorate. Also, to detect environmental change trends, particularly in soil, vegetation type and cover, as well as in coastal areas during the past three decades.

5.8.2 Study Objectives

The aim of this study is to monitor and help in building a baseline information that are required for the implementing of South Helwan Steam Power Plant (3x650) Mw, Helwan Governorate. The report presents. The ecological features of the study area are determined; fauna and flora to reflect the importance of natural habitats in such these agriculture areas in Egypt.

5.8.3 Study Area

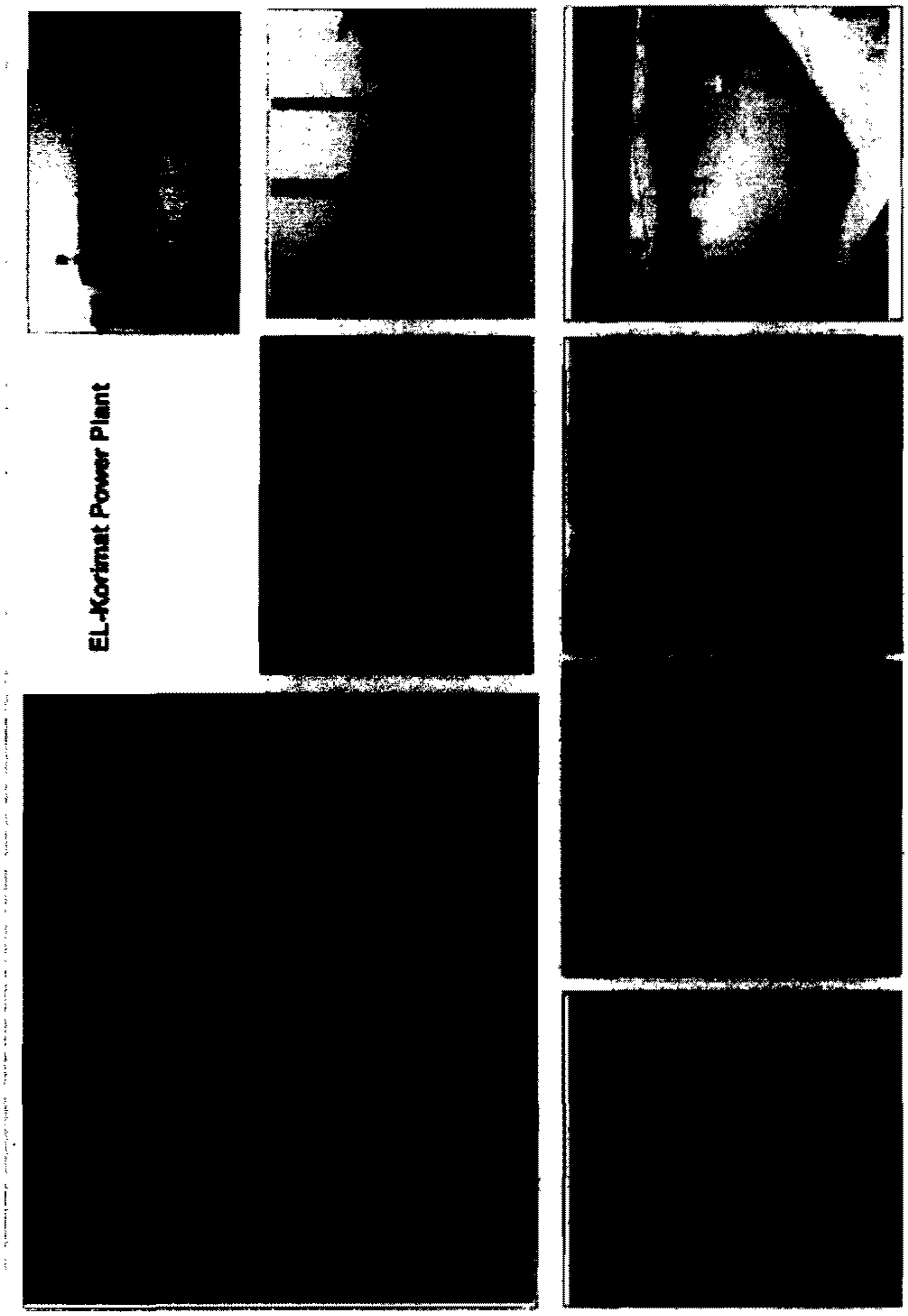
Helwan is one of the governorates of Egypt that was regarded as a part of Cairo Governorate till 2008. Nowadays it is a separate governorate bordered with Cairo from the northern , El Sharqeya , and El Qalyubiya Governorates , the Nile River from the west, and Suez Governorate from the east. **Helwan Governorate** is one of the governorates of Egypt, located in Lower Egypt. In April 2008, the administrative division of the Cairo Governorate was split into Cairo and Helwan, with Helwan encompassing most of the suburbs of Cairo. Helwan became the capital of the new Helwan governorate. The Helwan governorate boundary includes the following districts: Maadi, Helwan, 15th of May, EL-Sherouk city, El-Obour city, Badr city, New Cairo districts such as Madinaty, El-Rehab city, the Fifth compound district (El-Tagammu' El-Khames). The city of Helwan itself includes districts such as Wadi Hof, Hadayek Helwan, and Maasara

Helwan area witnessed an age of prosperity during the Mamluk rule of Egypt since it was regarded as the Capital of Mamluk Egypt and a luxuriously decorated palaces and mosques were established there . By the passage of time , the importance of the city decreased and most of the monuments in it were devastated till the reign of Khedive Ismail.

Nowadays Helwan Governorate comprises of a large number of administrative centers , cities and suburbs and the government encourages businessmen for investing their capital in it . It is one of the major industrial zones in Egypt that are famous for iron , steel , textile and cement industries that are regarded as the essential sources of income for the city . The main factor behind the industrial development in Helwan is the availability of means of transportation linking it with other important cities and governorates (*Figure 5-55*).

Figure 5-55

Map shows the Proposed Study Area



5.8.4 Data Acquisition

In order to present a reasonable evaluation of the land use/ land cover maps and their using in the determination of ecological characteristics of the study area, the following data were collected:

1. Topography
   - A topographic maps of a scale 1: 100,000
2. Satellite data
   - Landsat TM image year 1987
   - Egypt sat Image year 2006

The above data have been processed and various geo-spatial data has been determined automated into various GIS data sets. These data sets include

5.8.5 Line GIS Layers

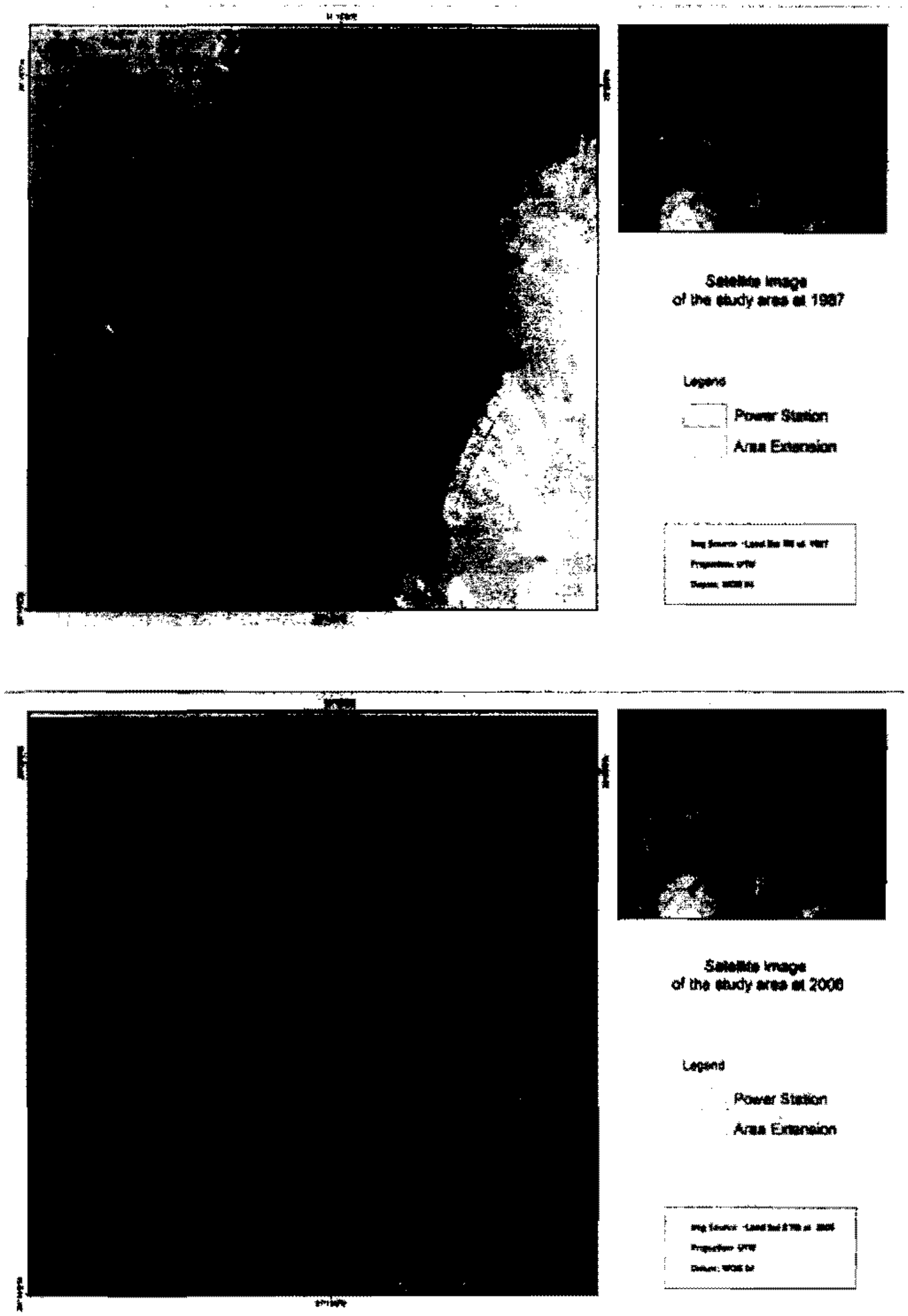
- Contours of elevations
- The shoreline
- Road networks
- Stream network

The hardcopy, the provided digital data and the automated GIS layers have been used to understand and present the baseline information about South Helwan Steam Power Plant Project (3x650) Mw, and to conduct a preliminary assessment of both the environmental assessment that might affect the planned installations and the impact of the planned activities on the surrounding environment.

Satellite data required accomplishing the objectives of remote sensing activities and consequently achieving the current work objectives surveyed from archived scenes. The Landsat image 1987 and 2006 that cover the study area were collected for the purpose of establishing a comprehensive GIS database, (*Figure 5-56*).

Figure 5-56

The Acquired Landsat Images for 1987 and 2006



5.8.6 Image Processing

Image processing, which comprised three principal steps of geometric correction, spectral enhancement and, in the case of the images of the study area, image classification was undertaken using ERDAS Imagine (v 8.7).

Geometric Correction: The geometric correction of each image was carried out using standard procedures. Geometric distortions are normally introduced to satellite data during acquisition. They result from several factors including attitude (roll, pitch, and yaw), the Earth's rotation and panoramic distortions, (ERDAS, 1999). The coordinates of a remotely sensed scene do not therefore correspond to a standard map projection and the coordinates of a fixed point vary from image to image. Geometric correction (rectification) is therefore necessary in order to remove geometric anomalies and created a faithful representation of the original scene by correcting pixel location errors and establishing a correspondence between ground features and their correct position throughout the image. As a result, it has the scale and projection properties (geometric integrity) of a map.

Image rectification is typically accomplished on the basis of well-distributed ground control points (GCPs) located on both the images and a map of the corresponding area (Olmanson et al., 2001). For each image a number of GCPs (between five and 19 depending on image) were identified. These points comprised static features visible in both an image (source points) and the corresponding 1:50:000 topographic map (reference points). GCPs included road and canal intersections, bridges and other large man-made features. Since both the source and corresponding reference points represented the same features with different coordinate systems they were used to generate a transformation polynomial using the regression analysis method (Milne, 1988). Acceptance of the transformation polynomial was based upon the RMS error reported between the two sets of points. It is recommended that the RMS error should not exceed the pixel size of the raw image and in the worst case (such as in mountainous areas) no more than double the original pixel size. Subsequently the transformation polynomial was used to rectify the image to the map coordinate system using the nearest neighbour re-sampling technique (Christensen et al., 1988).

Image enhancement: Enhancement techniques are often employed in order to enhance image display properties, identify different features in an image and thereby enhance subsequent visual interpretation. Enhancement of each of the remotely sensed images of the study area was undertaken by stretching the different spectral bands, one of the most common image enhancement techniques. This procedure modifies the distribution and range of Digital Numbers (DNs) of the image pixels so that the potentially limited range of DN values within the original image covers a larger range within the stretched image, (Lillesand et al., 2008).

Image classification: Review of the false colour composites of South Helwan Steam Power Plant (3x650) Mw, Helwan Governorate, (discussed below) highlighted major changes over time in the distribution of the characteristic feature of this particular site. The extensive desert nature of study area into different sub-classes so that they play an important ecological role. Therefore in order to more clearly illustrate these changes and to provide quantitative information on the relative extent of these classes compared to other areas of the remotely sensed images of South Helwan Steam Power Plant Project (3x650) Mw,were subject to a classification procedure. The basic premise of multi-spectral image classification is that different surfaces have sufficiently different reflectance properties in different regions of the electromagnetic spectrum (i.e. spectral signatures).

An unsupervised classification approach was adopted (e.g. Lillesand et al., 1998) in which pixels were classified based upon their spectral signatures alone without any prior knowledge of the different surfaces within the images. Classification was undertaken using image bands with the highest spatial resolution. These comprised all four bands 1-5 and 7 of the Landsat TM image (resolution 30 m). The classification was restricted to a digitised lake boundary for each image identified from the false colour composites, (*Figure 5-57).*

The unsupervised classification procedure was performed using the ISODATA ("Iterative Self-Organizing Data Analysis Technique") algorithm within ERDAS Imagine with an initial specified 15 arbitrary classes. This algorithm repeatedly performs an entire classification from which clusters of pixels with similar spectral signatures are identified. A minimum spectral distance formula is used to define these clusters. After initial unsupervised classification, classes were combined based upon knowledge of the characteristics of the site to provide major classes. The area and percentage cover of each of these classes was then evaluated, (*Figure 5-58*).

The most remotely sensed images used for the study area enable the identification of the key features within these environments and in their immediate surroundings at the time of image acquisition. Specific areas discussed in the text are labelled within the images.

Figure 5-57

Un-supervised Classification Images Dated 1987 and 2006 Producing Land Cover Map of the Study Area

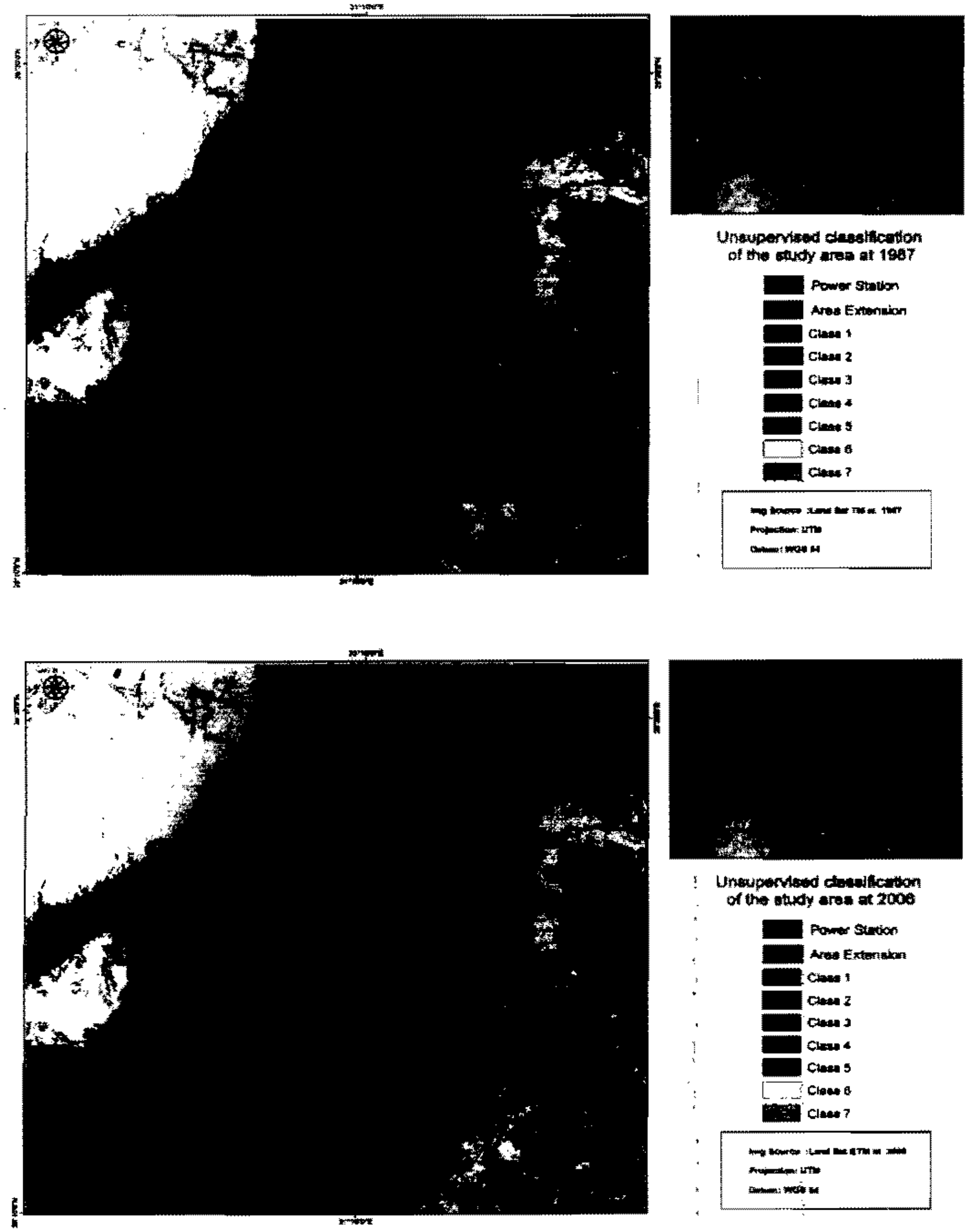
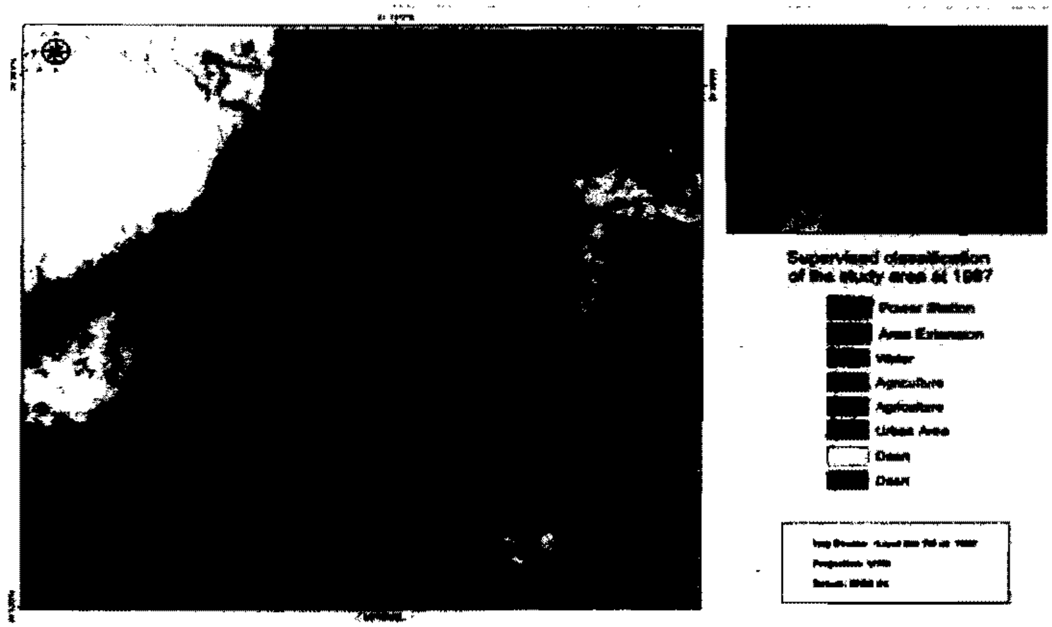
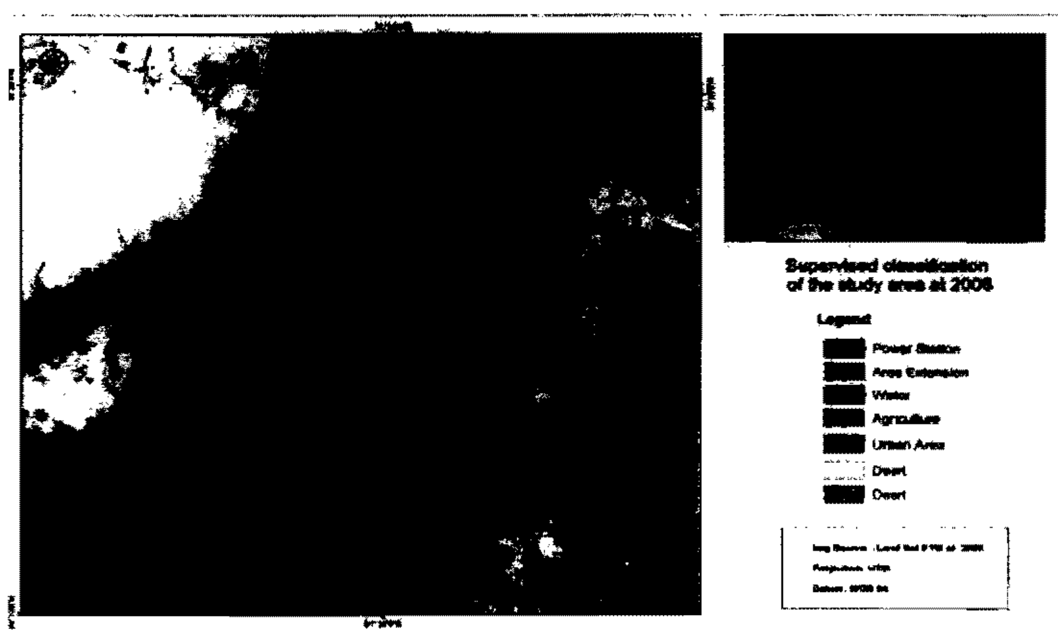


Figure 5-58

Supervised Classification Images Dated 1987 and 2006 Producing Land Cover Map of the Study Area





5.8.7 Data Conversion

The files include all the digitized layers along with their thickness values. Various layers of the dxf files are converted into their corresponding Sahpefiles using ArcGIS. In this step, each layer of these files is separated into a thematic GIS layer.

5.8.8 Geo-referencing

Geo-referencing is an essential step of the spatial data management. Geo-referencing aims at the conversion of the coordinates from the digitizing screen coordinates into a real world coordinate. Each GIS layer is geo-referenced using the following parameters:

Projection : Universal Transverse Mercator (UTM)
Unit : Meters
Spheroid : WGS 84
Datum : WGS 84
Zone : 36

5.8.9 Editing

Various editing operations have conducted over GIS layers to make them ready for display and analysis. These operations include the following:

- *GIS layers:* GIS layers have been overlain on the geo-referenced scanned map to check that all layers in the maps have been extracted.
- *Features*: Check the occurrence or the absence of various features in each GIS layer. Verify that each polygon is closed (No overshoots or undershoots). Verify that each line is smooth and connected with other line if necessary.
- *Attributes:* Removing all the non-required fields of the DXF files from the shape files except the thickness field, Create a new field called "Code" in the shape files, Transfer values of "Thickness field" into the new created code field, Display the features in each GIS layer using code values to assure the accuracy of data entry by comparing them with the source.

5.8.10 Edge matching

Having two GIS layers edge matched, they should be geo-referenced to the same projection parameters, they should be the same feature class, and the corresponding features should have the same attribute. Using these fundamentals, all the contiguous GIS layers in the study area have been edge matched.

5.8.11 Mapping

In order to produce the land use / land cover maps with proper scale, various topographic maps, Landsat images years 1987 and 2006, ground observations, and related ancillary data have been compiled and processed in different ways. These data have been systematically used to prepare the necessary layers to constitute an appropriate geographical information system (GIS) for the study area. These data were integrated to establish a digital data base which could be useful for site selections of proposed project, planning and management of such this development projects in the area.

The data available that were used in this study grouped into the following: (a) Natural hazards maps, (b) Satellite data (c) Topographic maps at scale 1:100 000, all of these materials are discussed in the following:

In the present work, Landsat imagery data dated in 1987 and 2006 that were covering the area of South Helwan Steam Power Plant project (3x650) Mw, Helwan Governorate have been digitally processed, analyzed and interpreted to produce a land-use/land-cover map at a scale of 1: 100.000, (*Figure 5-58*). The main classes of recognized land use (activities) and land cover (resources) at this scale are shown in *Figure 5-58*. This is based mainly on the multilevel land-use/land-cover classification system for use with remote sensor data adopted by the U.S. Geological survey (Anderson et al., 1976). Landsat image, clearly displays the major classes of land-use and land-cover.

Land-use and land-cover maps are essential for many development projects, such these temporal maps lead to detect the historical natural and human changes. Land-use / land-cover maps are helpful to determine quantitatively the environmental changes of both natural and human inputs. Remote sensing data are becoming important for mapping land-use and land-cover particularly for large inaccessible areas. They provide an unbiased permanent data set that may be interpreted for a wide range of land-use/land-cover (Sabins, 1997). Remotely sensed data can be acquired from various systems, with a spatial resolution that matches the degree of detail required for the study. The interpretation of remotely sensed data is faster and less expensive than conducting ground surveys. Furthermore, digital processing is becoming essential because as spatial resolution and spectral coverage increases, the volume of data also increases. The analysis and interpretation of remote sensing data should be supplemented by ground checks of areas that represent various categories of land-use and land-cover.

Geographical Information System application and digital analysis of Landsat TM data of years 1987 and 2006 have been utilized in this study to recognized and defined land use in South Helwan Steam Power Plant (3x650) Mw Project area. The different steps involved in this work could be explained as follow:

- Defining a comprehensive legend according to the scale of Landsat TM image.
- Field checking and necessary modification of the primary maps applying the auxiliary data and extant maps to promote the formation depicted on the land use / land cover maps.
- Measurement of land unit surface by applying geographical information system (GIS) facilities to accomplish the work.

5.8.12 Land Use-Land Cover (LU/LC) Classification Scheme

The produced land-use/land-cover maps of two different dates 1987 and 2006 (*Figure 5-59*) clearly displays the major classes of land use and land cover in the study area. The system includes all major categories of land use and land cover, and can be expanded for special situations. Basically, it could provide an accurate database for inventory of the existing patterns of land-use/land-cover at scales ranging from regional to local. Furthermore, image acquired in different dates for the same area may be digitally registered and compared to produce change detection images that emphasize changes in land-use and land-cover. Regulating these changes is an important action to minimize negative impacts on the environment due to the construction of the proposed project.

5.8.13 Appending GIS layers

This is the final step of data automation process where all the contiguous GIS layers that have the same feature class were appended to one GIS. At this point, we are having the following final layers as shown in *Figures 5-59, 5-60 and 5-61*.

Accurate detection of changes in the study area is helpful to assess the environmental status for all ecological types of both natural parameters and human activities. Land-use and land-cover maps provide an unbiased permanent data set that may be interpreted for a wide range of applications as well development activities.

A brief description of the main land-use/land-cover categories in the prepared maps of the study area, delineated from the interpretation of Land sat-TM images is as follows (Lotsch et al., 2003):

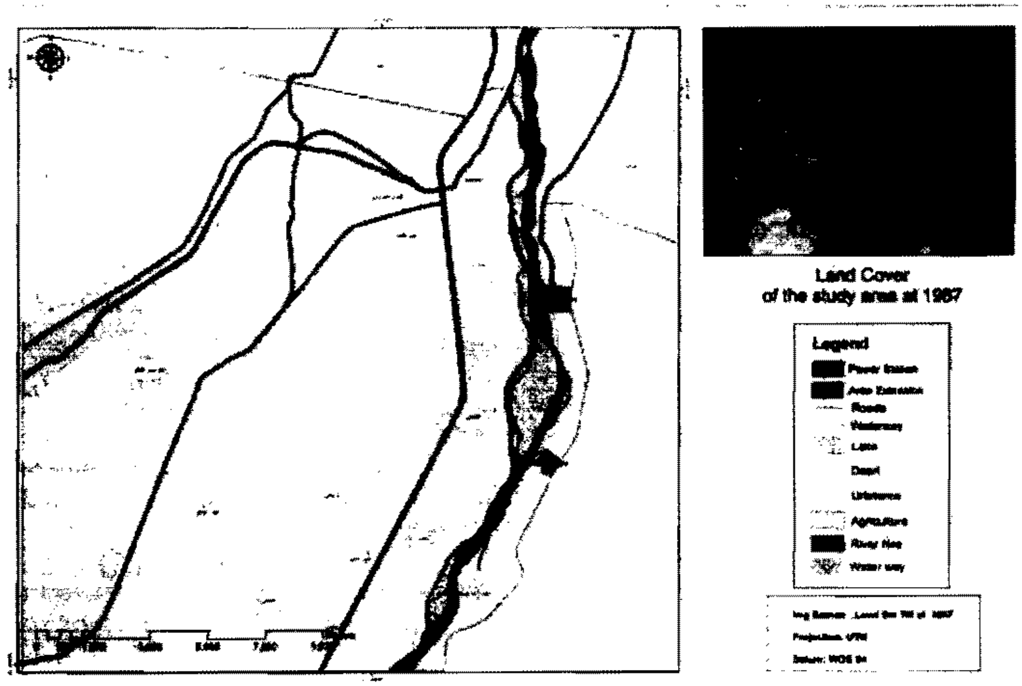
Urban: This GIS layer comprises urban areas of intensive land-use where much of the coastal land is covered by buildings, structures and streets (*Figure 5-61*). With the expanding urban development in South Helwan Steam Power Plant (3x650) Mw Project from year 1987 to year 2006, several other activities have been constructed particularly at the fringes of urban land along beach.

Vegetation: This layer includes both lands with agriculture activities and those with natural vegetation. Accordingly, it was subdivided into main classes, (*Figure 5-62*); the vegetation of the study area is confined to the drainage system. It shows a mosaic pattern and distinct seasonal aspects mainly due to the preponderant growth of the bryophytes' during the late winter and early spring. This aspect of seasonal phenology is not seen in the salt marsh ecosystem.

Cultivated Land, this is covering big areas surrounded to the proposed study area, and with the surrounding areas under urban developments, *Figures 5-63, 5-64 and 5-65*.

Figure 5-59

Quantitative Measurements of the Main Land-cover Classes that are Determined from Satellite Image in 1987



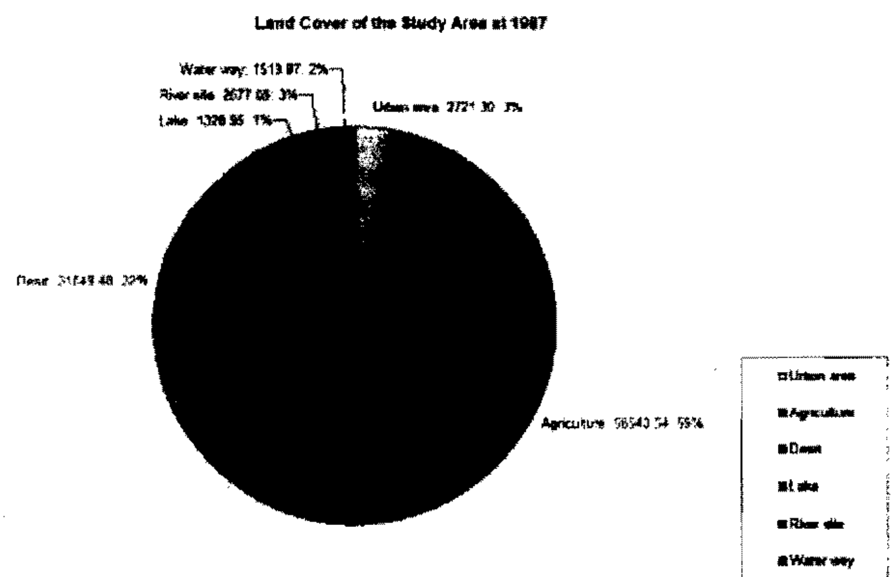
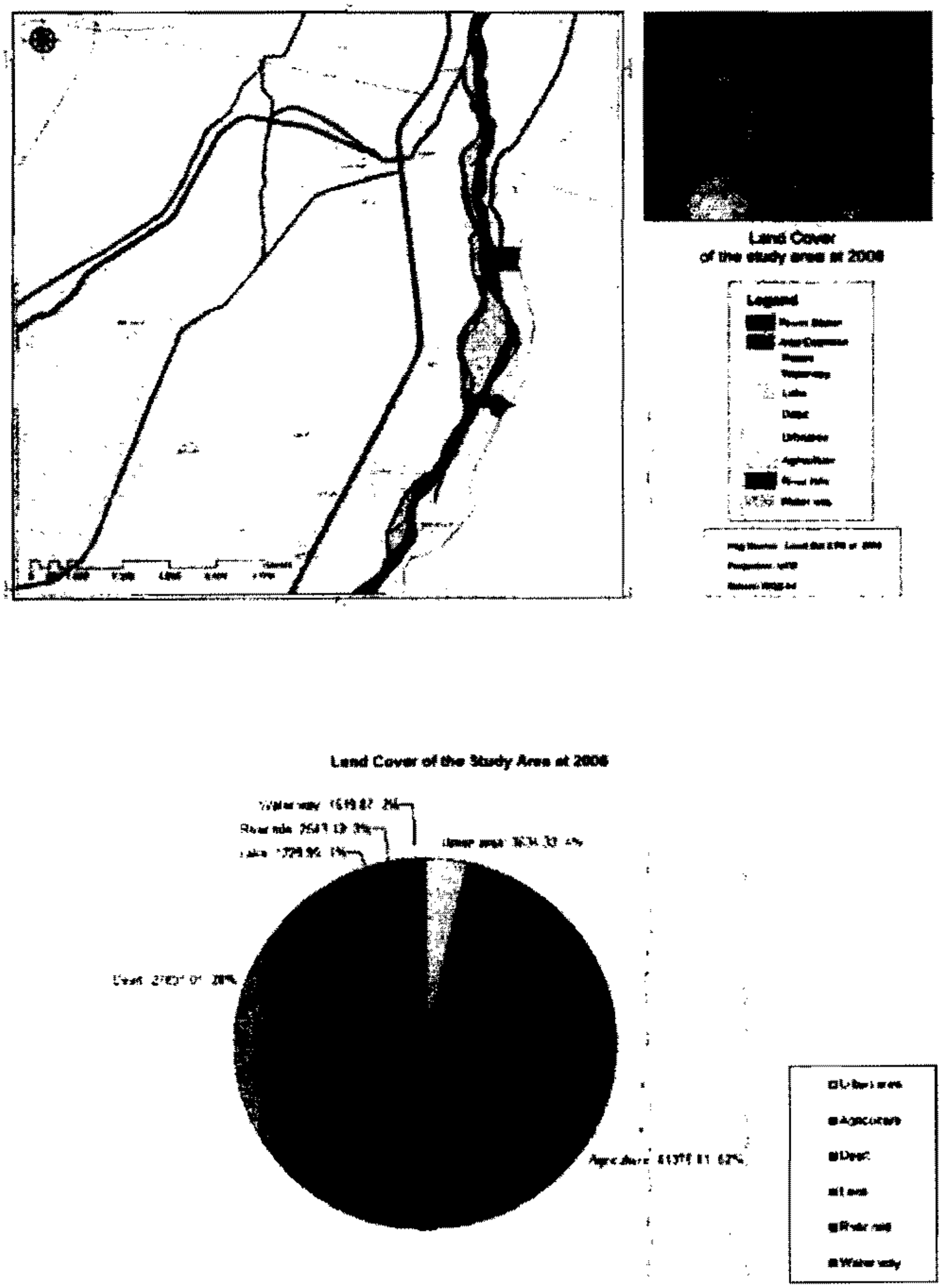


Figure 5-60

Quantitative Measurements of the Main Land-cover Classes that are Determined from Satellite Image in 2006



During the current study two images were selected to perform this analysis belonging to the years 1987 and 2006, collecting of these two dates is due to coverage on the surface of study area have to be detected at same time. The data obtained from the two images were subjected to analysis including spatial vegetation patterns and assessment of soil dynamics. Furthermore, this biophysical parameter is a key remote sensing observation related to several important physical properties including the proportion of photo synthetically absorbed radiation and leaf area index were also used.

Results of image processing in different dates 1987 and 2006 allow identifying the natural environmental condition and forces affecting the study area and detected the major changes for ecological components (*Figure 5-63*). The major distinct land use changes occurring in the study area due to the extension of urban, agriculture activities and water ecosystem which develops along the proposed study area.

The present status of land use-land cover in the districts of the South Helwan Steam Power Plant (3x650) Mw Project by digital analysis of satellite data indicates that majority of areas in these districts are used for development purpose.

Considering the change detections, there are many classes changes such as urban activities, oil exploration, Sabkha area which indicated the sea water – land penetration. This is clear in the salt soil covered the Sabkha area and colored vegetation cover. Development of anthropogenic input reflected the constructed roads, which occurred mostly for the urban and transporting fringe of South Helwan Steam Power Plant (3x650) Mw Project. These changes mostly are related to changes due to natural and resources found on barren and wet land in the desert plain, which are recognized as an environmental impact.

Main future activities planned for the study area are related to the nature of the study area and its natural resources, i.e. South Helwan Steam Power Plant (3x650) Mw Project. The proposed development project is also consistent with nature of the study area and ecological status sustainability.

Figure 5-61

Change Detection of Urban Development along the Study Area between Years 1987-2006 Extracted from Satellite Images

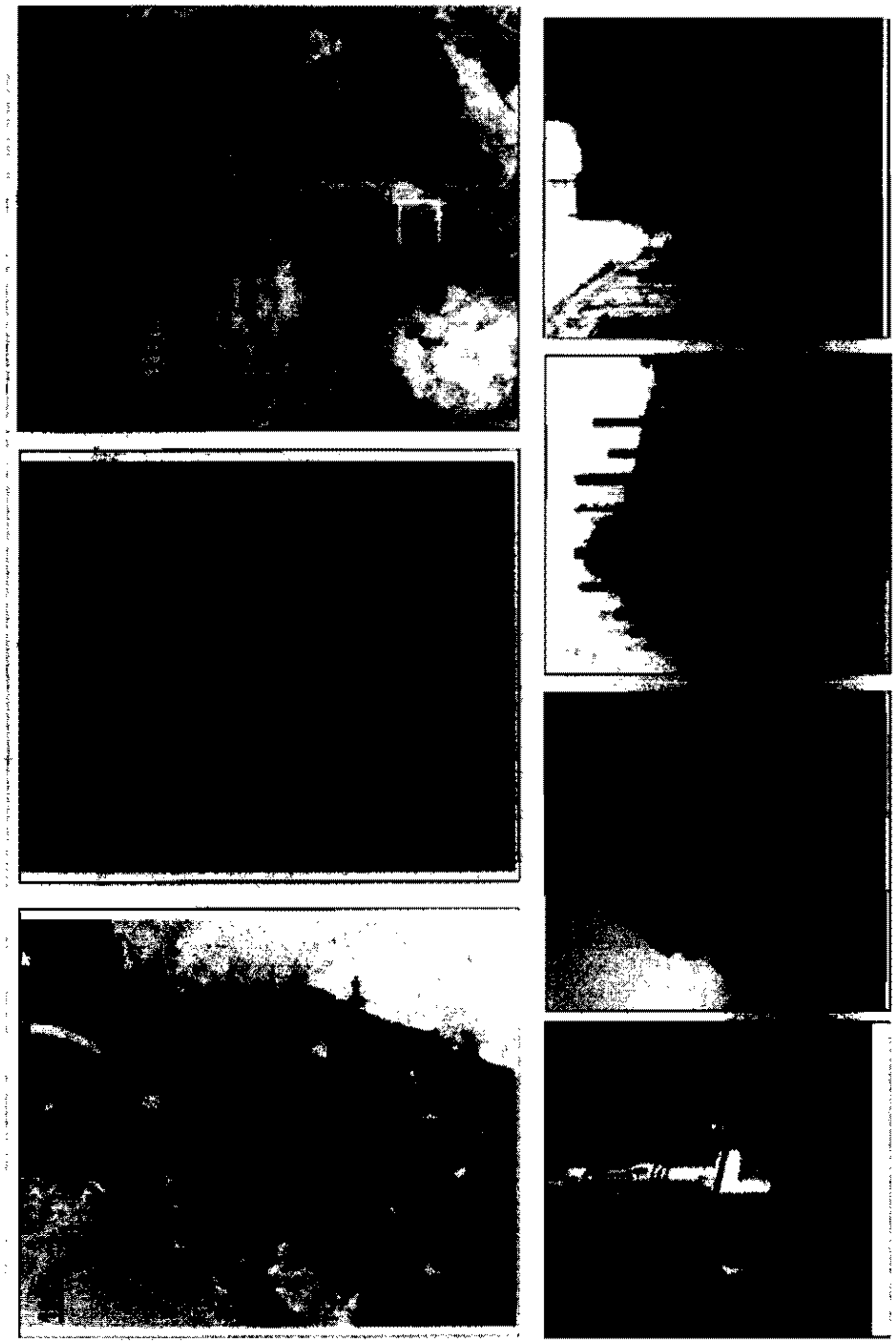


Figure 5-62

Change Detection of Agriculture Changes along the Study Area between Years 1987-2006 Extracted from Satellite Images

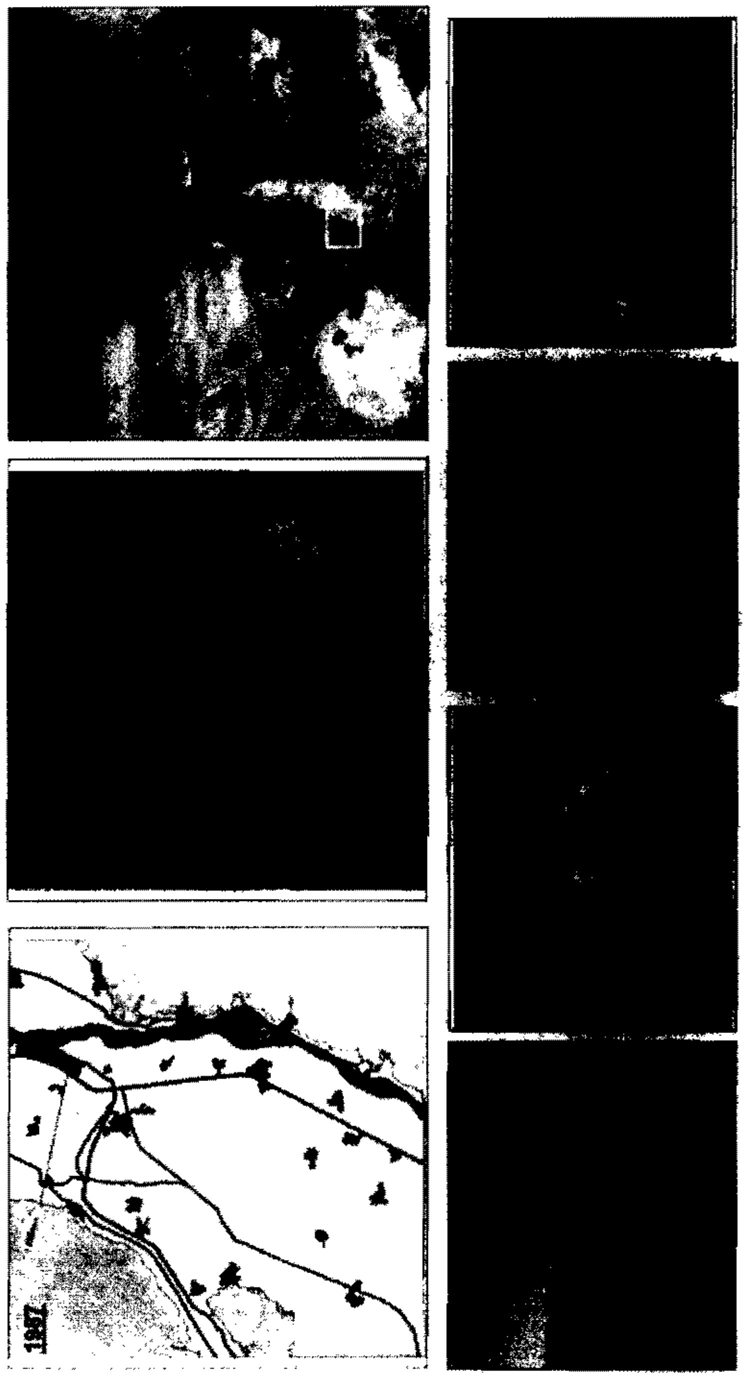


Figure 5-63

Change Detection of Desert Ecosystem along the Study Area between Years 1987-2006 Extracted from Satellite Images

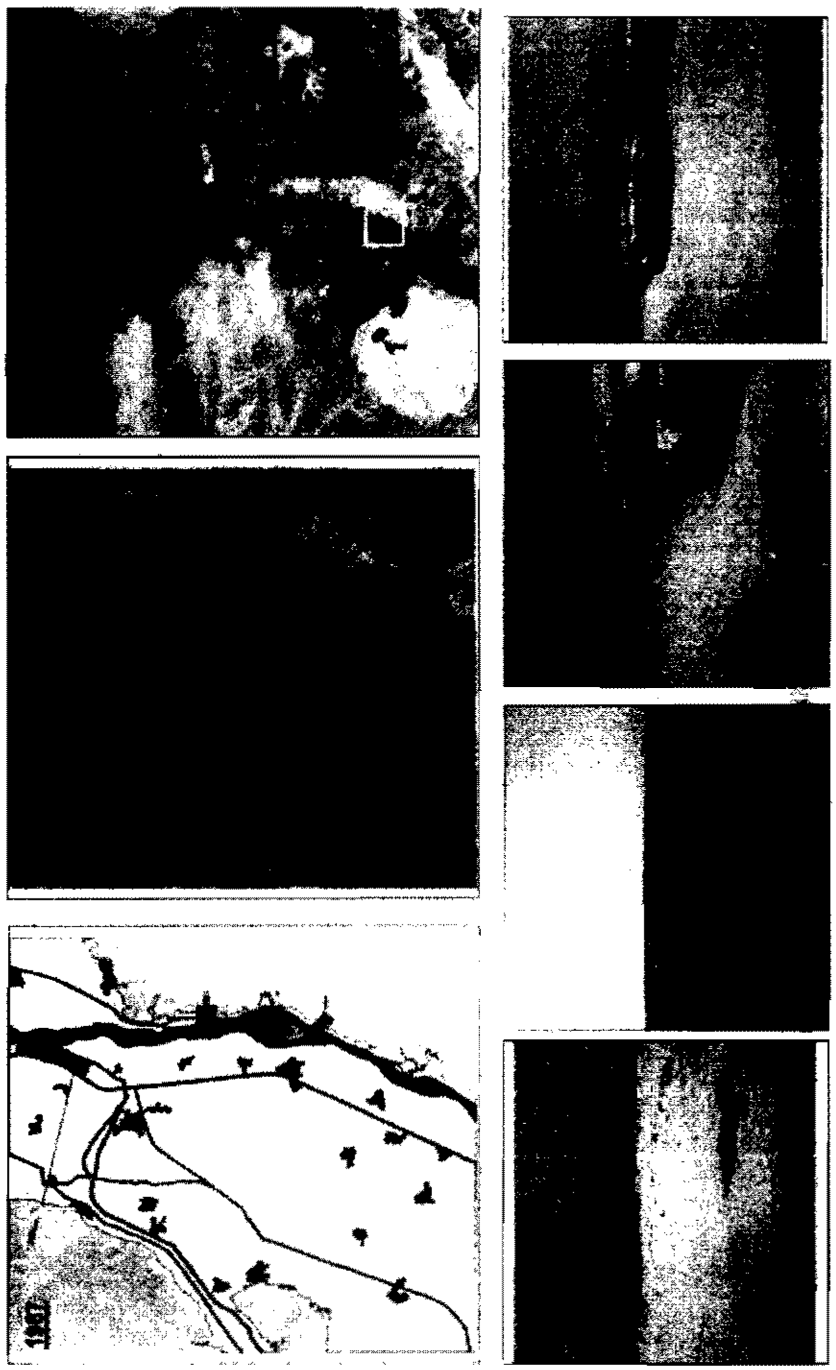


Figure 5-64

Change Detection of Cultivated Land along the Study Area between Years 1987-2006 Extracted from Satellite Images

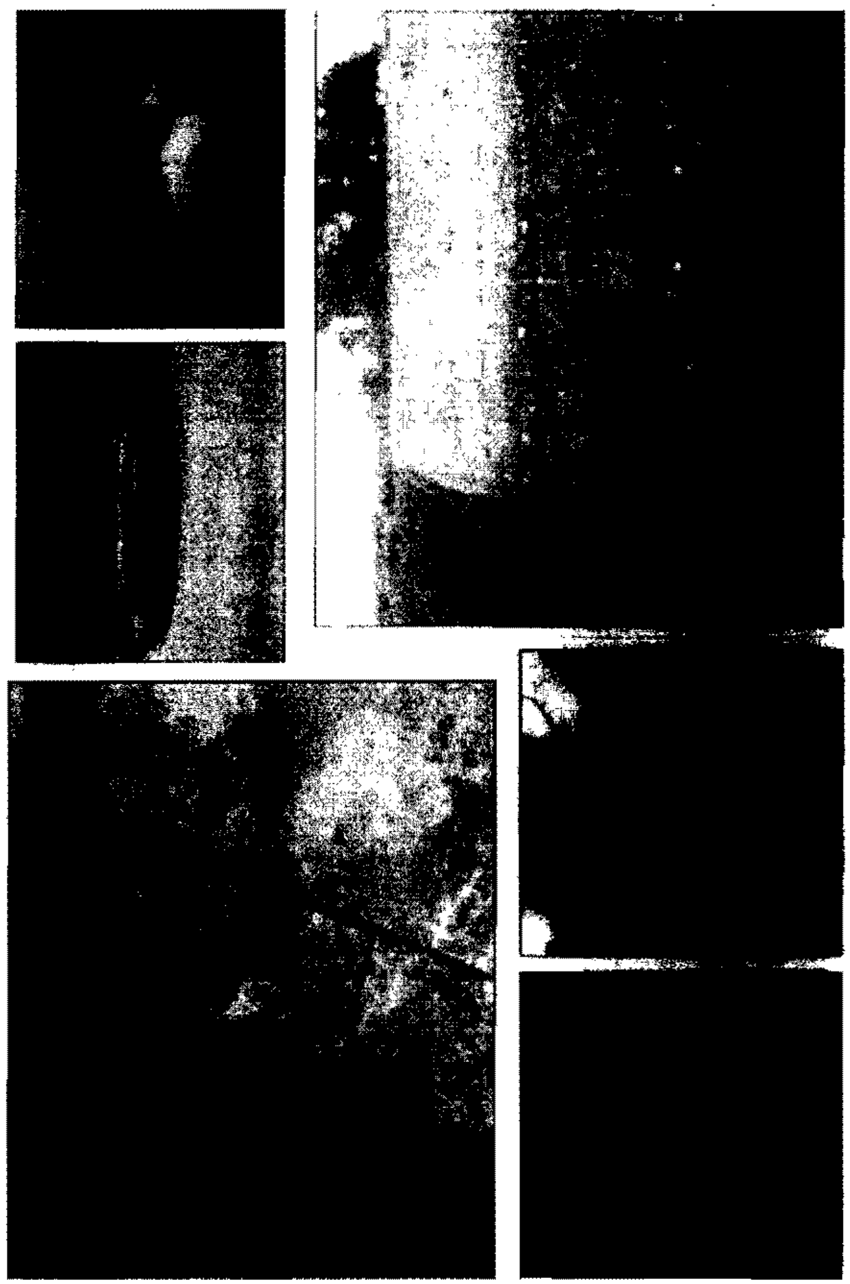


Figure 5-65

Change Detection of Range Land arround the Study Area between Years 1987-2006 Extracted from Satellite Images

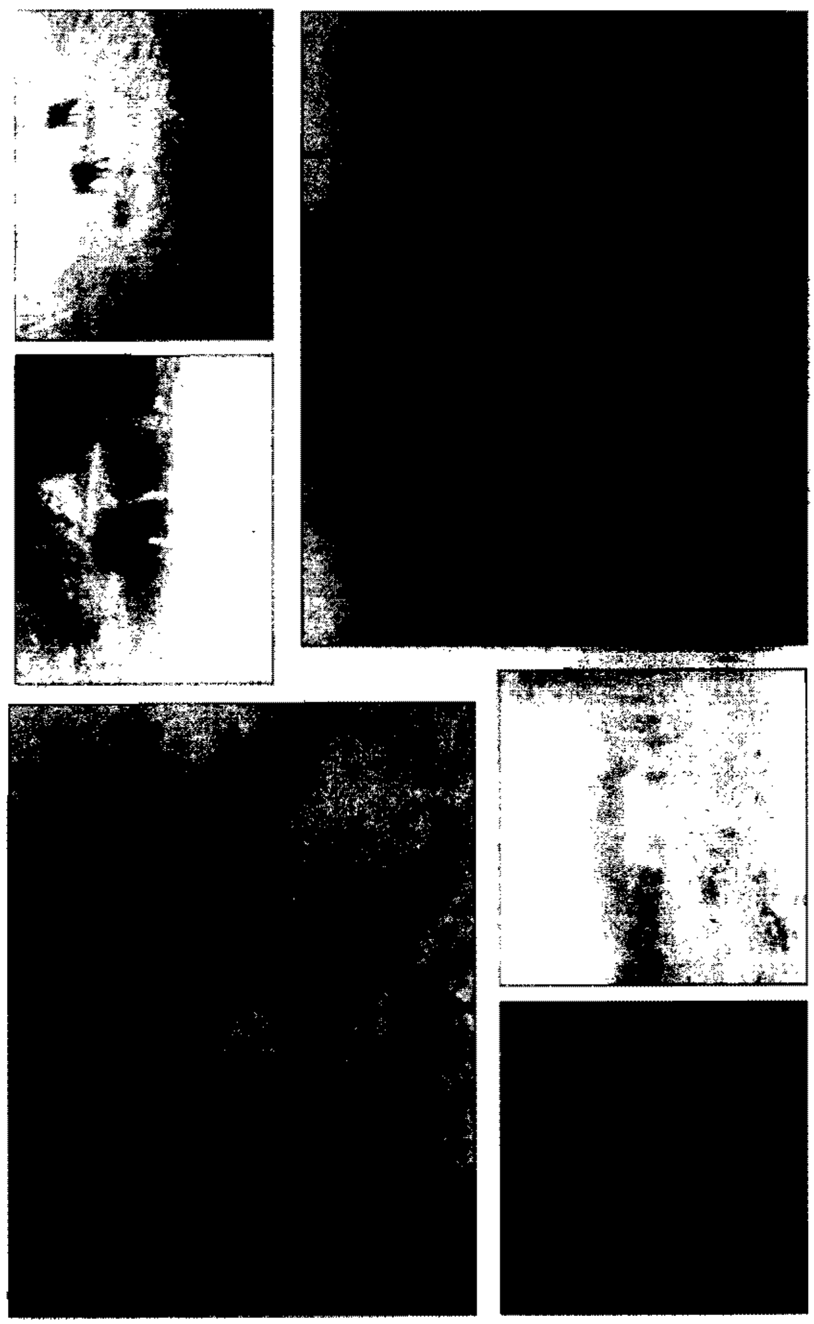
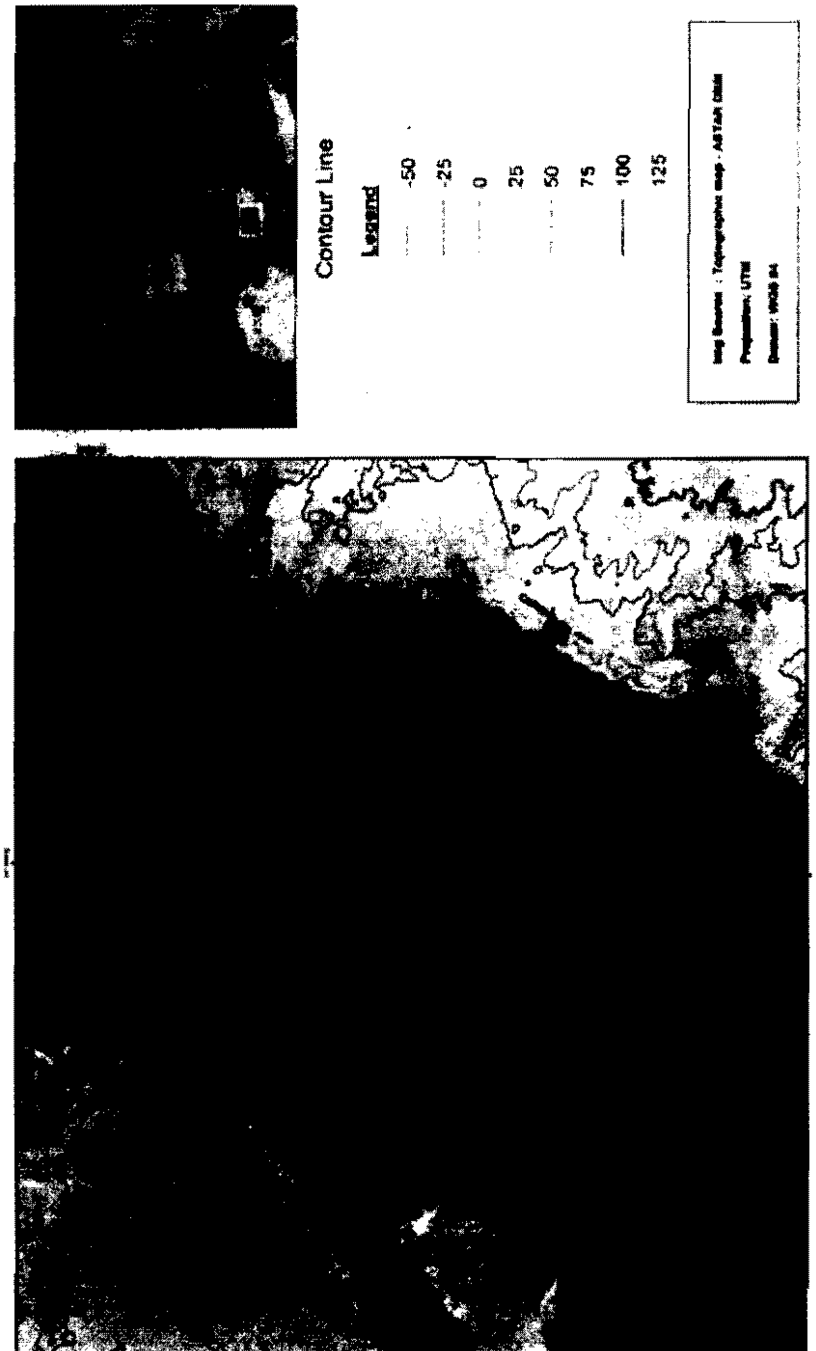


Figure 5-66

Contours Elevations of the Study Area showing the Elevation of the Study Area from East to West



5.8.14 Direct Land Uses at the Project Site

Figures 5-67, 5-68, 5-69 and 5-70 depict the surrounding features around the power plant site, which are identified as following:

- Helwan / Beni-Suweif freeway.
- The River Nile.
- Grains Silos.
- Cultivated lands.
- Small residential areas.

Figure 5-67

The Kureimat / Beni-Suweif Freeway to the East (tru East) of the Power Plant Site

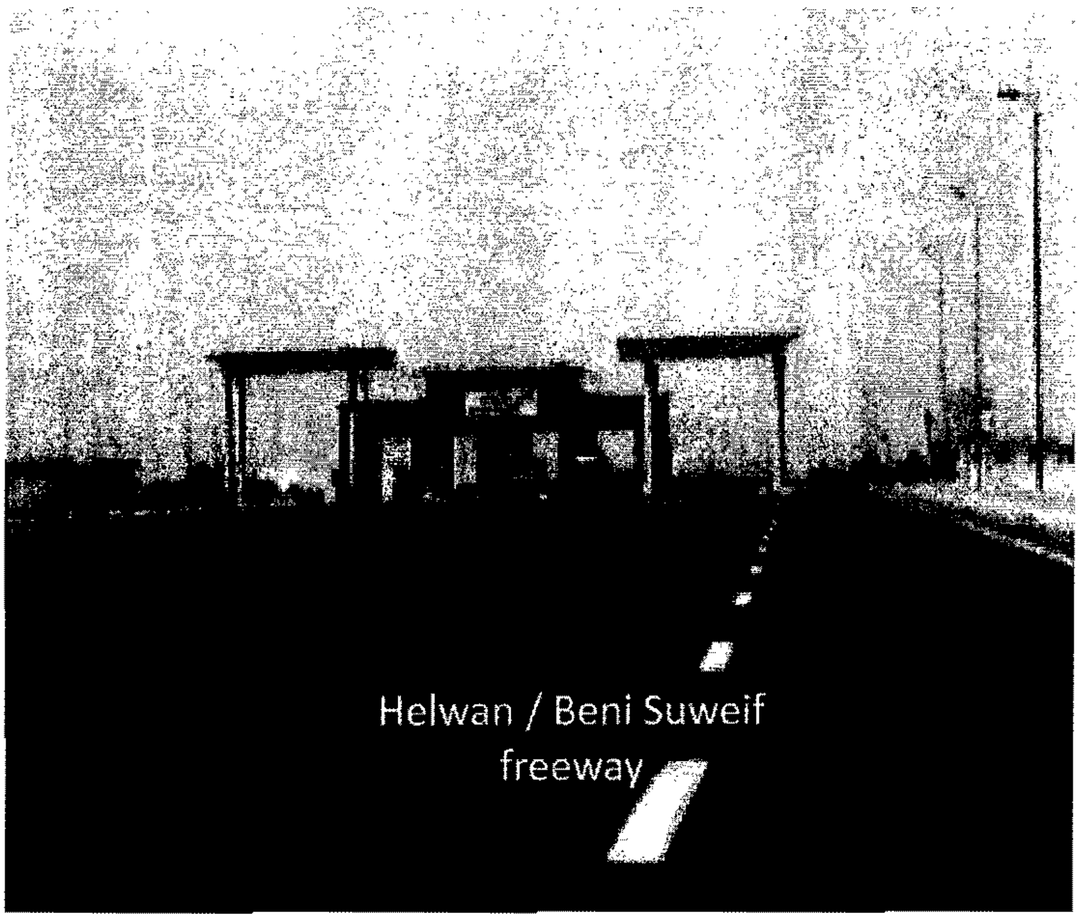


Figure 5-68

Grains Silos to the North (true North) of the Power Plant Site

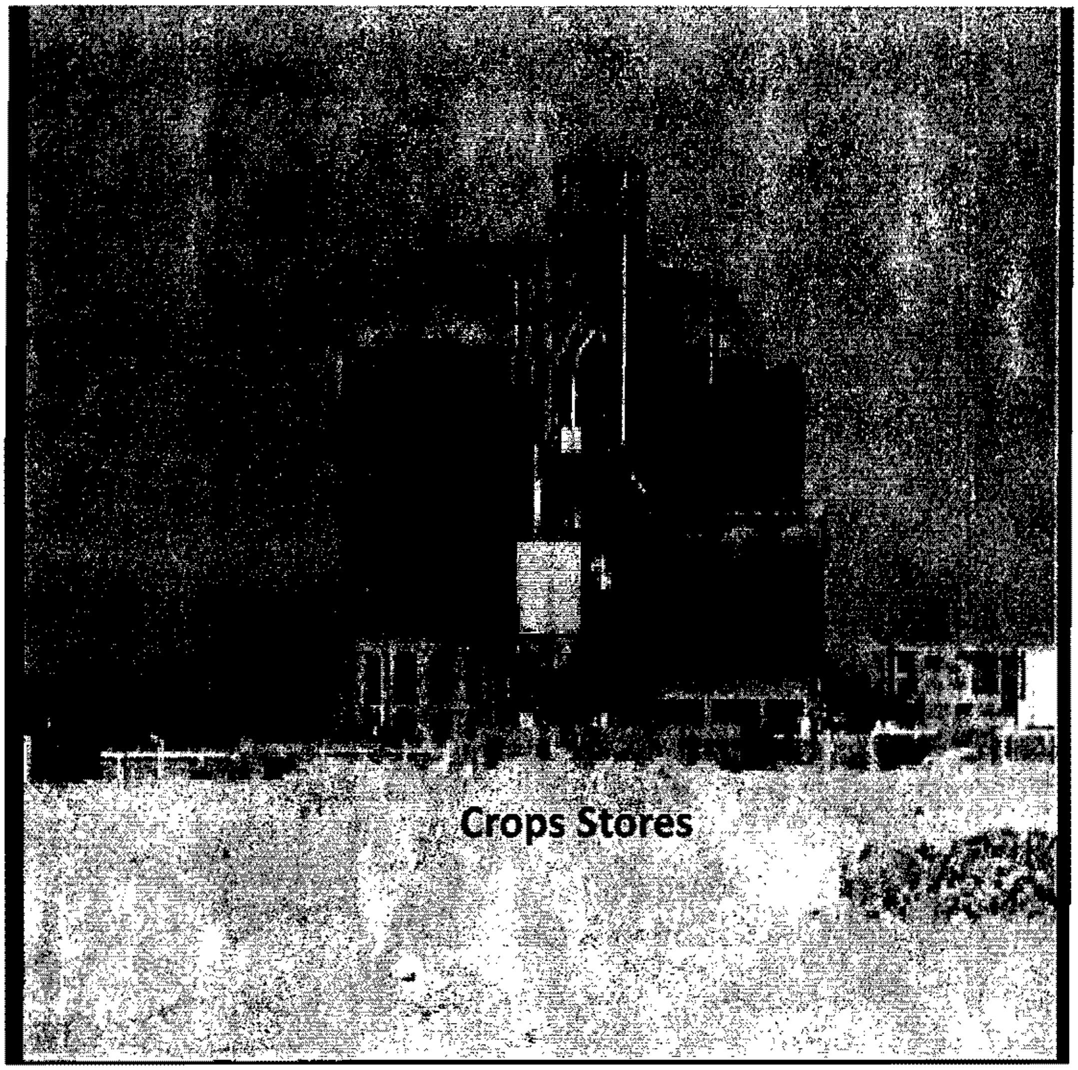


Figure 5-69

Cultivated Land to the West (true West) of the Power Plant Site

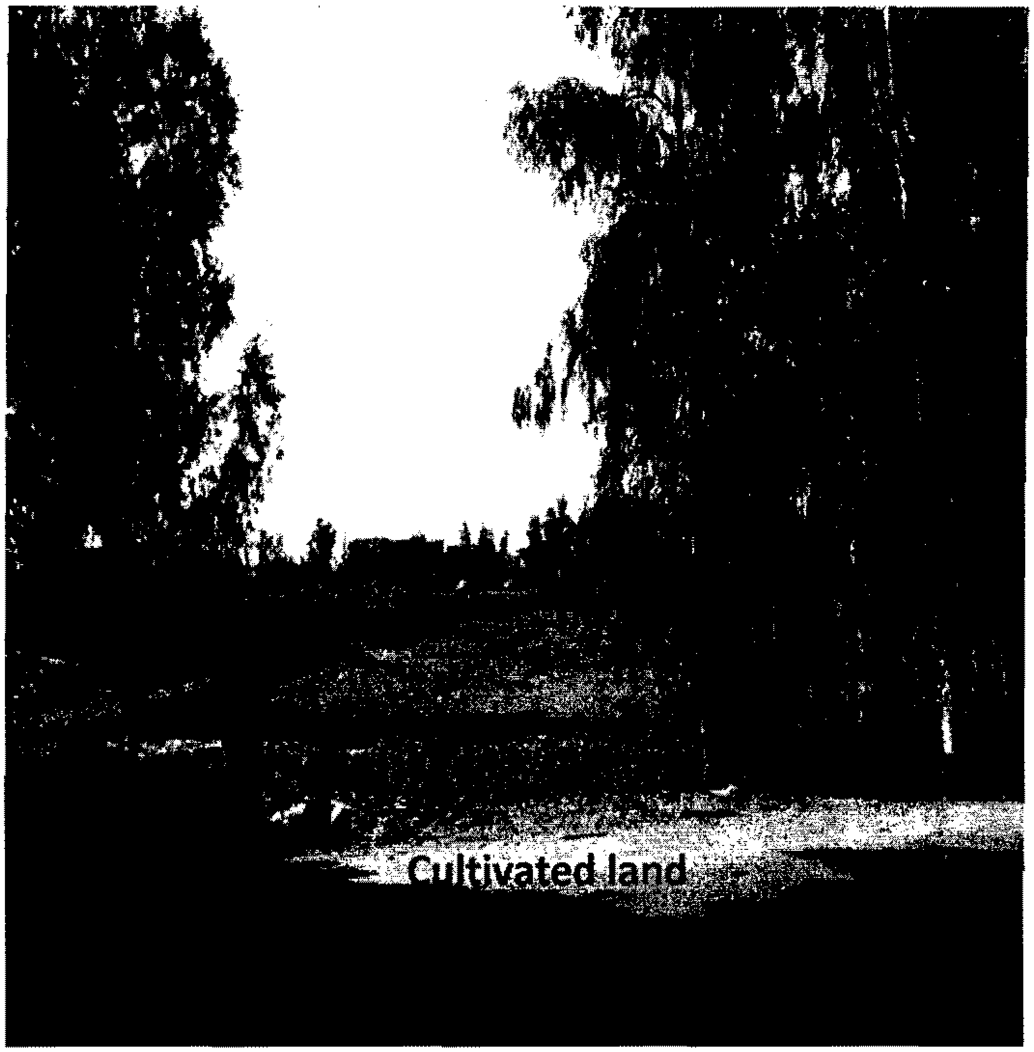


Figure 5-70

Residential Spot within the Agricultural Stripland

5.8.15 Landscape Character

The landscape character of the site and its surrounding area is determined and characterised by:

- the bankal location and the influence of the Nile water;
- the flat terrain and open character of the Dayr El-Maymoun rural/desert area;
- the sparsely vegetated plain;
- the dominant skyline of the farm lands which expands at the horizon of the agriculture stripland; and
- road linkages.

The proposed rural/desert character of the new development is the main influences on the area. The flat terrain and exposed Nile bankal location, ensures that views of the proposed power plant strongly influence the character of the area and is clearly visible up to at least 5 km along the roads (north west and south east) and several kilometres inland.

5.9 AMBIENT NOISE

5.9.1 Noise Sensitive Receivers

No residential properties have been identified along the El-Kureimat / Beni-Suweif Road and there are no major population centres within 5km all around the proposed site. The nearest land uses around the site are agricultural within a narrow strip of farmlands, its width 350-500m along the Nile River bank line. To the north, the grains silos, approximately 700 m and to the west is agricultural stripland, approximately 100m from the site.

Due to the rural / desert nature of the proposed site with no scattered houses, the area is categorized as "residential-commercial" with respect to the Egyptian ambient noise standards (see *Table 2-6 in Section 2.3.4).*

5.9.2 Ambient Noise Levels

In view of the lack of adjacent noise sensitive receivers, a noise survey was carried out on the site of the proposed plant by the Consultant representatives of UEEPC/EEHC on 21st October 2010. The main existing noise sources on, and surrounding the site, were found to comprise the following:

- vehicular traffic on the El-Kureimat / Beni-Suweif Road; and
- prevailing wind.

Measurements were taken using a calibrated Brüel and Kjaer (B & K) Type 2260 Precision Sound Analyser, in a "free-field" location away from any reflective surfaces and 1.2m above the ground. All of the instruments used conform to IEC 651 Type 1 accuracy (Precision sound level meter, intended for laboratory or field use where accurate measurements are required). The measuring equipment was calibrated before and after the survey in accordance to the manufacturer's instructions. The instruments were calibrated internally and externally at 94 dB using Bruel & Kjaer Sound Calibrator, Type 4231. (No variation in the calibration signal was noted). For all measurements, the sound level meter was mounted on a tripod 1.5m above the ground. The microphone was always fitted with a windshield during the noise measurements duration. The time weighting was fast, and the frequency weighting was A. Noise level was recorded at the locations by a series of spot measurements. All measurements and quantities are A-weighted. The instruments quickly provide time histories of the frequency weighted noise levels from which the Equivalent Continuous Sound Level LAeq is determined as well as all other needed variables. The standard statistical parameters and criteria (LAeq, LAFMax, LAFMin, LAF01, LAF10, LAF50 and LAF90). Sequential analysis in terms of 1/3 octave frequency bands (spectrum) was recorded as function of time. All precautions comply to ISO 1996-2:1987(and 1998) and BS 4142.

The average ambient level recorded at the site (during daytime) was around L_{Aeq} 48.9 dB(A) and on the Road around 70 dB (A). This means that background baseline noise level at the site is within the residential-commercial level specified by the Environmental Law (60 dB(A) at the daytime and 50 dB(A) at the night-time). The sounds cape of the area is expected of this type and only dominated by wind and vehicles on the road (around 300 m apart) from time to time.

All third octave analyses during vehicle-free road condition indicated normal orders for noise levels not exceeding the expected values around the fence area. *Figure 5-71* presents the measurement locations. Also, *Table 5-36* and *Figure 5-72* through *Figure 5-78* present the results giving the sound levels for each third-octave band.

The recorded noise levels were mainly due to wind and traffic movement on the El-Kureimat / Beni-Suweif Road at the time of measurement.

Figures 5-79, 5-80 and 5-81 depict some measurement photos.

Figure 5-71

Measurement Locations inside and around the Power Plant Site

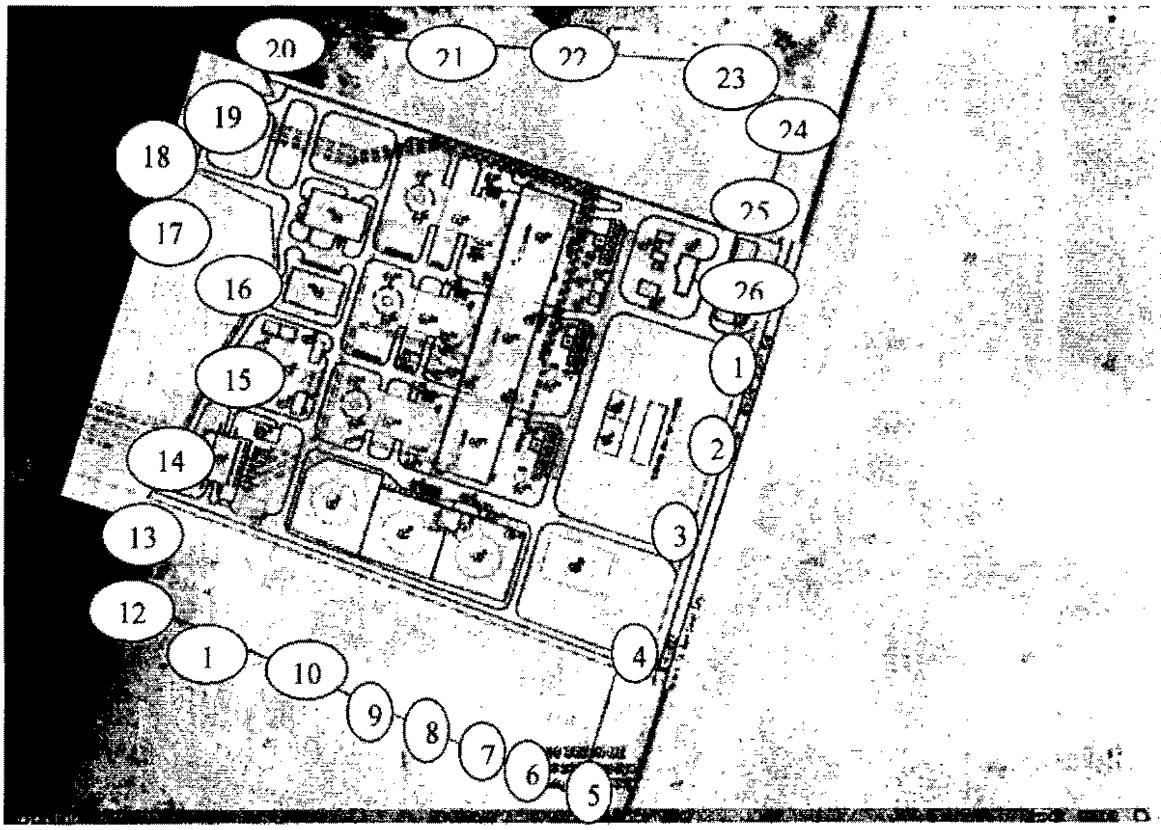


Table 5-36

Measured Parameters for the 26 Locations

Location	LAeq	LASMax	LASMin	LAF1	LAF5	LAF10	LAF50	LAF90	LAF95	LAF99
1	57.8	75.8	43.7	68.8	61.9	60.8	52.5	45.7	44.8	43.4
2	47.6	61.9	37.9	53.1	52.2	51.3	44.6	38.9	38.3	37.4
3	56.1	63.4	44.0	62.0	59.6	58.9	55.3	47.1	44.0	43.2
4	61.3	71.7	41.8	70.5	69.7	65.5	54.2	45.6	42.8	41.3
5	47.4	57.6	38.7	56.1	53.1	51.3	44.6	39.8	39.1	38.4
6	57.6	78.2	46.8	67.6	60.0	57.7	52.9	47.3	46.5	45.7
7	47.4	61.9	42.5	54.4	51.7	50.6	45.5	42.8	42.2	41.4
8	61.2	74.7	47.1	72.2	68.7	65.4	53.0	45.8	45.3	44.2
9	47.2	52.7	44.4	51.0	49.6	49.0	46.9	44.8	44.5	44.0
10	48.2	57.9	45.1	54.3	51.2	49.7	47.5	45.9	45.6	44.6
11	47.2	55.4	44.4	51.6	49.7	49.1	46.6	44.8	44.4	43.8
12	45.3	65.4	41.0	53.3	47.0	45.8	42.9	41.4	41.1	40.6
13	42.2	48.9	37.8	46.1	44.2	43.4	41.8	40.9	40.5	39.9
14	42.9	61.8	38.9	52.1	46.7	44.8	39.9	38.9	38.7	38.4
15	42.5	49.8	37.2	46.6	44.8	44.3	42.7	38.7	38.4	38.0
16	41.9	55.9	37.7	51.1	46.3	44.1	39.9	37.7	37.4	36.8
17	42.5	54.6	40.6	47.4	44.3	43.6	41.9	40.8	40.6	40.4
18	47.3	62.8	38.8	58.9	53.8	50.5	41.2	39.1	38.8	38.6
19	44.1	60.4	38.8	54.5	47.0	45.0	41.4	39.5	39.3	38.7
20	45.3	60.2	38.0	55.7	50.2	47.1	42.6	39.1	38.5	37.5
21	50.2	61.1	44.9	57.6	54.8	53.3	48.5	45.1	44.4	43.5
22	46.4	57.3	42.4	52.4	49.7	49.1	45.4	42.7	42.1	40.9
23	48.4	65.7	43.3	56.8	51.6	50.5	46.0	44.0	43.4	42.6
24	51.5	62.5	43.1	59.0	56.9	55.1	49.1	46.4	45.9	45.0
25	50.6	59.0	42.9	55.8	54.5	53.9	49.3	44.6	43.7	42.0
26	53.4	68.6	43.2	63.9	58.5	56.6	49.9	44.1	43.3	42.3
Average	48.9									

Figure 5-72

Main Parameter Values over the 26 Measured Locations

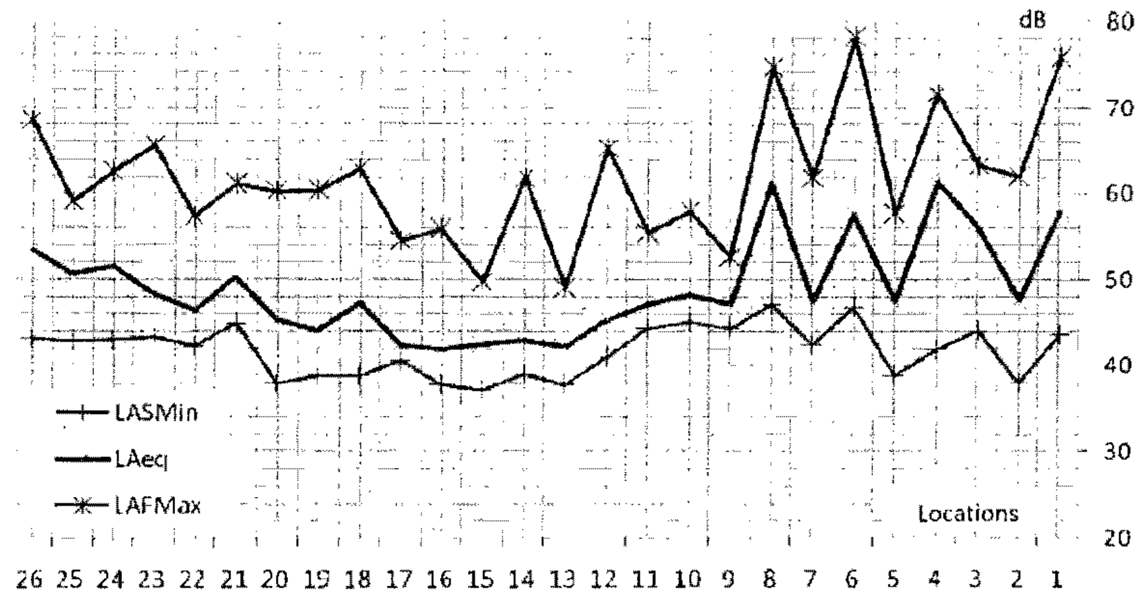


Figure 5-73

Statistical Parameter Values over the 26 Measured Locations

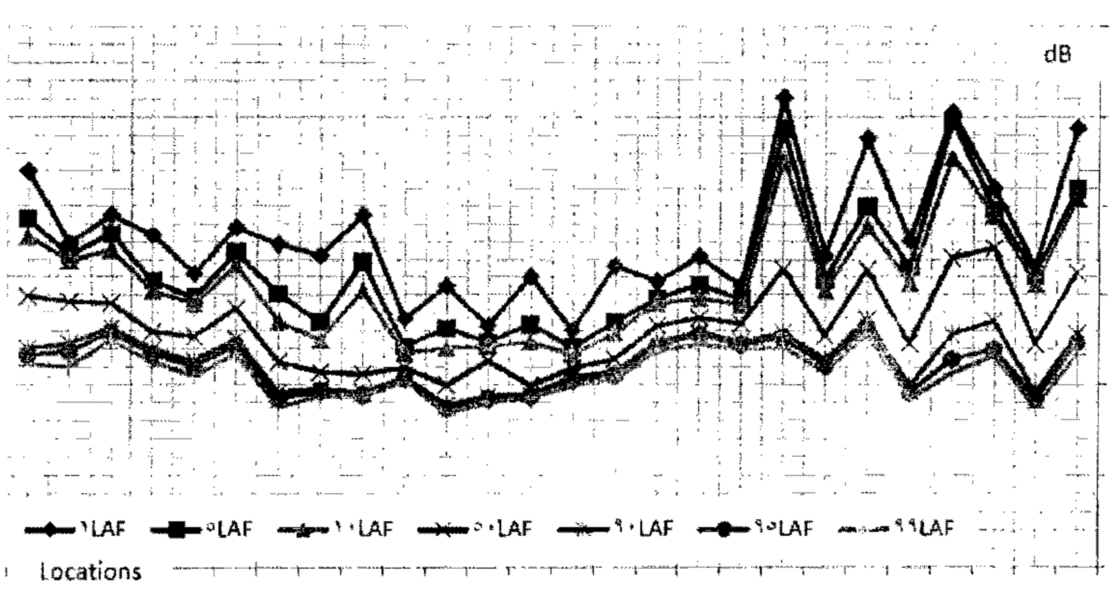
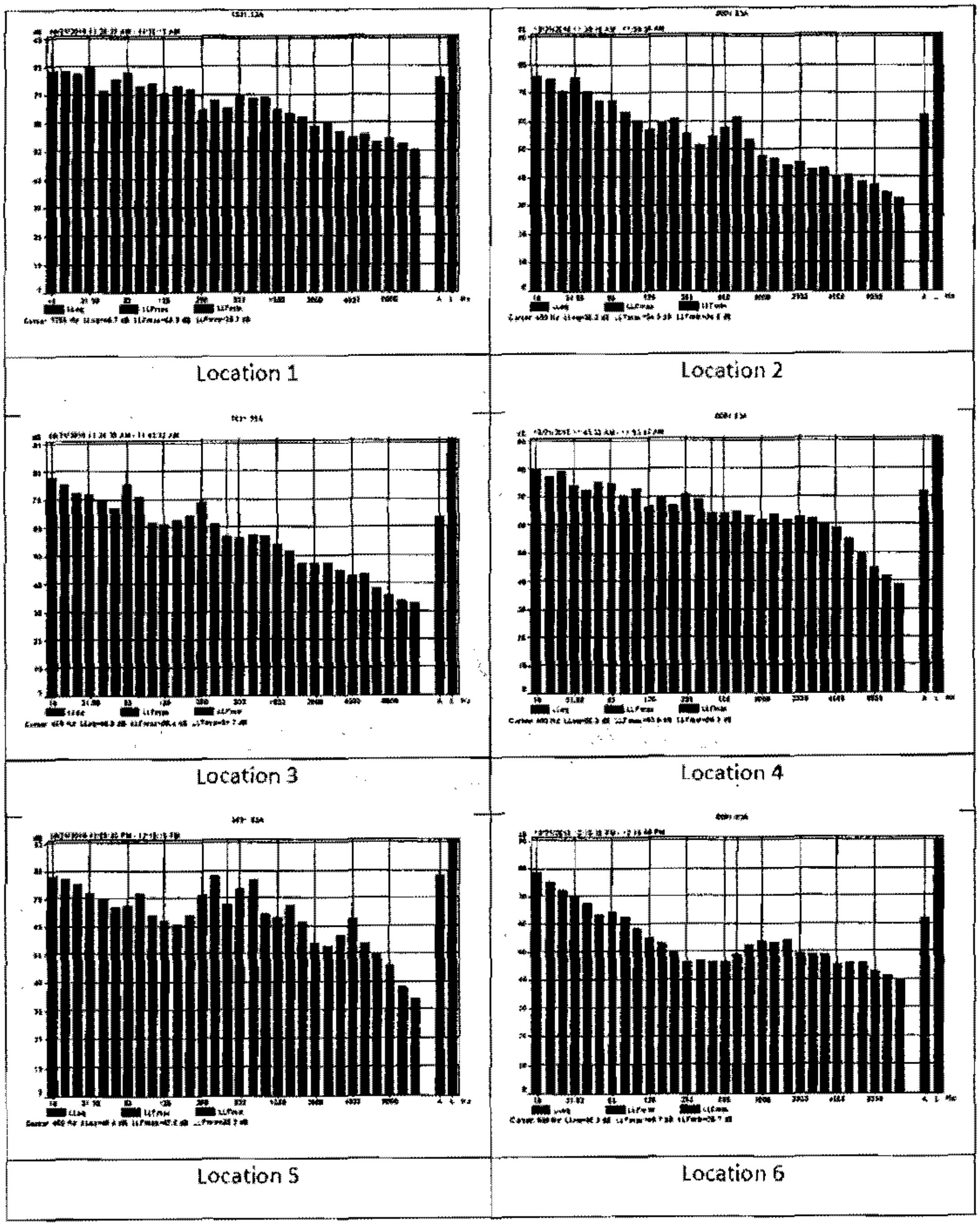


Figure 5-74

Spectrum Graph of Values of Sound Levels for Each Third Octave Band
(Locations 1 through 6)



Location 1 | Location 2
Location 3 | Location 4
Location 5 | Location 6

Figure 5-75

Spectrum Graph of Values of Sound Levels for Each Third Octave Band
(Locations 7 through 12)

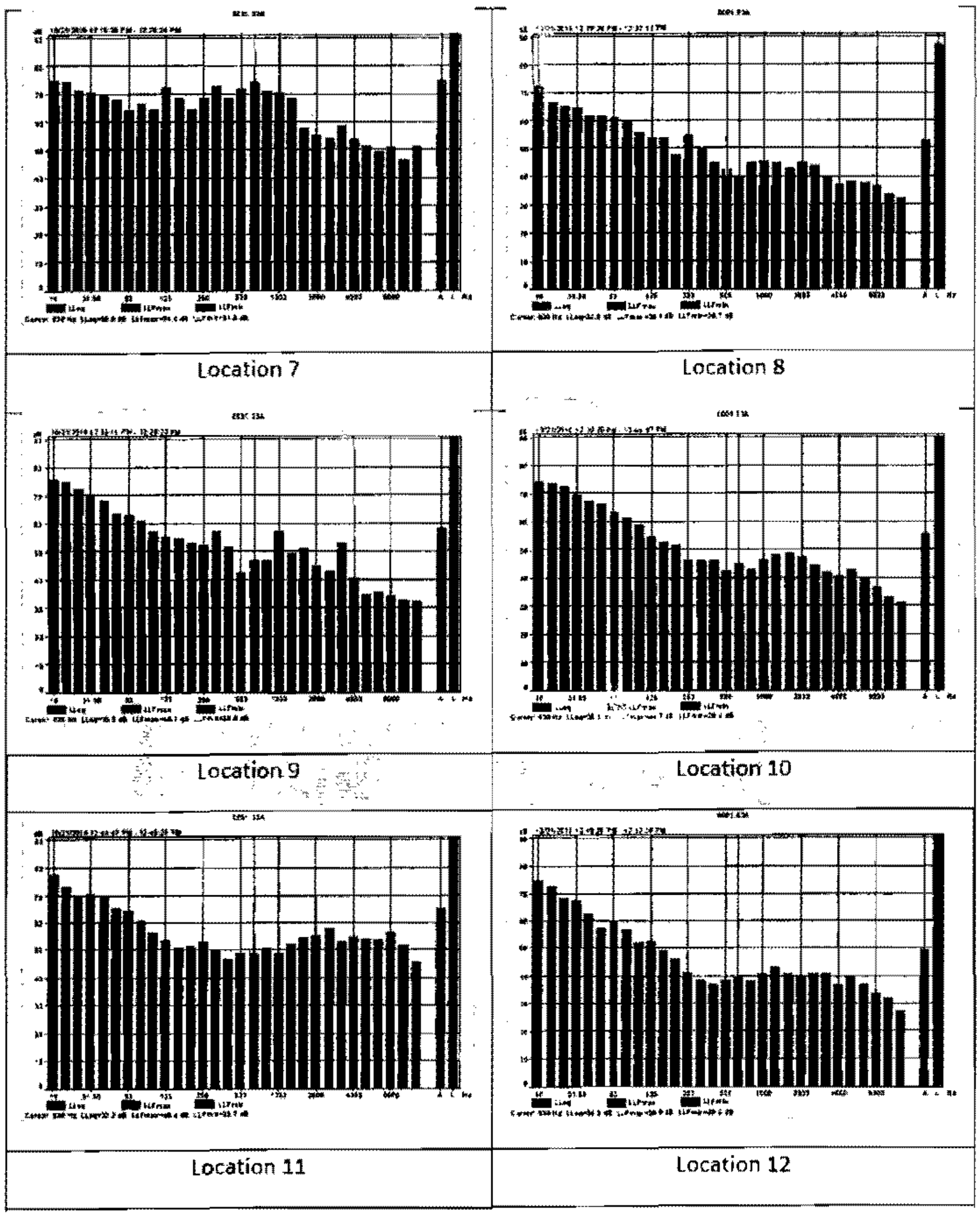
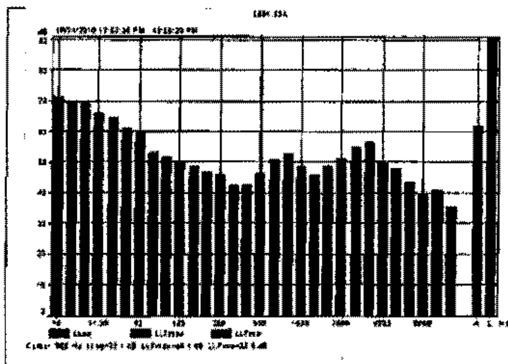
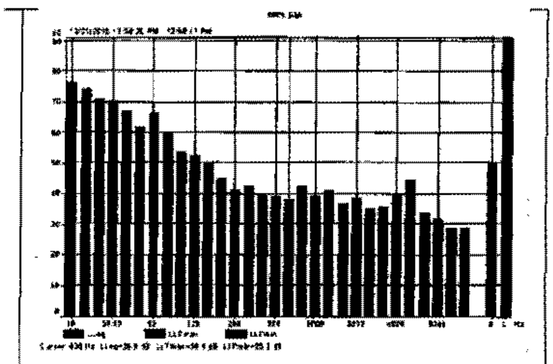


Figure 5-76

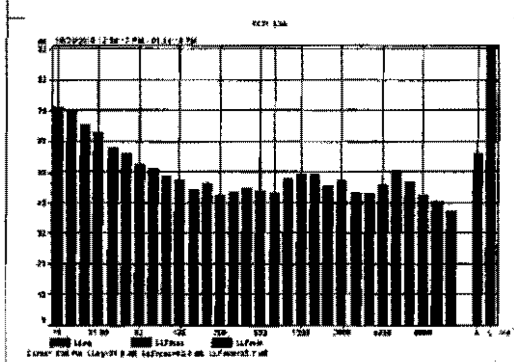
Spectrum Graph of Values of Sound Levels for Each Third Octave Band
(Locations 13 through 18)



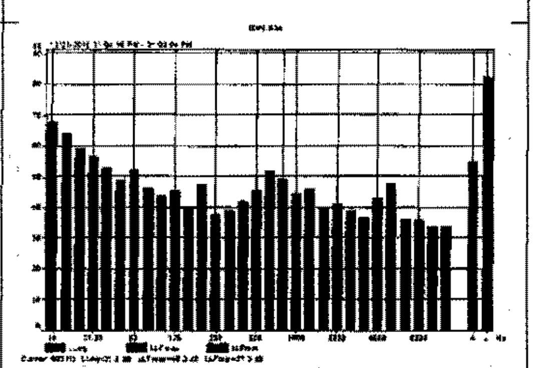
Location 13



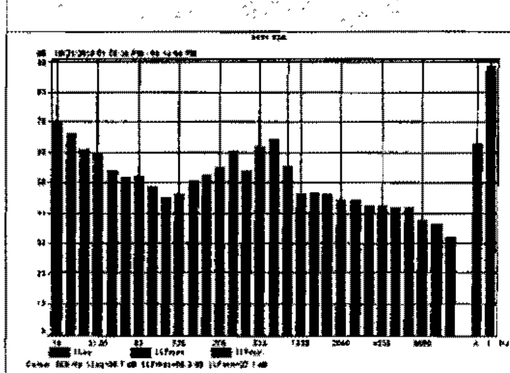
Location 14



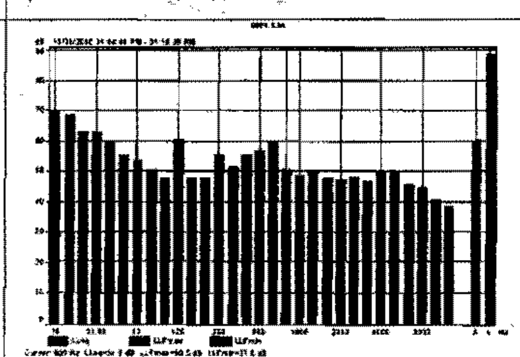
Location 15



Location 16



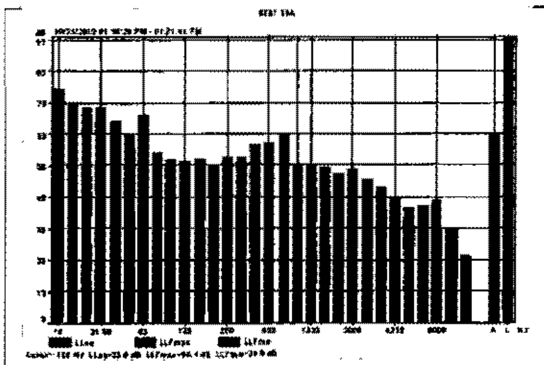
Location 17



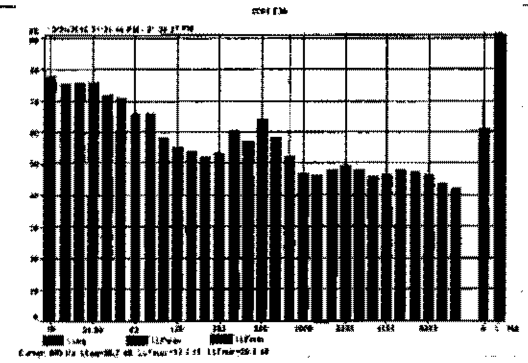
Location 18

Figure 5-77

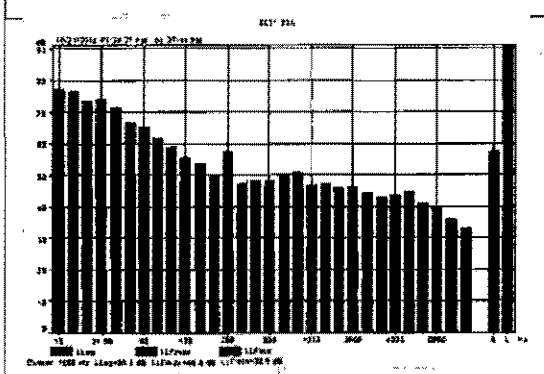
Spectrum Graph of Values of Sound Levels for Each Third Octave Band
(Locations 19 through 24)



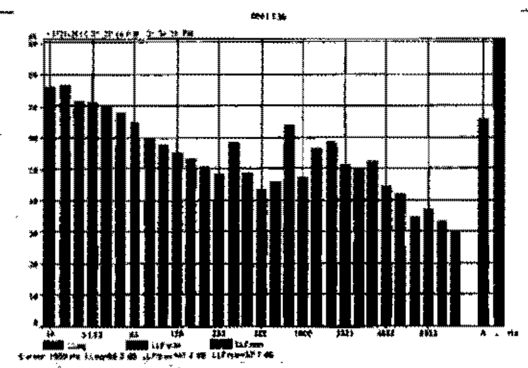
Location 19



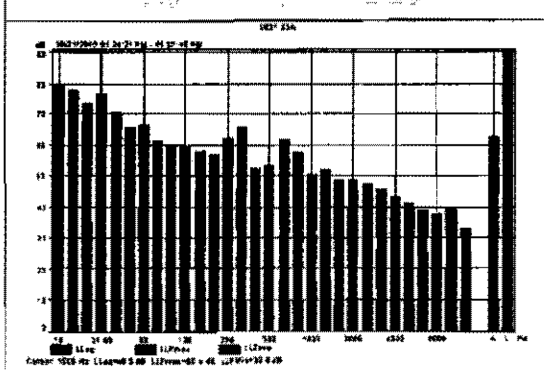
Location 20



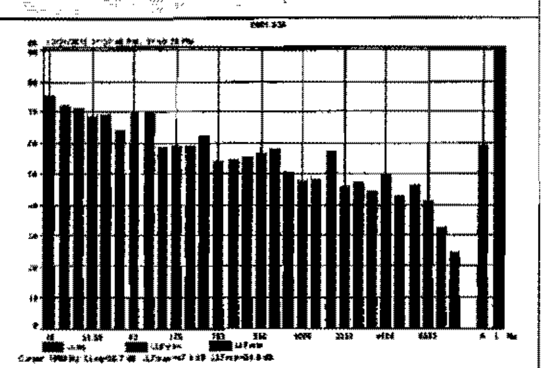
Location 21



Location 22



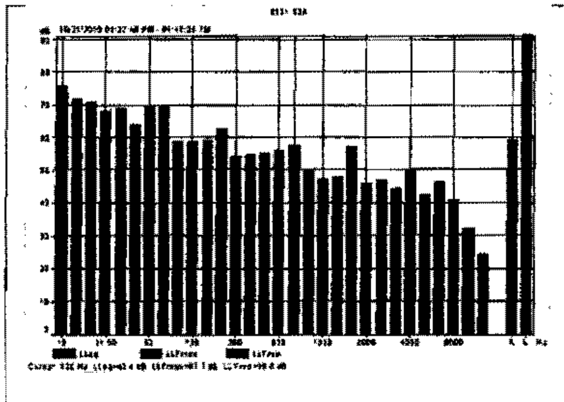
Location 23



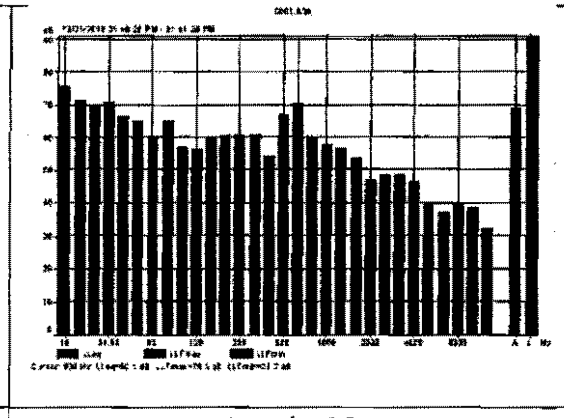
Location 24

Figure 5-78

Spectrum Graph of Values of Sound Levels for Each Third Octave Band
(Locations 25 and 26)



Location 25



Location26

Figure 5-79

Some Measurement Photos

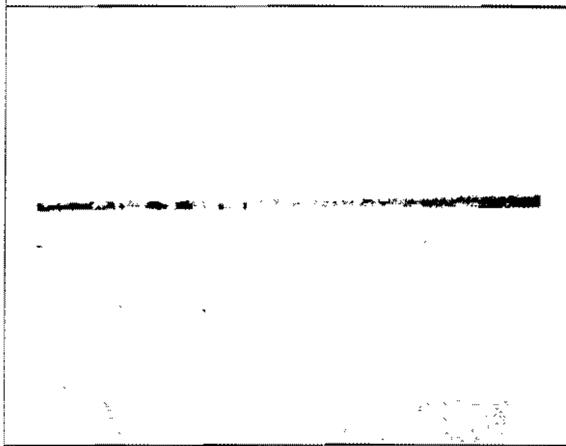
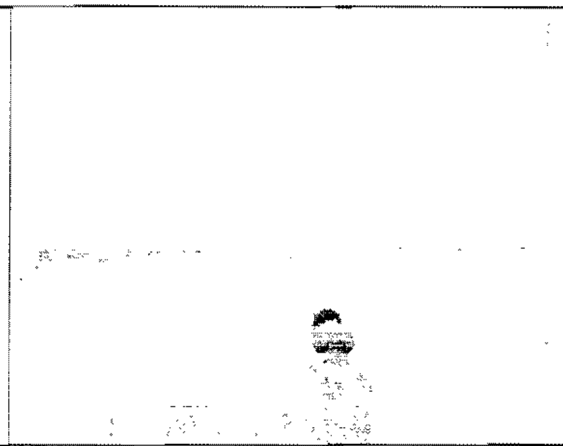
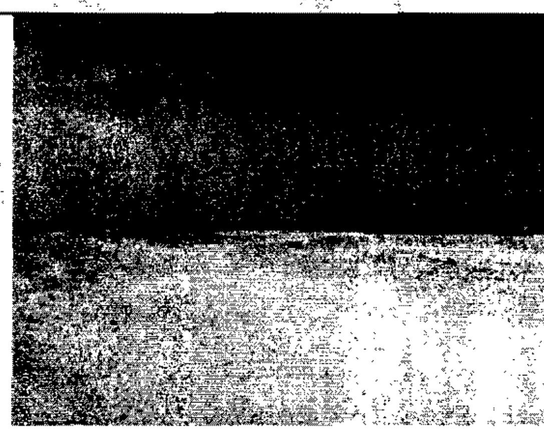
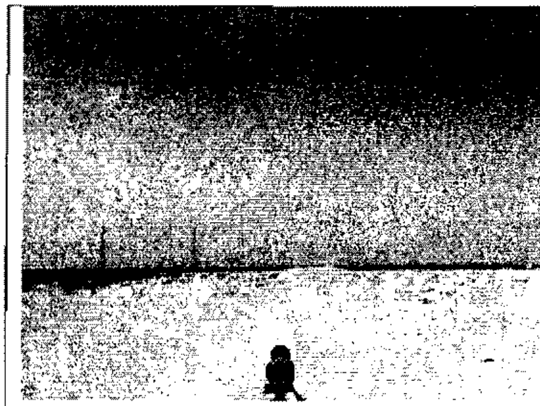
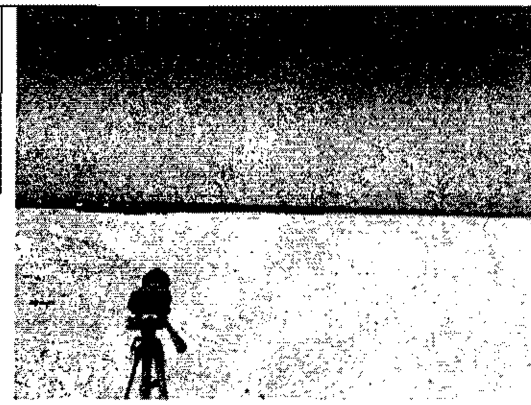
General View	
	
Measurement 1	Measurement 2
	
Measurement 3	Measurement 4

Figure 5-80

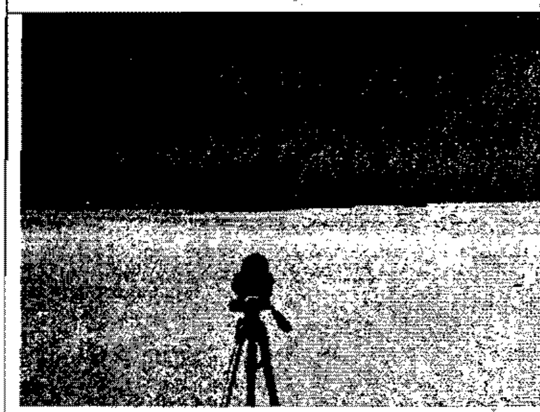
Additional Measurement Photos



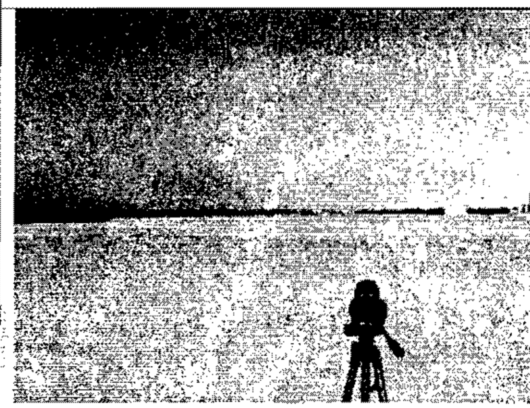
Measurement 5



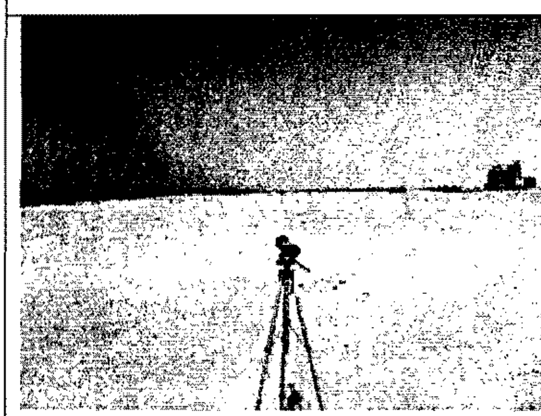
Measurement 6



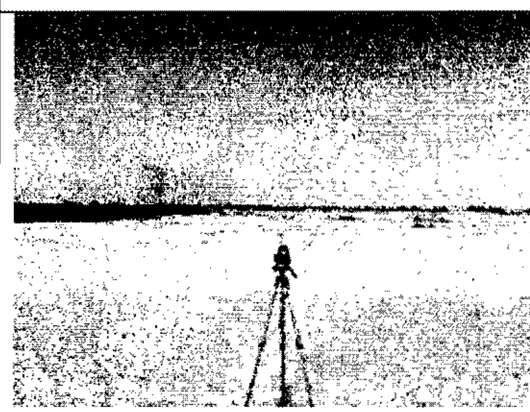
Measurement 7



Measurement 8



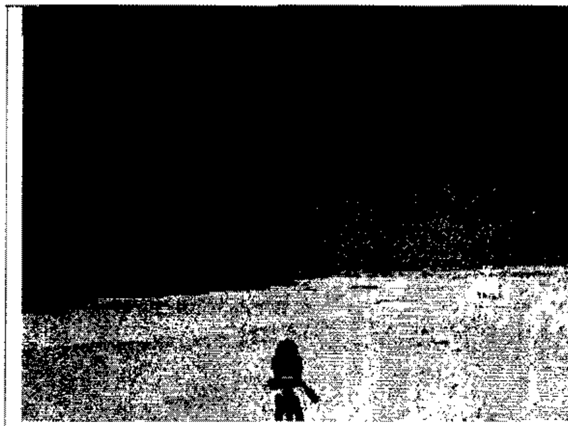
Measurement 9



Measurement 10

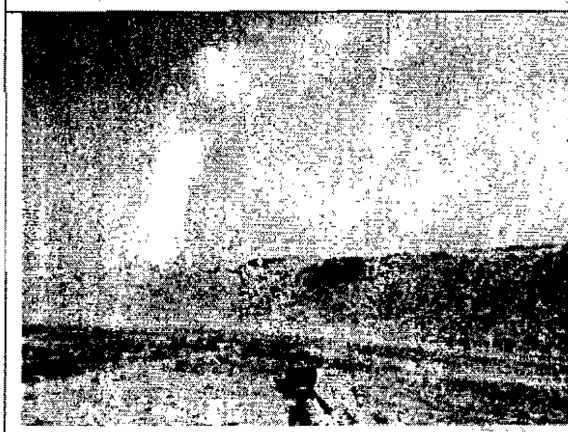
Figure 5-81

More Measurement Photos

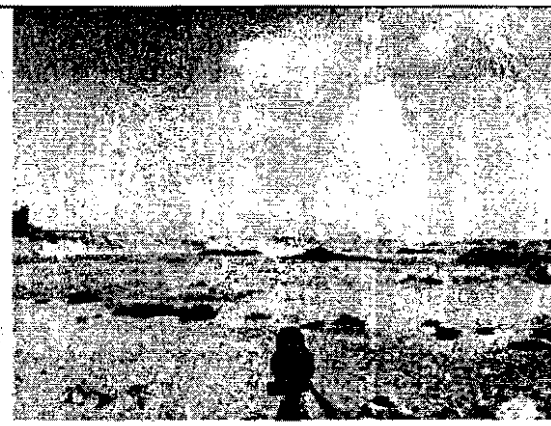


Measurement 11

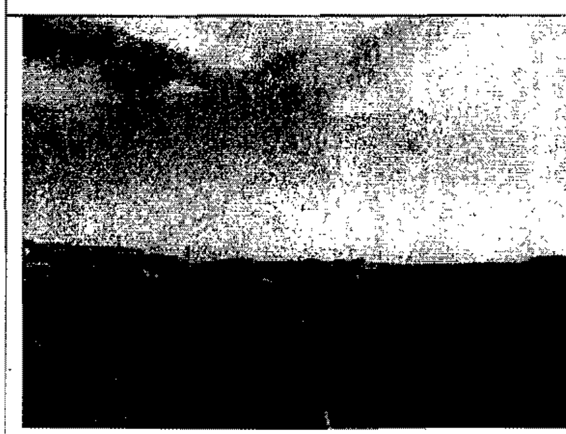
Measurement 12



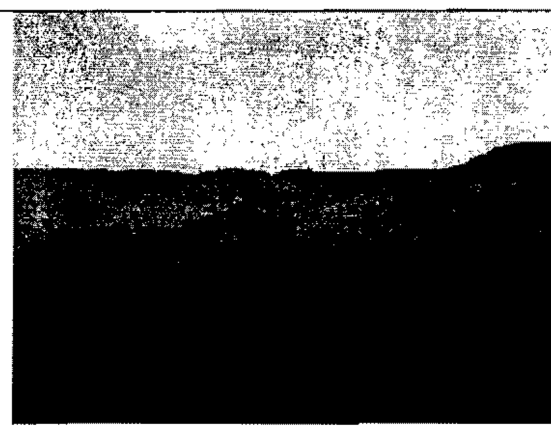
Measurement 13



Measurement 14



Measurement 15



Measurement 16

5.10 TRAFFIC AND TRANSPORT

5.10.1 Introduction

Road transport provides the main mode of transport in the Helwan Zone. The proposed power plant site will be accessed via the Kureimat / Beni-Suweif Regional Road and Cairo / Beni-Suweif Road. This road connect the proposed power plant site to the major road network as shown in *Figures 5-82, 5-83, 5-84 and 5-85.*

Information on traffic conditions and flows have been obtained from primary assessment work conducted by the "El-Azhar University, Faculty of Engineering: Department of Transport", during November 2010, and from observations made during site visit in October 2010.

5.10.2 Main Access Roads

Accessibility to the power plant

The power plant is located along Kureimat / Beni Suweif road on a section 8 km from Kureimat city. There is only one entrance to the site there is crops stores from the northern side, graveyard area from the southern side, cultivated land from the western side. This keeps only one entrance from the eastern side through the regional road Kureimat / Beni Suweif.

The entrance to the project site

As the project site lies on the regional road Kureimat / Beni Suweif, the entrance is unpaved branching from the Kureimat / Beni Suweif road to the eastern side of the project site. The entrance should be reconstructed with a width not less than 6 m to allow access of the trucks carrying the **power** plant equipment and also to allow entry of the construction equipment to the site. Acceleration and deceleration lanes should be provided to the entrance to ensure safe maneuver to vehicles entering or exiting the site. This entrance has no obstacles to obstruct trucks from access to the site (*Figure 5-86*).

Regional Roads around the Power Plant

Kureimat / Beni Suweif Road

This road is a section from the regional road Cairo / Beni Suweif which serves the movement of the passengers and goods from Cairo to Beni Suweif and vice versa. It is a rural 2 lane 2 way highway All the intersections are at grade, the U- turns as well. The volume of traffic is moderate to high through the year.

Its course is extends adjacent to eastern side of the river Nile from Kureimat to Beni Suweif. As the road is confined between the Nile and the Eastern Desert it is mostly characterized by its narrow right of way and the speed ranges between 50-90 km/h. The road section adjacent to the power plant site is provided with light posts. The main characteristics of the road are given below in *Table 5-37*.

Table 5-37

Characteristics of Kureimat / Beni-Suweif Road

Item	Characteristics
Road width	8m
Number of lanes	2 lanes
Median width	None
Design speed	110 Km/hour
Speed limit	≤ 90 Km/hour
Curb	None
Shoulders	1 m

Figure 5-82

Regional Roads from Seaports to the Site

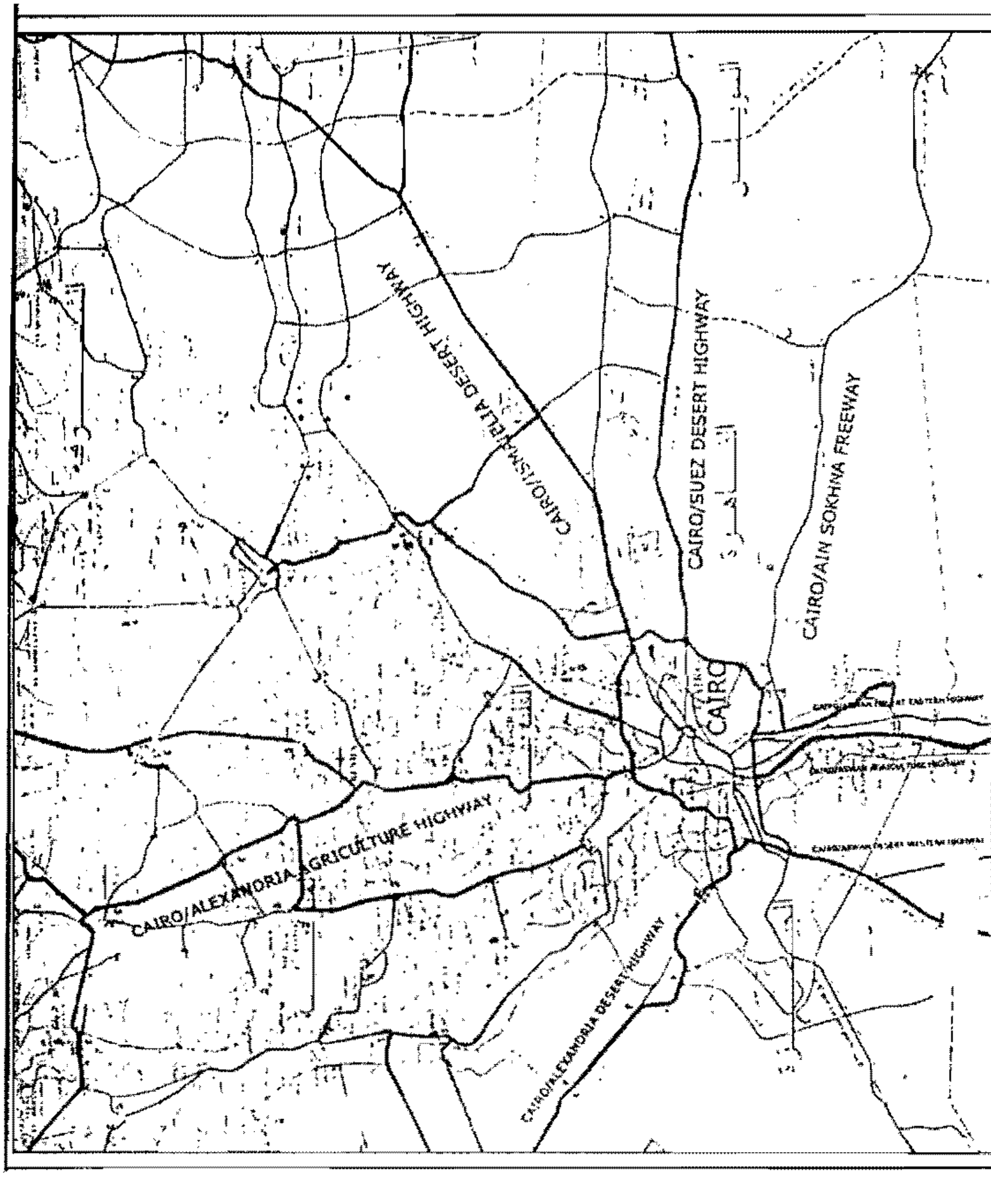


Figure (2) Map of Regional Roads Accessing the Power Plant

Figure 5-83

Main Access Roads to the Power Plant Site

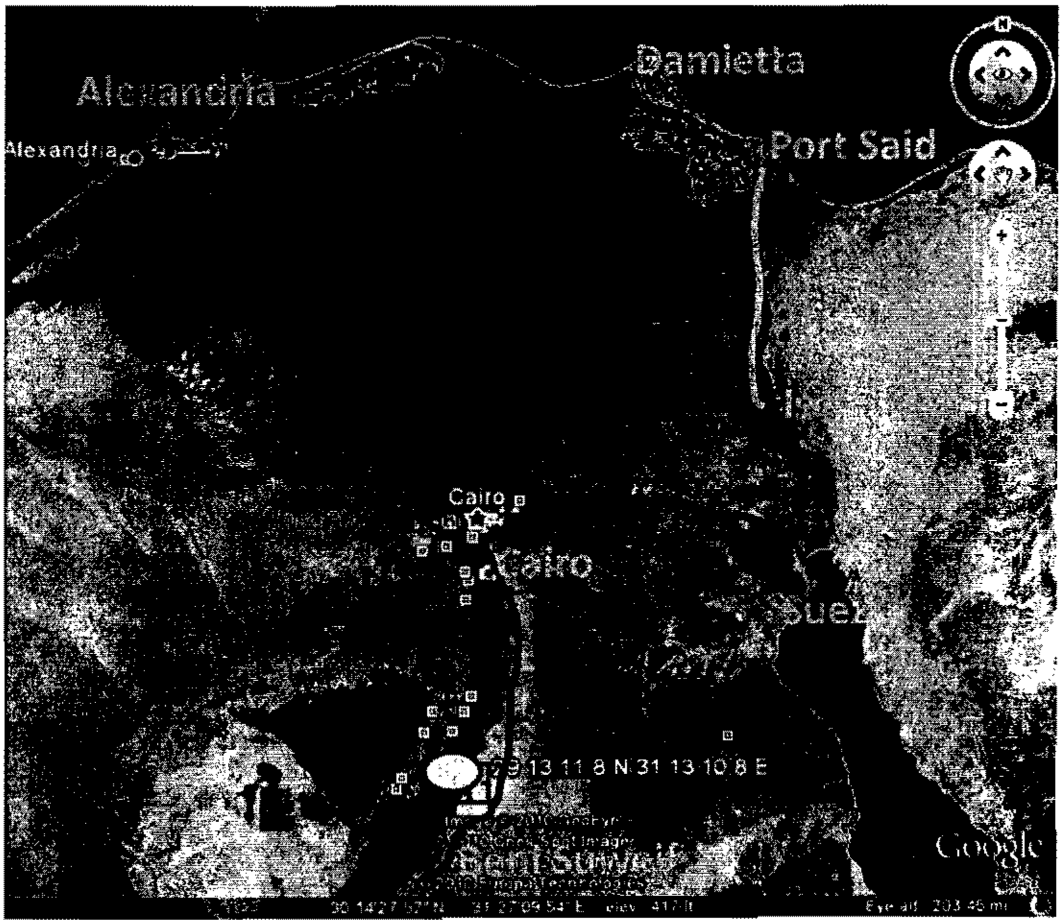


Figure 5-84

Location of Helwan Power Plant and the Connecting National Roads

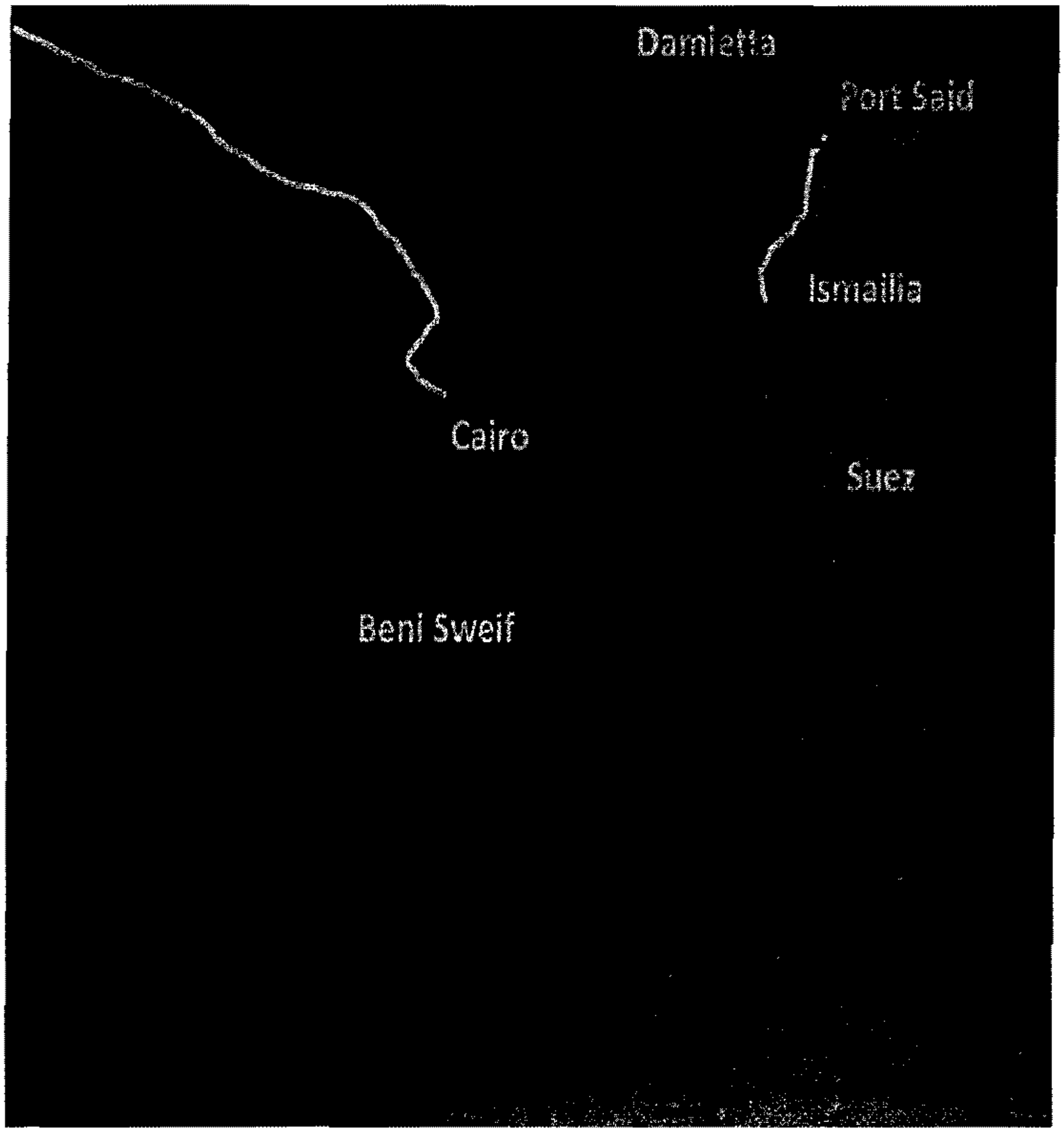


Figure 5-85

Location of Helwan Power Plant (Sketch)

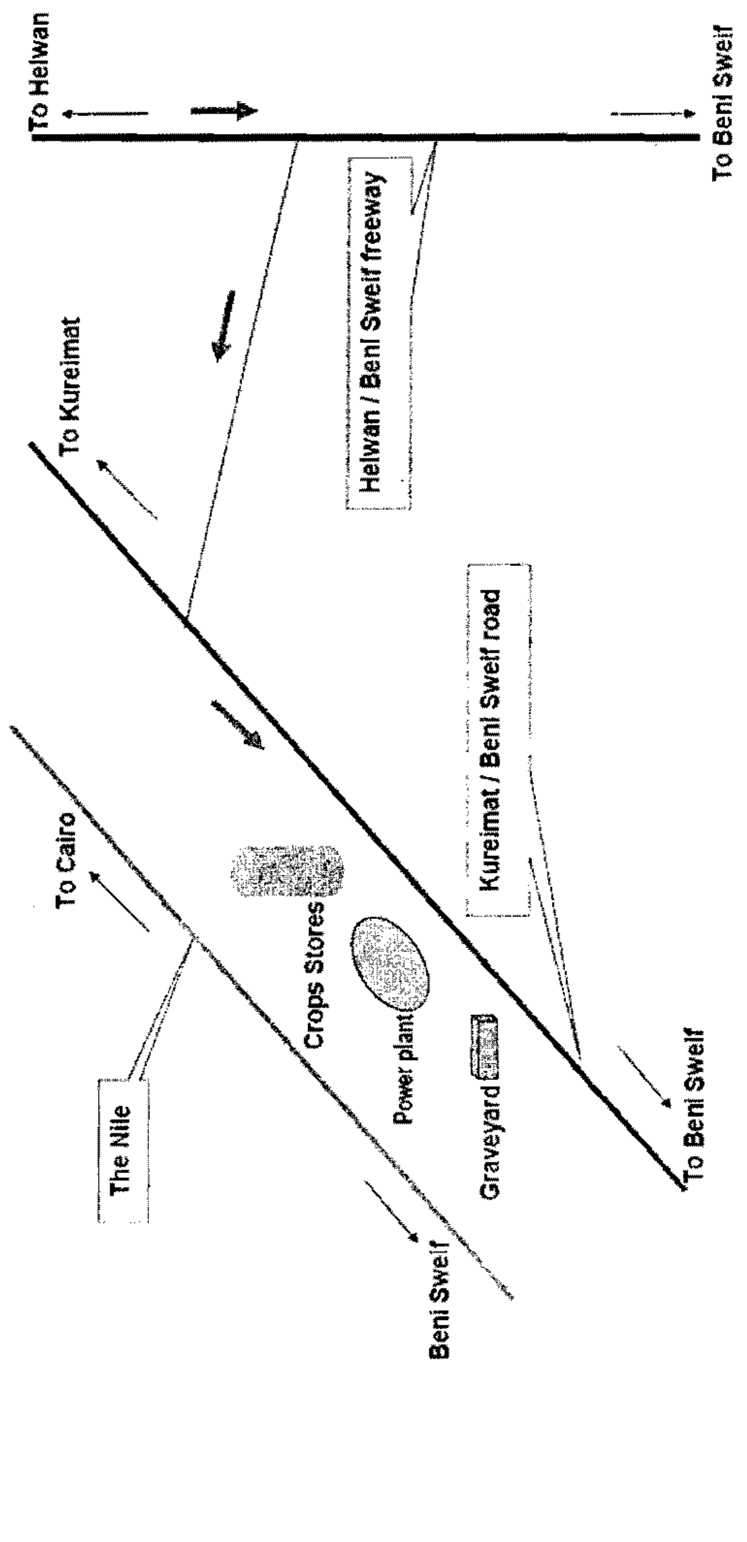
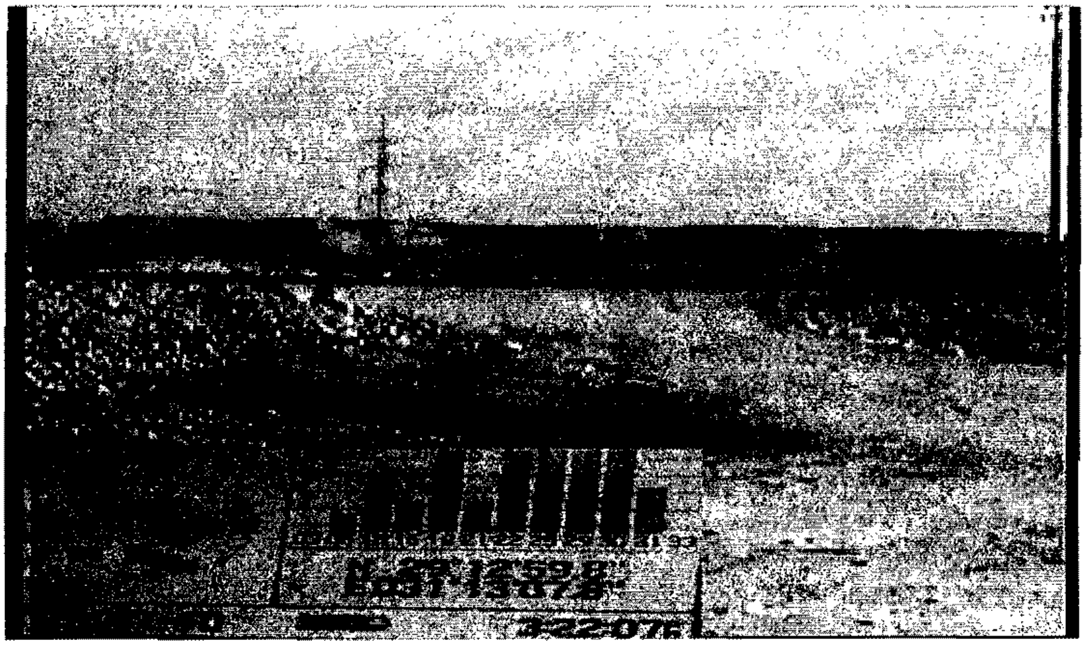


Figure 5-86

Accessibility to the Power Plant Located by GPS



5.10.3 National Roads Connecting the Power Plant to Different Ports in Egypt

In this part the traffic volumes for some regional roads connecting the power plant to major ports in Egypt will be viewed due to the heavy equipment required for the power plant and imported then transported to Helwan from a number of ports such as (Alexandria, Port Said, Damietta).

The main national roads connecting the ports to Helwan South power plant site are:

From Cairo:

- Helwan / Beni-Suweif Freeway.

From Alexandria, Port Said and Helwan:

- Cairo / Alexandria desert Highway.
- Cairo / Alexandria agriculture Highway. (not recommended)
- Helwan / Beni Suweif Freeway.

From Port Said and Damietta:

- The International Highway.
- Port Said / Ismailia Highway.
- Cairo / Ismailia Highway.
- Helwan / Beni Suweif Freeway.

From Suez (including Adabia and Sokhna ports):

- Cairo / Suez Highway
- Cairo / Sokhna Freeway.
- Helwan / Beni Suweif Freeway.

The geometric characteristics of the National highways included in the study are given in *Table 5-38*.

Traffic data for these roads (AADT) during the period 2005 to 2011 were obtained from General Authority for Roads, Bridges and Land Transport (GARBLT) (*Figure 5-87)*.

The traffic volume on Cairo/Alexandria Agricultural Highway is considered to be the highest traffic volume where it is equal to 3-6 times of traffic volume on other roads. That is because this road connects between the capital and one of the main ports (i.e. Alexandria). Moreover, it serves & passes through many governorates with high population densities, thus the speed is relatively low considered as a rural highway (average speed 70 km /hour). The lane capacity for the other national highways under study is 2000 vehicle / hour. The limit speed on the highways is 100 km/ hour except for the International highway is 90 km / hour.

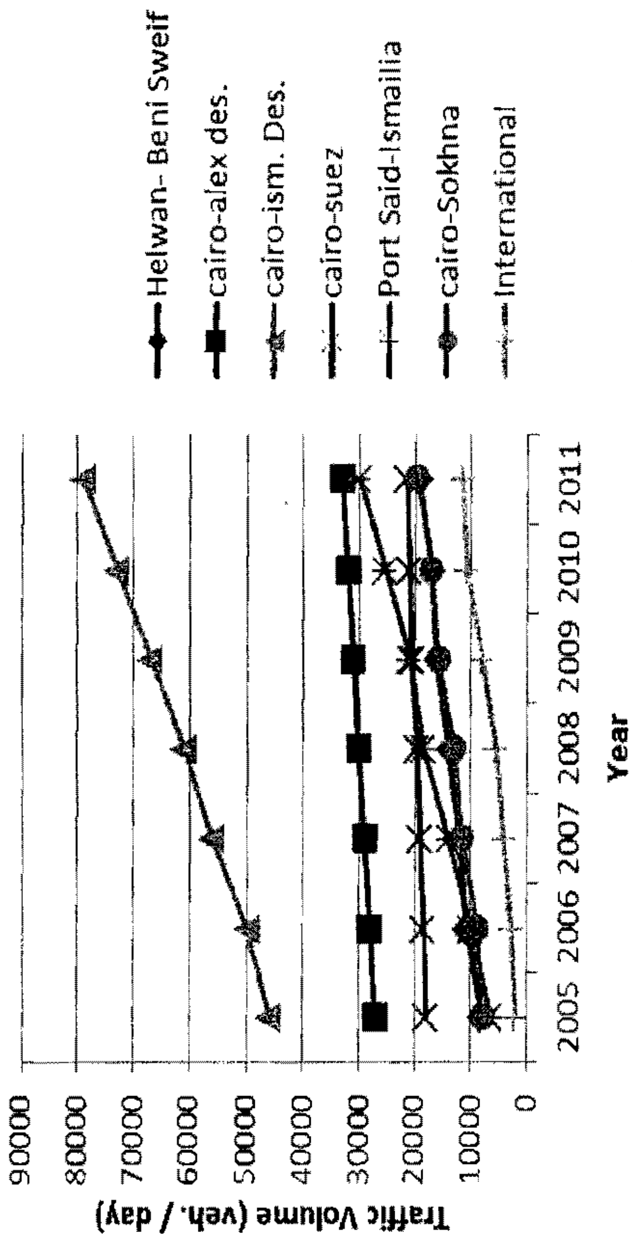
Table 5-38

Geometric Characteristics of the Main National Highways

Road Name	Geometric Description
Helwan / Beni Suweif Freeway	This is a dual 3-lane carriageway highway with a paved shoulder linking Helwan to Beni Suweif. The road is a toll road and becoming main road that transport a high proportion of passengers and freights which generated from the urban expansion along its route. The road is generally in a good condition. The average lane capacity is given as 2200 vehicle/hour.
Cairo/Alexandria Desert Highway	This is a dual 4-lane carriageway highway with a paved shoulder linking Cairo to Alexandria Seaport. The road is a toll road and becoming main road that transport a high proportion of passengers and freights which generated from the urban expansion along its route. The pavement condition is good. The average lane capacity is given as 2200 vehicle/hour.
Cairo/Alexandria Agriculture Highway	This is a dual 3-lane carriageway highway with a paved shoulder linking Cairo to Alexandria Seaport. The road is a main road that transport a high proportion of passengers and freights which generated from the urban expansion along its route. The road is generally in a good condition. The average lane capacity is given as 2000 vehicle/hour.
Cairo / Ismailia Desert Highway	This is a dual 2-lane carriageway highway (in most of its length) with a paved shoulder linking Cairo to Ismailia. The road is heavily used by passenger and freight transport. It serves local and regional traffic as it passes through 10th of Ramadan city. The average lane capacity is given as 2000 vehicle/hour and the pavement condition is good
Cairo/Suez Desert Highway	This is dual 2-lane carriageway highway with a paved shoulder linking Cairo to Suez Seaport. The road is generally in a good condition. The average lane capacity is given as 2200 vehicle/hour.
Port Said / Ismailia Desert Highway	This is dual 2-lane carriageway highway with a paved shoulder linking Port Said to Ismailia The road is recently upgraded and it is in a v.good condition. The average lane capacity is given as 2000 vehicle/hour.
Cairo / Sokhna Highway	This is dual 3-lane carriageway highway with a paved shoulder linking Cairo to Sokhna Seaport. The road is generally in a V.good condition. The average lane capacity is given as 2200 vehicle/hour.
International Highway	This is a dual 2-lane carriageway highway, with a concrete barrier in the median, linking Port Said to Marsa Matrouh passing by Helwan and Alexandria. The road is becoming a main road that transport a considerable proportion of passengers and freights from the east to the west of the Nile Delta and vice versa. The road is generally in a V. good condition. The average lane capacity is given as 2000 vehicle/hour. The post speed is 90 km/h.

Figure 5-87

Average Annual Daily Traffic on National Roads during the Period: 2005-2011



5.10.4 Traffic Classification Survey

As part of the evaluation of existing conditions, it was decided to carry out traffic counts on the plant's adjacent road and the counts were manually carried out for 24 hours on Monday 18 October 2010.

The counts were manually carried out to depict the daily flow, peak flow and existing traffic composition. The traffic was classified into the following five categories (*Table 5-39*).

a- Private car, van, jeep.
b- Pick-up, micro-bus, Mini-bus.
c- Motor Cycle.
d- Truck.
e- Truck trailer.

Traffic fluctuation on Kureimat / Beni Suweif road is given in *Figure 5-88*.

Table 5-39

Traffic Classification during the Peak Periods on Kureimat / Beni Suweif road

	Day					Total	Night					Total
	pc	Pickup	Motor Cycle	Truck	Truck trailer		pc	Pickup	Motor Cycle	Truck	Truck trailer	
To Kureimat	83	331	38	60	64	576	20	50	5	71	87	233
To Beni Suweif	166	373	44	50	53	686	23	45	6	64	93	231

Figure 5-88

Traffic Flow Fluctuations on Kureimat / Beni Suweif Road

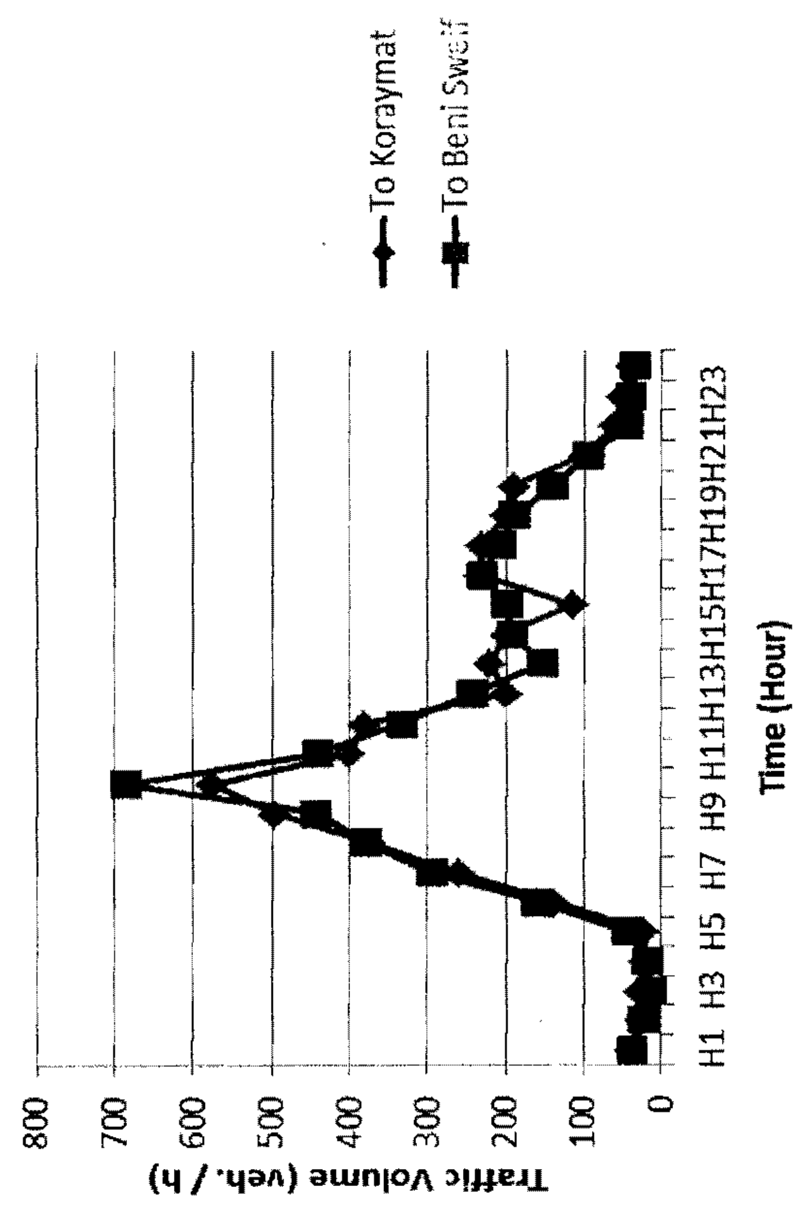


Table 5-39 indicates that there is moderate traffic volume on both directions by day and light traffic by night. The directional distribution of traffic for both directions is nearly 50% by day and by night. The traffic composition indicated that:

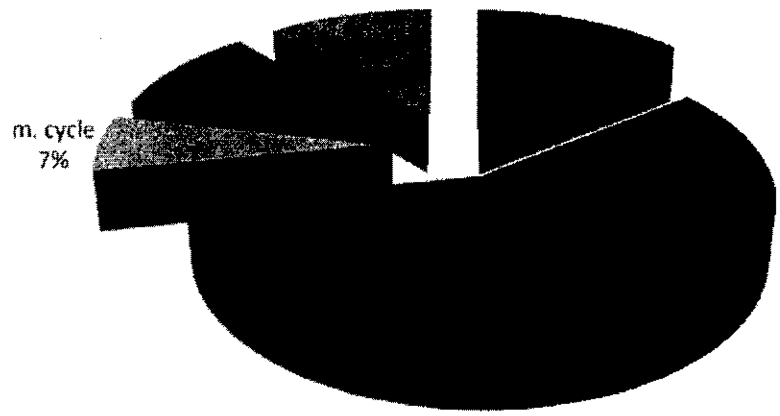
1. The percentage of pickups is dominant (58%) this is a normal phenomenon in the suburbs as this mode of transport is used to transport people as well as goods.
2. This is followed by the heavy vehicles categories including both trucks and trailers (21%), that is because the road is used for both usage transporting crops from stores to the market and transporting large boulders from quarries to places of manufacturing.
3. Then came the p.c (14%) and this is also normal as the car ownership in small cities as Kureimat and Beni Suweif is relatively low.
4. And at the tail came the category of motor cycles (7%).

The daytime variations are distinctive since the volume is reduced to approximately the half at night. But it is observed that the percentage of heavy vehicles at night reaches (68%) which conforms a real threat to other vehicles using the road.

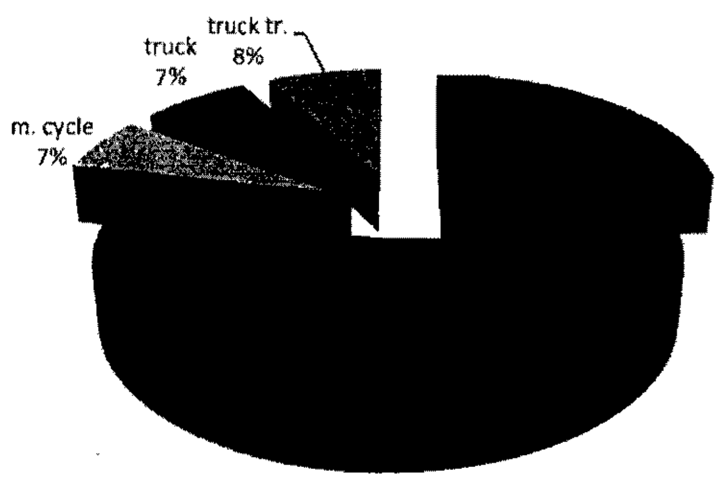
It should be also noted that the road in this section although having light posts there was no light observed at night. Hence it is advised not to use the road at night as it might be hazardous to the freight and equipment transported. Traffic composition for both directions, at day and night periods is shown in *Figures 5-89 and 5-90* respectively.

Figure 5-89

Traffic Composition on the Kureimat / Beni-Suweif Road (Day)



Traffic composition to Koraymat (day)

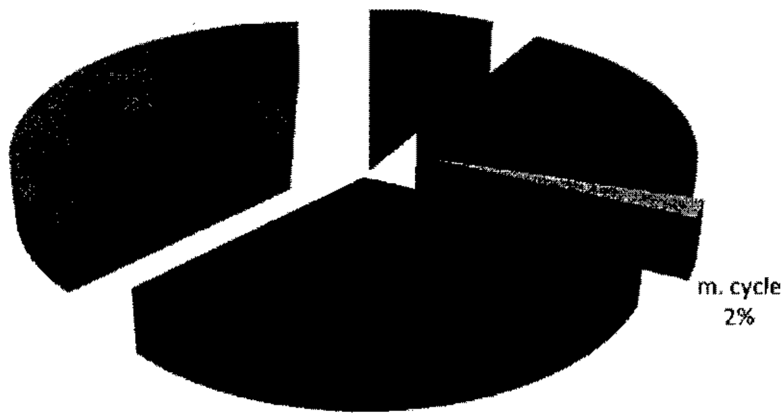


Traffic composition to Beni Sweif (day)

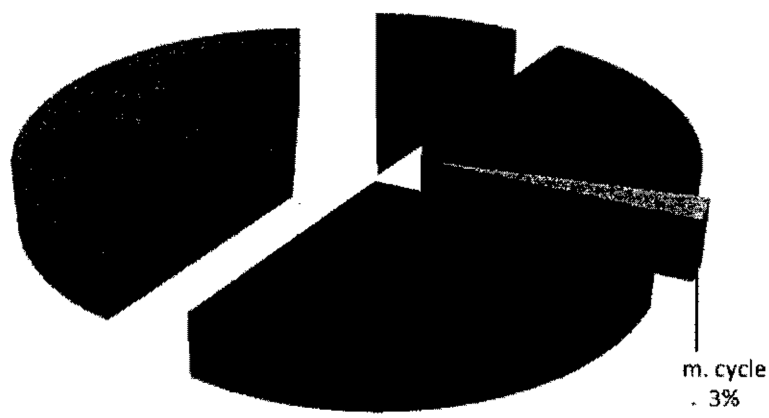
*figures on pie charts show the volume of vehicles in percentage

Figure 5-90

Traffic Composition on the Kureimat / Beni-Suweif Road (Night)



Traffic composition to Koraymat (night)



Traffic composition to Beni Sweif (night)

*figures on pie charts show the volume of vehicles in percentage

5.10.5 Trip Time Surveys at the Surrounding Roads of the Power Plant

To identify the operational characteristics of the road facing the power plant (Kureimat / Beni Suweif road). The moving observer method is used to measure the average journey time and speeds on this road. The length of section was 5.0 Km around the site. The observer car recorded the following data:

1- Running time at this section by using a stopwatch.
2- Manual survey of traffic volume in opposite direction of movement test car.
3- Manual survey to vehicles that overtake the test car and that be overtaken by the test car.

That was done for 8 rounds for both directions of travel on Kureimat / Beni Suweif road. The results of the journey time surveys are given in *Table 5-40.*

Table 5-40

Average Travel Time and Speed for the Selected Road Section

Road	**Average Trip Time (Minutes)**	**Average Speed (km/hr)**
Kureimat / Beni Suweif road **(To Beni Suweif)**	3.33	90
Kureimat / Beni Suweif road **(To Kureimat)**	3.29	89

5.10.6 Speed Analysis

The video tapes recorded were used to calculate individual speeds for 150 vehicles. The resulting speeds were statistically analyzed to estimate the average travel speed along road section and to assess the variation of the average speed. Speed data is given in *Table 5-41*, while *Table 5-42* presents a summary of the statistical analysis performed on the speed data. The speed distributions along Kureimat / Beni-Suweif road is shown in *Figure 5-91*.

Table 5-41

Speed Data for Kureimat / Beni Suweif Road

Veh. No.	Speed (Km/h)	Veh. No.	Speed (Km/h)	Veh. No.	Speed (Km/h)	Veh. No.	Speed (Km/h)	Veh. No.	Speed (Km/h)
1	50	**31**	63.4	**61**	67.2	**91**	73.5	**121**	78.7
2	50.5	**32**	63.5	**62**	67.2	**92**	73.6	**122**	78.7
3	50.5	**33**	63.5	**63**	67.6	**93**	73.7	**123**	78.9
4	51.5	**34**	63.5	**64**	67.6	**94**	73.7	**124**	78.9
5	51.5	**35**	63.5	**65**	68.2	**95**	73.7	**125**	78.9
6	51.5	**36**	63.5	**66**	68.7	**96**	73.8	**126**	80.4
7	52.6	**37**	63.6	**67**	68.7	**97**	73.9	**127**	80.7
8	52.7	**38**	63.7	**68**	68.9	**98**	74.1	**128**	81.5
9	53.7	**39**	63.7	**69**	68.9	**99**	74.2	**129**	81.6
10	53.7	**40**	63.7	**70**	68.9	**100**	74.6	**130**	81.6
11	54.1	**41**	64.1	**71**	69.1	**101**	74.7	**131**	81.6
12	54.3	**42**	64.3	**72**	69.4	**102**	74.7	**132**	81.6
13	54.5	**43**	64.5	**73**	69.5	**103**	74.7	**133**	81.6
14	54.6	**44**	64.6	**74**	69.6	**104**	74.8	**134**	81.6
15	54.9	**45**	64.9	**75**	69.7	**105**	74.9	**135**	81.6
16	55.2	**46**	65.2	**76**	70.4	**106**	75.2	**136**	81.4
17	55.2	**47**	65.2	**77**	70.4	**107**	75.2	**137**	83.7
18	55.2	**48**	65.2	**78**	70.4	**108**	75.2	**138**	83.7
19	56.1	**49**	66.1	**79**	71.4	**109**	76.1	**139**	83.7
20	56.2	**50**	66.2	**80**	71.5	**110**	76.2	**140**	85.1
21	56.4	**51**	66.4	**81**	71.7	**111**	76.4	**141**	85.1
22	56.5	**52**	66.5	**82**	73.2	**112**	76.5	**142**	85.2
23	56.5	**53**	66.5	**83**	73.3	**113**	76.5	**143**	85.9
24	56.5	**54**	66.5	**84**	73.3	**114**	76.5	**144**	90.2
25	56.5	**55**	66.5	**85**	73.3	**115**	77.5	**145**	90.2
26	61.3	**56**	66.7	**86**	73.3	**116**	77.7	**146**	90.2
27	61.8	**57**	66.7	**87**	73.3	**117**	77.7	**147**	90.3
28	61.8	**58**	66.7	**88**	73.4	**118**	77.7	**148**	90.3
29	61.8	**59**	66.8	**89**	73.4	**119**	77.8	**149**	90.3
30	61.8	**60**	66.9	**90**	73.5	**120**	77.9	**150**	90.3

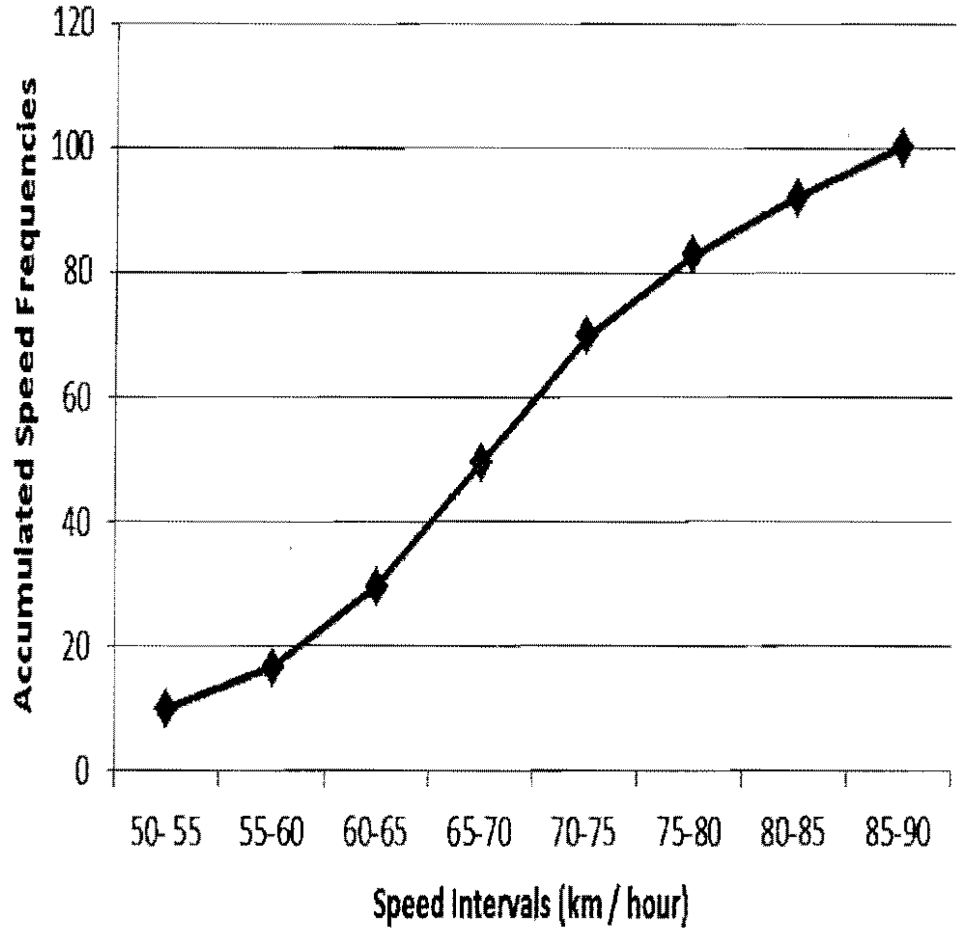
Table 5-42

Speed Analysis for Qanater / Khatatba Road

Speed (km/h)	Frequency	Percentage %
50-55	15	10
55-60	10	16.4
60-65	20	29.6
65-70	30	49.6
70-75	30	69.6
75-80	19	82.8
80-85	14	92
85-90	12	100
Time mean speed km/h	70	
Space mean speed km/h	68.8	
85% speed km/h	80	
98% speed km/h	86	
Range km/h	40.3	
Standard Deviation km/h	9.99	

Figure 5-91

Spot Speed Distribution



5.11 ARCHAEOLOGICAL, HISTORIC AND CULTURAL HERITAGE

Helwan Governorate has been formed recently to include districts from Cairo, Giza and some new cities. It was back to the original status after the political events of 11 Feb. 2011. The nearest archaeological, ancient and new heritage sites to Helwan Zone are located at Giza. Giza is one of the most ancient governorates, which dates back to thousands of years ago. Due to its unique location at the crossroad of Upper and Lower Egypt, Helwan has become the cradle of ancient Pharaonic civilization when King Menes unified both territories and chose Memphis "currently Helwan" as its capital. Historically, Memphis was the hub of all government activities and the destination of philosophers (Aristotle, Socrates, and Plato) while adopting its unique religious approach to interpret the origin of existence. Throughout the Pharaonic era, Memphis was the artistic and cultural center for different intellectual activities. Studies, research, religious legislations, and all kinds of documents and laws on sacred places were inscribed on the walls of its temples, tombs and filled its libraries, which made it the destination of scholars, researchers and travelers.

Ancient Heritage Sites in Giza

Giza heritage sites, ordered from north to south, are as follows:

1- Abu Rawash: located to the north of the Helwan Plateau and was chosen by king Djedefre, son of Kheops, to build his pyramid and mortuary complex. Other burial places have been found in this region, dating back to the 1st and 2nd dynasties.

2- Helwan Plateau: is one of the world's most recognized archeological sites, encompassing eleven pyramids including the Great Pyramid and the Sphinx.

3- Zawyet el-Eryan: located 2 kilometers south of Helwan and known for its step pyramid and the unfinished pyramid.

4- Abusir: located south of Helwan and north of Saqqara, and is considered the richest necropolis in Memphis. It is widely known for its sun temples, 5th dynasty pyramids and cemeteries that belong to other periods.

5- Saqqara: witnessed architectural development which had never before taken place in Egypt, namely the wide use of stone as a building material in King Djoser's Complex. It is the only necropolis in Egypt that includes tombs dating back to ancient Egyptian era until Greco-Roman periods. The most important monumental structures are Djoser's Complex and Userkaf Pyramid known as the "Ruined Pyramid".

6- Dahshur: located 11 kilometers south of Saqqara and includes the Bent Pyramid, the North pyramid of King Seneferu, the first smooth-sided pyramid in the history of ancient Egypt's architecture, in addition to the pyramids of Kings Amenemhat II, Sesostris III and Amenemhat III. The area is furthermore known for its collection of rare jewellery which has been found in tombs belonging to Middle Kingdom princesses, known as "Treasures of Dahshur."

7- El-Lisht: under the administration of El-Ayyat District, and located on the ruins of the city of Itjtawy (the Seizer of Two Lands) which was the capital of the 12th dynasty. The area contains the pyramid of Amenemhat I and Sesostris I and other tombs of senior officials.

8- Atfih: located southeast of El-Saff city and was the capital of the 22th nome. It is known in ancient Egyptian texts as Tp-yhwt meaning (the-first-of-the-cows) while it is called Atfeeh in Arabic. Recently, an animal necropolis used for the burial of the sacred cow (symbol of Goddess Hathor) has been discovered.

9- Memphis (currently Meet Rahyna): contains the largest necropolis in Egypt and once held the Mummy of Alexander the Great for a year before his tomb was set in Alexandria. Its most famous monument is the statue of Ramses II which stands in the heart of Ramses Square. The name of the city was altered to Memphis by the Ancient Greeks.

10- Torana: situated to the Northwest of Memphis on the Rosetta Distributary. It is currently under the administration of Imbaba District and includes many archeological sites that date back to the Greco-Roman periods.

11- Bahariya Oasis: situated at almost 370 kilometers west of Helwan and has many archeological sites dating back to Pharaonic and subsequent ages. The Valley of the Golden Mummies is the landmark of the area with over 234 gilded mummies discovered (the latest being in December, 2004) when 20 mummies and 50 bronze coins in their vicinity were unearthed. In Al-Sheikh Subi area, the tombs of Bahariya governor, Zed-Khons-uef-ankh, his wife, Naes and his son, Padi-Iset and were unearthed.

New Heritage Sites in Helwan

1- **Cultural landmarks:**
Cairo University, Helwan Zoo, Orman Botanical Garden, Pharaonic Village, Agricultural Museum, and Papyrological Research Institute.

2- **Artistic Museums:**
- Mahmoud Khalil Museum
- Ahmed Shawki Museum
- Taha Hussien Museum
- Nabil Darwish Ceramic Museum
- Modern Art School in Haranya
- Kerdassa
- El-Nadeem Gallery for Mashrabiyas
- Glass Art & Sculpture and Egyptian Paste Museum
- El-Ein Gallery for Folk and Traditional Handiwork
- Samir Shoukry Atelier
- Mohamed Nagi Museum
- Omar El-Nagdi Museum
- Ahmad Al-Nawar Atelier
- Mohey Al-Din Hussein \

3- **Sound and Light Show**:

Together with a show that details the Giza monuments through an enchanting presentation of the historical text accompanied by expressive music. It also recounts Sphinx history and the deeply-entrenched roots of the Ancient Egyptian Civilization together with the story of the pyramid building. The show is presented in several foreign languages, besides Arabic.

4- **Public theaters**:
- Balloon Theater
- El-Nile theater
- Helwan Theater
- Sayed Darwish Theater
- Student Union Theater
- National Circus

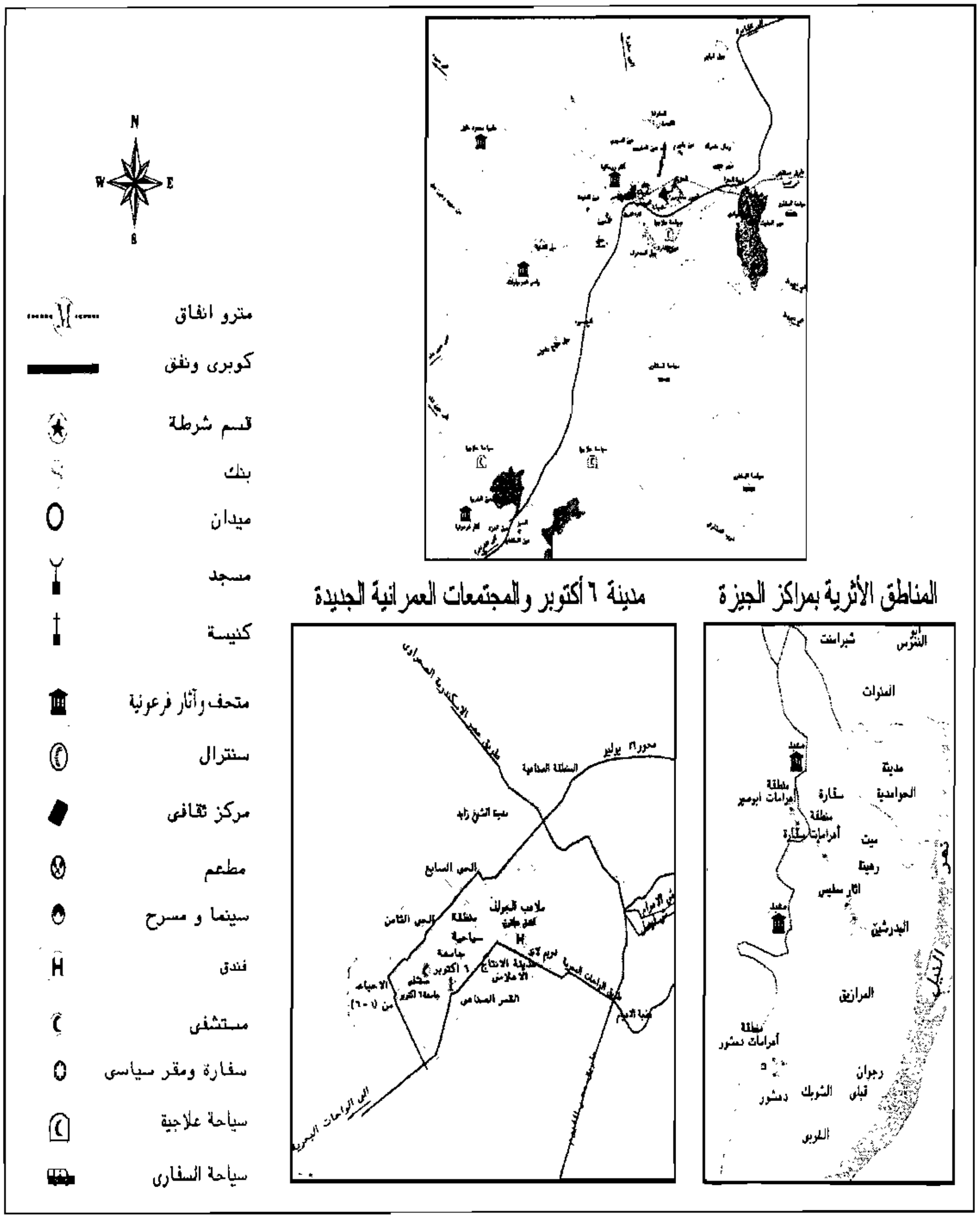
Figure 5-92 presents Cultural Legacy and Giza's most famous attractions and Figure 5-93 illustrates the Cultural legacy and Giza's most famous attractions.

Figuer 5-92

Cultural Legacy and Giza's most Famous Attractions (A)

Figuer 5-93

Cultural Legacy and Giza's most Famous Attractions (B)



5.12 SOCIO-ECONOMIC ENVIRONMENT

Helwan Governorate is recently formed as a distinct Governorate. It is separated mainly from Cairo Governorate and Giza Governorate, where most of its Kisms/ Marakez / Districts / Cities were basically affiliated to Cairo and Giza Governorates.

For this reason, social and economic database is not completed yet for Helwan Governorate and many of statistical classifications are not established yet for the Governorate.

However, statistics on population were found for Helwan Governorate, in addition to a fast prepared "Data Book" for the year 2009, with little of information about the ongoing developmental projects.

In the most recent days (after political events of 11 Feb. 2011) Helwan areas were back to original Governorates of Cairo and Giza.

The following section provides with all available data for the Helwan Zone as well as some other data as classified for Giza Governorate.

5.12.1 General Background

Helwan Zone includes Helwan city, with its three districts: Ain Helwan, El-Maasara and 15th of May; El-Maady City, with its two districts: El-Maady and Tourah; Markas Atfieh; Markaz Es-Saff; Tebbin City; New Cairo City; Badr City and El-Shorouk City (*Figure 5-94*).

The total area of the ex-Helwan governorate covers 903.471 km^2, representing 0.09% of the Republic's area. The governorate encompasses 2 marakez, 4 cities, 34 districts, 11 rural local units annexed by 43 villages, and 106 Kafrs & Ezbets (*see Tables 5-43, 5-44 and 5-45*).

According to the preliminary results of the 2006 census, population is 1.7 million people; 70.6% of them live in urban areas, and 29.4% in rural areas and population natural growth rate has reached 19.3 per thousand.

Beside being an agricultural area, Helwan is also considered an industrial one as it hosts many industries such as: Iron & Steel, Cement, basic metals, engineering and electronics, as well as mining. Moreover, the governorate hosts three industrial zones; one of them is located in Tebbin and has big industrial companies. The other two zones are located at Maady and Helwan. In addition to that, the governorate hosts many new projects such as the under construction new Tebbin power plant of capacity 2x350 MWe.

5.12.2 Population and Demography

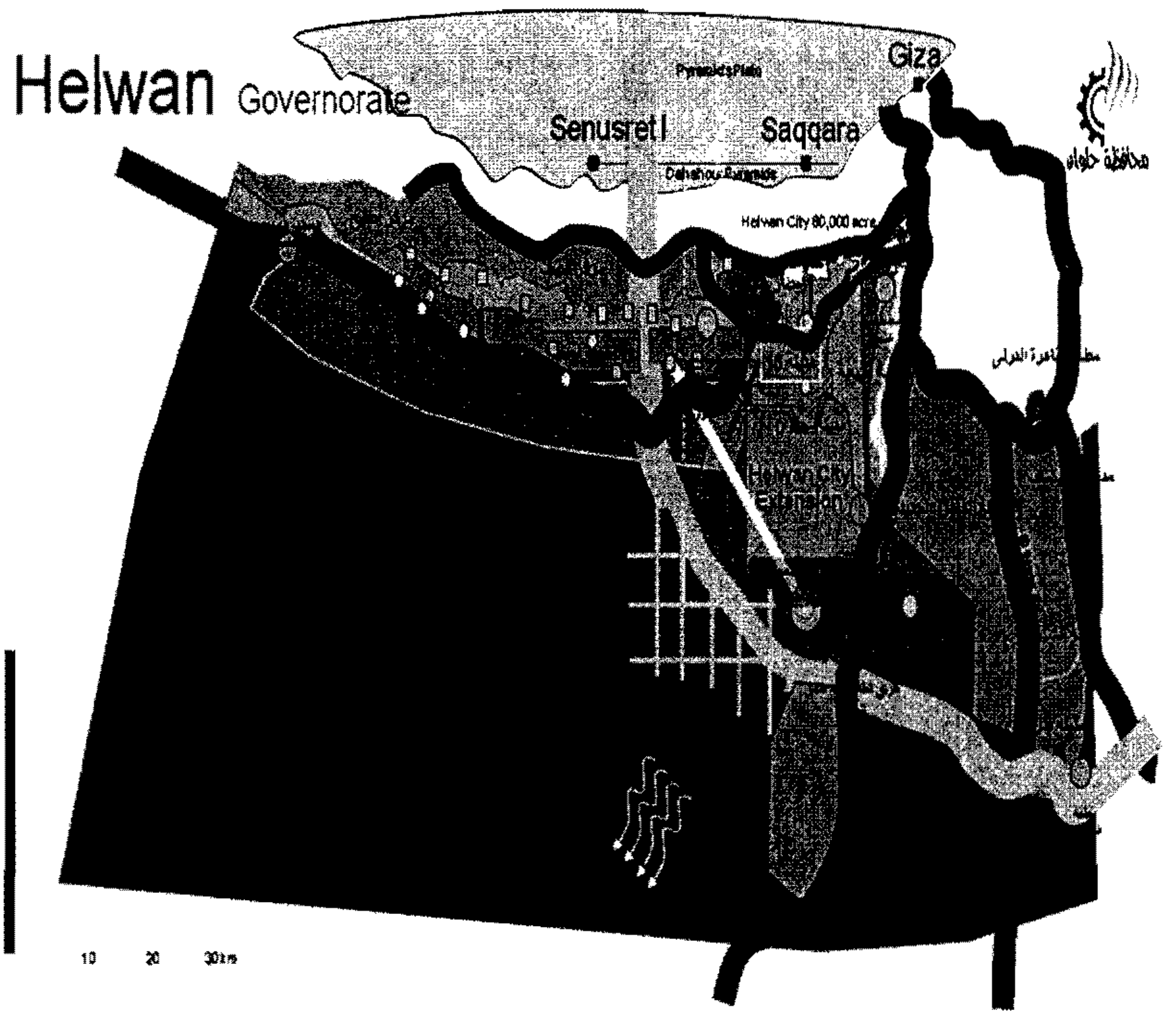
The project site is located at the Helwan southern area, which is along the River Nile and about 7.5 km south of the El-Kureimat existing power plant and about 12 km south of the El-Kureimat village and 97.5km south of Cairo. The site is an empty land area located among sandy bare, uncultivated, un-inhabited, state-owned land, just south of the Dayr Al-Maymun point. It is, also, located about 23.5km north of Beni-Suweif City. The site is approximately 12km from the nearest residential area. The total area of the Helwan Governorate (2009) is around 903.471 km^2 i.e. 215,112 Feddans. Total population of about 1,789,880 reside the Helwan Governorate (2009) and represent about 2.4% of the total population in Egypt. The population at the Markaz Atfieh is approximately 266,970.

The total population of Ex-Helwan Governorate, including all Marakez (Tebbin, Helwan, Maady, Es-Saff, Atfeih, New Cairo City, Al-Shoruk City and Badr City) was estimated at 1,789,880 in 2009 as the first year estimate after its separation from Cairo & Giza Governorates.

Under the proposals set out in the Helwan area's Development Plan, the population of the Markaz Atfieh Zone is likely to increase with the development of new industrial, commercial and residential businesses, and is expected to reach 295,802 by 2015. *Tables 5-46 through 5-58* show population data for the Helwan, with special emphasis on Markaz Atfieh Zone, obtained from both the Central Agency for Public Mobilization & Statistics (CAPMAS) and the Information and Decision Support Center of the Ex- Helwan Governorate.

Figure 5-94

Administrative Zones of the Ex- Helwan Governorate



Source: Helwan Governorate: Information and Decision Support Center, 2010.

Table 5-43

Administrative Division of the Ex- Helwan Governorate

No. of Marakz	No. of Cities	No. of Districts	No. of Rural Local Units	Affiliated Villages	Villages Outside Local Units	Kafrs & Ezbets
2	4	34	11	43	0	106

Source: Arab Republic of Egypt-The Cabinet Information & Decision Support Center: Egypt's Description by Information 2009, Helwan Governorate.

Table 5-44

Area of the Ex- Helwan Governorate, 2009

Item	Unit	Value
Total Area	**Km^2**	**903.471**
Total Populated Area	**Km^2**	**519.5**
Housing and Scattering Areas	Km^2	131.39
Facilities and Cemeteries	Km^2	81.294
Ponds and Fallow	Km^2	85.13
Agricultural Land within Agricultural Borders	Km^2	18.49
Agricultural Land Outside Agricultural Borders	Km^2	44.877
Population Density in the Populated Area	Thousand Persons/Km^2	3.29
Population Density in the Total Area	Thousand Persons/Km^2	1.89
Populated Area (% of Total Area)	%	57.5

Source: Arab Republic of Egypt-The Cabinet Information & Decision Support Center: Egypt's Description by Information 2009, Helwan Governorate.

Table 5-45

Slums Area of the Ex- Helwan Governorate, 2009

Item	Unit	Value
Total No. of Slums Areas	**Area**	**56**
Developed Slums Areas	Area	39
Slums Areas to be Developed	Area	16
Slums Areas under Development	Area	1

* Source: Ex- Helwan Governorate: Information and Decision Support Center, 2010.

Table 5-46

Population of Ex- Helwan Governorate,
with Details on Atfieh Zone, Year 2008 Estimates
(based on 1996 Census)

No.	*Sex Area*	Males (Capita)	Females (Capita)	Total (Capita)	% Age of Total
Helwan Governorate		880,692	832,586	1,713,278	100%
Helwan Marakez / Kisms/ Cities:					
1	Tebbin City	35,277	33,620	68,897	3.99%
2	Helwan City	376,428	363,883	740,311	43.22%
3	Maady City	87,245	84,984	172,229	10.06%
4	Es-Saff Markaz and City	157,910	144,894	302,804	17.67%
5	Atfieh Markaz and City	139,703	127,267	266,970	15.58%
6	New Cairo City	63,171	59,168	122,339	7.14%
7	Al-Shorouk City	12,211	10,359	22,570	1.33%
8	Badr City	8,747	8,411	17,158	100%

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-47

Population Projection for Entire Ex- Helwan Governorate
during the Period 2009-2027

Unit: No.

Year	2009	2012	2017	2022	2027
Population	1,713,278	1,790,375	1,969,412	2,156,506	2,393,722
Evolution Ratio (Base Year 2009=100)	100	104.49	115	125.8	139

Source: General Organization for Physical Planning: www.gopp.gov.eg,2010.

Table 5-48

Population of the Ex- Helwan Governorate according to Final Results of 2006 Population Census by Age Groups, Dec. 2009

Age Group		Less than One Year		1-4		5-14	
		No.	%age	No.	%age	No.	%age
Population	Males	9,760	1.1	88,115	10.0	186,284	21.2
	Females	9,515	1.1	83,535	10.0	174,846	21.0
	Total	19,275	1.1	171,650	10.0	361,130	21.1

Age Group		15-44		45-59		60+		Total
		No.	%age	No.	%age	No.	%age	
Population	Males	437,402	49.7	108,816	12.4	50,315	5.7	880,692
	Females	426,136	51.2	98,662	11.9	39,892	4.8	832,586
	Total	863,538	50.4	207,478	12.1	90,207	5.3	1,713,278

Source: Central Agency for Public Mobilization and Statistics (CAPMAS): Statistical Year Book, Dec. 2009.

Table 5-49

Number and Percentage of Population in Ex- Helwan Governorate in Urban/Rural according to Preliminary Results of Population Census 2006, Dec. 2009

Urban		Rural		Total	
Number	% age of Total Egypt	Number	% age of Total Egypt	Number	% age of Total Egypt
1,202,395	3.8	510,883	1.2	1,713,278	2.4

Source: Central Agency for Public Mobilization and Statistics (CAPMAS): Statistical Year Book, Dec. 2009.

Table 5-50

Estimated Population and their Percentage Distribution by Sex, 1/1/2009

Males	Females	Total	%age
920,068	869,812	1,789,880	2.4%

Source: Central Agency for Public Mobilization and Statistics (CAPMAS): Statistical Year Book, Dec. 2009.

Table 5-51

Estimated of Midyear Population for the Ex-Helwan Governorate (1997-2008)

Year	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	-	-	-	-	-	-	-	-	-	-	-	1,770,330

Source: Central Agency for Public Mobilization and Statistics (CAPMAS): Statistical Year Book, Dec. 2009.

Table 5-52

Percentage of Population and Ex-Helwan Governorate's Ranking by Census (1986-1996- 2006)

Year	1986	1996	2006
Percentage of Pop. (%)	-	-	2.4
Rank	-	-	18

Source: Central Agency for Public Mobilization and Statistics (CAPMAS): Statistical Year Book, Dec. 2009.

Table 5-53

Number and Percentage of Population Distribution in Ex-Helwan Governorate by Sex and Sex Ratio according to Preliminary Results of Population Census 2006

Males		Females		Total		Sex Ration (*)
Number	% age of Total Egypt	Number	% age of Total Egypt	Number	% age of Total Egypt	106
880,692	2.4%	832,586	2.3	1,713,278	2.4%	

(*) Sex Ratio = Males / Females x 100%

Source: Central Agency for Public Mobilization and Statistics (CAPMAS): Statistical Year Book, Dec. 2009.

Table 5-54

Average Size of Household Population, No. of Persons and Sex Ratio in Ex-Helwan Governorate according to Preliminary Results of Population Census 2006

No. of Households		No. of Persons in Households			Average Size of Household	Sex Ratio
		Males	Females	Total		
Urban	300,104	606,792	583,351	1,190,143	4.0	104
Rural	110,915	267,490	243,234	510,724	4.6	110
Total	411,019	874,282	826,585	1,700,867	4.1	106

Source: Central Agency for Public Mobilization and Statistics (CAPMAS): Statistical Year Book, Dec. 2009.

Table 5-55

Number and Percent of Population (10 Years & above) in Ex-Helwan Governorate byEducational Status according to Preliminary Results of Population Census 2006

No.	Educational Status	Number	Ratio %
1	Illiterate	327,600	24.50%
2	Read & Write	142,470	10.65%
3	Illiterate Erase	9,293	0.69%
4	Below Intermediate	288,427	21.56%
5	Intermediate	338,352	25.30%
6	Above Intermediate	40,929	3.06%
7	University Degree	182,868	13.67%
8	Above University Degree	7,027	0.53
9	Not Stated	0.00	0.00
	Total	**1,336,966**	

Source: Central Agency for Public Mobilization and Statistics (CAPMAS): Statistical Year Book, Dec. 2009.

Table 5-56

Population Distribution in Ex-Helwan Governorate by Marital Status according to Preliminary Results of Population Census 2006

All Urban

Never Married		Marriage Contract		Married		Divorced		Widowed		Under Age	Total
No.	%	No.	%	No.	%	No.	%	No.	%	No.	
306,706	17.9	5,117	0.3	707,990	41.3	10,115	0.6	58,950	3.4	624,400	1,713,278

Source: Central Agency for Public Mobilization and Statistics (CAPMAS): Statistical Year Book, Dec. 2009.

Table 5-57

Number of Internal Immigrants to the Ex-Helwan Governorate by Cause of Immigration and Sex According to the Final Results of 2006 Census

	No. & Reason of Internal Immigration to the Helwan Governorate							
	For Work	For Study	For Marriage	Divorced or Widowed	Attendant	Other	Not Stated	Total
Males	51,855	4,010	8,839	153	22,948	8,081	0.00	95,886
Females	2,908	2,285	45,159	1,041	39,659	4,559	0.00	95,611
Total	54,763	6,295	53,998	1,194	62,607	12,640	0.00	191,497

Source: Central Agency for Public Mobilization and Statistics (CAPMAS): Statistical Year Book, Dec. 2009.

Table 5-58

Total Area, Inhabited Areas' Population and Population Density in Ex-Helwan Governorate in 31/12/2009

Total Area (km^2)	Inhabited Area (km^2)	Inhabited Area/Total (%)	Population in 1/1/2008 (No.)	Population/ Total Area (No./km^2)	Population/ Inhabited Area (No./km^2)
903.471	519.5	57.50%	1,713,278	1,896.3	3,297.9

Source: Central Agency for Public Mobilization and Statistics (CAPMAS): Statistical Year Book, Dec. 2009.

5.12.3 Employment and the Labor Market

The labor force of Ex- Helwan Governorate is around 448,362, i.e. 26.17% of total population, with unemployment, including job loosers, at around 10% in 2009. *Tables 5-59 through 5-74* give labor force data for Ex- Helwan Governorate with a special emphasis on Atfieh.

In the Atfieh Zone, around 30.6% of the Zone total population forms the active work force, while in the Entire Helwan area this ratio reaches about 26.17%. This labor pool is comprised of employees of industrial activities (chemicals, building and construction, Iron &

Steel, Cement, textiles, basic metals products, wood, wooden products & upholstery, spinning, weaving, garments & leather, paper products and food products), employees of small industry and small business operators. Around 58% of the total labor pool can be categorized as skilled, having been trained as industrial technicians. *Tables 5-59 through 5-62* present some details on the labour market in Giza Governorate in the year 2006/2007, while *Table 5-59* gives some details on the work force by work status, 15 years and above. *Table 5-63* provides with some details on workforce according to person's work status and *Table 5-64* provides with estimates of employees by economic activity and sex. *Table 5-65* gives some details on registered industrial establishments and their employment in Giza.

A considerable portion of the Helwan Zone's economy centers on small businesses which comprise handicraft workshops sector as indicated in *Table 5-66*. *Table 5-67* gives some details on the industrial zones-productive companies associations in the Giza Governorate.

The proposals outlined in the Giza & the Helwan Region Master Scheme 2015, which corresponds to the Government of Egypt's development program for the country, are likely to offer thousands of employment opportunities through the construction and operation of the proposed businesses as well as industrial and commercial developments in the entire area.

Table 5-67 gives basic data on industrial zones and *Table 5-68* gives an overview regarding agricultural activity during the year 2007.

Tables 5-70 through 5-74 present some details on tourism activity, construction and building activity, and investments as employment opportunities in Giza, including considerable portion of the Helwan Zone, in 2007.

Table 5-59

Labor Market in Ex- Helwan Governorate according to Preliminary Results of Population Census 2006

Item	Unit	Value
Total Labor Force	(1000) persons	1,713,278
No. of Employed Persons	(1000) employed	448,362
No. of Un-employed Persons	(1000) un-employed	176.59
Labor Force (% age of population)	%	26.17
Rate of Un-employment	%	9.7
Growth Rate of Work Force	%	26.27
Females (% age of Work Force)	%	14.2
Un-employment Rate of High Education Graduates	%	15.4
Un-employment Rate of Intermediate & above Intermediate Education Graduates	%	11.3

Source: CAPMAS: "Labor Force Sample Survey 2006", Preliminary Data, 1/1/2009.

Table 5-60

Number and Proportion Distribution of Un-employed Persons in Ex- Helwan Governorate by Education Status and Sex, 2009

Educational Status	Males		Females		Total	
	No.	%	No.	%	No.	%
Illiterate	6,100	7.0	0.00	0.0	6,100	4.9
Read & Write	1,500	2	0.00	0.0	1,500	1.0
Lower than Intermediate	4,100	5.0	300	1.0	4,400	4.0
Intermediate	40,100	46.1	16,800	45.0	56,900	45.8
Upper than Intermediate & Lower than University	8,600	9.9	3,900	10.5	12,500	10.1
University & Above University	26,500	30.5	16.300	43.7	42,800	34.5
Total	**86,900**		**37,300**		**124,200**	

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Table 5-61

Employees in Governmental Sector in Ex- Helwan Governorate by Sex during 2005-2007

Sex	Males	Females	Total
2005	285,976	100,981	386,957
2006	217,672	101,348	319,020
2007	213,329	101,262	314,591

Source: CAPMAS, Statistical Year Book, Dec. 2009.

Table 5-62

Labour Market in Ex- Helwan Governorate: Number of Appointees and State Administration Contracts, 2006

Item	Unit	Value
No. of Appointees in Private and Investment Sectors	Person	16,310
No. of State Administration Contracts	Contract	4,139

Source: CAPMAS and Ministry of Manpower and Immigration, 1/1/2009.

Table 5-63

Workforce According to Person's Work Status and Type (Above 15) in the Ex- Helwan Governorate, 2009

Markaz/ Kism	Within Workforce								Outside Workforce								Grand Total
	Job Owner	Works for Own	Works for Wage	Works for No Wage		Unemployed worked previously	Unemployed Not worked previously	Total	Student	House Wife	Pensioners	Overaged	Un-able to Work	Doesn't want to Work	Other	Total	
				For Family	For Others												
Tebbin	342	1170	14528	31	6	616	3110	19803	6235	15414	2153	1631	158	687	1463	27741	**47544**
Helwan	6604	11436	171089	349	48	3413	27936	220875	81854	158450	25941	16844	1778	8995	8615	302477	**523352**
Maady	3367	3271	43830	108	11	629	4687	55903	18826	35987	5927	5806	365	959	3094	70964	**126867**
Es-Saff	1851	3943	65527	416	55	972	8698	81462	20977	69874	6100	5438	701	2239	4666	109995	**191457**
Atfieh	1001	1894	65009	351	16	437	3694	72402	19570	62206	2146	4505	702	933	1924	91986	**164388**
New Cairo	37525	522	140	141	1593	2124	22350	10655	44548	3070	443	42	106	35962	2427	2498	**82073**
El-Shorouk	285	388	5799	4	0	54	453	6983	2746	4201	515	213	18	20	36	7749	**14732**
Badr	624	337	3677	5	0	158	237	5038	802	4191	337	195	44	56	147	5772	**10810**
Total of the Governorate	**16572**	**24866**	**405421**	**1370**	**178**	**6722**	**51885**	**507014**	**161665**	**372673**	**45243**	**36225**	**3907**	**14029**	**20467**	**654209**	**1161223**

Source: Ex-Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-64

Estimates of Employed Persons by Economic Activity and Sex in Giza Governorate, 2007

No.	Economic Activity	Males	Females	Total
1	Agriculture & Hunting	158,900	34,100	193,000
2	Mining, Quarrying & Manufacturing	316,900	21,100	338,000
3	Construction & Building	224,900	3,700	228,600
4	Retail & Wholesale Trade & Repair	238,700	18,100	256,800
5	Hotels & Restaurants	48,900	2,300	51,200
6	Transportation, Storage & Communications	157,800	8,700	166,500
7	Education	72,400	48,800	121,200
8	Health & Social Activity	26,000	26,500	52,500
9	Services	149,700	22,400	172,100
10	Others	114,200	44,500	158,500
	Total	**1,508,400**	**230,200**	**1,738,400**

Source: CAPMAS: Statistical Year Book, Dec. 2008.

Table 5-65

Registered Industrial Establishments and their Employment in Giza Governorate, 2006

No.	Industrial Establishments	Number of Establishments	Registered workers
1	Basic Chemicals & their Products	461	30,550
2	Building Materials, Porcelain, china-wares & Refractories	270	10,642
3	Basic Metals Products	59	5,452
4	Metal Products, Machinery & Transport Equipment	619	48,803
5	Wood, Wooden Products & Upholstery	156	5,885
6	Spinning, Weaving, Garments & Leather	388	35,405
7	Paper, Paper Products, Printing & Publishing	192	11,398
8	Food Products, Beverages & Tobacco	596	52,714
9	Other Manufacturing Industries	16	529
	Total	2,757	**201,378**

Source: Arab Republic of Egypt-The Cabinet Information & Decision Support Center: Egypt's Description by Information 2007, Giza Governorate.

Table 5-66

Registered Handicraft Workshops and their Employment in Giza Governorate, 2006

No.	Workshops	Number of Workshops	Registered workers
1	Chemical, Petroleum Products & Rubber	236	277
2	No-metalic Mining Materials	0.00	0.00
3	Basic Metals	769	807
4	Metalic Products, Machinery & Equipment	539	646
5	Wood & Kork Products	718	779
6	Spinning & Weaving Products	227	279
7	Paper, Printing & Publishing	170	221
8	Food Products, Tobacco & Beverages	1,090	1,277
9	Other Workers	4,670	11,255
	Total	**8,419**	**15,541**

Source: Arab Republic of Egypt-The Cabinet, Information & Decision Support Center: Egypt's Description by Information 2007, Giza Governorate.

Table 5-67

Industrial Zones – Productive Companies Associations in Giza Governorate, 2006/2007

Item	Unit	Value
No. of Industrial Zones	Zone	2
No. of Productive Factories in the Industrial Zones	Factory	830
Area Allocated for Industrial Activity	**Feddan**	**6,745**
• Area Allocated for Factories	Feddan	6,290
• Area Available for Allocation	Feddan	455
No. of Productive Cooperation Associations	Association	35
No. of Members of Productive Cooperation Associations	Member	1,423

Source: Arab Republic of Egypt-The Cabinet Information & Decision Support Center: Egypt's Description by Information 2007, Giza Governorate (Ministry of Trade & Industry, 2006/2007).

Table 5-68

Agricultural Activity, in Ex-Helwan Governorate, 2007

No.	Markaz/ Kism	Total Area of Cultivated Land (Feddan)			Total Area of New Cultivated Land (Feddan)			Total Area of Old Cultivated Land (Feddan)		
		2009	2008	2007	2009	2008	2007	2009	2008	2007
1	Helwan	1364	1277	1677	0	0	0	663	1277	1677
2	Maady	0	0	0	0	0	0	0	0	0
3	Tebbin	144	758	992	0	0	0	168	758	992
4	Atfieh	42498	28243	25013	5680	1350	2018	22965	26894	22995
5	Es-Saff	45120	29093	26703	8254	2747	4106	22522	26345	22597
6	El-Shorouk	0	0	0	0	0	0	0	0	0
7	Badr	0	0	0	0	0	0	0	0	0
8	New Cairo	0	0	0	0	0	0	0	0	0
	Total of the Governorate	**89126**	**59371**	**54385**	**13934**	**4097**	**6124**	**46318**	**85274**	**48261**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-69

Agricultural Activity in Giza Governorate, Major Crops 2007

Item	Unit	Cultivated Area (Thousand feddans)	Production	Productivity (Production/Cultivated Area)
Wheat	Thousand Ardabs	41.67	827.92	19.87 (Ardab/Feddan)
Tomato	Thousand tons	40.98	784.99	19.16 (Ton/Feddan)
Maize	Thousand tons	57.73	233.98	4.05 (Ton/Feddan)

Source: Ministry of Agriculture and Land Reclamation, 1/1/2008.

Table 5-70

Tourism in Giza Governorate, 2007(A)

No. of Hotels & Resort (Hotel & Resort)	5 Stars	4 Stars	3 Stars	2 Stars and less	Under Classification
75	13	9	22	19	12

Source: Ministry of Tourism – Giza Governorate Information & Decision Support Center, 1/1/2007.

Table 5-71

Tourism in Giza Governorate, 2007 (B)

Item	Unit	Value
No. of Rooms	Room	9708
% of Room Occupancy	%	64.2
No. of beds	Bed	19416
No. of Tourist Night	Thousand Nights	7028
Tourism Education:		
No. of hotels & tourism schools	School	9
No. of hotels & tourism institutes	Institute	2
No. of hotels & tourism faculties	Faculty	0

Source: Ministry of Tourism - Giza Governorate Information & Decision Support Center, 1/1/2007.

Table 5-72

Construction and Building in Giza Governorate, 2006/2007

Item	Unit	Value
Total number of Constructed Housing Units	**Housing unit**	**6711**
Government Sector:	**Housing unit**	0
Low cost housing	Housing unit	3064
Economy	Housing unit	0
Middle	Housing unit	0
Above middle and luxurious	Housing unit	**3064**
Private Sector	**Housing unit**	**9775**

Source: Arab Republic of Egypt-The Cabinet Information & Decision Support Center: Egypt's Description by Information 2007, Giza Governorate (Ministry of Trade & Industry, 2006/2007).

Table 5-73

Construction and Building in Giza Governorate, New Cities 2006

Item	Unit	Value
No. of new cities	City	2
No. of productive factories	Factory	875
No. of factories under construction	Factory	352
No. of housing units (youth housing)	Housing unit	18,796
No. of land plots allocated for household housing	Plot of land	1139
No. of cities and villages with endorsed urban boundaries	City/ Village	127

Source: Arab Republic of Egypt-The Cabinet Information & Decision Support Center: Egypt's Description by Information 2007, Giza Governorate (Ministry of Trade & Industry, 2006/2007).

Table 5-74

Investments as Employment Opportunities in Giza Governorate, 2007

Area of Investment	Investment Basis and Incentives	Investment Opportunities
Industrial	• Industrial zones in Helwan Governorate, and plots of lands provided with utilities are available for investors. • Public transportation networks connecting industrial zones with cities and new urban communities in addition to businessmen service centers. • Lands allocated for investors enjoy the incentives provided for in the Investment law. • Abundant skilled labor, and raw materials such as: "lime stone, clay, basalt, marble, sand, and pebbles" • The governorate established Investment Services Bureau to bring down the establishment period and streamline investment procedures. • The governorate is currently establishing new industrial zones.	• Paper and printing. • Medical equipment and tools. • Leather • Wood products. • Waste recycling . • Packing of food products. • Spinning, weaving and linen. • Cardboard, packing and wrapping. • Metal, glass, marble, granite, & ceramics. • Electric appliances.
Agricultural and Livestock	• Plain desert hinterlands for cultivation. • Vegetables and fruits that are successfully grown in the reclaimed lands in the desert. • A Network of roads connecting the arable lands with the governorate's cities. • Large number of farms for poultry and livestock breeding and fattening. • Various sources of water. • Highly skillful labor in the agricultural field. • Abundant amounts of high quality vegetables and fruits.	• Land reclamation and cultivation. • Wells digging and application of modern irrigation networks in the reclaimed lands. • Cultivation of non traditional crops for export. • Production of processed meat. • Production of dairy products. • Drying and packing of food products for export.
Tourism	• Diversified tourism attractions: pharaonic monuments, and entertainment and cultural sites. • A lot of monumental areas. • A network of transportation "land, air, railway, buses, taxis. • Many areas suitable for Safari tourism and sight seeing tours.	• Hotels and tourist villages. • Tourist restaurants and floating restaurants. • Development of tourist sites. • Curative and religious tourism. • Promotion of safari trips and tourist sight seeing.

Source: Arab Republic of Egypt-The Cabinet Information & Decision Support Center: Egypt's Description by Information 2007, Giza Governorate (Ministry of Trade & Industry, 2006/2007).

5.12.4 Income Distribution and Socio-economic Profile

There is no published information concerning the income distribution and socio-economic profile of the population within the Helwan area. The only available information on weekly average wages by economic activities and sector in Egypt is abstracted from CAPMAS as indicated in *Table 5-75*. However, fieldwork carried out by EEHC/UEEPC & the Consultant representatives, suggests that the local population of the Helwan Zone is composed of a mix of professional and manual workers.

In discussions with Governorate representatives during EEHC/UEEPC & the Consultant's field visits during November 2010, it was suggested that manual construction work is generally undertaken by migrant labor as there is little indigenous labor available (or willing) to carry out this work. Migrants, often from Upper Egypt, travel to the many places inside Egypt, including the Helwan area, attracted by the employment possibilities in the areas. They are actively recruited from outside the area by development companies. The migrants remain in these areas until employment prospects draw them elsewhere. This migrant labor process is common in northern Egypt. All Governorate officials consulted by EEHC/UEEPC & the Consultant expressed that facilities (housing, public and social services etc.) in the Helwan and Giza areas are more than adequate to absorb these migrants and they do not create any social problems in the area.

Table 5-75

Weekly Average Wages by Economic Activities and Sector(*) in Egypt, 2001-2005

No.	Economic Activities Divisions	Sector	2001	2002	2003	2004	2005
1	Agriculture, hunting, forestry & cutting wood trees	Public	85	112	112	119	354
		Private	70	108	78	293	105
2	Fishing	Public	102	103	106	113	123
		Private	64	82	104	108	104
3	Mining & quarrying	Public	276	267	263	537	390
		Private	402	304	388	525	506
4	Manufactures	Public	168	173	183	219	247
		Private	117	123	121	149	147
5	Electricity, gas & water supplies	Public	154	177	213	225	267
		Private	184	152	490	191	387
6	Constructions (construction & building	Public	161	170	192	256	236
		Private	140	136	136	176	236
7	Wholesale & retail trade, repairing	Public	176	194	197	301	226

	motor vehicles & motor cycles, domestic & personal commodities	Privat e	134	133	144	147	185
8	Hotels & restaurants	Public	143	216	224	189	133
		Privat e	108	114	116	128	156

Table 5-75 (Cont'd)

Weekly Average Wages by Economic Activities and Sector(*) in Egypt, 2001-2005

No.	Economic Activities Divisions	Sector	2001	2002	2003	2004	2005
9	Transport, storage & communications	Public	197	209	220	149	253
		Private	167	155	173	237	220
10	Brokerage	Public	176	201	201	239	317
		Private	381	417	513	453	514
11	Real estate activity, renting & business services	Public	179	140	151	115	299
		Private	322	316	328	261	410
12	Education	Public	60	78	50	58	0
		Private	91	98	86	124	93
13	Health & social work	Public	90	79	95	116	43
		Private	85	79	115	85	88
14	Social & personal services	Public	79	137	125	90	267
		Private	99	100	135	140	133
General Average		Public	171	182	195	232	257
		Private	138	141	149	175	168

(*) Average wages in the first week of October each year.

Source: CAPMAS, Statistical Year Book 2007.

5.12.5 Government and Public Services

Potable Water Supply

Tables 5-76 and 5-77 present production of refined and non-refined water in Giza in 2005/2006.

Table 5-78 shows water resources and distribution of potable water in Helwan in the year 2008 and *Table 5-79* gives useful details on supply and consumption of potable water. The Nile river is the principal source for potable water for the entire Giza and Helwan. Nile river freshwater canals are the principal source of fresh water in Giza and Helwan Zones. The Helwan water stations provide the entire area with actual capacity of about 997,580 m^3/day (*Table 5-78*). The total potable water consumption for the whole area, including the Southern Zone of Atfieh, is 852,000 m^3/day.

The percentage of households with access to potable water reaches 99.3%.

The per capita potable water consumption in Helwan reaches an average of about 1.26 liters/day.

Table 5-79 provides with useful details on supply and consumption of potable water in Giza Governorate in 2006.

Sewage System

Table 5-80 lists the evolution of sanitary average capacity and actual drainage capacity of main stations during the period 2003-2006. Table 40 presents sanitation capacity in the Helwan Zone. This capacity reached 830,000 m^3/day in 2009. *Table 5-81* shows that the average per capita sanitary drainage capacity for Giza districts in the year 2007, including that of Atfieh Zone, is 192.4 liters/day/person.

The total sanitation capacity of Giza Governorate was 1,207,000 m^3/day in 2007, while the Governorate's actual drainage of sewage stations owned by city councils totaled 254,382,000 m^3 in 2006.

Table 5-83 gives 2006 estimate for buildings distribution by connection to public utilities (water and sanitary sewage facilities) in Giza Governorate.

The proposed power plant will dispose its sanitary wastewater – after necessary treatment - into the drainage system already in service in the Helwan Zone.

Table 5-76

Production of Refined Water in Giza Governorate, 2007/2008

Unit of Production: 10^3m^3

No.	Producing Authority	Parameter	Value
1	City Councils	No. of Stations	20
		Production	61,941
2	New Cities	No. of Stations	2
		Production	89,331
3	Water Companies & Organizations	No. of Stations	0.00
		Production(*)	0.00
Total		No. of Stations	22
		Production (Total)	151,272
		Production (% age of all Egypt)	2%

(*) Includes exported water to City Councils.

Source: CAPMAS, Statistical Year Book, Dec. 2009.

Table 5-77

Production of Non-refined Water in Giza Governorate, 2007/2008

Unit of Production: $10^3 m^3$

No.	Producing Authority	Parameter	Value
1	City Councils	No. of Stations	0
		Production	0
2	Water Companies & Organizations	No. of Stations	2
		Production	3,912
Total		No. of Stations & Pumps	2
		Production (Total)	3,912
		Production (% age of all Egypt)	≃ 0

Source: CAPMAS, Statistical Year Book , Dec. 2009.

Table 5-78

Distribution of Potable Water in Helwan's Marakez, 2008

Markaz / Town	Population	Total Actual Production of Water (m^3/day)	Total Actual Consumption of Water (m^3/day)	Per Capita Water Production (m^3/day)	Per Capita Water Consumption (m^3/day)
1. Helwan	376,428	206,160	195,810	0.55	0.52
2. El-Maady	172,229	70,420	75,230	0.40	0.44
3. Atfieh	266,970	153,000	139,540	0.57	0.52
4. Es-Saff	302,804	178,400	162,200	0.59	0.53
5. Tebbin	35,277	208,100	174,220	5.89	4.94
6. New Cairo	122,339	181,500	105,000	1.12	0.65
7. Badr	17,158				
8. El-Shorouk	22,570				
Total	1,713,278	997,580	852,000	Average 1.52	Average 1.26

Source: Information Center, Ex- Helwan Governorate, 9/10/2008.

Table 5-79
Supply and Consumption of Potable Water in Giza Governorate, 2006

Item	Unit	Urban	Rural	Total
Production of Potable Water	1000m^3/day	1,547	500	2,047
Consumption of Potable Water	1000m^3/day	1,463	417	1,880
% age of Household with access to Potable Water	%	99.4	96.9	98.4
Pep Capita Potable Water Consumption	Liter. day/person	398	160.6	299.7
Per Capita Potable Water Production	Liter. day/person	420.8	192.6	326.3

Source: CAPMAS Statistical Year Book 2007 - Ministry of Housing Utilities & Urban Development, 2007 – Giza Governorate Information & Decision Support Center,1/1/2007.

Table 5-80
The Average Capacity of Sewage Stations(*) Owned by City Councils (Municipalities) and their Actual Drainage in Giza Governorate, 2003/2006

Capacity: $10^2 m^3$/hr
Actual Drainage: $10^3 m^3$

No.	Capacity	Year	Value
1	Average Capacity	2003	1,312
		2004	5,002
		2005	4,261
		2006	4,747
2	Actual Drainage	2003	416,151
		2004	241,792
		2005	243,792
		2006	254,382

(*) Data restricted to main stations only.

Source: CAPMAS, Statistical Year Book, Dec. 2008.

Table 5-81
Sanitation System in Giza Governorate, 2007

Item	Unit	Value
Sanitation Capacity	1000m^3/day	1,207
Per Capita Sanitation Capacity	Liter. day/person	192.4
% age of Households with access to Sanitation	%	69.3

Source: CAPMAS Statistical Year Book 2007 - Ministry of Housing Utilities & Urban Development, 2007 – Giza Governorate Information & Decision Support Center,1/1/2007.

Table 5-82

Sanitation Capacity in the Helwan Zone during the Period 2007-2009

No.	Markaz/City	Sanitation Capacity (10^3 m^3/day)		
		2007	2008	2009
1.	Helwan	336.14	340.00	420
2.	El-Maady	90.04	98.00	230
3.	Atfieh	0.00	0.00	0.00
4.	Es-Saff	0.00	0.00	0.00
5.	Tebbin	322.50	324.00	50
6.	New Cairo	48.58	50.00	130
7.	Badr			
8.	El-Shorouk			
Total		**797.25**	**812.00**	**830.00**

Source: CAPMAS: Statistical Year book, Dec. 2009.

Table 5-83

Distribution of Regular Buildings by Connection to Public Utilities (Water & Sanitary Sewage) in Helwan Zone according to Preliminary Results of Population, Housing & Establishments Census, 2006

Unit: No.

Connection to Public Utilities	Category	Unit	Value
Water	Public Network	Number	184,382
		%	88.8
	Other	Number	3,930
		%	1.9
	Nil	Number	19,355
		%	9.3
Sanitary Sewage	Public Network	Number	98,171
		%	47.3
	Other	Number	98,454
		%	47.4
	Nil	Number	11,042
		%	5.3
Total No. of Building			**207,667**

Source: CAPMAS: Statistical Year book, Dec. 2009.

Electricity and Natural Gas

Table 5-84 gives basic energy data for Giza Governorate (including Es-Saff and Atfieh) in terms of number of subscribers in both the electricity network and natural gas services as well as the electricity consumption *Tables 5-85* and *5-86* give some details on the electricity supply and consumption. *Table 5-87* gives information on power generating facilities in service today in the Helwan Zone. *Tables 5-88 and 5-89* provide with more details on city gas services and connection to both natural gas and electricity public utilities.

Figure 5-95 shows the existing electrical facilities for the entire Helwan area in 2010. *Figure 5-96* also shows how the proposed power plant will be connected to existing electrical facilities running around the site and supplying all industrial, commercial and residential demands located in the Ex- Helwan Governorate and connected to the unified power grid.

Table 5-84

Energy Data for Giza Governorate, 2006

Item	Unit	Urban	Rural	Total
No. of Subscribers in the Electricity Network	1000 Subscribers	-	-	2,524
No. of Subscribers in Natural gas Services	1000 Subscribers	-	-	365.2
Total Electricity Consumption	M kWh/year	7,330	1,148	8,478
Electricity Consumed for Lighting	M kW/year	5,006	1,096	6,102
Electricity Consumed for Industrial Utilization	M kWh/year	2,324	52	2,376
Per Capita Consumption of Electricity for Lighting	kWh/year/person	1,361.8	422.1	972.8

Source: The Cabinet Information and Decision Support Center: The Egypt's Description by Information 2007, 7th Edition.

Table 5-85

Number of Subscribers and Electricity Consumption in the Ex- Helwan Governorate during 2007-2008

No.	Markaz/City	Number of Subscribers		Electricity Consumed in Lighting (Million kWh/year)		Electricity Consumed for Industry (Million kWh/year)		Total Electricity Consumed (Million kWh/year)	
		2007	2008	2007	2008	2007	2008	2007	2008
1.	Atfieh	54304	73743	68.00	91.26	2.40	5.20	70.40	96.46
2.	Es-Saff	73085	101625	100.00	125.83	5.00	12.18	105.00	138.01
3.	El-Maady	176649	236078	500.91	666.26	79.47	184.03	580.37	850.29
4.	Helwan	237963	311202	413.93	537.23	18.74	61.88	432.67	599.11
5.	Tebbin	included in Helwan data		included in Helwan data		included in Helwan data		included in Helwan data	
6.	New Cairo								
7.	Badr								
8.	El-Shorouk								
Total		**542001**	**722648**	**1082.83**	**1420.57**	**105.61**	**263.29**	**1188.44**	**1683.86**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-86

Electricity Consumption and Number of Subscribers in the Ex- Helwan Governorate, 2008

<table>
<tr><th>No.</th><th colspan="2">Markaz/City/District</th><th>Number of Subscribers</th><th>Electricity Consumed in Lighting (Million kWh/year)</th><th>Electricity Consumed for Industry (Million kWh/year)</th></tr>
<tr><td rowspan="3">1.</td><td rowspan="3">Helwan City</td><td>Ain Helwan District</td><td rowspan="2">165685</td><td rowspan="2">324.166</td><td rowspan="2">45.218</td></tr>
<tr><td>El-Maasara District</td></tr>
<tr><td>15th of May District</td><td>127211</td><td>213.061</td><td>16.662</td></tr>
<tr><td rowspan="2">2.</td><td rowspan="2">El-Maady City</td><td>El-Maady District</td><td rowspan="2">217069</td><td rowspan="2">66.263</td><td rowspan="2">184.029</td></tr>
<tr><td>Tourah District</td></tr>
<tr><td>3.</td><td colspan="2">Atfieh Markaz & City</td><td>61774</td><td>91.258</td><td>5.200</td></tr>
<tr><td>4.</td><td colspan="2">Es-Saff Markaz & City</td><td>85131</td><td>125.526</td><td>12.180</td></tr>
<tr><td>5.</td><td colspan="2">Tebbin City</td><td colspan="3">include in Helwan data</td></tr>
<tr><td>6.</td><td colspan="2">New Cairo City</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>7.</td><td colspan="2">Badr City</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>8.</td><td colspan="2">El-Shorouk City</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td colspan="3">Total</td><td>656870</td><td>1421</td><td>263.289</td></tr>
</table>

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-87
Power Plants in the Helwan Zone, Year 2007/2008

Location (Site)	Power Plant	Commercial Operation Date	Installed Capacity (MWe)	Total Energy Generated (GWeh)
Tebbin	New Tebbin 2x345	2011-2012	690	expected energy to be generated is 4,000
Kureimat	Steam (1) 2x627 C.C. (2) 1x750 C.C. (3) 1x750	1998-1999 2007-2008 2009	1254 750 750	9,235 3,820 1,543

Source: Annual Report 2007/2008, Egyptian Electricity Holding Company (EEHC).

Table 5-88
Natural Gas Subscribers in the Helwan Zone, 2007

<table>
<tr><th>No.</th><th colspan="2">Markaz/City/District</th><th>Number of Subscribers</th></tr>
<tr><td rowspan="3">1.</td><td rowspan="3">Helwan City</td><td>Ain Helwan District</td><td rowspan="2">43650</td></tr>
<tr><td>El-Maasara District</td></tr>
<tr><td>15th of May District</td><td>14596</td></tr>
<tr><td rowspan="2">2.</td><td rowspan="2">El-Maady City</td><td>El-Maady District</td><td>22417</td></tr>
<tr><td>Tourah District</td><td>-</td></tr>
<tr><td>3.</td><td colspan="2">Atfieh Markaz & City</td><td>-</td></tr>
<tr><td>4.</td><td colspan="2">Es-Saff Markaz & City</td><td>-</td></tr>
</table>

5.	Tebbin City	-
6.	New Cairo City	8871
7.	Badr City	-
8.	El-Shorouk City	-
	Total	**89534**

Source: Information Center, Ex- Helwan Governorate, 1/1/2009.

Table 5-89

Distribution of Regular Buildings by Connection to Public Utilities (Natural Gas & Electricity) in Giza Governorate according to Preliminary Results of Population, Housing & Establishments Census 2006

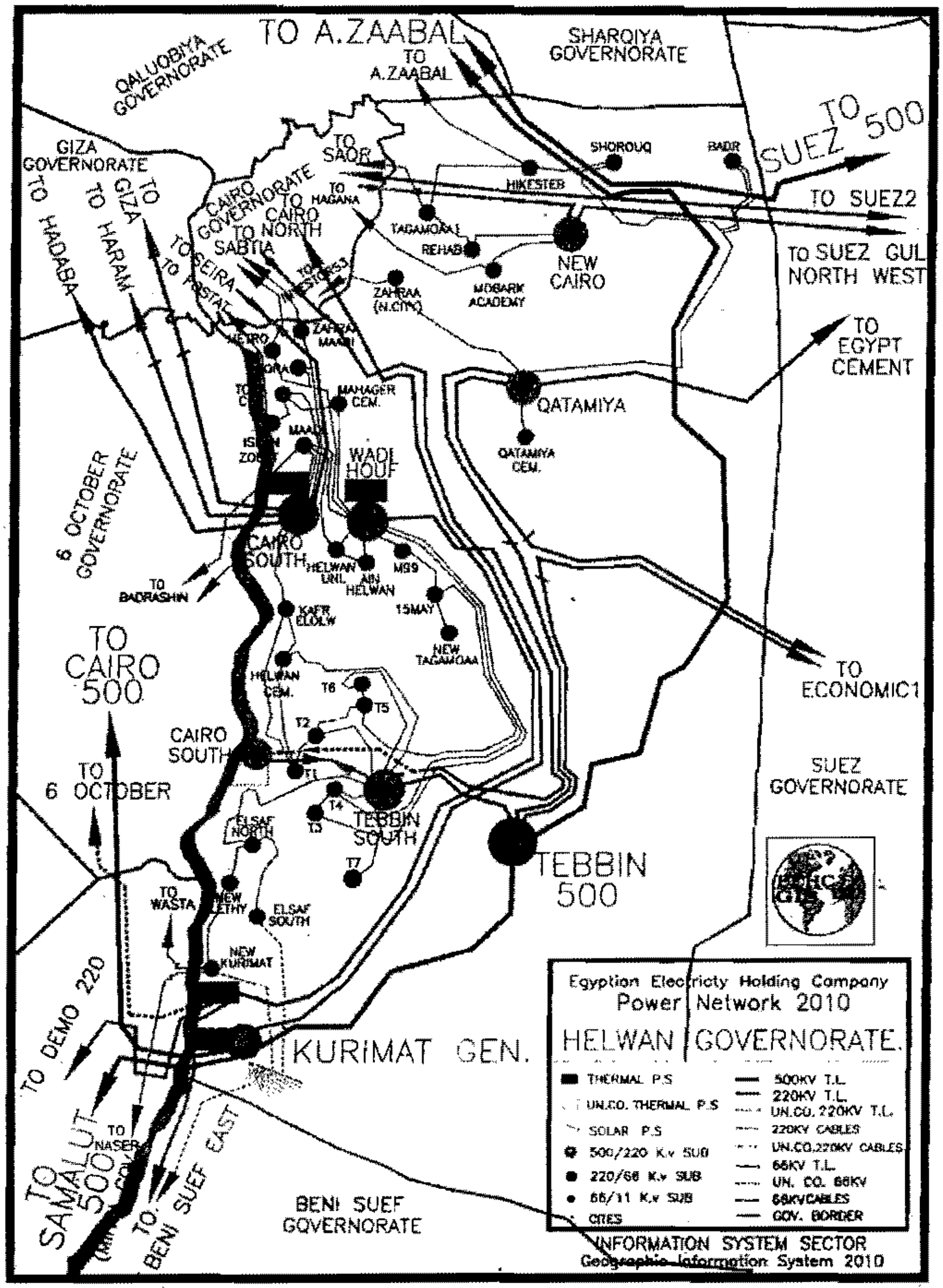
Unit: No.

Connection to Public Utilities	Category	Unit	Value
Natural Gas	Connected	Number	10,098
		%	4.9
	Not Connected	Number	197,569
		%	95.1
Electricity	Public Network	Number	193.072
		%	93.0
	Other	Number	1,229
		%	0.6
	Nil	Number	13,366
		%	6.4
Total No. of Buildings			**207,667**

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Figure 5-95

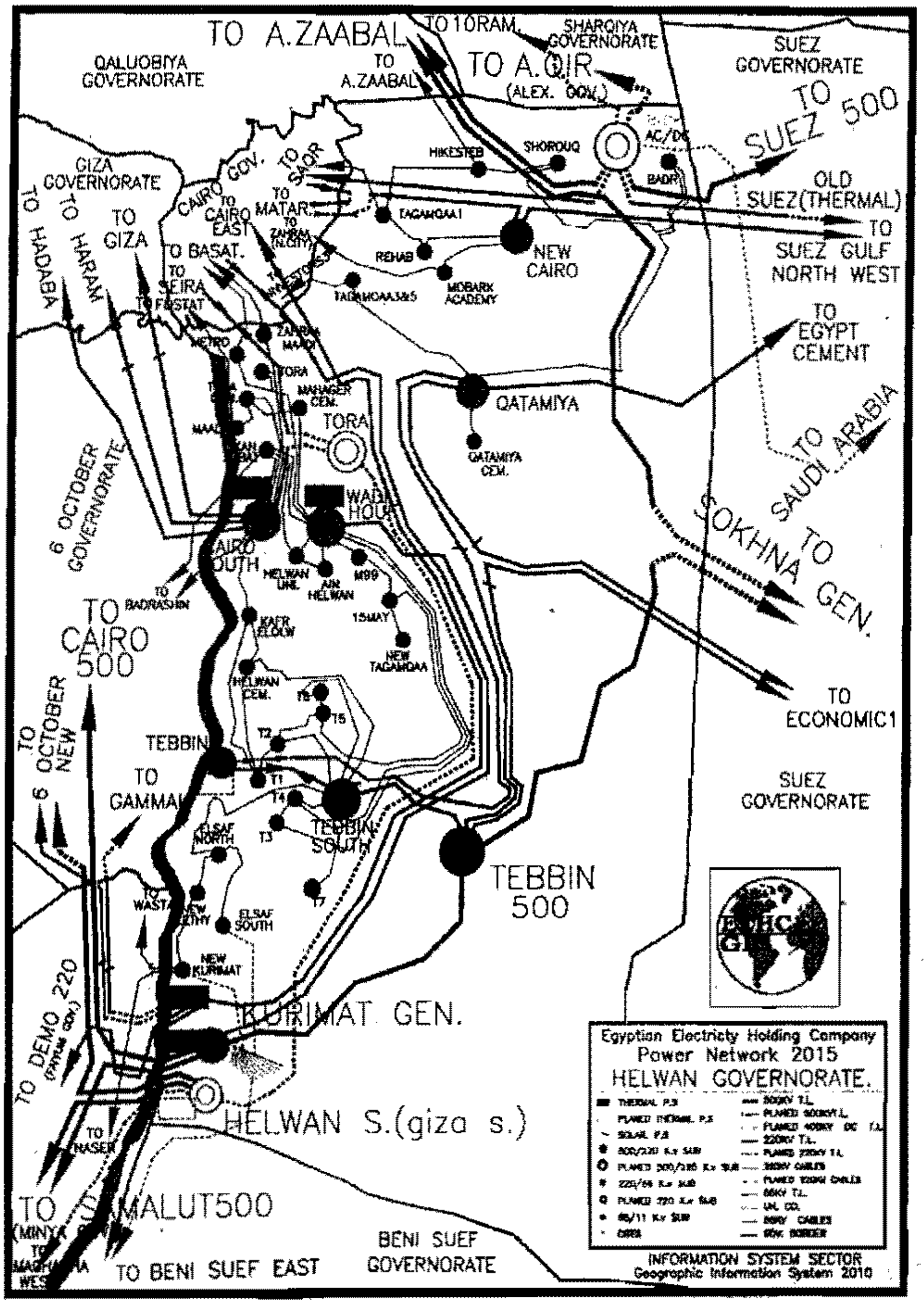
Electrical Network of the Ex- Helwan Governorate Region, 2010



Source: Egyptian Electricity Holding Company (EEHC): Geographic Information Center, 2010.

Figure 5-96

Future Electrical Network of the Ex- Helwan Governorate Region, 2015



Source: Egyptian Electricity Holding Company (EEHC): Geographic Information Center, 2010.

Health and Education

Main medical facilities in the Ex- Helwan Governorate consist of 8 public and central hospitals, 2 hospitals belong to the Ministry of Health, One University Hospital, 4 Police and Prison Hospitals and one specialized hospital. The hospitals collectively support approximately 2,368 beds, they are well equipped for most types of surgery and convalescence and are staffed by more than 889 physicians, 261 dentists and 1,495 nurses covering all medical specializations. Many other private hospitals, clinics, kidney washing facilities and physical therapy units are distributed over the Helwan area. Additional health care services in the Ex- Helwan Governorate include, also, 63 private sector hospitals, 46 emergency centers and points, 44 ambulances, 39 urban health units, 57 health care units, 80 family planning units/centers, 37 child care centers and 15 health outreach offices shown in *Tables 5-90 through 5-95*. *Table 5-96* gives the number of pharmacies in Giza Governorate, including Es-Saff and Atfieh, and *Table 5-97* shows main health care indicators.

The educational status of the Ex- Helwan Governorate population is partially classified yet and the Giza Governorate data, which incorporates southern area of Es-Saff and Atfieh, is given by *Tables 5-98 through 5-112.*

The educational facilities (governmental) available within the Ex- Helwan Governorate include 8,332 classrooms for Nursery (ages under 6), Elementary schools (age 6-12) for both boys and girls, Preparatory (ages 12-15) and Secondary (ages 15-18) schools, in addition to 12 Vocational Education Centers.

Table 5-101 gives more details on the undergraduate education in Ex- Helwan Governorate. *Tables 5-102 & 5-103* give data on technical and vocational education in Helwan Governorate. *Tables 5-106, 5-107 and 5-108* summarize Al-Azhar Education in 2008/2009. Finally, *Table 5-99 and Table 5-100* give some details on high education in Giza Governorate in the year 2007/2008.

Table 5-90

Hospitals belong to the Ministry of Health and Public,
Centrals and Specialized Hospitals in Ex- Helwan Governorate, 2010

Markaz/City	Hospitals belong to the Ministry of Health				Public Hospitals				Central Hospitals				Specialized Hospitals			
	No		Beds.		No		Beds.		No		Beds.		No		Beds.	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Helwan	1		26		2		472		0		0		1		322	
El-Maady	0		0		0		0		0		0		0		0	
Atfieh	0		0		0		0		1		95		0		0	
Es-Saff	0		0		0		0		1		139		0		0	
Tebbin	1		28		0		0		0		0		0		0	
New Cairo	0		0		0		0		0		0		0		0	
Badr	0		0		0		0		0		0		0		0	
El-Shorouk	0		0		0		0		0		0		0		0	
Total	**2**	**0**	**54**	**0**	**2**	**0**	**472**	**0**	**2**	**0**	**234**	**0**	**1**	**0**	**322**	**0**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-91

University Hospitals, Police & Prison Hospitals, Railway Hospitals, Other Hospitals and Private Sector Hospitals in the Ex- Helwan Governorate, 2010

Markaz/City	University Hospitals				Police & Prison Hospitals				Railway Hospitals				Other Hospitals				Private Sector Hospitals			
	No.		Beds		No.		Beds		No.		Beds		No.		Beds		No.		Beds	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Helwan	0	1	0	120	0	0	0	0	0	0	0	0	0	1	0	600	43	42	756	717
El-Maady	0	0	0	0	4	0	240	230	0	0	0	0	0	0	0	0	17	17	485	485
Atfieh	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Es-Saff	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	4	51	51
Tebbin	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
New Cairo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Badr	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
El-Shorouk	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total	**0**	**1**	**0**	**120**	**4**	**0**	**240**	**230**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**600**	**64**	**63**	**1292**	**1253**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-92

Educational Hospitals and Institutions, Medical Institutions and Health Insurance Hospitals in the Ex- Helwan Governorate, 2010

Markaz/City	Educational Hospitals				Educational Institutions				Medical Institutions				Health Insurance Hospitals			
	No.		Beds		No.		Beds		No.		Beds		No.		Beds	
	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009	2008	2009
Helwan	0		0		0		0		0		0		1		232	
El-Maady	0		0		0		0		1		182		0		0	
Atfieh	0		0		0		0		0		0		0		0	
Es-Saff	0		0		0		0		0		0		0		0	
Tebbin	0		0		0		0		0		0		0		0	
New Cairo	0		0		0		0		0		0		0		0	
Badr	0		0		0		0		0		0		0		0	
El-Shorouk	0		0		0		0		0		0		0		0	
Total	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**182**	**0**	**1**	**0**	**232**	**0**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-93

Health Care Units, Urban Health Centers, Family Planning Units and Ambulances in the Ex- Helwan Governorate, 2010

Markaz/City	Health Care Units			Urban Health Centers			Family Planning Units			Ambulances		
	2007	2008	2009	2007	2008	2009	2007	2008	2009	2007	2008	2009
Helwan	0	0	8	12	13	18	8	6	19	8	8	9
El-Maady	0	0	1	1	1	4	5	5	4	6	6	4
Atfieh	11	13	15	0	0	1	18	16	16	7	7	11
Es-Saff	21	23	25	0	0	1	28	25	26	2	2	10
Tebbin	1	1	1	3	4	5	6	6	5	1	1	2
New Cairo	0	0	4	5	6	6	6	6	6	4	4	4
Badr	0	0	1	2	3	1	8	6	1	2	2	2
El-Shorouk	0	0	2	3	3	3	6	6	3	2	2	2
Total	**33**	**37**	**57**	**26**	**30**	**39**	**85**	**76**	**80**	**32**	**32**	**44**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-94

Number of Physicians, Dentists, Pharmacists and Nurses in the Ex- Helwan Governorate, 2010

Markaz/City	No. of Physicians			No. of Dentists			No. of Pharmacists			No. of Nurses		
	2007	2008	2009	2007	2008	2009	2007	2008	2009	2007	2008	2009
Helwan	318	321	372	57	58	99	51	51	73	423	423	535
El-Maady	75	75	44	31	32	32	12	12	14	115	115	48
Atfieh	180	132	157	10	10	20	21	21	13	392	392	350
Es-Saff	241	198	171	19	19	22	31	31	12	545	545	397
Tebbin	62	62	21	13	13	11	10	10	7	99	99	47
New Cairo	71	78	78	46	47	47	12	12	26	68	68	68
Badr	10	10	10	3	3	3	3	3	2	19	19	19
El-Shorouk	34	36	36	27	27	27	7	7	17	31	31	31
Total	**991**	**912**	**889**	**206**	**209**	**261**	**147**	**147**	**164**	**1692**	**1692**	**1495**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-95

Number of Pharmacists in the Ex- Helwan Governorate, 2010

Markaz / City		Urban/ Rural	Number of Active Pharmacists
Helwan City	Ain Helwan District	Urban	61
	El-Maasara District		7
	15th of May District		22
El-Maady City	El-Maady District	Urban	12
	Tourah District		2
Atfieh Markaz & City		Urban	4
		Rural	8
Es-Saff Markaz & City		Urban	-
		Rural	15
Tebbin City		Urban	10
		Rural	-
New Cairo City		Urban	33
Badr City		Urban	5
El-Shorouk City		Urban	6
Total			**185**

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Table 5-96

Number of Pharmacies in Giza Governorate, 1/1/2007

Unit: No.

Category	General Pharmacies	Cooperative Pharmacies	Treatment Pharmacies	Egyptian Comp. Pharmacies
Number	2,770	18	16	0.0

Category	Egyptian Comp. Branches	Storage Pharmacies	Night Service	Total	% age of total Egypt
Number	3	37	9	2,853	10.4%

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Table 5-97

Health Care Indicators for the Giza Governorate, 2007

Indicator	Unit	Value
No. of Inhabitants per bed	Inhabitant/Bed	528.3
No. of Working Physicians	Physician	4,541
No. of Inhabitants per physician	Inhabitant/physician	1,381.3
No. of Working Dentists	Dentist	657
No. of Working Pharmacists	Pharmacist	355
No. of Working Nursing Staff	Nurse	5,536
No. of Inhabitants per Nurse	Inhabitant/Nurse	1,133.1
No. of Inhabitants per pharmacy	Inhabitant/pharmacy	2,237.0
No. of Beneficiaries from Health Insurance System	1000 Beneficiaries	3,097
No. of Patients Treated at the State Expense (in Egypt)	1000 Persons	69.92
Total Medical Treatment Expenditure at the State Expense (in Egypt)	L.E. Million	75.06
No. of Mobile Clinics	Clinic	25
No. of Ambulance	Ambulance	103
No. of inhabitants per Ambulance	1000 Inhabitant/ Ambulance	60.9
Prevalence of Contraceptives	%	68.0
No. of Family Planning Units	Unit	241

Source: Ministry of Heath and Population–Governorate Information & Decision Support Center, 1/1/2007.

Table 5-98

Education & Scientific Research in Giza Governorate, Literacy, 2007/2008

Item	Unit	Males	Females	Total
No. of targeted illiterates	Thousand persons	-	-	48.6
No. of enrolled in literacy classes	Thousand persons	18.5	16.6	35.1
Enrolled (% of targeted illiterates)	%	-	-	72.2
No. of literates	Thousand persons	9.3	8.5	17.8
Literates (% of enrolled)	%	50.2	51.2	50.7
Illiteracy rate (10 years+)	%	-	-	26.0

Source: The General Authority for Adult Education, 2007/2008 and CAPMAS "According to Census Preliminary Results, 2006"

Table 5-99

Education & Scientific Research in Giza Governorate, Higher Education, 2007/2008

Item	Unit	Value
No. of faculties	Faculty	40
No. of institutes	Institute	27
Total no. of students	Thousand students	225.9
Females (% of total students)	%	44.8
Total no. of faculty staff members	Thousand staff members	7.7
No. of students per faculty staff member	Student/ Staff member	29.5
Females (% of total staff members)	%	37.7

Source: Ministry of Higher Education & the State for Scientific Research - Al-Azhar University 2007/2008.

Table 5-100

Education & Scientific Research in Giza Governorate, Research Centers, 2007/2008

Item	Unit	Value
No. of research centers	Centre	82
Ministries research centers	Centre	60
Universities research centers	Centre	22

Source: Ministry of Higher Education & the State for Scientific Research 2007/2008.

Table 5-101

Teachers and Pupils of the General Education in the Ex- Helwan Governorate, 2007/2008

Unit: No.

Educational Stage	Governmental							Private						
	No. of Teachers			No. of Pupils			Rate(*)	No. of Teachers			No. of Pupils			Rate
	Males	Females	Total	Males	Females	Total		Males	Females	Total	Males	Females	Total	
Pre-Primary (Kindergarten)	13	381	394	7,390	6,514	13,904	35.5	22	796	818	6,313	5,414	11,727	14.3
Primary	2,575	4,160	6,735	109,603	101,251	210,854	31.3	532	1,815	2,347	20,547	18,113	38,660	16.5
Preparatory	2,233	1,974	4,207	44,191	42,297	86,488	20.6	614	648	1,262	7,876	6,629	14,505	11.5
Secondary	1,238	837	2,075	10,624	11,413	22,037	10.6	384	308	692	2,197	2,000	4,197	6

(*) Rate = Students per Teacher

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Table 5-102

Pupils in Technical Education in the Ex- Helwan Governorate, 2008/2009

Unit: No.

No.	Specialization	Governmental, or Private	Number
1	Industrial Secondary	Governmental	10,129
		Private	-
		Total	10,129
2	Commercial Secondary	Governmental	2,867
		Private	4,217
		Total	7,084
3	Agricultural Secondary (*)		225
	Total		17,438

(*) There is no private agricultural secondary education.

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Table 5-103

General Education – Number of Schools and Classrooms in the Ex- Helwan Governorate, 2010

Markaz / City		Number of Schools			Number of Classrooms		
		2007-2008	2008-2009	2009-2010	2007-2008	2008-2009	2009-2010
15th of May	Urban	81	86	41	724	768	514
Atfieh Markaz & City	Urban	110	118	11	1092	1193	169
	Rural	145	153	94	1271	1354	1364
Tebbin City	Urban	25	27	30	361	402	654
Es-Saff Markaz & City	Urban	29	29	54	359	339	695
	Rural	135	140	57	1225	1260	893
New Cairo City	Urban	60	77	75	473	552	869
El-Maady City	Urban	144	143	47	1735	1745	931
Helwan City	Urban	267	272	117	3115	3120	2243
Badr City	Urban	Included in New Cairo					
El-Shorouk City	Urban	Included in New Cairo					
Total		**996**	**1045**	**526**	**10355**	**10733**	**8332**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-104

General Education – Number of Pupils (Males & Females) in the Ex- Helwan Governorate, 2010

Markaz / City		Number of Pupils-Males			Number of Pupils–Females		
		2007-2008	2008-2009	2009-2010	2007-2008	2008-2009	2009-2010
15th of May	Urban	12117	12764	8646	11521	12260	8128
Atfieh Markaz & City	Urban	19323	20111	2985	16278	17757	2785
	Rural	29384	28668	26639	24127	25920	22805
Tebbin City	Urban	8713	10179	14293	7705	8993	16797
Es-Saff Markaz & City	Urban	6078	6270	12874	5331	5409	11564
	Rural	24630	25465	17344	22298	22869	15201
New Cairo City	Urban	6177	9182	16573	2859	8238	15631
El-Maady City	Urban	34691	34471	19445	33787	33720	18831
Helwan City	Urban	70366	71949	46924	67220	68367	47259
Badr City	Urban	Included in New Cairo					
El-Shorouk City	Urban	Included in New Cairo					
Total		**211479**	**219059**	**165723**	**191126**	**203533**	**159001**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-105

General Education – Number of Teachers (Males & Females) in the Ex- Helwan Governorate, 2010

Markaz / City		Number of Teachers-Males			Number of Teachers-Females		
		2007-2008	2008-2009	2009-2010	2007-2008	2008-2009	2009-2010
15th of May	Urban	479	446	464	1033	1080	784
Atfieh Markaz & City	Urban	792	990	78	1920	1980	47
	Rural	912	1304	972	289	588	360
Tebbin City	Urban	305	292	771	300	303	540
Es-Saff Markaz & City	Urban	343	331	466	410	388	875
	Rural	600	590	492	815	791	888
New Cairo City	Urban	520	602	891	794	886	1211
El-Maady City	Urban	1832	1809	1244	2560	2572	1207
Helwan City	Urban	2338	2256	1544	3482	3373	2534
Badr City	Urban	Included in New Cairo					
El-Shorouk City	Urban	Included in New Cairo					
Total		**8121**	**8620**	**6922**	**11603**	**11961**	**8446**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-106

Al-Azhar Education – Number of Schools and Classrooms in the Ex- Helwan Governorate, 2010

Markaz / City		Number of Schools			Number of Classrooms		
		2007-2008	2008-2009	2009-2010	2007-2008	2008-2009	2009-2010
15th of May	Urban	16	15	0	109	113	0
	Rural	0	0	0	0	0	0
Atfieh Markaz & City	Urban	2	3	0	14	19	0
	Rural	36	38	0	259	271	0
Tebbin City	Urban	1	1	0	12	12	0
	Rural	0	0	0	0	0	0
Es-Saff Markaz & City	Urban	8	11	0	59	86	0
	Rural	31	30	0	214	213	0
New Cairo City	Urban	8	8	0	55	112	0
	Rural	0	0	0	0	0	0
El-Maady City	Urban	19	17	0	154	164	0
	Rural	0	0	0	0	0	0
Helwan City	Urban	25	25	0	234	253	0
	Rural	0	0	0	0	0	0
El-Shorouk City	Urban	0	0	0	0	0	0
	Rural	0	0	0	0	0	0
Badr City	Urban	0	0	0	0	0	0
	Rural	0	0	0	0	0	0
Total		**146**	**148**	**0**	**1110**	**1243**	**0**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-107

Al-Azhar Education – Number of Pupils (Males & Females) in the Ex- Helwan Governorate, 2010

Markaz / City		Number of Pupils- Males			Number of Pupils- Females		
		2007-2008	2008-2009	2009-2010	2007-2008	2008-2009	2009-2010
15th of May	Urban	1732	1586	0	1878	1964	0
	Rural	0	0	0	0	0	0
Atfieh Markaz & City	Urban	293	331	0	158	251	0
	Rural	4795	4902	0	4324	4623	0
Tebbin City	Urban	225	212	0	174	165	0
	Rural	0	0	0	0	0	0
Es-Saff Markaz & City	Urban	1379	1895	0	1137	1914	0
	Rural	4630	4510	0	3690	3311	0
New Cairo City	Urban	934	1496	0	1030	2234	0
	Rural	0	0	0	0	0	0
El-Maady City	Urban	3138	3407	0	2060	2275	0
	Rural	0	0	0	0	0	0
Helwan City	Urban	3797	3591	0	4276	3666	0
	Rural	0	0	0	0	0	0
El-Shorouk City	Urban	0	0	0	0	0	0
	Rural	0	0	0	0	0	0
Badr City	Urban	0	0	0	0	0	0
	Rural	0	0	0	0	0	0
Total		**20923**	**21930**	**0**	**18727**	**20403**	**0**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-108

Al-Azhar Education – Number of Teachers (Males & Females) in the Ex- Helwan Governorate, 2010

Markaz / City		Number of Teachers-Males			Number of Teachers-Females		
		2007-2008	2008-2009	2009-2010	2007-2008	2008-2009	2009-2010
15th of May	Urban	109	98		245	255	
	Rural	0	0		0	0	
Atfieh Markaz & City	Urban	17	18		0	5	
	Rural	351	326		97	87	
Tebbin City	Urban	6	9		13	23	
	Rural	0	0		0	0	
Es-Saff Markaz & City	Urban	32	75		23	23	
	Rural	169	204		129	146	
New Cairo City	Urban	21	88		150	281	
	Rural	0	0		0	0	
El-Maady City	Urban	274	225		353	248	
	Rural	0	0		0	0	
Helwan City	Urban	271	395		430	420	
	Rural	0	0		0	0	
El-Shorouk City	Urban	0	0		0	0	
	Rural	0	0		0	0	
Badr City	Urban	0	0		0	0	
	Rural	0	0		0	0	
Total		**1250**	**1438**	**0**	**1440**	**1488**	**0**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-109

Number of Private Schools in the Ex- Helwan Governorate, 2010

Markaz / City		No. of Private Schools		
		2007-2008	2008-2009	2009-2010
15th of May	Urban	9	12	6
	Rural	0	0	0
Atfieh Markaz & City	Urban	0	0	0
	Rural	0	0	0
Tebbin City	Urban	3	3	0
	Rural	0	0	0
Es-Saff Markaz & City	Urban	9	8	6
	Rural	0	0	0
New Cairo City	Urban	100	103	111
	Rural	0	0	0
Badr City	Urban	including in New Cairo		
	Rural			
El-Shorouk City	Urban			
	Rural			
El-Maady City	Urban	85	81	76
	Rural	0	0	0
Helwan City	Urban	87	87	76
	Rural	0	0	0
Total		**293**	**294**	**275**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-110

Number of Technical Schools in the Ex- Helwan Governorate, 2010

Markaz / City		No. of Private Schools		
		2007-2008	2008-2009	2009-2010
15th of May	Urban	4	4	3
	Rural	0	0	0
Atfieh Markaz & City	Urban	2	2	4
	Rural	4	5	6
Tebbin City	Urban	1	1	2
	Rural	0	0	0
Es-Saff Markaz & City	Urban	4	4	4
	Rural	0	0	0
New Cairo City	Urban	1	1	1
	Rural	0	0	0
Badr City	Urban	including in New Cairo		
	Rural			
El-Shorouk City	Urban			
	Rural			
El-Maady City	Urban	4	4	3
	Rural	0	0	0
Helwan City	Urban	13	13	12
	Rural	0	0	0
Total		**33**	**34**	**35**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-111

Number of Cooperative Schools in the Ex- Helwan Governorate, 2010

Markaz / City		Number of Cooperative Schools		
		2007-2008	2008-2009	2009-2010
Helwan City	Urban	0	0	0
	Rural	0	0	0
El-Maady City	Urban	4	8	0
	Rural	0	0	0
Markaz Atfieh	Urban	0	0	0
	Rural	0	0	0
Markaz Es-Saff	Urban	0	0	0
	Rural	0	0	0
Tebbin City	Urban	0	0	0
	Rural	0	0	0
New Cairo City	Urban	0	0	0
	Rural	0	0	0
Badr City	Urban	0	0	0
	Rural	0	0	0
El-Shorouk City	Urban	0	0	0
	Rural	0	0	0
Total		**4**	**8**	**0**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-112

Vocational Training Centers in the Ex- Helwan Governorate, 2010

Markaz / City		Urban/ Rural	No. of Centers	No. of Trainees (Males)	No. of Trainees- (Females)	Capacity of Training Centers (Trainee)
Helwan City	Ain Helwan District El-Maasara District 15th of May District	Urban	7	1123	310	1665
El-Maady City	El-Maady District Tourah District	Urban	2	309	-	600
Atfieh Markaz & City		Urban	-	-	-	-
		Rural	-	-	-	-
Es-Saff Markaz & City		Urban	1	228	-	440
		Rural	-	-	-	-
Tebbin City		Urban	2	27	-	2660
New Cairo City		Urban	-	-	-	-
Badr City		Urban	-	-	-	-
El-Shorouk City		Urban	-	-	-	-
Total			**12**	**1687**	**310**	**5365**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Communications and Transportation

Table 5-113 lists the available communication services in Giza Governorate and *Table 5-114* gives the evolution of telephone density in Giza Governorate during the period 2002-2006. Giza Zone includes 80 Telephone Centrals and about 1,529,000 telephone lines. The Governorate is currently in the process of providing additional telephone lines for about 12,175 list-waited customers. *Table 5-113*, also, gives the total number of working post offices, where 223 post offices provide the entire Giza Governorate with posting services. *Tables 5-115 through 5-119* provides with some useful details on communication services in Giza Governorate.

The transportation network available within the Giza Governorate includes 1,718 km main paved roads, and 200 km un-paved ones.

About 11,239 buses run within all over the Giza Governorate. A total of 475,000 licensed vehicles provide transportation services in the Giza Governorate, out of them about 288,517 private cars and 31,818 taxis.

Tables 5-120 through 5-124 give some more details on transport services in the Giza Governorate.

Security and Tribunals

The Giza Governorate Comprises 34 Districts, 12 Kisms (Police Divisions) and 51 shiakhats (Police sub-divisions). There are police points also available and extinguishing centers served by extinguishing cars and extinguishing taps. The Giza Governorate has 3 tribunals located at Giza District. *Table 5-125* gives the administrative and municipal data for Giza Governorate as of 2007.

Table 5-113
Communications Services in Giza Governorate, 2006

Item	Unit	Urban	Rural	Total
No. of Telephone Centrals	Central	35	45	80
No. of Telephone Lines	1000 Lines	1,212.4	317	1,529
Telephone Density	Line/100 persons	33	12.2	24.4
No. of Working Post Offices	Post Office	95	128	223
No. of Inhabitants per Post Office	1000 inhabitant/Post Office	38.7	20.3	28.1
No. of Information Technology Clubs	Club	-	-	152

Source: Ministry of Communications & Information Technology, 1/1/2007.

Table 5-114
Evolution of Telephone Density in Giza Governorate, 2002-2006

Unit: Line/100 persons

Year	2002	2003	2004	2005	2006
Telephone Density of Giza Governorate	22.6	24.9	25.3	25.2	24.4
Telephone Density of Total Egypt	15.3	16.4	17.1	17.7	18.4

Source: Ministry of Communications & Information Technology, 1/1/2007.

Table 5-115
Basic Communication Services in Giza Governorate, 2006

Facilities & Subscribers	Number
Total Communications:	
• Telephone Centrals	68
• Subscribers	959,239
• Available Telephone Lines	1,227,155
• Wait-listed Subscribers	12,175
Public Telephones:	
• Egyptian Company for Communications	282
• Menatell (Co.)	2,997
• Telephone Offices	76
• Telex Offices	161
• Nile for Communications (Co.)	1,587
Post Offices	185

Source: Information Center, Giza Governorate, 9/6/2006.

Table 5-116
Distribution of Communication Services in Es-Saff and Atfieh Zones, 2006

No.	Markaz/Town/ District	Telephone Central				Communication Service	
		Automatic		Half-Automatic		Telex Numbers	Card Numbers
		Number	Capacity	Number	Capacity		
1.	Es-Saff	6	21,536	-	-	-	57
2.	Atfeih	7	17,600	-	-	-	-
Total		13	39,136	-	-	-	57

Source: Information Center, Giza Governorate, 9/6/2006.

Table 5-117

Distribution of Telephone Services in Es-Saff and Atfieh Zones, 2006

No.	Markaz/Town/ District	Total Population	Available Telephone Lines	Number of Subscribers	Waite-listed Subscribers	
					Paid Fees	Waiting for Payment
1.	Es-Saff	257,936	21,536	12,985	1,428	Open
2.	Atfieh	229,060	17,600	9,703	828	Open
Total			**39,136**	**22,688**	**2,256**	**-**

Source: Information Center, Giza Governorate, 9/6/2006.

Table 5-118

Telephone Centrals and Lines in the Ex- Helwan Governorate, 2010

Markaz / City		No. of Telephone Centrals			No. of Telephone Lines		
		2007	2008	2009	2007	2008	2009
Helwan City	Urban	7	7	0	399748	399748	179079
	Rural	0	0	0	0	0	
El-Maady City	Urban	11	11	0	131700	131700	246895
	Rural	0	0	0	0	0	
Markaz Atfieh	Urban	1	1	1	6600	6600	2450
	Rural	6	6	0	15528	15528	6400
Markaz Es-Saff	Urban	1	1	0	11100	11100	4800
	Rural	5	5	0	19543	19543	11660
Tebbin City	Urban	1	1	0	23192	23192	24892
	Rural	0	0	0	0	0	0
New Cairo City	Urban	including in Helwan City		0	including in Helwan City		0
	Rural			0			0
Badr City	Urban	including in Helwan City		0	including in Helwan City		0
	Rural			0			0
El-Shorouk City	Urban	including in Helwan City		0	including in Helwan City		0
	Rural			0			0
Total		**32**	**32**	**1**	**607411**	**607411**	**476176**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-119

Governmental Post Offices in the Ex- Helwan Governorate, 2010

Markaz / City		Governmental Post Offices		
		2007-2008	2008-2009	2009-2010
Helwan City	Urban	35	38	38
El-Maady City	Urban	11	11	5
Markaz Atfieh	Urban	1	1	1
	Rural	12	13	13
Markaz Es-Saff	Urban	1	1	1
	Rural	17	18	18
Tebbin City	Urban	4	4	4
New Cairo City	Urban	4	4	5
Badr City	Urban	1	1	3
El-Shorouk City	Urban	2	2	2
Total		**88**	**93**	**90**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-120

Transport Services and Roads in Giza Governorate, 2006

Item	Unit	Value
Length of Paved Road	km	1,718
Length of Un-paved Roads	Km	200
No. of Inhabitants per km of Paved Roads	Inhabitant/km	3,651.1
% age of Paved to Total Roads	%	89.6
No. of Licensed Vehicles	1000 Vehicles	475

Source: Ministry of Transport - General Authority for Roads & Bridges - Ministry of Interior, 1/1/2007.

Table 5-121

Evolution of Licensed Vehicles in Giza Governorate, 2002-2006

Unit: 1000 Vehicles

Year	2002	2003	2004	2005	2006
No. of Vehicles	419.2	397.7	409.7	433.1	475

Source: Ministry of Transport - General Authority for Roads & Bridges - Ministry of Interior, 1/1/2007.

Table 5-122

Length of Roads in Giza Governorate, 30/6/2007

Unit: km

No.	Attribution	Road Spec.	Length of Roads
1	General Authority for Roads & Bridges	Les than 7.5m	0
		7.5-12m	600
		More than 12m	348
		Total	948
2	Local Administration	Local Paved Roads	914
3	Un-paved Roads	Total	142
	Total Paved (Asphalted) Roads	Total	1,862
		% age of total Gov.	89.6

Source: CAPMAS: Statistical Year Book , Dec. 2008.

Table 5-123

Number of Licensed Vehicles in Service in Giza Governorate, up to December 2007

Unit: No.

No.	Type		Number
1	Private Cars		288,517
2	Caravan		313
3	Taxi		31,818
4	Buses	Public	734
		Private	3,396
		Tourism	1,035
		Travel	5,068
		School	1,006

5	Commercial & Temporary	682
6	Customs Plates	-
7	Public Sector	6,099
8	Buyer's Cars	331

Source: CAPMAS: Statistical Year Book , Dec. 2008.

Table 5-124

Number of Licensed Vehicles in Service in Giza Governorate, up to December 2007

Unit: No.

No.	Type	Number
1	Lorry	68,616
2	Truck	3,567
3	Tractor	622
4	Motorcycle	78,444
5	Diplomat (Political Authority)	-
6	Government	7,828
7	Governorate	3,329
	Total	**162,406**
	% age of all Egypt	**10.2%**

Source: CAPMAS: Statistical Year Book , Dec. 2008.

Table 5-125

Administrative and Municipal Sections in the Ex- Helwan Governorate according to the Administrative Units Directory, 2009

Unit: No.

No.	Administrative & Municipal Sections	Number
1	No. of Administrative Cities	4
2	No. of Districts	34
3	No. of Kismis (Police Division)	12
4	No. of Shiakhats(1) (Police sub-Division)	51
5	No. of Marakez	2
6	No. of Provincial Municipal Units	106
7	No. of Administrative Villages	43
8	Cities of New Communities	2
9	Nominal Units(2)	11

(1) Number of Shiakha includes port police administrations following the Authority of Ports Security, which are four (4) administrations.

(2) Nominal units are areas which their administrative entities are not determined and no administrative resolutions have been issued regarding these units as they are considered villages.

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Social Services and Social Care

Community Services Units registered in the Ministry of Social Solidarity in Ex- Helwan Governorate totaled 50 associations in 2007/2008, while Non Governmental Organizations (NGOs) reached 824 in 2008/2009.

Expensed sum for cases benefitting from social insurance was 12.89 million L.E. in the year 2008/2009 distributed on pensions, monthly aids, previous workers, child pension and disaster sufferings.

Number of physio-therapy centers and kindergartens of the handicapped and other beneficiaries in Giza Governorate reached 3 centers, which served 474 beneficiaries by the end of 2007. Also, athletic establishments totaled 237 in the same year. *Tables 5-126 through 5-144* give useful information about social services, including guidance and family consultation offices and lodges in expatriate houses.

Table 5-126

Community Associations(*) Registered in the Ministry of Social Solidarity distributed by Activity in Giza Governorate, 2006/2007

Unit: No.

National Societies	Childhood & Maternity	Household Care	Social Aid	Anecdotage Care	Special Groups
Number	73	52	573	11	56

National Societies	Cultural, Scientific & Religious	Literature Activity	Organization & Management
Number	1,307	0.00	7

Prison Household Care	Family Planning	Communities Friendship	Societies Development	Social Defense	Environment Protection	Economic Development
2	0.00	0.00	323	5	48	34

Consumers Protection	Others	More than a Field of Work	Total
6	10	0.00	2,507

(*) Including all national societies registered by Ministry of Social Solidarity.

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Table 5-127

Solidarity and Child Pension and Other Assistances in the Ex- Helwan Governorate, 2010

Markaz/City	Solidarity & Child Pension		Other Assistances		Total	
	No. of Beneficiaries	Total Expenditures (EGP)	No. of Beneficiaries	Total Expenditures (EGP)	No. of Beneficiaries	Total Expenditures (EGP)
	2008/2009		2008/2009		2008/2009	
Helwan	3719	4129680	227	266700	3946	4396380
El-Maady .	1010	1148400	97	115152	1107	1263552
Atfieh	6331	1055581.4	579	696936	6910	1752517.4
Es-Saff	3997	4442484	212	253800	4209	4696284
Tebbin	657	697428	60	85560	717	782,988
New Cairo	0	0	0	0	0	0
Badr	0	0	0	0	0	0
El-Shorouk	0	0	0	0	0	0
Total	**15,714**	**11,473,573.4**	**1,175**	**141,814.8**	**16,889**	**12,891,721.4**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-128

Number of Nursery Houses and Number of Children in the Ex- Helwan Governorate, 2010

Markaz / City		No. of Nursery Houses			No. of Children		
		2007	2008	2009	2007	2008	2009
Helwan City	Urban	111	109	33	2834	2874	3700
El-Maady City	Urban	70	68	10	1739	1764	1211
Markaz Atfieh	Urban	8	8	0	440	448	.
	Rural	12	12	4	920	933	367
Markaz Es-Saff	Urban	13	13	5	698	708	560
	Rural	78	78	1	5383	5457	34
Tebbin City	Urban	8	8	appurtenance	660	669	1558
New Cairo City	Urban	including in Helwan		0	including in Helwan		0
Badr City	Urban	including in Helwan		0	including in Helwan		0
El-Shorouk City	Urban	including in Helwan		0	including in Helwan		0
Total		**300**	**296**	**53**	**12674**	**12853**	**7430**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-129(A)

Number of NGOs and Social Services Units in the Ex- Helwan Governorate, 2010

Markaz / City		No. of NGOs			No. of Social Services Units		
		2006/2007	2007/2008	2008/2009	2006/2007	2007/2008	2008/2009
Helwan City	Urban	456	407	407	22	23	17
El-Maady City	Urban	140	122	144	7	7	3
Markaz Atfieh	Urban	4	4	64	1	1	8
	Rural	58	50	—	7	7	—
Markaz Es-Saff	Urban	20	20	84	1	1	9
	Rural	61	55	—	8	8	—
Tebbin City	Urban	55	43	58	3	3	3
New Cairo City	Urban	including in Helwan		32	including in Helwan		4
Badr City	Urban	including in Helwan		7	including in Helwan		2
El-Shorouk City	Urban	including in Helwan		28	including in Helwan		3
Total		**794**	**701**	**824**	**49**	**50**	**49**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-129 (B)

Agricultural and Other Specialized Associations in the Ex- Helwan Governorate, 2010

Markaz/City	Cooperative Agricultural Associations			Other Specialized Associations		
	2007	2008	2009	2007	2008	2009
Helwan	0	0	1	0	0	0
El-Maady	0	0	0	0	0	0
Atfieh	20	16	21	10	10	5
Es-Saff	17	20	18	2	2	12
Tebbin	0	0	1	0	0	0
New Cairo	0	0	0	0	0	0
Badr	0	0	0	0	0	0
El-Shorouk	0	0	0	0	0	0
Total	**37**	**36**	**41**	**12**	**12**	**17**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-129 (C)

Active NGOs in the Field of Environment and Development in the Entire Helwan Area, 2010

Sr.	Department	Unit	Association	Month		Phone #	Address	Fields of Work	No of Members	Association Activities	Association Type	
				No.	Date						Development	Care
1	Helwan Social Department	Helwan, 1st	Al-Safaa Charity Association	4540	26/7/1998	5567199	17B- Abdel Rahman St., Helwan	- Cultural, Scientific, and Religious Services, Social Aid.	5	- Cash and In-kind support - Hajj, Minor Hajj, and Religious seminars - Organizing fairs		✓
2	Helwan Social Department	Helwan, 1st	Environment Development	4401	21/6/1997	5575520	3, Haydar St., Helwan	- Environment Development - Cultural, Scientific, and Religious Services	15	- Tree-Planting - Cultivating Gardens - Establishing factory for garbage recycling - Raising-awareness Seminars		✓
3	Helwan Social Department	Helwan, 1st	Local Community Development (North of Helwan)	2779	28/7/1980	-	Building of Political Club	- Family, Child, and Mother Care - Social, Cultural, Scientific, and Religious Services, Environment Protection	9	- Nursery - Hajj and Minor Hajj - Cultural Trips - Social Aids	✓	
4	Helwan Social Department	Helwan, 1st	Orphans' Support and Environment Protection for Cleaners	2661	15/10/1979	-	Abu Dharr Al-Ghiffari	- Social Aids - Scientific and Religious Services	9	- Cash and In-Kind support - Orphan Support - Hajj and Minor Hajj		✓
5	Helwan Social Department	Helwan, 1st	New Baby Garden for Local Community Development	4692	28/5/2000	5547201	31, Khesru St.	- Family, Child, and Mother Care - Cultural, Scientific, and Religious Services	5	- Nursery - Orphanage	✓	
6	Helwan Social Department	Helwan, 1st	Social Care	1981	14/4/2000	7645549	34 Al-Maraghy St.	- Disabled and Special Needs Care - Family, Child, and Mother Care - Old Age Care - Family Planning and Local Community Development	9	- Hajj and Minor Hajj - Nursery - Training Center and Children's Library - Infant Nursery		✓

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-129 (C) *(Contd.)*

Active NGOs in the Field of Environment and Development in the Entire Helwan Area, 2010

Sr.	Department	Unit	Association	Month		Phone #	Address	Fields of Work	No of Members	Association Activities	Association Type	
				No.	Date						Development	Care
7	Helwan Social Department	Helwan, 1st	Helwan Rotary Club	4381	-	5547180	1A Al-Qebly St., Helwan	- Family, Child, and Mother Care - Old Age and Special Needs' Care - Community Development, Economic and Religious Services	11	- Recreation Trips - Financial Support - Special Needs' Care	✓	
8	Helwan Social Department	Helwan, 1st	Helwan Local Community Development	3357	1/6/1985	-	Mansour St., Gharb Al-Sekka Al-Hadid (West of Railways) Market, Behind the Metro	- Social Aids - Cultural, Scientific, and Religious Services	5	- Financial and In-kind Support - Hajj and Minor Hajj - Graveyard Building		✓
9	Helwan Social Department	Helwan, 1st	Social Care for Helwan District Office Staff	2380	28/7/1992	5561896	19 Yussef St., Al-Musenin (Seniors) Club, Helwan	- Cultural, Scientific, and Religious Services - Mother and Child Care - Social Aids - Local Community Development	9	- Cultural Seminars - Graveyard Building - Child Care - Establishing Nursery	✓	
10	Helwan Social Department	Helwan, 1st	15th of May Institution for Culture, Science, and Educational Services	4666	4/2000	-	28 Mostafa Fahmy St., Helwan	- Religious, Scientific, and Cultural Services - Educational Activities	13	- Establishing Library - Scientific and Cultural Seminars - Hajj and Minor Hajj - Establishing Scientific Institution		✓
11	Helwan Social Department	Helwan, 1st	Bremble and Kuraymat Sons	2203	-	-	8 Youssef St.	-	-	- On Hold		
12	Helwan Social Department	Helwan, 1st	Helwan and Tibbin for Environment Protection	5175	-	-	42 Ragheb St., Emaret Al-Qahera (Cairo Building), Helwan	- Fighting Pollution - Tree-Planting in Public Places and Squares - Problem-Solving for the people - Waste Processing - Holding Conferences	7	- Tree-Planting - Combating Sources of Pollution - Seminars for Waste Processing		✓

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-129 (C) *(Contd.)*

Active NGOs in the Field of Environment and Development in the Entire Helwan Area, 2010

Sr.	Department	Unit	Association	Month No.	Month Date	Phone #	Address	Fields of Work	No of Members	Association Activities	Association Type: Development	Association Type: Care
13	Helwan Social Department	Helwan, 1st	Ar-ru'a Association for Training, Environment, and Human Resources	5736	28/7/2004	-	63 Al-Maraghy St., Helwan (Qawmyya Club for Cement)	- Cultural, Scientific, and Religious Services - Seminars and Trips	11	- Cultural Seminars - Recreation Trips - Hajj and Minor Hajj - Computer Learning Courses		✓
14	Helwan Social Department	Helwan, 1st	Central Association for Public Services and Environment Development	5695	1996	-	14 Lazoghli St., Helwan	- Environment Protection - Social Aids	15	- Financial and In-Kind Support - Social Gatherings - Hajj and Minor Hajj		✓
15	Helwan Social Department	Helwan, 2nd	Environment Development and Conservation	4453	1997	-	7 El-Bar El-Bahry St., Helwan Al-Balad	- Environment Protection and Conservation - Aids and Services	11	- Environment Protection - Aids and Services - Religious Seminars		✓
16	Helwan Social Department	Helwan, 2nd	Association of Social Care and Environmental Services	4437	25/8/1997	-	15 Extension of Al-Mekkawy St.	- Social Aids - Cultural Services - Health Activities and Social Services - Mother and Child Care	5	- Hajj and Minor Hajj - Enhancement Courses - Financial Support		✓
17	Helwan Social Department	Helwan, 2nd	Care and Social Development for sons of Al-Sharqeyya Governorate at Arab Rashed	4674	9/5/2000	5575004	1 Street no. 9, Al-Sekka Al-Hadid St. (Railways), Arab Rashed	- Social Aids - Scientific, Cultural, and Religious Services - Family and Child Care - Environment Protection	15	- Hajj and Minor Hajj - Enhancement Courses - Cultural Seminars - Illiteracy classes	✓	
18	Helwan Social Department	Eastern Helwan	Development of Environment and New Communities	2512	-	-	Eastern Helwan Housing, Behind Al-Gam'eyyat (Associations)	- Social, Cultural, Scientific, and Religious Field	-	- On Hold. Currently being dissolved due to non-compliance with Law of year 84		✓
19	Helwan Social Department	Eastern Helwan	Development of Environment and New Communities	2512	-	-	Eastern Helwan Housing	-	-	-		
20	Helwan Social Department	Eastern Helwan	Al-Masrya for Forests and Environment	5221	23/6/2003	-	Street 15, Block 23, Compound 3, American Project	- Holding Conferences and Seminars for Environment Development	7	- Call for Streets Maintenence - Seminars for combating Pollution		✓

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-129 (C) *(Contd.)*

Active NGOs in the Field of Environment and Development in the Entire Helwan Area, 2010

Sr.	Department	Unit	Association	Month		Phone #	Address	Fields of Work	No of Members	Association Activities	Association Type	
				No.	Date						Development	Care
21	Helwan Social Department	Eastern Helwan	Southern Cairo for Community Service and Environment Improvement	4617	11/3/1999	-	Apt 4, Entrance 2, Compound 9, American Project	- Environment Protection - Cultural, Scientific, and Religious Services - Health Activities	11	- Publishing a Newspaper - Supporting Small Projects - Holding Parties		✓
22	Helwan Social Department	Eastern Helwan	Islamic Flowers for Environment and Community Development and Care	5495	2004	-	Compound 9, Block 6, Entrance 30, Apt 2, American Project	- Financial and In-Kind Aids - Graveyard Building - Ceremony House	15	- Aids - Graveyard Building - Burials - Medical Center		✓
23	Helwan Social Department	Ezbet Al-Walda	Local Community Development for people of Rokn Helwan	4444	3/9/1997	-	Street 4, Al-Nasr, Rokn Helwan City	- Cultural, Scientific, and Religious Environment - Mother, Child, and Family Care - Aids	9	- Hajj and Minor Hajj - Nursery - Trips - Aids		✓
24	Helwan Social Department	Ezbet Al-Walda	Ezzbet Al-Walda Association for Environment and Development	5882	2004	-	Street 16, Abu Al-So'ud, Ezzbet Al-Walda	- Environment Protection - Tree-Planting - (Plant) Nursery - Paving Streets	15	- Tree-Planting - Establishing Nurseries (for Plants) - Streets Paving - Establishing Factories for Garbage Recycling	✓	
25	Helwan Social Department	Hadayek Helwan	Social Association for Environment Affairs and Youths Employment	5741	2004	-	63, Montasser Buildings, Nile Corniche	- Environment Protection - Raising Awareness Seminars and Magazines - Tree Planting	7	- Environmental Awareness - Seminars - Researches		✓
26	Helwan Social Department	Hadayek Helwan	Social Society for Environment Service	32961	1985	-	Al-Meedan St., Hadayek Helwan	- Cultural Services - Aids	-	- On Hold for Non-Compliance		
27	Helwan Social Department	Arab Ghonaim	Beni Suef for Environment Services	1663	-	3706160	4, Meligi St., Arab Ghonaim	- Cultural, Scientific, and Religious Services - Health Services and Educational Activities - Mother and Child Care - Environment Protection	15	- Regular Nursery - Hajj and Minor Hajj - Clinic - Memorization of Holy Qur'an		✓

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-129 (C) *(Contd.)*

Active NGOs in the Field of Environment and Development in the Entire Helwan Area, 2010

Sr.	Department	Unit	Association	Month		Phone #	Address	Fields of Work	No of Members	Association Activities	Association Type	
				No.	Date						Development	Care
28	Helwan Social Department	Al-Ezbah Al-Qebleya	Social Services for Staff of The National Project for Cleaning	3949	1993	-	1, Al-Mou'ayad St.	- Economic Aids - Cultural, Scientific, and Religious Services - Mother and Child Care - Support for In-Family Breadwinning Mothers	7	- Financial and In-Kind Support - Establishing a Workshop - Ceremony House - Hajj and Minor Hajj		✓
29	Helwan Social Department	Al-Ma'asara Al-Balad	Al-Ro'ya Society for Social Development	6209	30/8/2005	-	17, Street 6, Ezbet Khalil, Al-Ma'asara Al-Balad	- Social Aids	7	- Graveyard Building - Burials - Orphans' Support - Supporting Poor families		✓
30	Helwan Social Department	Ein Helwan	Helwan Sons Charity Association for Environment Service	6318	7/12/2005	0123463990	Masr Al-'olia (Upper Egypt) Buildings, Bldg 6, Entrance A, Apt 2, Helwan	- Social Aids	9	- Graveyard Building - Burials - Orphans' Support - Supporting Poor families		✓
31	Helwan Social Department	Al-Ma'asara Al-Balad	Aheba' Al-Insan (Philanthropists) and Environment Friends Society	6429	14/3/2006	-	12 Ahmed Zayed St., Arab Sallam, Al-Ma'asara	- Social Aids	9	- Graveyard Building - Supporting Poor Families - Orphans' Support		✓

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-129 (D)

Es-Saff City / Province NGOs, 2010

Sr.	Association	Registration No.	Registration Date	Address
1	El Shobak El Sharqy Development Association	80	25/6/2006	El Shobak El Sharqy, next to the Local Unit
2	Ashara'iya Association of Meniya	402	20/1/2003	Minya, Road 54
3	Ashara'iya Association of El Shobak El Sharqy	465	1/7/2003	El Shobak El Sharqy
4	Al Ekram Development of El Shobak El Sharqy	2268	23/2/2005	El Shobak El Sharqy
5	El Ekhsas Development Association	255	18/3/2003	El Ekhsas Local Unit
6	Ashara'iya Association of El Shorafa	1768	12/5/2005	El Shorafa Village
7	El Shorafa Development Association	383	29/3/2003	El Shorafa Village
8	Ashara'iya of Ghamazat Al-Kobra	1530	9/4/2003	Ghamazat El Kobra
9	Ashara'iya of Kafr Tarkhan	2270	5/2/2005	Kafr Tarkhan
10	El-Ekhsas of Farmers Development	2309	5/4/2005	El-Ekhsas
11	Al-Ateyyat Development	2176	5/9/2004	Al-Ateyyat Village
12	Ghamazat Al-Soghra Development	38	27/4/2003	Ghamazat Al-Soghra Local Unit
13	Al-Tarabyn Development	655	19/5/2003	Arab Al-Tarabyn – Hager Nazlat Alyan
14	Ashara'iya of Ghamazat Al-Soghra	1003	23/6/2003	Ghamazat – Road 54
15	Ashara'iya of Al-Hayy	1185	28/3/2003	Al-Hayy Village
16	Ezzbet Al-Raqqawy Development	1327	27/4/2003	Ezzbet Al-Raqqawy – Al-Arab Hamlets
17	Nazlet Alyan Development	1347	4/8/2003	Nazlet Alyan
18	Ashara'iya of Al-Arab Hamlets	1412	1/4/2003	Al-Arab Hamlets
19	Al-Hayy Development	1697	18/5/2003	Al-Hayy Village
20	Arab Abu Aridha Development	1749	12/4/2003	Arab Abu Aridha
21	Abu Ar-Rish Development	8796	18/6/2003	Abu Ar-Rish – Ghamazat Al-Soghra

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-129 (D) *(Contd.)*

Es-Saff City / Province NGOs, 2010

Sr.	Association	Registration No.	Registration Date	Address
22	Ashara'iya of Arab Abu Aridha	2284	27/2/2005	Arab Abu Aridha
23	Al-Aqwaz Development	249	10/3/2003	Al-Aqwaz Local Unit
24	Ashara'iya of Al-Aqwaz	806	24/5/2003	Al-Aqwaz Village
25	Ashara'iya of Al-Gazeera Ashaqraa	1862	9/9/2003	Al-Gazeera Ashaqraa
26	Ashara'iya of Al-Fahmyeen	1450	19/5/2003	Al-Fahmyeen, Above Al-Fardos Mosque, Es-Saff
27	Ashara'iya of Hussein Awad	1892	25/10/2003	Next to Al-Fardos Mosque, As-Saff
28	Arab Al-Hessar Development	580	10/8/2003	Arab Al-Hessar
29	Ashara'iya of Arab Al-Hessar	1608	26/5/2003	Arab Al-Hessar, Above Belal Bin Rabah Mosque
30	Al-Mostaqbal Al-Mounir (Enlightened Future)	1770	18/5/2003	Arab Al-Hessar
31	Assakaniya (Housing) Social Unit	1920	12/3/2003	Al-Alfy St., Next to Health Unit
32	Abu Bakr Development, As-Saff	934	7/5/2003	Al-Geish St., Abu Al-'ela
33	Conservancy of Holy Quran, As-Saff	63	7/6/2003	As-Saff, Next to the Central)Phone Company)
34	Orphan Child Custody, As-Saff	1161	7/6/2003	As-Saff, Next to the Central (Phone Company)
35	Friends of Kidney Failure Patients	1109	18/3/2003	Al-Mahkama (the Court)St., As-Saff
36	The Islamic Charity Association	419	27/4/2004	Al-Orouba St., East of Al-Mat-han, As-Saff
37	The Services Association for Vocational Training, Es-Saff	1022	30/4/2003	Vocational Training Compound
38	Al-Ayyat Charity Association	1033	21/1/2003	Next to Industrial School for Girls
39	Al-Fayyoum Charity Association	158	7/5/2003	Al-Geish St., As-Saff
40	As-Sa'eed (Upper Egypt) Charity Association	1074	19/5/2003	An-Nasr St., Next to Helal Mosque
41	Atfeeh and Others Association for Services	1313	23/9/2003	Al-Mat-han St., As-Saff
42	Al-Wasta Sons Association, As-Saff	1706	15/2/2003	Al-Geish St., Next to Zare' Al-Mengad

43	Ashar'iya Association, North of As-Saff	1558	17/5/2003	Northern As-Saff, Next to Abu Bakr Mosque
44	As-Saff and Atfeeh Attorneys for Social Solidarity	2208	9/1/2004	3, Al-Mahkama (The Court)St., Ali Allam Mansion
45	Marriage Facilitation, As-Saff	2018	15/5/2004	57, Ahmed Orabi St., As-Saff
46	Ashara'iya Association, As-Saff Al-Balad	720	7/6/2003	As-Saff Al-Balad, Nour Al-Qur'an Mosque
47	As-Saff Al-Balad Development Association	27	19/5/2003	As-Saff Al-Balad

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-129 (D) ***(Contd.)***

Es-Saff City / Province NGOs, 2010

Sr.	Association	Registration No.	Registration Date	Address
48	Ashara'iya Association, Askar	1455	12/5/2003	Askar Village, Next to Ar-Rahman Mosque
49	Conservancy of Holy Qur'an Association, Askar	410	15/6/2003	Askar Village, Next to An-Nasr Mosque
50	Al-Wediy Development Association	275	15/3/2003	Al-Wediy
51	Ashara'iya Association, Al-Wediy	1523	25/5/2003	Al-Wediy Village, Ar-Rahman Mosque
52	Nahr Al-Wafaa (River of Loyalty) for Farmers Services, Al-Wediy	2211	23/2/2005	Al-Wediy Village
53	Al-Hoda w An-Nour Association, Ad-Dismy	657	24/2/2003	Ad-Dismy, Next to Police Station
54	Ad-Dismy Development	183	11/3/2003	Ad-Dismy Village, Next to Health Station
55	Ashara'iya Association, Ad-Dismy	1461	23/4/2003	Next to Dismy Youths Center
56	Kholoud Nahr Al-'ataa, Al-Aqwaz	2337	24/4/2005	Al-Aqwaz Village
57	Environment Friends and Nazlet Alyan Development	2390	13/7/2005	Nazlet Alyan
58	Development of Al-Arab Hamlets	2421	15/8/2005	Al-Arab Hamlets
59	Ambassador of Good for Society Development and Environment Protection, As-Saff	2451	27/9/2005	Behind National Bank, Above Omar Bin Al-Khattab Mosque
60	River of Holy Rights for Women, Children and Environment	2456	3/10/2005	Tolombat Al-Leithy St., As-Saff
61	Local Community Development, Al-Fahmyeen	2469	15/10/2005	Al-Fahmyeen, Behind Al-Hoda Mosque
62	Local Community Development, Al-Mansha	2457	3/10/2005	Al-Mansha Village
63	Egyptian Cultural Association for Local Community Development and International Cooperation	2470	15/10/2005	As-Saff, Thi An-Nouain St., Behind Village Bank
64	Peace Lovers for Local Community Development and International Cooperation, Al-Mansha	2462	8/10/2005	Al-Mansha Village
65	Al-Arab Communities Development, Arab Abu	2477	23/10/2005	Arab Abu Tama'ah, Al-Arab Hamlets

	Tama'ah			
66	Ashara'iya Association, El-Akhsas	2334	16/4/2005	El-Akhsas
67	Ashara'iya Association, Arab Al-Hessar, Al-Bahariya	2507	3/12/2005	Arab Al-Hessar Al-Bahariya
68	Arab Al-Hessar Al-Bahariya Development	2513	10/12/2005	Arab Al-Hessar Al-Bahariya
69	Ashara'iya Association, Arab Al-Ayayda	2528	26/12/2005	Arab Al-Ayayda

Source: Ex- Helwan Governorate, Information and Decision Support Center, November 2010.

Table 5-130

Number of Covered Halls, Stadiums, Sport Clubs and Playing Yards in the Ex- Helwan Governorate, 2010

Markaz / City		No. of Covered Halls			No. of Sports Clubs			No. of Stadiums			Total		
		2007	2008	2009	2007	2008	2009	2007	2008	2009	2007	2008	2009
Helwan City	Urban	0	0	0	35	35	35	0	0	0	61	61	46
	Rural	0	0	0	0	0	0	0	0	0	0	0	0
El-Maady City	Urban	2	4	6	6	6	4	0	0	0	17	17	24
	Rural	0	0	0	0	0	0	0	0	0	0	0	0
Markaz Atfieh	Urban	0	0	0	1	1	1	0	0	0	3	3	0
	Rural	0	0	0	0	0	0	0	0	0	5	5	0
Markaz Es-Saff	Urban	0	0	0	1	1	0	0	0	0	6	6	0
	Rural	0	0	0	0	0	0	0	0	0	12	12	0
Tebbin City	Urban	0	0	0	1	1	3	0	0	0	5	5	10
	Rural	0	0	0	0	0	0	0	0	0	0	0	0
New Cairo City	Urban	0	0	0	0	0	2	0	0	0	0	0	16
	Rural	0	0	0	0	0	0	0	0	0	0	0	0
Badr City	Urban	0	0	0	0	0	0	0	0	0	0	0	0
	Rural	0	0	0	0	0	0	0	0	0	0	0	0
El-Shorouk City	Urban	0	0	0	0	0	1	0	0	0	0	0	0
	Rural	0	0	0	0	0	0	0	0	0	0	0	2
Total		**2**	**4**	**6**	**44**	**44**	**46**	**0**	**0**	**0**	**109**	**109**	**98**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-131

Number of Youth Centers and Number of Libraries at the Youth Centers in the Ex- Helwan Governorate, 2010

Markaz / City		No. of Youth Centers			No. of Libraries		
		2007	2008	2009	2007	2008	2009
Helwan City	Urban	5	6	6	5	5	6
	Rural	0	0	0	0	0	0
El-Maady City	Urban	4	4	4	4	4	2
	Rural	0	0		0	0	0
Markaz Atfieh	Urban	1	1	1	1	1	1
	Rural	13	13	12	11	11	1
Markaz Es-Saff	Urban	1	1	1	1	1	1
	Rural	28	28	29	24	24	24
Tebbin City	Urban	1	1	1	1	1	1
	Rural	0	0	0	0	0	0
New Cairo City	Urban	1	1	2	1	1	2
	Rural	0	0	0	0	0	0
Badr City	Urban	1	1	1	1	1	1
	Rural	0	0	0	0	0	0
El-Shorouk City	Urban	1	1	0	1	1	1
	Rural	0	0	0	0	0	0
Total		**56**	**57**	**57**	**50**	**50**	**40**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-132

Number of General, Specialized and Academic Libraries in the Ex- Helwan Governorate, 2010

Markaz / City		No. of General			No. of Specialized Libraries			No. of Academic Libraries		
		2007	2008	2009	2007	2008	2009	2007	2008	2009
Helwan City	Urban	1	1	3	2	2	3	6	6	0
	Rural	0	0	0	0	0	0	0	0	0
El-Maady City	Urban	0	0	1	0	0	1	5	5	0
	Rural	0	0	0	0	0	0	0	0	0
Markaz Atfieh	Urban	0	0	0	0	0	0	0	0	0
	Rural	0	0	2	0	0	2	0	0	0
Markaz Es-Saff	Urban	0	0	0	0	0	0	0	0	0
	Rural	0	0	2	0	0	2	0	0	0
Tebbin City	Urban	0	0	0	0	0	0	1	1	0
	Rural	0	0	0	0	0	0	0	0	0
New Cairo City	Urban	0	0	0	0	0	0	0	0	0
	Rural	0	0	0	0	0	0	0	0	0
Badr City	Urban	0	0	0	0	0	0	0	0	0
	Rural	0	0	0	0	0	0	0	0	0
El-Shorouk City	Urban	0	0	0	0	0	0	0	0	0
	Rural	0	0	0	0	0	0	0	0	0
Total		**1**	**1**	**8**	**2**	**2**	**8**	**12**	**12**	**0**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-133

Number of Cultural Palaces and Houses in the Ex- Helwan Governorate, 2010

Markaz / City		**Culture Places**			**Culture Houses**			**Total**		
		2007	**2008**	**2009**	**2007**	**2008**	**2009**	**2007**	**2008**	**2009**
Helwan City	Urban	2	3	2	0	0	0	2	2	3
	Rural	0	0	0	0	0	0	0	0	0
El-Maady City	Urban	0	0	0	0	0	0	0	0	0
	Rural	0	0	0	0	0	0	0	0	0
Markaz Atfieh	Urban	0	0	0	0	0	0	0	0	0
	Rural	0	0	0	2	2	2	1	1	2
Markaz Es-Saff	Urban	0	0	0	0	0	0	1	1	0
	Rural	0	0	0	2	2	2	0	0	2
Tebbin City	Urban	0	0	0	0	0	0	0	0	0
	Rural	0	0	0	0	0	0	0	0	0
New Cairo City	Urban	0	0	0	0	0	0	0	0	0
	Rural	0	0	0	0	0	0	0	0	0
Badr City	Urban	0	0	0	0	0	0	0	0	0
	Rural	0	0	0	0	0	0	0	0	0
El-Shorouk City	Urban	0	0	0	0	0	0	0	0	0
	Rural	0	0	0	0	0	0	0	0	0
Total		**2**	**3**	**2**	**4**	**4**	**4**	**4**	**4**	**7**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-134

Number of Information Technology Clubs in the Ex- Helwan Governorate, 2010

Markaz / City		**No. IT Clubs**		
		2007	**2008**	**2009**
Tebbin City	Urban	2	2	1
El-Maady City	Urban	15	16	3
Helwan City	Urban	39	40	7
Badr City	Urban	0	0	1
New Cairo City	Urban	6	6	2
El-Shorouk City	Urban	0	0	0
Markaz Atfieh	Urban	0	1	1
	Rural	1	1	1
Markaz Es-Saff	Urban	2	2	1
	Rural	0	0	0
Total		**65**	**68**	**17**

Source: Ex- Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-135

Non-profit Subsidized Care Associations in Giza Governorate, 2002-2007

Unit: No.

No.	**Non-Profit Societies**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
1	Motherhood & Childhood Non-profit Subsidized Care Associations	8	7	8	6	5	5
2	Family Care & Planning Non-profit Subsidized Associations	7	8	7	6	6	6
3	Social Aids Non-profit Subsidized Associations	8	7	11	8	10	10
4	Handicapped Care Non-profit Subsidized Associations	2	1	1	1	1	1
5	Non-profit subsidized Cultural, Scientific & Religious Services Associations	5	5	5	5	4	4
6	Non-profit Subsidized Associations Practicing more than One Activity	9	12	10	10	15	15

Source: Helwan Governorate: Information and Decision Support Center, November 2010.

Table 5-136

Cases Benefiting from Social Insurance and their Expensed Sum in the Giza Governorate, 2006/2007

Expensed: 000 L.E.

Type of Insurance	Pensions	Monthly Aids	One-time Aids	Previous Workers	Child Pension	Disasters
No. of Cases	50,820	21,794	10,166	409	4,540	2,713
Expensed Value	45,336	1,955	2,313	172	1,821	3,259

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Table 5-137

Kindergartens Enrolled Children by Affiliated Direction in Giza Governorate, 2006

Kindergarten Affiliation	Number
Kindergarten affiliated to the Ministry of Social Solidarity	1,513
Local Units	539
Public Sector, public business & public organizations	2
Total	2,054
No. of Enrolled Children	132,059

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Table 5-138

Number of Physio-therapy Centers and Kindergartens of the Handicapped and other Beneficiaries in the Giza Governorate, 2006/2007

Unit: No.

Type of Facility	Physio-therapy Centers	Kindergartens
Number of Facilities	1	2
Number of Beneficiaries	461	13

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Table 5-139

Number of Athletic Establishments in the Giza Governorate, 2007

Unit: No.

Clubs Category	Number	Total	% age of Total Egypt
Clubs following Governmental Sector	22	38	4.2%
Clubs following Public & Business Sectors	7		
Clubs following Private Sector	9		
Youth Centers in Cities	29	198	4.8%
Youth Centers in Villages	169		
Total Centers & Clubs		**237**	**4.7%**

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Table 5-140

Number of Guidance and Family Consultation Offices in the Giza Governorate, 2006/2007

No. of Offices	16
Total Cases	1,459
Serviced Cases	1,296
Cases Kept for the Next Year	163

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Table 5-141

Number of Lodgers in Expatriate Houses by Residence in the Giza Governorate, 2006/2007

No. of Houses	7
Fullboard Residency	0.00
Halfboard Residency	78
Residency only	320
Total Residency	398

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Table 5-142

Culture & Entertainment in the Giza Governorate, 2007

Item	Unit	Urban	Rural	Total
No. of culture palaces & houses	Palace & house	7	10	17
No. of inhabitants per culture palace & House	Thousand inhabitants/ Palace & house	525.1	259.7	369.0
No. of culture palaces & houses provided with computers	Palace & house	-	-	1
No. of monuments museums	Museum	-	-	2

Total number of libraries	**Library**	**177**
No. of public libraries	Library	67
No. of specialized libraries	Library	74
No. of academic libraries	Library	36
No. of libraries provided with libraries automatic system	Library	89

Source: Ministry of Culture 1/1/2007.

Table 5-143

Youth and Sports in the Giza Governorate, 2007

Item	Unit	Urban	Rural	Total
No. of youth centers	Center	23	182	205
No. of sporting clubs	Club	67	0	67
No. of sporting committees	Committee	30	0	30
No. of inhabitants per sporting authority	Thousand inhabitants/ Authority	30.6	14.3	20.8
No. of sporting stadiums	Stadium	-	-	0
No. of youth houses	House	-	-	0
No. of youth hostels	Hostel	-	-	2
No. of libraries in youth centers	Library	-	-	154
No. of inhabitants per youth center	Thousand inhabitants/ Center	159.8	14.3	30.6
No. of covered sports halls(*)	Hall	-	-	6
No. of sporting courts	Court	-	-	143

Notes:
(*)The covered halls inside stadiums and sporting clubs.

Source: National Council for Youth - National Council for Sports 1/1/2007.

Table 5-144

Social Affairs in the Giza Governorate, 2006/2007

Item	Unit	Urban	Rural	Total
No. of social units	Unit	41	77	118
No. of inhabitants per social unit	Thousand inhabitants/ Unit	89.7	33.7	53.2
No. of community associations	Association	1531	714	2245
No. of inhabitants per community association	Thousand inhabitants/ Association	2.4	3.6	2.8
No. of children at the nursery age	Thousand children	444.2	425.6	869.8
No. of nurseries(*)	Nursery	568	829	1397
No. of children enrolled in nurseries(*)	Thousand children	41.11	52.82	93.93
No. of children per nursery(*)	Child/ Nursery	72.4	63.7	67.2
No. of nurseries for disabled children	Nursery	-	-	4
No. of centers for persons with special needs	Center	-	-	3
No. of vocational formation centers	Center	-	-	3
No. of rehabilitation offices	Office	-	-	9
No. of physiotherapy centers	Center	-	-	4
No. of beneficiaries of social security	Thousand cases	-	-	50.1
Disbursed amount of social security funds	L.E Million	-	-	36.3
Amount of disbursed funds per beneficiary	L.E/ Case	-	-	725.0
No. of productive family projects(*)	Thousand projects	-	-	63
No. of social insurance beneficiaries in the government sector(*)	Thousand beneficiaries	-	-	323.9
No. of social insurance beneficiaries in public & private sectors(*)	Thousand beneficiaries	-	-	846.9

Notes:
(*) The number of productive family projects reflects the number of families benefiting from productive family projects

Source: CAPMAS " According to Census Preliminary Results 2006", Dec. 2009 and Ministry of Social Solidarity 2006/2007.

Environmental Conditions

Environmental measures for improving local background conditions and community practices are acquiring greater concern. *Tables 5-145 through 5-148* provide with some environmental indicators, which reflect environmental improvement procedures in Giza Governorate.

Table 5-145

Areas of Gardens and Parks in the Giza Governorate, 2007

Unit: $000m^2$

	Affiliation			
	City Councils		Others	
	No.	Area	No.	Area
Areas of Zoo & Aquarium Gardens	0.00	0.00	1	461
Areas of Botanical Gardens & Parks	112	970	21	250
Total	No.		Area	
	134		1,681	

Source: CAPMAS: Statistical Year Book, Dec. 2009.

Table 5-146

Environment in the Giza Governorate, 2007

Item	Unit	Value
No. of natural protectorates	Protectorate	1
No. of garbage recycling factories	Factory	4
No. of air observation stations	Station	4
No. of land fills for solid wastes	Land Fill	2

Source: Ministry of State for Environmental Affairs 1/1/2007.

Table 5-147

Annual Average of Main Air Pollutants in Giza Area, 2000-2007

Unit: Microgram/m^3/($\mu g/m^3$)

Pollutant	2000	2001	2002	2003	2004	2005	2006	2007	Annual Limit (EEAA(*) Regulations)
Lead (PB)	0.24	0.54	0.441	0.278	0.285	0.173	0.128	0.12	1
PM_{10}	-	389	214	197	214	129	115	102	70
Smoke	65.18	89.98	72.72	80.71	70.8	66.05	49.96	66.93	60
SO_2	24.13	18.9	21.22	17.33	25.18	30.91	29.30	21.05	60
TSP	523	457	528	532	552	493	466	582	90

(*) EEAA = Egyptian Environmental Affairs Agency.

Source: Environmental Monitoring Center, Ministry of Health & Population (Copied from CAPMAS, Statistical Year Book, Dec. 2009).

Table 5-148

Solid Waste (Garbage) Weight and Quantity according to Authority that Collects & Disposes it in the Giza Governorate, 2007

		Ton	m^3
Authority that Disposes Solid Waste	Municipalities	2,139,410	2,323,390
	Collecting Companies	524,840	887,645
	Collector Personnel	36,000	600
Total Solid Waste Quantity (*)		2,700,250	3,211,635

(*) The Kind of garbage in tons differs from the kind of garbage in cubic meters.

Source: CAPMAS: Statistical Year Book, Dec. 2009.

6. ENVIRONMENTAL IMPACT ASSESSMENT

6.1 ENVIRONMENTAL IMPACT PROCESS

6.1.1 Introduction

This section identifies and evaluates the primary environmental and social impacts of the proposed construction and operation of the Helwan South Power Plant.

For each subject area (i.e. air quality, noise etc.), the nature of the impact is discussed along with its potential significance, given the existing characteristics of the site and the Egyptian and World Bank Guidelines for New Thermal Power Plants[1]. Where potentially significant adverse impacts are identified, possible mitigation measures are suggested wherever possible, to ameliorate the impact to an acceptable level. Where identified, beneficial or positive impacts/effects of the project are also highlighted.

6.1.2 Assessment Methodology

Identification and assessment of impacts has been undertaken through a process comprising consultation, on site observations, literature review and experience of other similar projects. In addition, several impact models were carried out by independent consultants outsourced by UEEPC/EEHC and ECG representatives as follows:

- atmospheric dispersion modeling of the stack emissions (carried out by Engineering Consultants Group (ECG));
- thermal modeling of the water cooling discharge system (carried out by the Hydraulics Research Institute, National Water Research Center, Ministry of Water Resources and Irrigation;
- noise levels modeling of the power plant during operation (carried out by M.B. Consultant, Prof. of noise and vibration engineering, Ain Shams University;
- transport Impact modeling (conducted by Dr. Ibrahim Mabrouk Ibrahim, Professor of Traffic & Transport, Faculty of Engineering, Al-Azhar University;
- ecological assessment, including aquatic ecological assessment, of impacts that may occur due to the power plant operation (carried out by Expert Ecologists, Institute of Environmental Studies and Research, Ain Shams University and the National Authority for Remote Sensing & Space Sciences (NARSS) in collaboration with Faculty of Sciences, Ain Shams University); and

(1) World Bank Group, Pollution Prevention and Abatement Handbook- Thermal Power Guidelines for New Plants, July 1998.

- geological and seismic investigation of impacts which may affect the power plant during its overall life time carried out by Expert Geologists of both the National Research Institute of Astronomy and Geophysics (NRIAG) and the National Authority for Remote Sensing & Space Sciences (NARSS) in collaboration with Commercial Services Corporation "CSC").

These modeling and assessment results have been reviewed, verified and commented on by ECG as part of the preparation of this ESIA report. The results of this process are documented in this ESIA along with further work and investigations that have taken place.

The potential impacts associated with the construction and operation of the Helwan South Power Plant are listed in *Table 6-1*.

Table 6-1

Environmental, Health and Safety Issues Relating to Construction and Operation of Helwan South Power Plant

Subject Area	Potential Impacts During Construction	Potential Impacts During Operation
Air Quality	Dust from construction activities. Traffic-related air quality impacts.	Impacts of emissions from stacks on ambient air quality. Traffic-related air quality impacts. Global warming potential.
Aquatic Environment	Control and management of site drainage. Wastewater discharge. Sewage disposal and foul drainage.	Thermal water discharge. Water requirements for power plant operation. Discharge of process and wastewater. Operation of drainage systems on site. Discharge of storm water, sewage and drainage.
Noise and Vibration	Noise from construction activities.	Noise from power plant operations on surrounding land uses.
Flora and Fauna	Loss of habitat or species due to landtake. Disturbance or damage to adjacent habitat of species.	Disturbance or damage to adjacent habitat. Effects of structures on bird migration routes.

Table 6-1 (Contd.)

Environmental, Health and Safety Issues Relating to Construction and Operation of Helwan South Power Plant

Subject Area	Potential Impacts During Construction	Potential Impacts During Operation
Land Use, Landscape and Visual Issues	Land use on site. Land use in the surrounding area. Effects of construction activities on landscape character. Visual impact of construction activities.	Land use on site. Land use in the surrounding area. Effects on landscape character. Visual impact of operating facilities.
Soils, Geology and Hydrogeology	Effects on soils and geological features. Ground contamination. Effects on groundwater.	Ground contamination. Effects on groundwater.
Traffic	Traffic conditions/disruption to road users. Traffic-related air quality. Traffic-related noise.	Traffic conditions/disruption to road users. Traffic-related air quality impacts. Traffic-related noise impacts.
Natural Disaster Risk	Seismic risk. Flood risk.	Seismic risk. Flood risk.
Major Accident Hazards	Risk to third-party hazardous industry.	Risk to third-party hazardous industry. Risk to power plant of third-party hazardous industry.
Solid and Hazardous Waste Management	Contamination of Soils and Water. Hazards to Workers Health. Accident Risks.	Contamination of Soils and Water. Hazards to Workers Health. Accident Risks.
Occupational Health and Safety	Accidents. Effects on health of workforce. Safety at work.	Accidents. Effects on health of workforce. Safety at work.

6.1.3 Assessment Content

The following items are examined in the corresponding sub-sections of this Section:

- Air Quality;
- Aquatic Environment ;
- Noise and Vibration;
- Flora and Fauna;
- Land use, Landscape and Visual Impacts;
- Soils, Geology and Hydrology;
- Traffic;
- Socio-economics and Socio-cultural Effects;
- Archaeology, Historic and Cultural Heritage;
- Natural Disaster Risks;
- Major Accident Hazards;
- Solid and Hazardous Waste Management;
- Public Health Effects;
- Occupational Health and Safety; and
- Associated Infrastructure.

For each of these items, a concise description and evaluation of the significance of potential impacts of the project is presented. Where modeling has been undertaken, a description of the model as well as corresponding maps summarizing the results of the assessment are provided.

If mitigation measures are considered to be necessary, these measures are presented and taken into account in order to estimate the predicted environmental and social impacts of the power plant.

6.2 AIR QUALITY

6.2.1 Introduction

One of the more significant impacts of the power Plant on environment is the impact on the air quality. During construction activities and power plant operation, several pollutants will be released to the atmosphere including:

- intermittent fugitive emissions of dust during the construction period;
- emissions from the exhausts of vehicles used for the transport of the workers, the transport of construction materials and of basic equipment as well as transport during the power plant operation (light fuel trucks); and
- stack emissions during the power plant operation (particularly of nitrogen oxides (NOx).

The power plant will burn natural gas as the main fuel. As a result, emissions of particulate matter and sulfur dioxide during normal operation of the power plant will be very low.

Atmospheric dispersion modeling of stack emissions has been carried out in order to assess the impact of the power plant operation on ground level concentrations of nitrogen oxides (NOx), sulfur dioxide (SO_2) and carbon monoxide (CO) and to determine the scale of any impact on air quality, relative to accepted criteria.

Whilst the plume from the power station may travel ultimately over many hundreds of kilometers, the impacts in terms of increments to ground level concentrations of nitrogen dioxide will be confined to an area within a 5-8 km radius of the power station site (see air quality dispersion modeling). This then may be regarded as the "airshed", to use the terminology from the World Bank guidelines on thermal power plants.

6.2.2 Atmospheric Emissions during Construction Activities

Dust Emissions

Dust generated during construction can be significant locally. The following activities have the potential to result in the generation of dust during construction:

- "earthmoving" operations on site (excavation and removal of superficial sands);
- earthworks engineering;
- site stripping;
- wind blow; and
- circulation of vehicles and trucks for the import of the construction materials, for the export of excavated soil, for the transport of the workers and the transport of the equipment. This is a particularly significant source of dust emissions on unmade roads.

In the climate type experienced in this region as well as the relatively low quality of background air in terms of particulate pollutants, existing concentrations of airborne dust are high. Relative to these existing levels, the contribution of additional dust from construction will be low.

Other Emissions

The movements of vehicles will also result in the emission of airborne pollutants from the exhausts of the vehicles. The amount of such emissions will depend on the number of the vehicles concerned, vehicle type and the volume of traffic.

Mitigation Measures

In order to limit the impact of the construction activities on air quality, the following mitigation measures will be implemented:

- the construction phase will begin with the construction of access roads (in order to minimize dust from vehicle movements);
- roads during construction will be compacted and graveled if necessary;
- roads will be maintained in good condition;
- access to the site will be regulated;
- vehicle speed will be limited on site;
- vehicles will correspond with Egyptian pollutant emission standards;
- where possible, the contractor will select equipment designed to minimize dust emissions;
- activities that produce significant dust emissions will be monitored during periods of high winds and dust control measures will be adjusted to account for ambient conditions to minimize fugitive dust, *e.g.* the contractor will limit work activities which may generate dust if they pose an immediate danger or significant nuisance to the construction workforce or surrounding environment;
- stockpiles of soil and similar materials will be carefully managed to minimize the risk of windblow;
- water spray dampening of soils and spoil will be undertaken to prevent dust blow when necessary;
- where possible, drop heights for material transfer activities such as unloading of friable materials will be minimized and carefully managed; and
- sheeting of lorries on-site during transportation of friable construction materials and spoil.

6.2.3 Atmospheric Emissions during Power Plant Operation

Pollutants Emitted

The Helwan South power plant will burn primarily natural gas or heavy fuel oil (HFO) (No. 6 fuel oil) as an occasional substitute in an emergency. Both primary and alternate fuels for the power plant project will be purchased from "City Gas" and petroleum refineries of Mustorod or Suez, Egyptian General Petroleum Corporation (EGPC) under a Fuel Supply Agreements.

The supercritical steam power plant will have two modes of operation with regard to fuel type. The normal, and preferred mode is firing with natural gas. This will be the case for the majority of the time. In case of an interruption of the gas supply, the power plant will use heavy fuel oil as an alternate fuel.

The principal pollutant when burning natural gas will be oxides of nitrogen (NOx). Use of no. 6 fuel oil will also result in emissions of particulate matter (PM) and sulfur dioxide (SO_2), along with trace amounts of some other pollutants.

The characteristics of the emissions of the supercritical steam plant of the Helwan South power project are described below according to the fuel supply (natural gas or no. 6 fuel oil as an alternative).

Operation with Natural Gas

The concentrations of SO_2 will depend directly on the sulfur content in the fuel. The natural gas used as primary fuel is practically free from sulfur, and emissions of SO_2 will be negligible when firing natural gas fuel during normal operation.

Egyptian regulations and requirements of the World Bank (1998) for stack emissions will be complied with when firing with the main fuel. *Table 6-2* summarizes this.

Table 6-2

Stack Emissions for Firing with Natural Gas, mg/Nm^3 (1)
[Ceiling Values of both the Egyptian & the W.B. Standards]

Emission Type	Emission Concentration		
	Estimate Value	Egyptian Requirement	World Bank Guideline (3)
NOx	$\leq$ 300 mg/Nm^3 (2)	300 mg/m^3	$\leq$ 240 mg/Nm^3 (4)
SO_2	Negligible	Not Specified	Not Specified
Particulate Matter (all size): TSP	$\leq$ 5 mg/Nm^3	Not Specified	Not Specified

Notes:

(1) Values taken at 3% O_2 in dry fumes and for 100% load.

(2) Nm = Natural meter cubed.

(3) All parameters for World Bank standards are normalized to standard conditions: 273°K, 101.3 kPa, 3% O_2, dry gas emission rates and 100% load as a worst case on a per unit basis. It has been assumed that there will be 1000 hrs/year of forced outage, 7590 hrs of natural gas firing and 170 hrs of mazout firing.

(4) World Bank Pollution Prevention Guidelines for New Plants, Dec. 2008.

Operation with Emergency Fuel

Firing with heavy fuel oil as a substitute fuel will occur for only a limited number of hours per year (a maximum of 170 hours per year) and only if natural gas is not available.

As the power plant will fire heavy fuel oil for less than 2% of operating time, Egyptian and World Bank emission standards are not applicable.

Nevertheless, estimated values of emissions in these circumstances are presented, for information, in *Table 6-3* below. It shows that the Egyptian regulations and guidelines of the World Bank (1998) for stack emissions will be complied with.

Table 6-3

Stack Emissions for Firing with Heavy Fuel Oil, mg/Nm³ (1)
[Ceiling Values of both the Egyptian & the W.B. Standards]

Emission Type	Emission Concentration		
	Estimate Value	Egyptian Requirement	World Bank Guideline (2),(3)
NOx	$\leq$ 300 mg/Nm^3	300 mg/m^3	$\leq$ 400 mg/Nm^3
SO_2	$\leq$ 2000 mg/Nm^3	3600 mg/m^3	850 mg/Nm
Particulate Matter (all size): TSP	$\leq$ 150 mg/Nm^3	150 mg/m^3	50 mg/Nm^3

Notes:

(1) Values taken at 3% O_2 in dry fumes and for 100% load.

(2) All parameters for World Bank standards are normalized to standard conditions: 273°K, 101.3 kPa, 3% O_2, dry gas emission rates and 100% load as a worst case on a per unit basis. It has been assumed that there will be 1000 hrs/year of forced outage, 7590 hrs of natural gas firing and 170 hrs of mazout firing.

(3) World Bank Pollution Prevention Guidelines for New Plants, Dec. 2008.

In addition, ECG has undertaken modeling of the normal (operational) fuel and the results of the analysis are given below.

Mitigation Measures

Several specific measures have been taken to reduce stack emissions from the power plant and to comply with Egyptian and World Bank standards. The power plant will fire natural gas as main fuel which is the least polluting fuel available, (with negligible sulfur dioxide emissions and low particulate matter emissions). Heavy fuel oil will only be used as an emergency fuel. In order to reduce NOx emissions when firing natural gas or heavy fuel oil, low-NOx burners will be used on the boilers. Low-NOx burners reduce NOx emissions by:

- shortening gas residence time in the high temperature zone; and
- lowering the oxygen concentration in the combustion zone.

This is achieved by:

- staggering combustion (modification of the location of burners in the furnace); and
- excess air control (modification on the regulation of the total air to the furnace).

Conclusion

The pollutant emissions of the power plant will comply with all requirements when firing natural gas.

No mitigation measures will be implemented for potential exceedences of TSPs and SO_2 when firing on HFO.

The exceedence of air quality standards would be due to any other background levels and could not be attributed to the plant. The costs of reducing these emissions would not be economically viable given the minor benefits to air quality that measures would bring. In addition, the alternate fuel will only be used for a maximum of 2% of the operating time. The World Bank Guidelines for New Thermal Power Plants state that all of the maximum emission levels should be achieved for at least 95% of the time the plant is operating. The remaining 5% is assumed to be for start-up, shut down or emergency fuel use. This is the stance also taken by the EEHC & UEEPC.

6.2.4 Atmospheric Dispersion Modeling

The height of the stack will comply with Egyptian requirements and World Bank guidance on Good Engineering Practice (GEP). The height of the stack has been fixed by EEHC in the design criteria of the power plant project. The tentative stack height of 152 m (at least) was defined in the preliminary conceptual design according to the screening dispersion modeling undertaken for the Helwan South power plant feasibility study in early 2010.

Purpose

Atmospheric dispersion modeling has been carried out by ECG in order to determine power plant impacts on local air quality, when firing natural gas.

This modeling is able to quantify the impact of stack emissions on local air quality, define the areas where the maximum impact will occur and enable the evaluation of the concentrations of nitrogen oxides, particulate matter and sulfur dioxides in the air against the ambient air quality standards.

As heavy fuel oil will be used only as an emergency fuel, less than 2% of the operating time, the modeling has been restricted to the case of firing on natural gas.

Air Pollution Dispersion Modeling

Air Pollution Dispersion Modeling is the mathematical simulation of how air pollutants disperse in the ambient atmosphere. It is performed with computer programs that solve the mathematical equations and algorithms which simulate the pollutant dispersion. The dispersion models are used to estimate or to predict the downwind concentration of air pollutants emitted from sources such as industrial plants and vehicular traffic.

Such models are important to governmental agencies tasked with protecting and managing the ambient air quality. The models are typically employed to determine whether existing or proposed new industrial facilities are or will be in compliance with the National Ambient Air Quality Standards (NAAQS). The models also serve to assist in the design of effective control strategies to reduce emissions of harmful air pollutants.

The dispersion models require input data, which includes:

1. Meteorological conditions such as wind speed and direction, the amount of atmospheric turbulence (as characterized by what is called the "stability class"), the ambient air temperature and the height to the bottom of any inversion aloft that may be present.
2. Emissions parameters such as source location and height, source vent stack diameter and exit velocity, exit temperature and mass flow rate.
3. Terrain elevations at the source location and at the receptor location.
4. The location, height and width of any obstructions (such as buildings or other structures) in the path of the emitted gaseous plume.

Many of the modern, advanced dispersion modeling programs include a pre-processor module for the input of meteorological and other data, and many also include a post-processor module for graphing the output data and/or plotting the area impacted by the air pollutants on maps.

The atmospheric dispersion models are also known as atmospheric diffusion models, air dispersion models, air quality models, and air pollution dispersion models.

Description of the Model ISC-Prime

The ISC-Prime air dispersion model was used to estimate the off site air quality impacts. Off site impacts were investigated to determine compliance to the Egyptian Ambient Air Quality Limits (EAAQLs).

ISC-Prime is a computer program designed to simulate atmospheric dispersion processes over long periods, in order to estimate ambient concentration levels of air pollutants resulting from any set of gas emission sources or suspended particulate matter emission sources. It concerns mainly stack emissions, but can be applied to other stationary emission sources.

It is appropriate for application to a wide variety of problems (in particular regulatory applications) related to industrial source complexes, with transport distance up to 50 km in flat or rolling terrain.

The model is mainly based on the Gaussian plume dispersion equations as described by Pasquill, Gifford and Turner, as well as the Brigg's plume rise equations. It includes several sets of dispersion coefficients, alternative plume rise equations, and various options concerning plume downwash, such as buoyancy-induced dispersion and terrain adjustment.

Computations are made with an hourly time step and allow if necessary hourly variations in the pollutant emission rates. For every day over the period for which meteorological data are used as input to the model, concentrations are calculated over three different averaging times including one hour, 24 hours and annual. At the end of the simulation the program output provides the maximum value of pollutants considered for each of the three averaging times for each receptor considered over the study zone.

In addition, detailed information about the highest concentrations is computed over the period.

From such results, various levels of pollution can be established and comparisons can be made with current air quality standands.

Method of Application

All the simulations have been performed over a period of 3 years (2007, 2008 & 2009) with the time series of meteorological data provided by the Helwan station.

In each case, the additional concentrations arising from the plant emissions are estimated within a 10 km radius airshed and based on the source of emission (see pollution maps in *Figures 6-6* through *6-11*). The receptor grid used is such that the concentrations of pollutants in the ambient air are computed over a set of about 10,000 points covering the area.

Figures 6-1 and *6-2* provide with a localization map for the modeled project and a plant layout for the stack location within site arrangement. *Figure 6-3* depicts receptor map used in air quality modeling. Also, *Figure 6-4* illustrates wind roses of meteorological data used for the years 2007, 2008 & 2009 in performing modeling exercise.

Modeling Assumptions

The results have been obtained using the following assumptions developed by the Consultant:

- the plant is running continuously at full load;
- the actual volume flow rate of exhaust gas (per unit, at 100% load) is about 2,278,800m^3/hr for gas firing and about 2,505,600m^3/hr for mazout firing (3% O_2, dry gas);
- number of stacks is 3;
- the stack height is 152 m for each unit;
- the internal flue diameter is 6.2m for both of the gas firing and mazout firing;
- the flue gas exit velocity (100% load) is 23.05m/sec. for gas firing and 16m/sec. for mazout firing;
- the temperature of gas at stack exit is 110°C for gas firing and 152°C for mazout firing;
- the emission rate of NO_x is 144.47 gm/sec. for 100% gas firing and 205.51 gm/sec. for 100% oil firing;

- the emission concentration of NO_2 is 300mg/Nm^3 for both of the gas firing and mazout firing (3% O_2, dry gas);

- the operating mode taken into account is as follows:

  - Gas firing operating period during 8000 hr/year;
  - Mazout firing period during 170 hr/year;
  - Forced outage during 760hrs/ year as indicated below:

Stack / period	Outage Period 1 10Days start	Period 2 10Days start	Period 3 11Days start
Unit 1	15th Jan	15th May	15th Sep
Unit 2	15th Feb	15th Jun	15th Oct
Unit 3	15th Mar	15th Jul	15th Nov

Figure 6-1

Localization Map Used for Dispersion Modeling

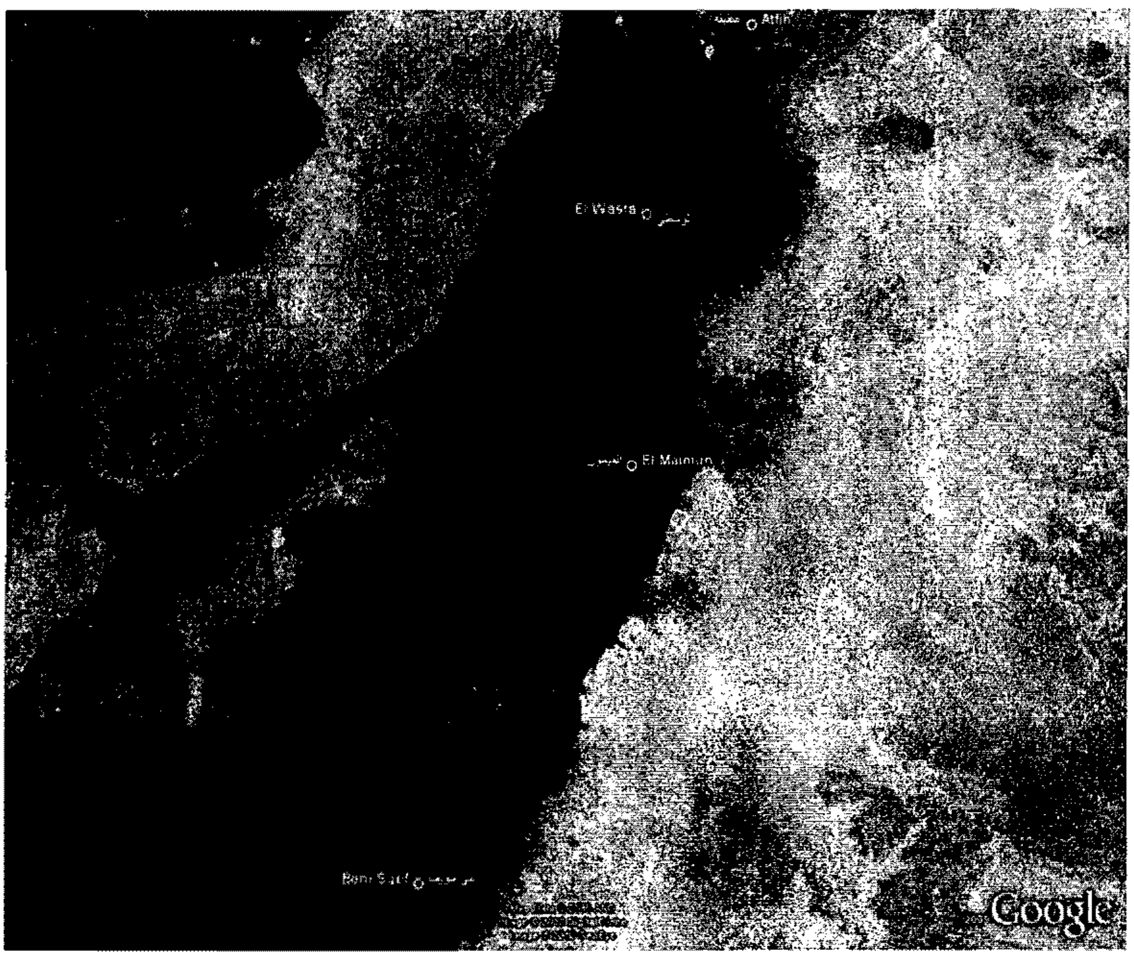
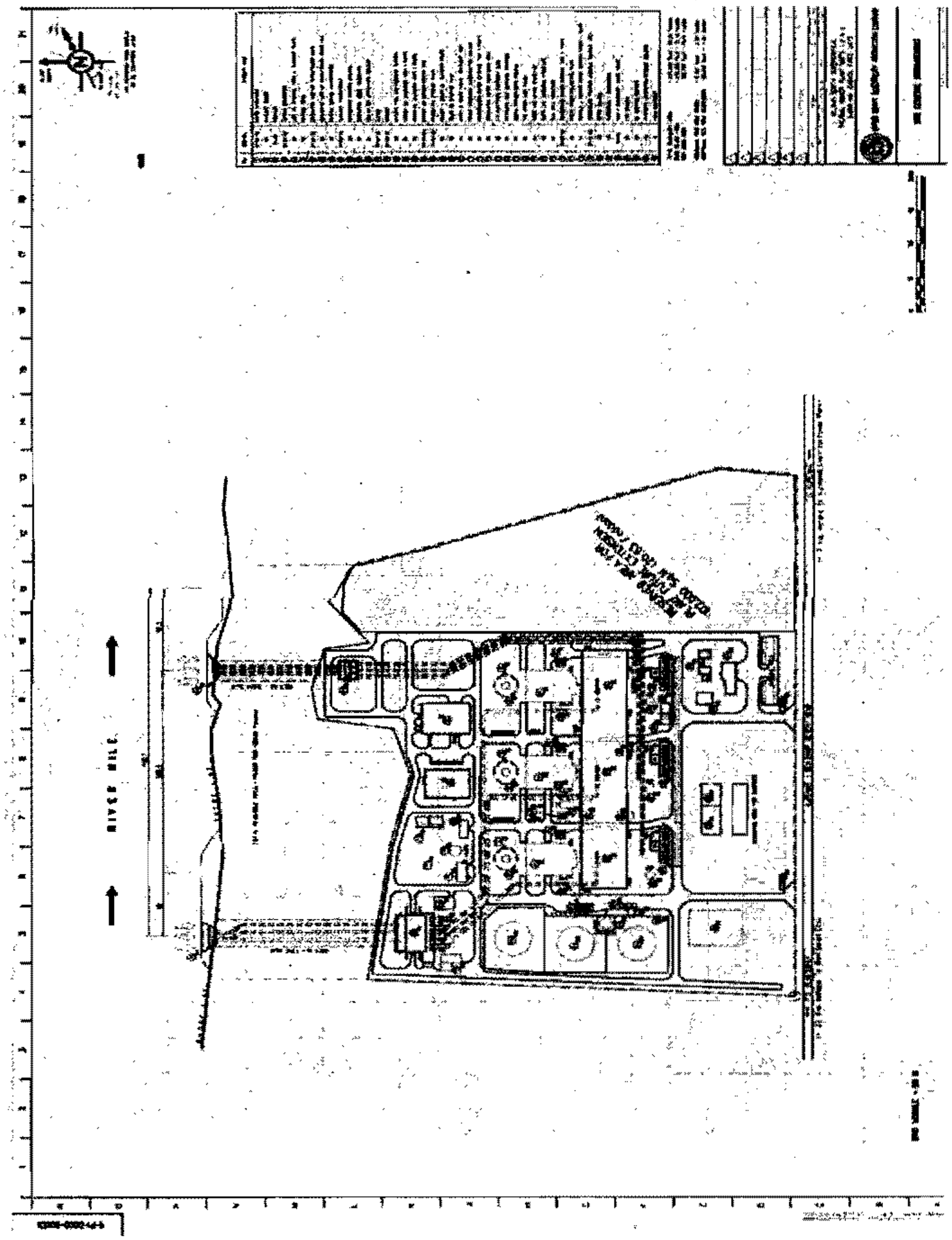


Figure 6-2

Plant Layout for the Stack Location within Site Arrangement



- the conversion rate (i.e. NO to NO_2) during the time it takes the plume to reach the receptor is equal to 75% (almost certainly an overestimate).

The simulations were performed using the following model features:

- Brigg's plume rise formulas;
- classical "urban" dispersion parameters (Pasquill, Gifford);
- stack-tip downwash (Briggs);
- buoyancy-induced dispersion (Pasquill); and
- flat terrain.

It should be noted that hours of calm, i.e. no wind, have been left out of the computations. To compensate for these 'missing' hours, the wind speed has been set at 1 m/sec. at the emission level, with a random direction, according to the frequency distribution observed at the station for low winds (1 to 2 m/sec.).

LOCATION AND SURROUNDING TOPOGRAPHY

The proposed power plant lies within the south Helwan on the eastern side of the Nile River, about 100 km south of Cairo City.

The site lies between latitude 29° 16' 17.40'' North, and longitude 31° 13' 35.51'' East. The eastern side is bounded by desert land and the Kureimat / Beni-Suweif road.

To the north side of the power plant site located is grains silos at around 500m distance. The southern side is around 700 apart from the El-Maymoun cemetery.

Land Uses around the Site

As mentioned above, the land uses around the site includes grains storage facilities to the north, cemetery to the south, desert land and agricultural narrow strip of land on the western side of the power plant parallel to the River Nile.

METEOROLOGICAL DATA AND MODELING

The Fifth-Generation Pennsylvania State/National Center for Atmospheric Research (NCAR) Mesoscale Model (MM5) is used to generate the meteorological inputs to the air quality model.

MM5 is a limited-area, non-hydrostatic, terrain-following sigma-coordinate model designed to simulate or predict mesoscale and regional-scale atmospheric circulation. It has been developed at Pennsylvania State and NCAR as a community mesoscale model and is continuously being improved by contributions from users at several universities and government laboratories.

The model solves the set of atmospheric dynamical and physical governing equations. It also includes parameterization treatments for more complicated physical and dynamical processes; such as:

Precipitation physics, planetary boundary layer process, surface layer process, and atmospheric radiation.

MM5 include: A multiple-nest capability, non-hydrostatic dynamics, which allows the model to be used at a few-kilometer scale, multitasking capability on shared- and distributed-memory machines, a four-dimensional data-assimilation capability, and multiple physics options.

Nesting technique means that the model can run on regional scale (large) area with emphasize on local scale (small) area. The regional model uses initial and boundary conditions extracted from a global model and the local uses boundary conditions extracted from the outputs of the regional one. The regional and local area meshes are set to start run at the same time where each mesh has its own initial meteorological data, topography, land use and surface fields.

The model is supported by several auxiliary programs, which are referred to collectively as the MM5 modeling system.

Data Required to Run the MM5 Modeling System

Since MM5 is a regional model, it requires an initial condition as well as lateral boundary condition to run. Grided data for the entire time period that is being modeled are needed in order to produce lateral boundary condition for a model run.

Two dimensions grided data for: Topography, vegetation data, land use, mean sea-level pressure, 10m wind speed and directions, 2m temp., soil humidity, soil wetness and temp.

Three dimensions grided data for: Wind, temperature, relative humidity and geo-potential height and at the standard atmospheric pressure levels: 1000, 850, 700, 500, 400, 300, 250, 200, 150, 100 Hectopascal. Also, **Observation data** that contains soundings and surface reports could be included.

Meteorological Data Sources

According to World Meteorological Organization, there are many regional centers covering the world (Cairo is one of them) each one collects the observed meteorological data from surrounding countries and resubmit the collected data to global centers which collect all data of the world and resubmit it to the regional ones.

Figure 6-3 (A)

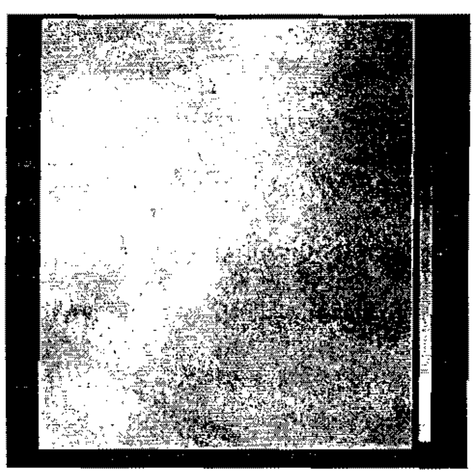
Receptor Map Used for Air Quality Modeling
(MM5 Nested Areas)

[The modeling domain covers the area between Longitudes 22°-40° E and Latitudes 21°-35.5° N]

Figure 6-3 (B)

Receptor Map Used for Air Quality Modeling
(MM5 Nested Areas)

[The modeling domain covers the area between Longitudes 30.65°-31.77° E and Latitudes 28.65°-29.8° N]



All this process use well-known wireless frequencies and is opened to every country. Egypt has 104 different meteorological stations of different types. Meteorological station observes every 12, 6, 3 or every one hour and any observation should be done within the last ten minutes of the previous hour. In addition to ground observations there are meteorological ships, rockets, aircrafts, radars and satellites observations.

All available data are being collected and processed for quality assurance in the global centers. The Global center in Washington, which is called National Center for Environmental Predictions (NCEP), continue processing on the global observation and produce global forecasts covering ten days and make the first five available on the internet to be used by regional and local centers for more accurate processing and predictions.

NCEP broadcasts global model outputs as girded data to be used for initial and boundary conditions by World Area Forecast centers WAFS.

The WAFS's horizontal resolution is 1.25° in latitude and longitude (at Equator) on 12 standard vertical pressure levels.

MM5 Nest and Areas Setup

MM5 is run on 1-way nested regional and local meshes. The resolutions of the regional and local meshes are 30km and 10km, respectively. The regional modeling domain, *Figure 6-3(A)*, covers the area from 22°E to 40° E longitudes and from 21°N to 35.5°N latitudes. More attention is paid to a local area surrounding the Power plant location as an internal nested domain. *Figure 6-3(B)* show the Local area which is bounded by, longitudes 30.65°: 31.77° E and latitudes 28.65°: 29.8° N. The vertical resolution is 32 levels between ground surface and 100HPa (~16km aloft).

Modeled Time Span

The modeling exercise covered a three years starting Jan 1st and ending Dec 31st, 2007, 2008, 2009. The meteorological inputs were prepared for this time frame using MM5 meteorological model.

CLIMATE AND DISPERSION METEOROLOGY

The key parameters affecting dispersion of air emissions are summarized below.

Dry Deposition is the removal of gaseous or particulate material from the pollution plume by contact with the ground surface or vegetation (or even water surfaces) through transfer processes such as absorption and gravitational sedimentation.

This may be calculated by means of a *deposition velocity*, which is related to the resistance of the underlying surface to the transfer.
Wet Deposition is the removal of pollution plume components by the action of rain. The wet deposition of radio nuclides in a pollution plume by a burst of rain often forms so called *hot spots* of radioactivity on the underlying surface

Surface Roughness Length Parameter is a measure for the ground surface roughness which determines the turbulence characteristics of the ambient boundary layer.

It is taken to be about 1/10 to 1/30 of the height of a typical roughness element as present on the ground surface. It is about 1 m for cities, forests and industrial sites, 10 cm for agricultural crops, 1 cm for grass and 1 mm for water or paved surfaces.

Inversion Layers: Normally, the air near the Earth's surface is warmer than the air above it because the atmosphere is heated from below as solar radiation warms the earth's surface, which in turn then warms the layer of the atmosphere directly above it. Thus, the atmospheric temperature normally decreases with increasing altitude.

However, under certain meteorological conditions, atmospheric layers may form in which the temperature increases with increasing altitude. Such layers are called inversion layers. When such a layer forms at the earth's surface, it is called a **surface inversion**. When an inversion layer forms at some distance above the earth, it is called an **inversion aloft** (sometimes referred to as a *capping inversion*).

The air within an inversion aloft is very stable with very little vertical motion. Any rising parcel of air within the inversion soon expands, thereby adiabatically cooling to a lower temperature than the surrounding air and the parcel stops rising. Any sinking parcel soon compresses adiabatically to a higher temperature than the surrounding air and the parcel stops sinking. Thus, any air pollution plume that enters an inversion aloft will undergo very little vertical mixing unless it has sufficient momentum to completely pass through the inversion aloft. That is one reason why an inversion aloft is sometimes called a capping inversion.

Mixing Layer Height

The mixing layer height is the height above ground through which ground-based emissions will eventually be dispersed once thorough mixing occurs. In general, the mixed layer height will increase during the day as the sun causes convection to deepen the turbulent layer near the ground. The depth of the mixed layer will also increase as wind speeds increase due to the generation of turbulence produced by flow over the rough ground surface. Thus mixing layer depth is heavily influenced by wind speeds and surface roughness, and is an important consideration for determining the dispersion of ground based emissions into the atmosphere.

Any air pollution plume dispersing beneath an inversion aloft will be limited in vertical mixing to that which occurs beneath the bottom of the inversion aloft (sometimes called the *lid*). Even if the pollution plume penetrates the inversion, it will not undergo any further significant vertical mixing. As for a pollution plume passing completely through an inversion layer aloft, that rarely occurs unless the pollution plume's source stack is very tall and the inversion lid is fairly low.

Atmospheric Stability Classes

The amount of turbulence in the ambient atmosphere has a major effect on the dispersion of air pollution plumes because turbulence increases the entrainment and mixing of unpolluted air into the plume and thereby acts to reduce the concentration of pollutants in the plume (i.e, enhances the plume dispersion). It is therefore important to categorize the amount of atmospheric turbulence present at any given time.(Passquil Stability Classes).

Stability Class	Definition
A	Very unstable
B	Unstable
C	Slightly unstable
D	Neutral

E	Slightly stable
F	Stable

The surface wind distributions for South Helwan area extracted from MM5 outputs show that 24.8% of the time having wind velocity less than 3m/s.

Wind Rose

Wind rose of the three modeled years are shown in *Figure 6-4*.
Wind direction of the area show that predominant winds are from the north and north-east most of the year. Winter times show more South western winds because of the passage of the fast moving depressions affecting the area.

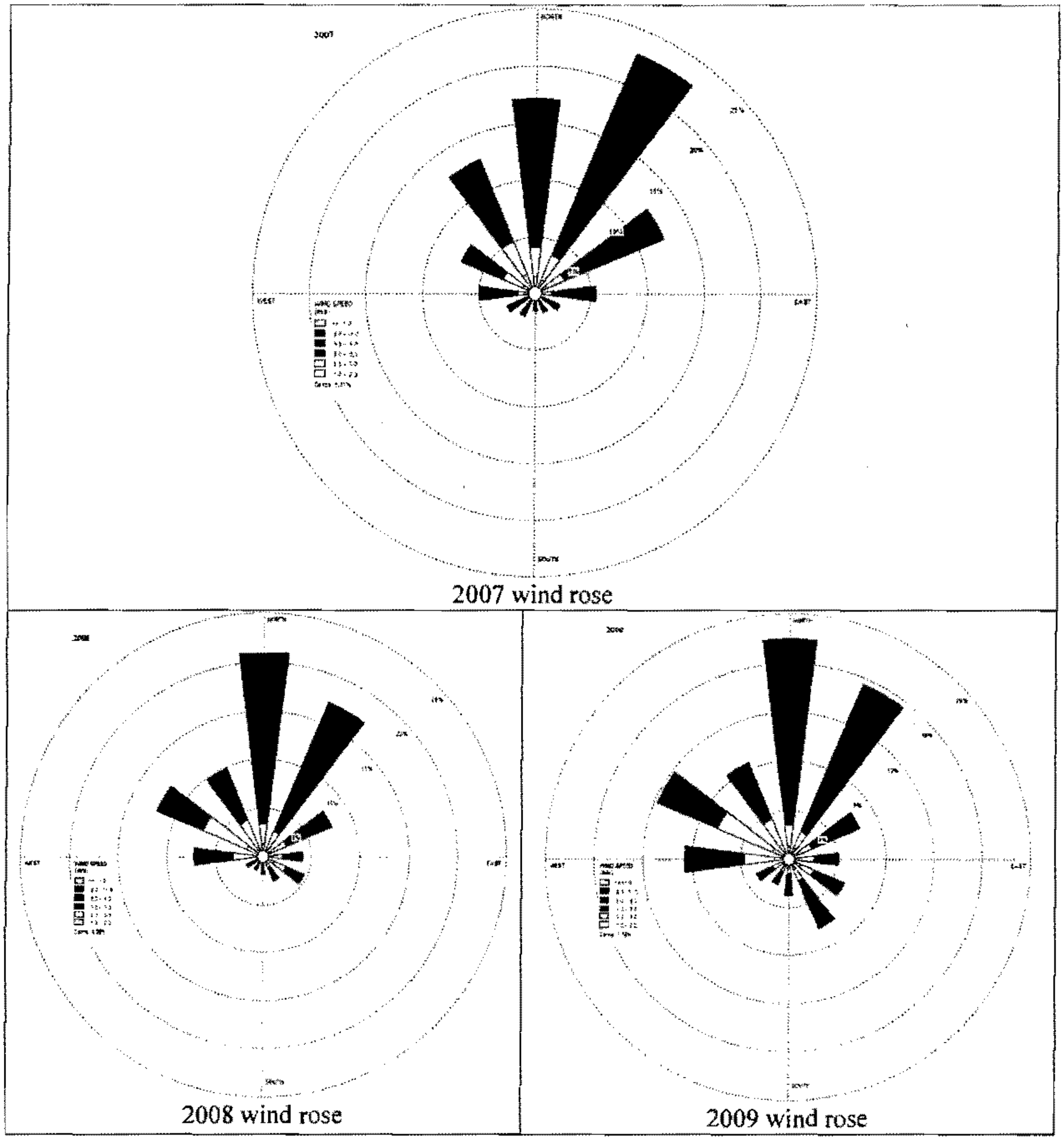
The following climate summary data is obtained from the Egyptian Meteorological Authority bulletin based on 30 years observations at Helwan station located near to the north of the proposed development.

Temperature

The warmest months of the year are June, July and August, which experience a mean daily maximum temperature of 42.1°C, 42.0°C and 41.3°C respectively and a mean daily minimum temperature of 32.2.7°C, 32.0°C and 32.5°C respectively. December, January and February are the coolest months experiencing daily maximum temperature of 21.4°C, 19.4°C and 21.9°C respectively and a mean daily minimum temperature of 15.4°C, 13.5°C and 15.5°C respectively.

Figure 6-4

Wind Roses Representing Meteorological Data Used for Modeling, 2007, 2008 & 2009



2007 wind rose

2008 wind rose

2009 wind rose

Humidity

Relative humidity peaks in July and decreases as the spring months approach. The 12 pm relative humidity readings are lower than the 06 am readings throughout the year. The 9 am relative humidity has an average annual range of approximately 57.5% with a minimum of 47.9% in May and a maximum of 62.8% in Dec.

Rainfall

December, January and March are the wettest months of the year, receiving a mean monthly rainfall of 5.07mm, 5.9mm and 4.8mm respectively. Summer Months are dry having zero rainfall amounts.

GAUSSIAN AIR POLLUTION DISPERSION EQUATION

The technical literature on air pollution dispersion models is quite extensive and dates back to the 1930's and earlier.

The ISC short term model uses the steady-state Gaussian plume equation for a continuous elevated source. For each source and each hour, the origin of the source's coordinate system is placed at the ground surface at the base of the stack. The x axis is positive in the downwind direction, the y axis is crosswind (normal) to the x axis and the z axis extends vertically. The fixed receptor locations are converted to each source's coordinate system for each hourly concentration calculation. The hourly concentrations calculated for each source at each receptor are summed to obtain the total concentration produced at each receptor by the combined source emissions.

For a steady-state Gaussian plume, the hourly concentration at downwind distance x (meters) and crosswind distance y (meters) is given by:

$$C = \frac{Q}{u} \cdot \frac{f}{\sigma_y \sqrt{2\pi}} \cdot \frac{g_1 + g_2 + g_3}{\sigma_z \sqrt{2\pi}}$$

where:

f = crosswind dispersion parameter

$= \exp\left[-y^2 / (2\,\sigma_y^2)\right]$

g = vertical dispersion parameter = $g_1 + g_2 + g_3$

g_1 = vertical dispersion with no reflections

$= \exp\left[-(z - H)^2 / (2\,\sigma_z^2)\right]$

g_2 = vertical dispersion for reflection from the ground

$= \exp\left[-(z + H)^2 / (2\,\sigma_z^2)\right]$

g_3 = vertical dispersion for reflection from an inversion aloft

$$= \sum_{m=1}^{\infty} \{\exp\left[-(z - H - 2mL)^2 / (2\,\sigma_z^2)\right]$$

$$+ \exp\left[-(z + H + 2mL)^2 / (2\,\sigma_z^2)\right]$$
$$+ \exp\left[-(z + H - 2mL)^2 / (2\,\sigma_z^2)\right]$$
$$+ \exp\left[-(z - H + 2mL)^2 / (2\,\sigma_z^2)\right]$$

C	= concentration of emissions, in g/m³, at any receptor located: x meters downwind from the emission source point y meters crosswind from the emission plume centerline z meters above ground level
Q	= source pollutant emission rate, in g/s
u	= horizontal wind velocity along the plume centerline, m/s
H	= height of emission plume centerline above ground level, in m
σ_z	= vertical standard deviation of the emission distribution, in m
σ_y	= horizontal standard deviation of the emission distribution, in m
L	= height from ground level to bottom of the inversion aloft, in m
exp	= the exponential function

It should be noted that σ_z and σ_y are functions of the atmospheric stability class (i.e., a measure of the turbulence in the ambient atmosphere) and of the downwind distance to the receptor. The two most important variables affecting the degree of pollutant emission dispersion obtained are the height of the emission source point and the degree of atmospheric turbulence. The more turbulence, the better degree of dispersion.

The resulting calculations for air pollutant concentrations are often expressed as an air pollutant concentration contour map in order to show the spatial variation in contaminant levels over a wide area under study. In this way the contour lines can overlay sensitive receptor locations and reveal the spatial relationship of air pollutants to areas of interest.

AIR QUALITY MODEL ISC3ST-PRIME

The short-term industrial source complex model (ISC3ST-Prime) has been used in this study. The model is an advanced Gaussian dispersion model approved by the United States Environment Protection Agency (USEPA) for use in regulatory assessments undertaken within the United States. It is one of the most widely used regulatory models in the world.

The ISC3ST-PRIME model uses the steady state Gaussian dispersion equation to simulate the dispersion of a plume from point, area or volume sources. The model takes account of dry and wet deposition and includes mechanisms for determining the effect of terrain and buildings on plume dispersion. The modeled area extended 10km West-East and 10km North-South covered by 10000 grided receptors. The grid distance is 60 meters. *Figure 6-5* shows the squire receptor grid.

AIR POLLUTION MODEL METEOROLOGICAL INPUTS

The **ISC3ST-Prime** model moeteorological inputs are extracted from MM5 output in the format:

- yy, mm, dd, hh, wd, ws, st, pa, mdu, mdr, us, mo, zo, pc, pr
- where, yy:year, mm:month, dd:day, hh:hour, wd:wind direction(degrees from north), ws:wind speed(m/s), st:surface air temperature (K°), pa:Pasquill stability class, mdu: urban mixing depth, mdr: rural mixing depth, us:friction velocity, mo:Monen Obokhove length, zo:roughness parameter, pc:precipitation code, pr:precipitation rate.

AIR POLLUTION MODEL RESULTS

Scenario I : Business as usual assuming the power plant is operating in full capacity for No Low NOx Burners. (NoLoNOx)

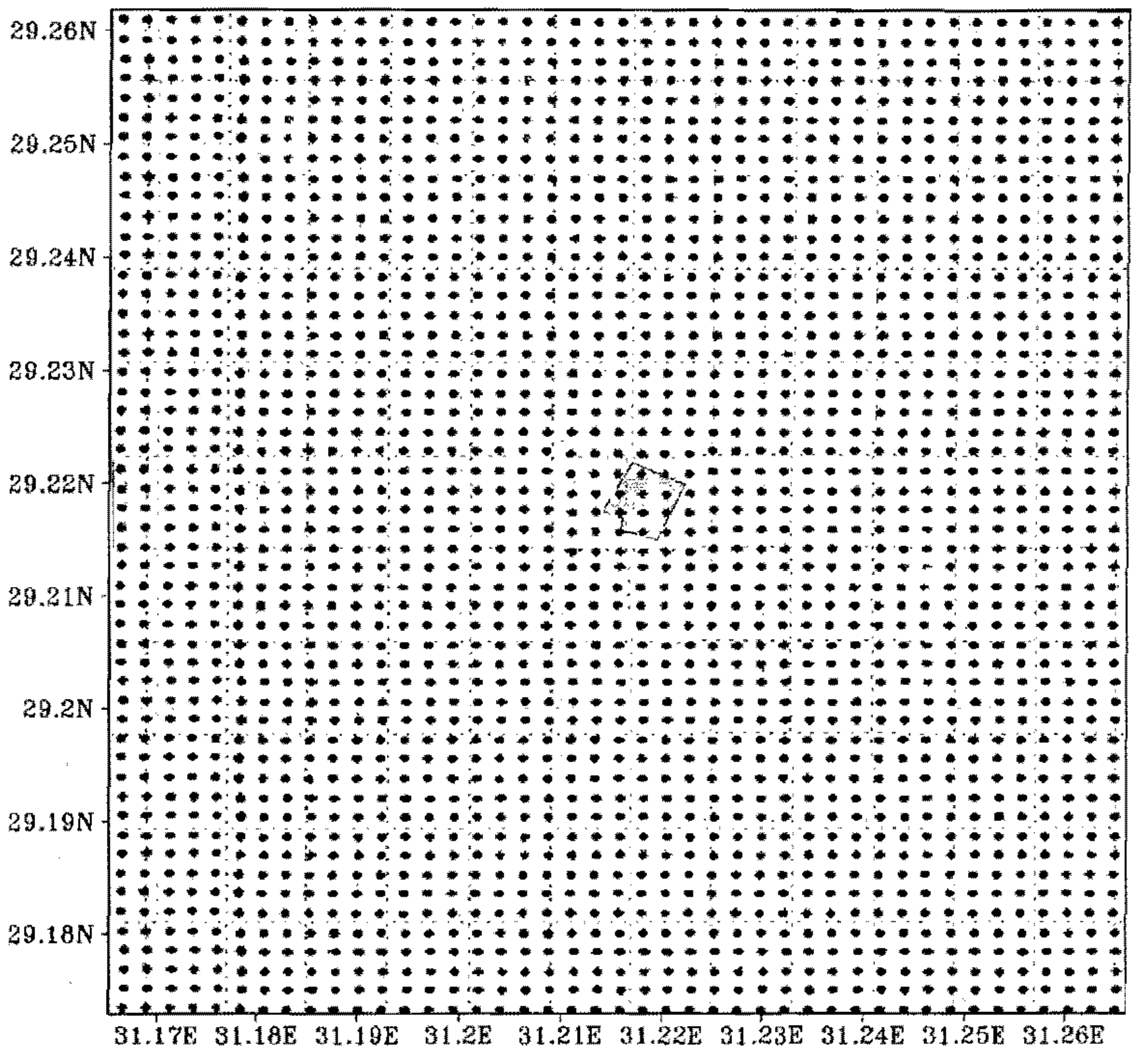
Figures 6-6(A), 6-7(A) and 6-8(A) (s-shaded) and 6-6(B), 6-7(B) and 6-8(B) (c-contours) show Maximum NO2 concentration contours in micrograms per cubic meter for the modeled area over the three years. *Table 6-5(A)* shows the 1st 15 Maximum values in micrograms per cubic meter with their distances and locations referenced to point between the stacks.

The maximum hourly average value is 367.3μg/m^3 at 608.9 meters, the maximum 24-Hours average is 126.7μg/m^3 at 623.0meters and the maximum annual average is 37.3μg/m^3 at 630.1meters

Table 6-5(B) shows the 1st Maximum values for the three years with their distances and locations referenced to point between the stacks.

Figure 6-5

The Squire Receptor Grid



Scenario II : Business as usual assuming the power plant is operating in full capacity for Low NOx Burners. (LoNOx)

Figures 6-9(A), 6-10(A) and 6-11(A) (s-shaded) and 6-9(B), 6-10(B) and 6-11(B) (c-contours) show Maximum NO_2 concentration contours in micrograms per cubic meter for the modeled area over the three years. *Table 6-6(A)* shows the 1st 15 Maximum values in micrograms per cubic meter with their distances and locations referenced to point between the stacks.

The maximum hourly average value is 223.6μg/m^3 at 608.9meters, the maximum 24-Hours average is 100.7μg/m^3 at 623.0meters and the maximum annual average is 22.3μg/m^3 at 630.1meters

Table 6-6(B) shows the 1st Maximum values for the three years with their distances and locations referenced to point between the stacks.

SUMMARY OF AIR POLLUTION MODEL RESULTS FOR HELWAN SOUTH

Two Scenarios are done for Business as usual assuming the power plant is operating in full capacity, No Low NOx Burners as Scenario I and assuming Low NOx Burners as Scenario II.

Outage mode is not modeled as it is just less emissions than Business as usual.

Scenario	Max. Hourly Ave.	Max. 24-Hours Ave.	Max. Annual Ave.
	NO_2 μg/m^3	NO_2 μg/m^3	NO_2 μg/m^3
NoLoNOx	367.3	126.7	37.3
LoNOx	223.6	100.7	22.3
EEAA guidelines	400	150	

The air modeling predicts that the emissions guided by Business as usual mode, including both cases of without and with Low- NO_x burners will comply with the Egyptian Environmental Affairs Agency's (EEAA) guidelines.

Background Air Quality Levels

The model-predicted maximum concentrations were added to the representative ambient background concentrations in order to compare with the Egyptian Ambient Air Quality Limits (EAAQLs). The total maximum combined impact levels should be lower than the corresponding EAAQLs. The EAAQLs are defined in Law #4 of 1994 (Law for the Environment) established by the Egyptian Environmental Affairs Agency.

The representative onsite background air quality concentrations for the Helwan South Project were compiled and reported by the Air Pollution Preclusion Department, National Research Center in October 2010. Those background levels were collected at five monitoring stations located within the Helwan South site (see Figure 5-20). The averages of the monitored levels were treated as air quality levels representing background status at the Helwan South site for a one single day during 2010. NO_2, SO_2, and particulate matter (PM) background levels were measured on 24-hour basis, while the CO levels were measured on 8-hour basis. In order to obtain the 1-hour, 3-hour, and annual averaging background levels, the U.S. Environmental Protection Agency (EPA) suggested conversion factors (EPA, 1995) were used. Although other conversion factors are also available (Turner 1994), the EPA-suggested factors are more conservative; therefore, they were used in the study.

Commulative Impacts

Many significant existing sources of pollutants are placed in the wider area of the Helwan South site. Combined effects from the proposed Helwan South power project and the surrounding sources for nitrogen oxides (NOx) have been obtained using the background NOx measurements recorded for the Helwan South area via the NRC (*Table 6-4*).

As indicated in *Table 6-7*, the maximum total combined 24-hour impact level (138.79 $\mu g/m^3$, including the background level) is under the Egyptian 24-hour limit of 150 $\mu g/m^3$. The maximum 24-hour impact level of the Helwan South power project is 126.7 $\mu g/m^3$ (excluding the background level).

The maximum combined 1-hour impact level, including the highest value during 2008, is 397.52 $\mu g/m^3$. The Helwan South plant contributed 367.3$\mu g/m^3$ at this location.

Mitigation Measures

On the basis of the dispersion modeling results, no further mitigation measures are required to reduce stack emissions (i.e. beyond the use of natural gas and low-NOx burners). The stack height (152 meters) has been designed to reduce air pollutant concentrations and optimize atmospheric dilution of the stack plume and is considered adequate for this purpose.

Conclusion

Although these concentrations of pollutants have been established for the worst case operating conditions of the plant (continuous operation of both steam units at full load) using the primary fuel, they still remain below the Egyptian requirements and the World Bank guidelines corresponding to the air quality standards. Their addition to the existing background concentrations will not cause these standards and guidelines to be exceeded. Even the Helwan South area is considered a relatively polluted area, given its industrial setting, the plant will have no significant impact on the ambient air quality.

6.2.6 Fugitive Emissions from Fuel Storage Tanks

There will be two principal fixed-roof fuel storage tanks on the power plant site for storage of heavy fuel oil and one for storage of light fuel oil. Fugitive emissions from fixed-roof tanks may occur as a result of evaporation of the liquid fuel into the space between the roof and the liquid surface. This vapor may be emitted to the atmosphere through vents during the tank filling process. However, since the fuel oil consists of low volatility liquid and the tanks will only be filled infrequently (as these fuels will only be used if natural gas is unavailable), the potential for significant releases through venting of the tanks is limited and therefore the potential to cause odor nuisance is not considered to be significant. Additionally, the nearest receptors are relatively far.

Final Results

The executive regulations of the Egyptian Law No. 4 of the year 1994, article-42, item B regarding the elevations of chimneys, bullet No. 2 states the following:

"Chimneys from which a total of gaseous wastes reaches more than 15000 kg/hr: the height of the chimney shall be more than at least two and half times the height of surrounding buildings, including the building served by the chimney".

Therefore the minimum stack height for Helwan South Power Plant in accordance with the Egyptian Law No. 4 of the year 1994 is equal to approximately 37 x2.5 = 92.5 meters (where 37 m is the highest surrounding building or the highest building in the proposed power project). This is near to the stack height calculated by the GEP method.

Even though GEP height of stack is around 115 m, the stack height is designed to be 152 m considering the relatively degraded air quality of the Helwan South area.

Also, since the main pollutant emitted by the gas-fired Helwan South Project is nitrogen oxides (NOx), computations are made also with the designated GEP stack height of 152 m for obtaining the highest concentrations for each of the three averaging periods under consideration (annual, daily, hourly). The results obtained over the period of five years are presented in *Table 6-7.*

Based on the results presented in *Table 6-7,* the maximum annual impact area consistently occurred between 180° and 200° to the south - south - west from plant north at a distance of 630.1m from the origin point intermediating all the Helwan South power stack group locations. The majority of the 24-hour maximum impact areas due to the operation of the three Helwan South thermal supercritical units occurred between 175° and 180° at a distance 623 m. The maximum 1-hour impact levels are very similar among the three years (2007, 2008 & 2009) considered. The majority of the maximum impact areas occurred between 310° and 320° at plant north – west and at a distance of about 608.9m. A comparison of the estimated maximum concentrations with the relevant standards is given in *Table 6-7*.

Table 6-4 (A)

Egyptian Ambient Air Quality Limits, Law #4 ($\mu g/m^3$)

Averaging Time	SO_2	CO	NO_2	TSP	PM_{10}
1-hour	350	30,000	400	N/A	N/A
8-hour	N/A(1)	10,000	N/A	N/A	N/A
24-hour	150	N/A	150	230	150
Annual	60	N/A	N/A	90	70

Notes:

(1) N/A = Not Available.

Table 6-4 (B)

Helwan South Background Air Quality Levels (1) ($\mu g/m^3$),

Measured by the National Research Center within the Site Boundaries

Averaging Time	SO_2	$CO^{(2)}$	NO_2	TSP	PM_{10}
1-hour	19.62	2.9	30.22	N/A	N/A
8-hour	N/A(3)	N/A	N/A	N/A	N/A
24-hour	7.85	1.16	12.09	379.7	112(4)
Annual	1.57	N/A	2.42	75.9	22.4

Notes:

(1) Reference: Air Pollution Preclusion Department, National Research Center; Cairo, October 2010
(2) CO measured in mg/m^3 (EEAA 8 hrs mean = 10 mg/m^3).
(3) N/A = Not Available.
(4) Calculated 30% of TSP.

Table 6-5(A)

Estimated Maximum Average Concentrations of Nitrogen Dioxide, $\mu g/m^3$
[Three Helwan South Units (3x650 MWe) Burning Natural Gas without Low NOx Burners and Running as of BAU Scenario]
[Stack Height = 152m]

No.	1-hr				24-hrs				Annual			
	Max. Hourly Ave.				Max. 24-Hours Ave.				Max. Annual Ave.			
	NO2	Dis.	x	y	NO2	Dis.	x	y	NO2	Dis.	x	Y
1	367.3	608.9	-305.0	527.0	126.7	623.0	5.1	-622.9	37.3	630.1	-95.0	-622.9
2	364.0	541.2	-305.0	447.1	126.0	623.0	5.1	-622.9	35.4	541.3	-95.0	-532.9
3	345.9	672.8	-614.9	-272.9	125.5	570.9	-204.8	-532.9	35.0	655.8	-204.8	-622.9
4	343.8	714.8	105.1	707.1	124.7	713.0	5.1	-713.0	33.6	462.8	-95.0	-453.0
5	343.1	641.6	-614.9	-182.9	123.7	655.8	-204.8	-622.9	33.5	719.3	-95.0	-713.0
6	342.9	664.6	-404.9	527.0	123.4	630.1	-95.0	-622.9	32.8	630.1	-95.0	-622.9
7	342.8	738.0	-404.9	617.0	123.3	631.7	105.1	-622.9	32.6	623.0	5.1	-622.9
8	342.6	653.5	215.1	617.0	121.9	497.2	-204.8	-453.0	31.6	693.6	-305.0	-622.9
9	342.1	739.1	215.1	707.1	121.8	719.3	-95.0	-713.0	30.7	570.9	-204.8	-532.9
10	341.8	625.9	105.1	617.0	121.6	453.0	5.1	-453.0	30.7	532.9	5.1	-532.9
11	337.5	765.2	-714.9	-272.9	120.6	541.3	-95.0	-532.9	30.2	828.7	-204.8	-803.0
12	337.3	623.0	5.1	-622.9	120.4	803.0	5.1	-803.0	29.8	808.6	-95.0	-803.0
13	335.6	678.3	-504.9	-453.0	119.7	543.2	105.1	-532.9	29.6	497.2	-204.8	-453.0
14	333.8	630.1	-95.0	-622.9	119.6	720.7	105.1	-713.0	29.5	713.0	5.1	-713.0
15	333.8	763.8	-614.9	-453.0	118.4	465.0	105.1	-453.0	29.5	614.0	-305.0	-532.9

Table 6-5(B)

Estimated Maximum Average Concentrations of Nitrogen Dioxide, μg/m³
[Three Helwan South Units (3x650 MWe) Burning Natural Gas without Low NOx Burners and Running as of BAU Scenario]
[Stack Height = 152m]

	Max. Hourly Ave.				Max. 24-Hours Ave.				Max. Annual Ave.			
	NO2 μg/m³	Dis.	x	y	NO2 μg/m³	Dis.	x	y	NO2 μg/m³	Dis.	x	y
2007	345.9	672.8	-614.9	-272.9	125.5	570.9	-204.8	-532.9	32.2	655.8	-204.8	-622.9
2008	367.3	608.9	-305.0	527.0	126.7	623.0	5.1	-622.9	37.3	630.1	-95.0	-622.9
2009	342.9	664.6	-404.9	527.0	126.0	623.0	5.1	-622.9	32.8	630.1	-95.0	-622.9

Table 6-6(A)

Estimated Maximum Average Concentrations of Nitrogen Dioxide, μg/m³
[Three Helwan South Units (3x650 MWe) Burning Natural Gas with Low NOx Burners and Running as of BAU Scenario]
[Stack Height = 152m]

	Max. Hourly Ave.				Max. 24-Hours Ave.				Max. Annual Ave.			
	NO2	Dis.	x	y	NO2	Dis.	x	y	NO2	Dis.	x	y
1	223.6	608.9	-305.0	527.0	100.7	623.0	5.1	-622.9	22.3	630.1	-95.0	-622.9
2	217.4	541.2	-305.0	447.1	98.9	532.9	5.1	-532.9	21.1	541.3	-95.0	-532.9
3	206.6	672.8	-614.9	-272.9	97.6	570.9	-204.8	-532.9	20.9	655.8	-204.8	-622.9
4	205.4	714.8	105.1	707.1	96.2	713.0	5.1	-713.0	20.1	462.8	-95.0	-453.0
5	204.9	641.6	-614.9	-182.9	94.4	655.8	-204.8	-622.9	20.0	719.3	-95.0	-713.0
6	204.8	664.6	-404.9	527.0	94.0	630.1	-95.0	-622.9	19.7	741.8	-204.8	-713.0
7	204.7	738.0	-404.9	617.0	93.8	631.7	105.1	-622.9	19.6	541.3	-95.0	-532.9
8	204.6	653.5	215.1	617.0	91.6	497.2	-204.8	-453.0	19.2	655.8	-204.8	-622.9
9	204.3	739.1	215.1	707.1	91.4	719.3	-95.0	-713.0	18.3	570.9	-204.8	-532.9
10	204.1	625.9	105.1	617.0	91.2	453.0	5.1	-453.0	18.3	532.9	5.1	-532.9
11	201.6	765.2	-714.9	-272.9	89.8	541.3	-95.0	-532.9	18.0	828.7	-204.8	-803.0
12	201.4	623.0	5.1	-622.9	89.5	803.0	5.1	-803.0	17.8	808.6	-95.0	-803.0
13	200.4	678.3	-504.9	-453.0	88.6	543.2	105.1	-532.9	17.7	497.2	-204.8	-453.0
14	199.4	630.1	-95.0	-622.9	88.5	720.7	105.1	-713.0	17.6	713.0	5.1	-713.0
15	199.4	763.8	-614.9	-453.0	86.9	465.0	105.1	-453.0	17.6	614.0	-305.0	-532.9

Table 6-6(B)

Estimated Maximum Average Concentrations of Nitrogen Dioxide, μg/m³
[Three Helwan South Units (3x650 MWe) Burning Natural Gas without Low NOx Burners and Running as of BAU Scenario]
[Stack Height = 152m]

	Max. Hourly Ave.				Max. 24-Hours Ave.				Max. Annual Ave.			
	NO2 μg/m³	Dis.	x	y	NO2 μg/m³	Dis.	x	y	NO2 μg/m³	Dis.	x	y
2007	206.6	672.8	-614.9	-272.9	97.6	570.9	-204.8	-532.9	19.2	655.8	-204.8	-622.9
2008	223.6	608.9	-305.0	527.0	100.7	623.0	5.1	-622.9	22.3	630.1	-95.0	-622.9
2009	204.8	664.6	-404.9	527.0	98.9	532.9	5.1	-532.9	19.6	541.3	-95.0	-532.9

Table 6-7

Commulative Effect of the Proposed Helwan South Gas-Fired Power Project and the Surrounding Pollution Load (Air Dispersion Modeling Results, in addition to the Background levels in the Background Atmosphere) (Stack Height = 152 m)

Pollutant	NO_2 (1)	NO_2	NO_2
Averaging Period, µg/m^3	1 hr	24-hr	Annual
First Maximum, µg/m^3	367.3 (4) (-305.0m, 527.0m)	126.7 (5.1m, -622.9m)	37.3 (-95.0m, -622.9m)
Background Level (measured by NRC) (2)	30.22	12.09	2.42
Total, µg/m^3	397.52	138.79	39.72
Egyptian Limit, µg/m^3	400	150	N/A (3)
World Bank Guideline, µg/m^3	No Limit	150	

Notes:

(1) NO_2 : There are no NOx Egyptian Standards for ambient air quality.
(2) NRC = National Research Center.
(3) N/A = Not Available.
(4) Worst case without Low-NOx burners, eventhough the power plant Boilers will be equipped by Low-NOx burners.

Figure 6-6(A)

NO_2-Maximum Annual Mean Concentrations in $\mu g/m_3$
[Three Helwan South Units (3x650 MWe) Burning Natural Gas without Low NOx Burners and Running as of BAU Scenario]

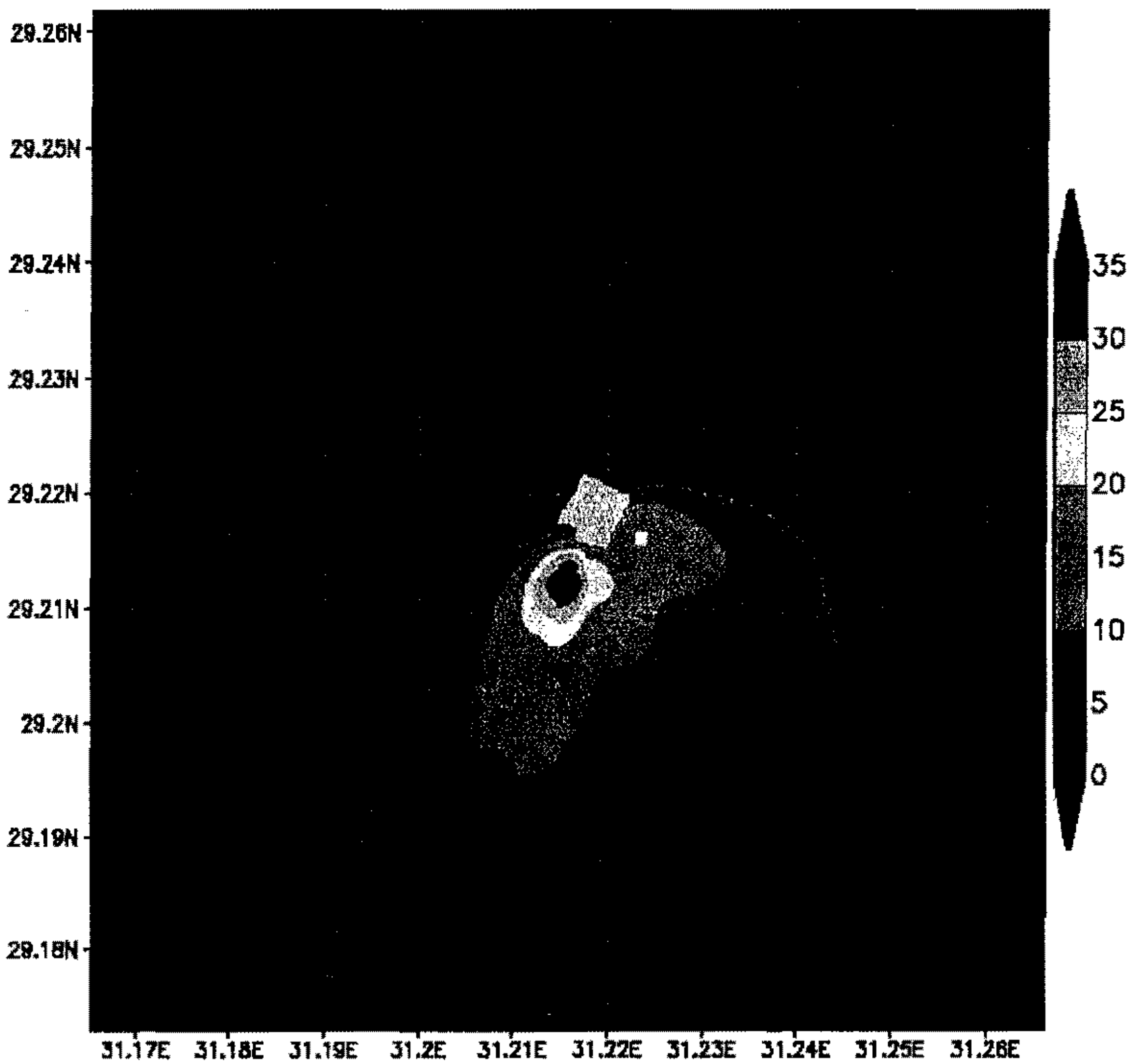


Figure 6-6(B)

NO_2-Maximum Annual Mean Concentrations in $\mu g/m_3$
[Three Helwan South Units (3x650 MWe) Burning Natural Gas without Low NOx Burners and Running as of BAU Scenario]

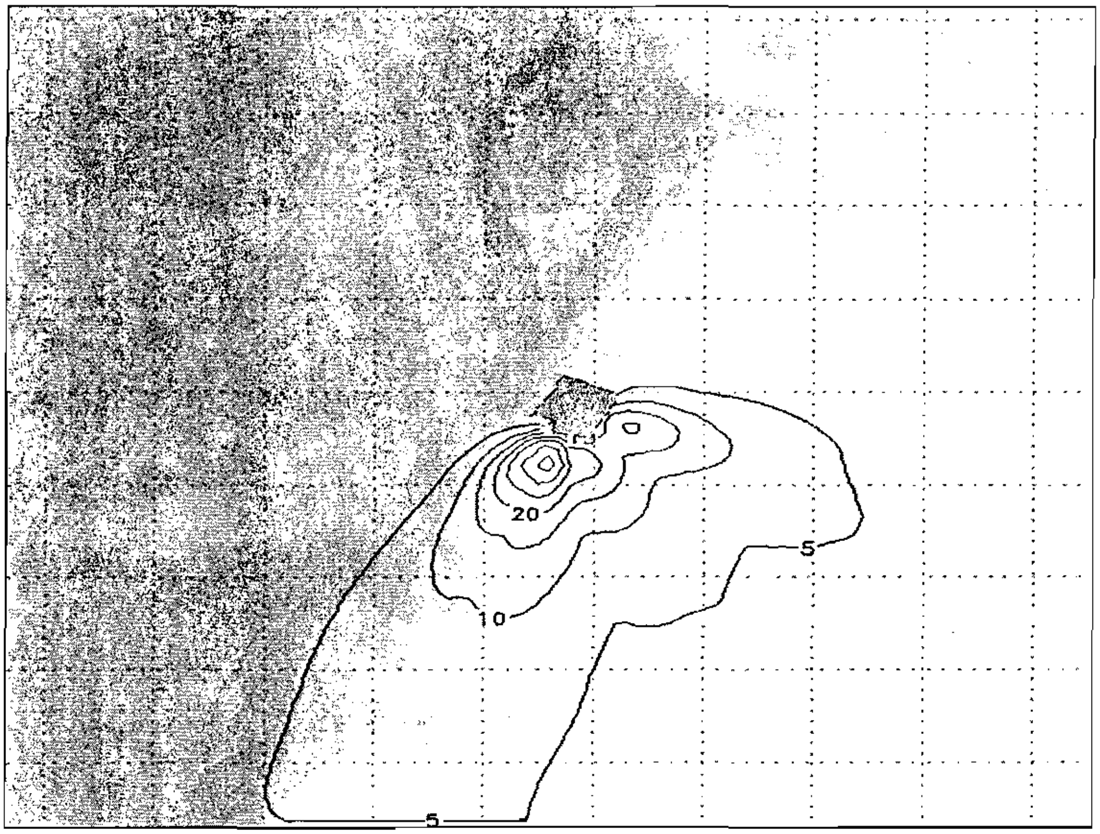


Figure 6-7(A)

NO_2-Maximum 24 Hrs (Daily) Mean Concentrations in $\mu g/m_3$
[Three Helwan South Units (3x650 MWe) Burning Natural Gas without Low NOx Burners and Running as of BAU Scenario]

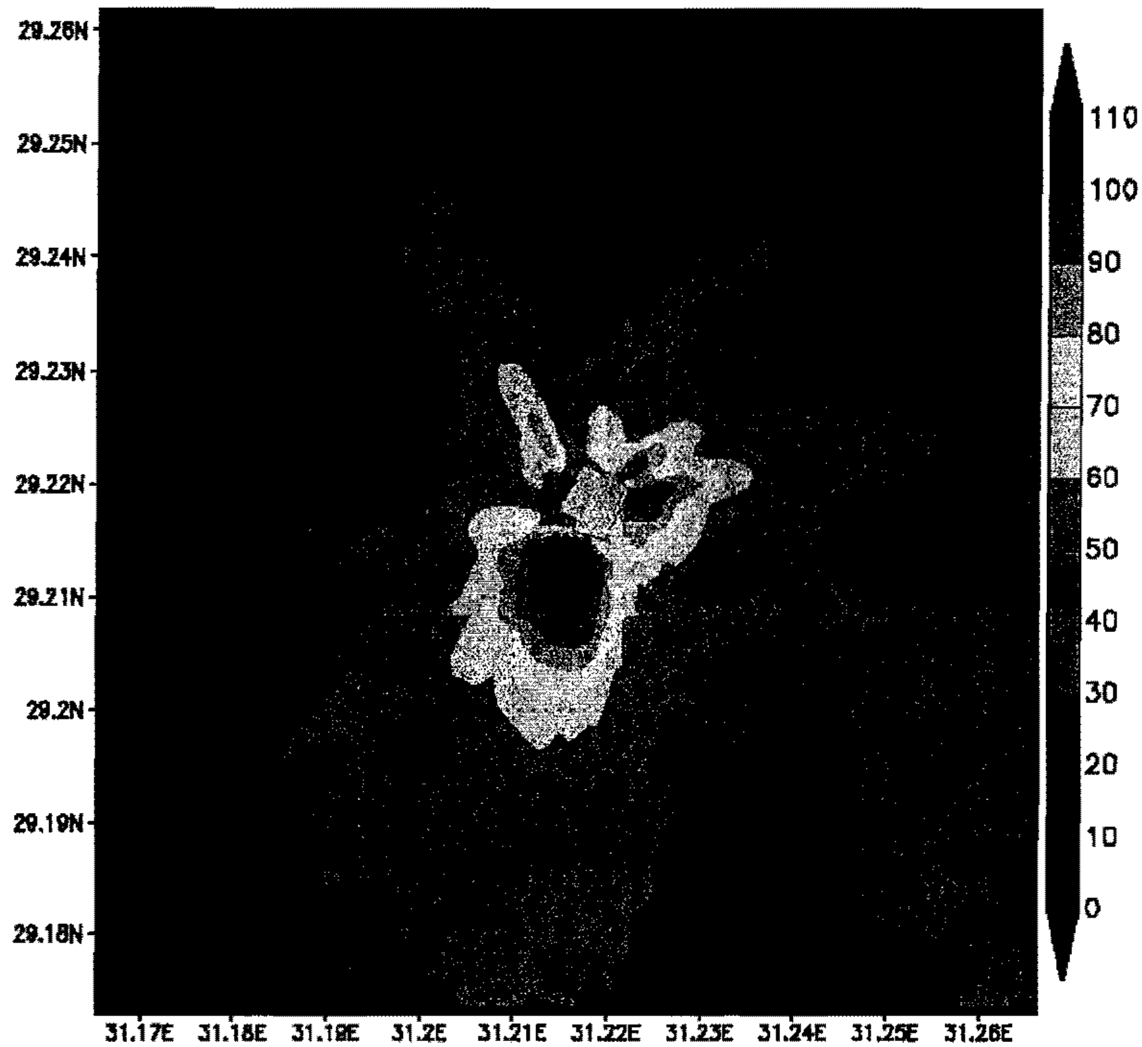


Figure 6-7(B)

NO_2-Maximum 24 Hrs (Daily) Mean Concentrations in μg/m_3
[Three Helwan South Units (3x650 MWe) Burning Natural Gas without Low NOx Burners and Running as of BAU Scenario]

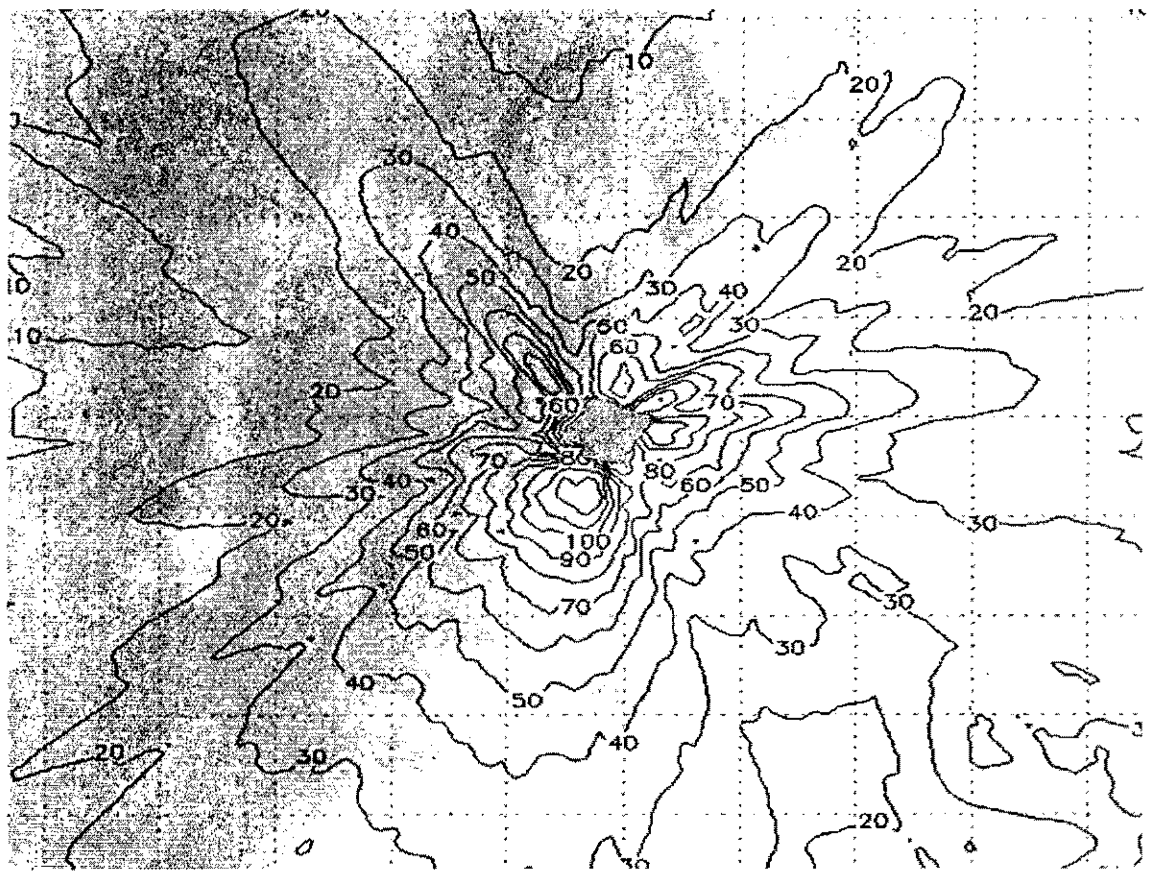


Figure 6-8(A)

NO_2-Maximum 1 Hr (Hourly) Mean Concentrations in µg/m3
[Three Helwan South Units (3x650 MWe) Burning Natural Gas without Low NOx Burners and Running as of BAU Scenario]

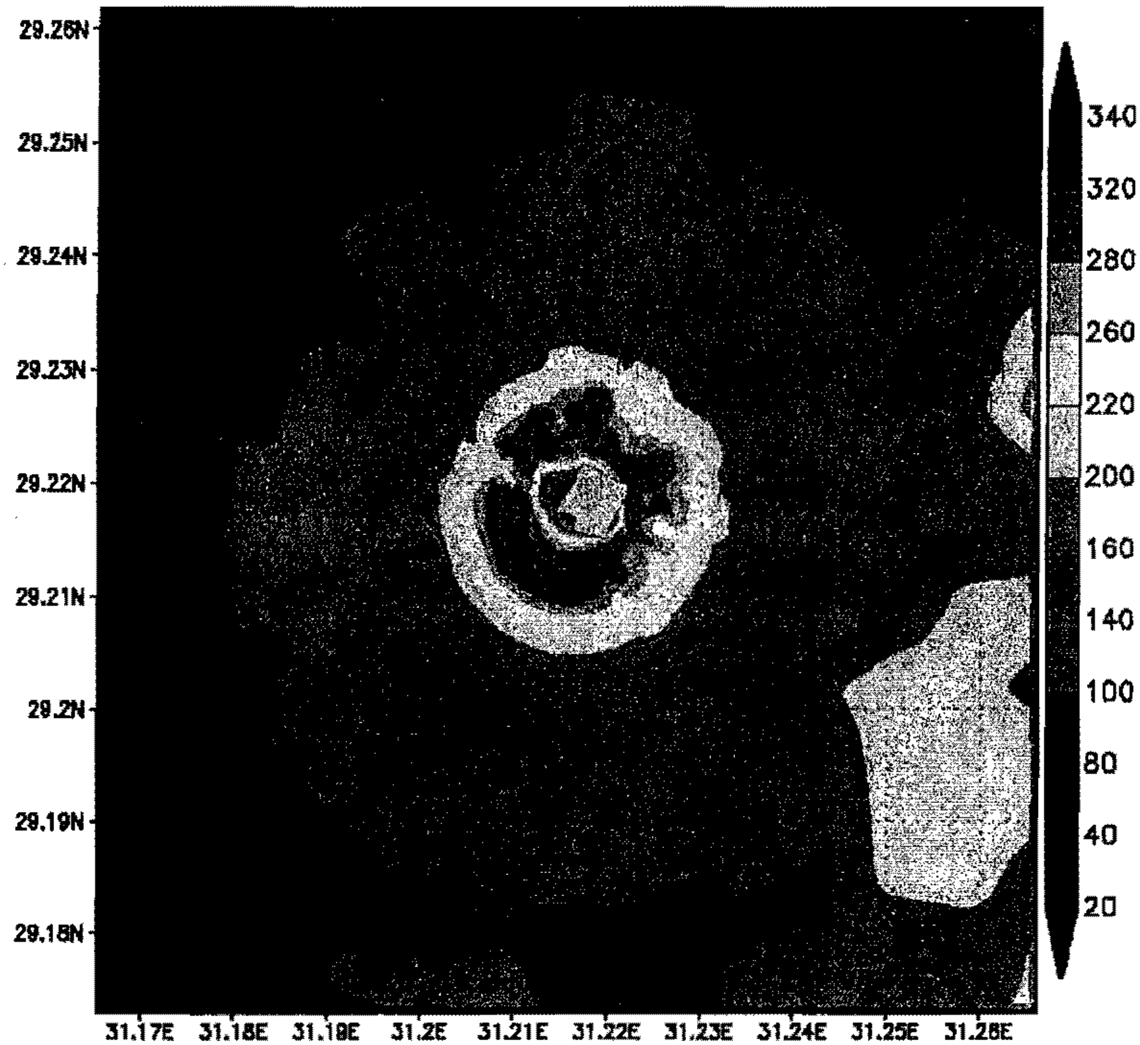


Figure 6-8(B)

NO_2-Maximum 1 Hr (Hourly) Mean Concentrations in $\mu g/m_3$
[Three Helwan South Units (3x650 MWe) Burning Natural Gas
without Low NOx Burners and Running as of BAU Scenario]

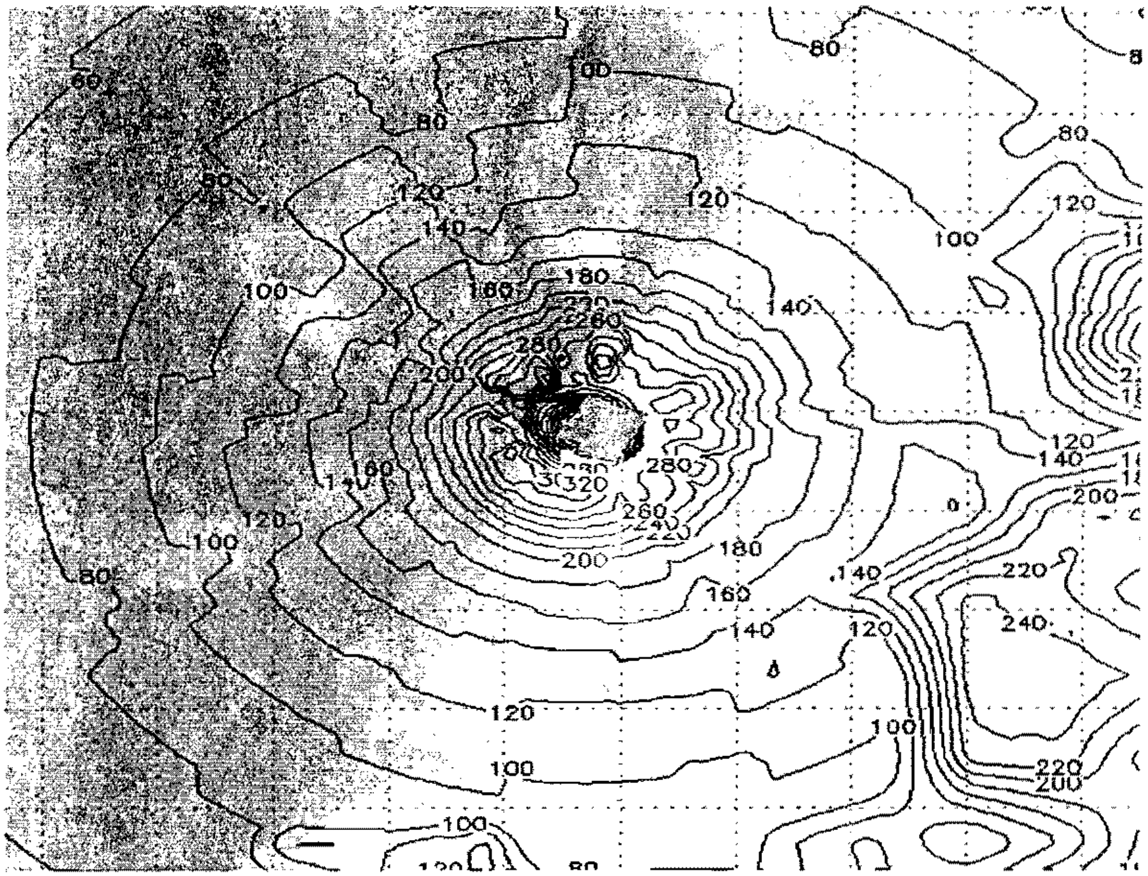


Figure 6-9(A)

NO_2-Maximum Annual Mean Concentrations in $\mu g/m_3$
[Three Helwan South Units (3x650 MWe) Burning Natural Gas
with Low NOx Burners and Running as of BAU Scenario]

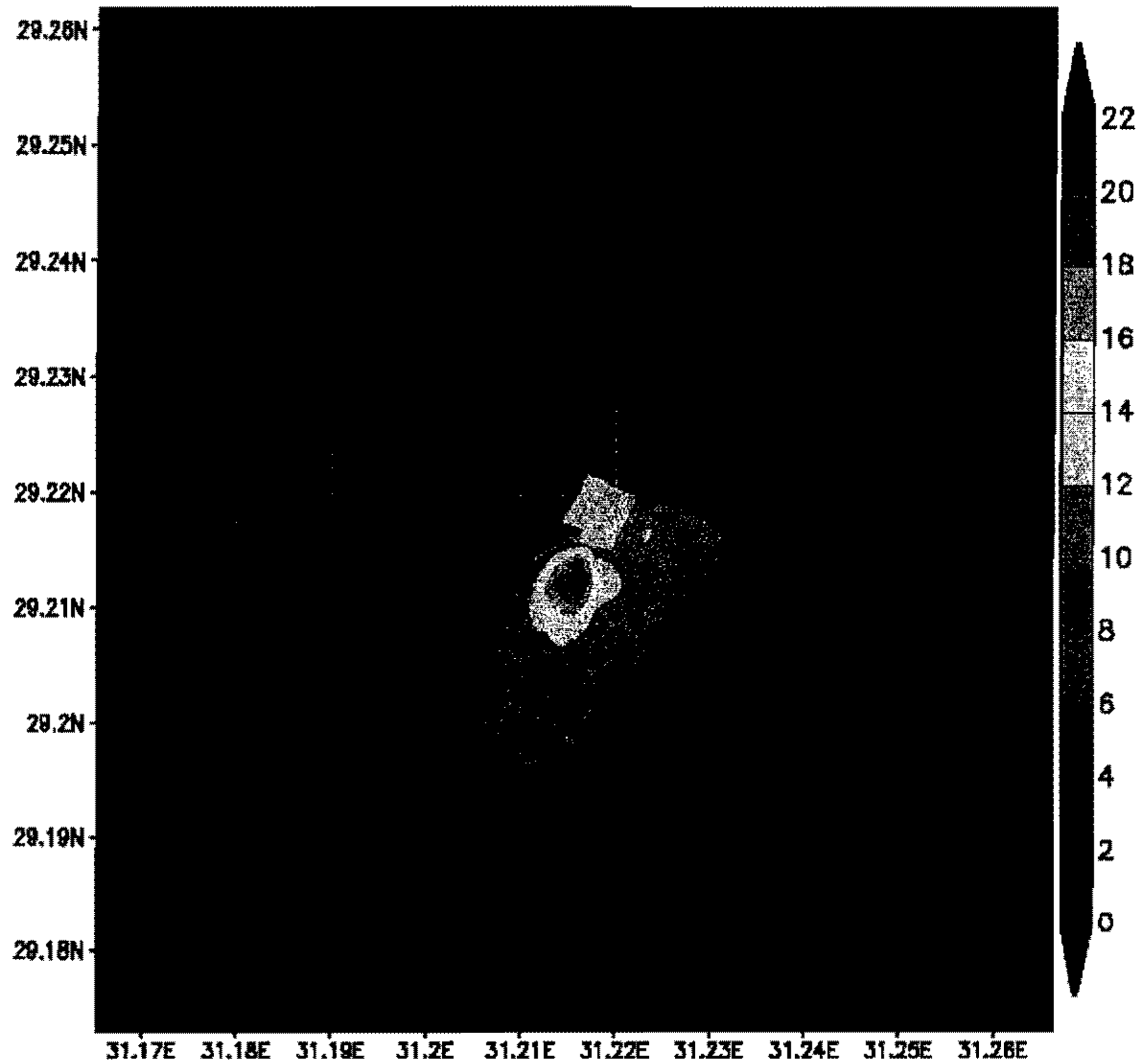


Figure 6-9(B)

NO_2-Maximum Annual Mean Concentrations in $\mu g/m_3$
[Three Helwan South Units (3x650 MWe) Burning Natural Gas
with Low NOx Burners and Running as of BAU Scenario]

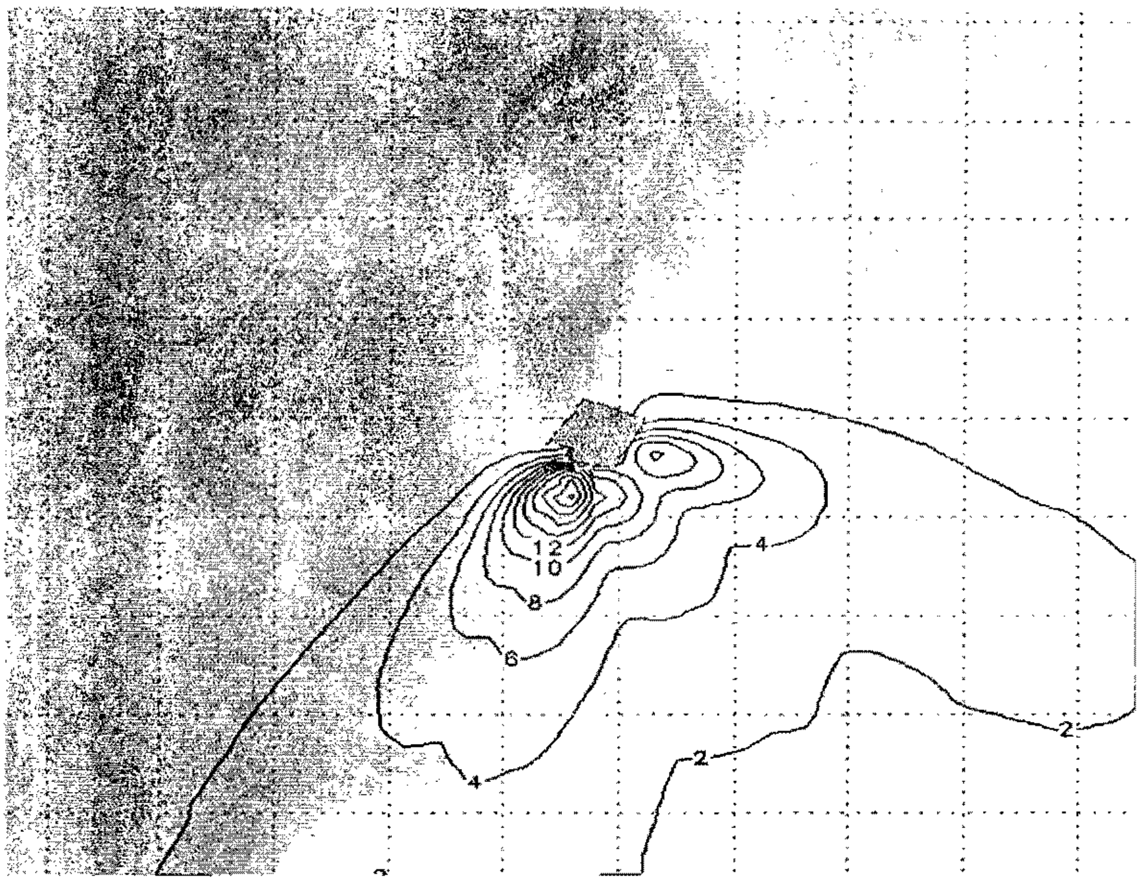


Figure 6-10(A)

NO_2-Maximum 24 Hrs (Daily) Mean Concentrations in μg/m₃
[Three Helwan South Units (3x650 MWe) Burning Natural Gas with Low NOx Burners and Running as of BAU Scenario]

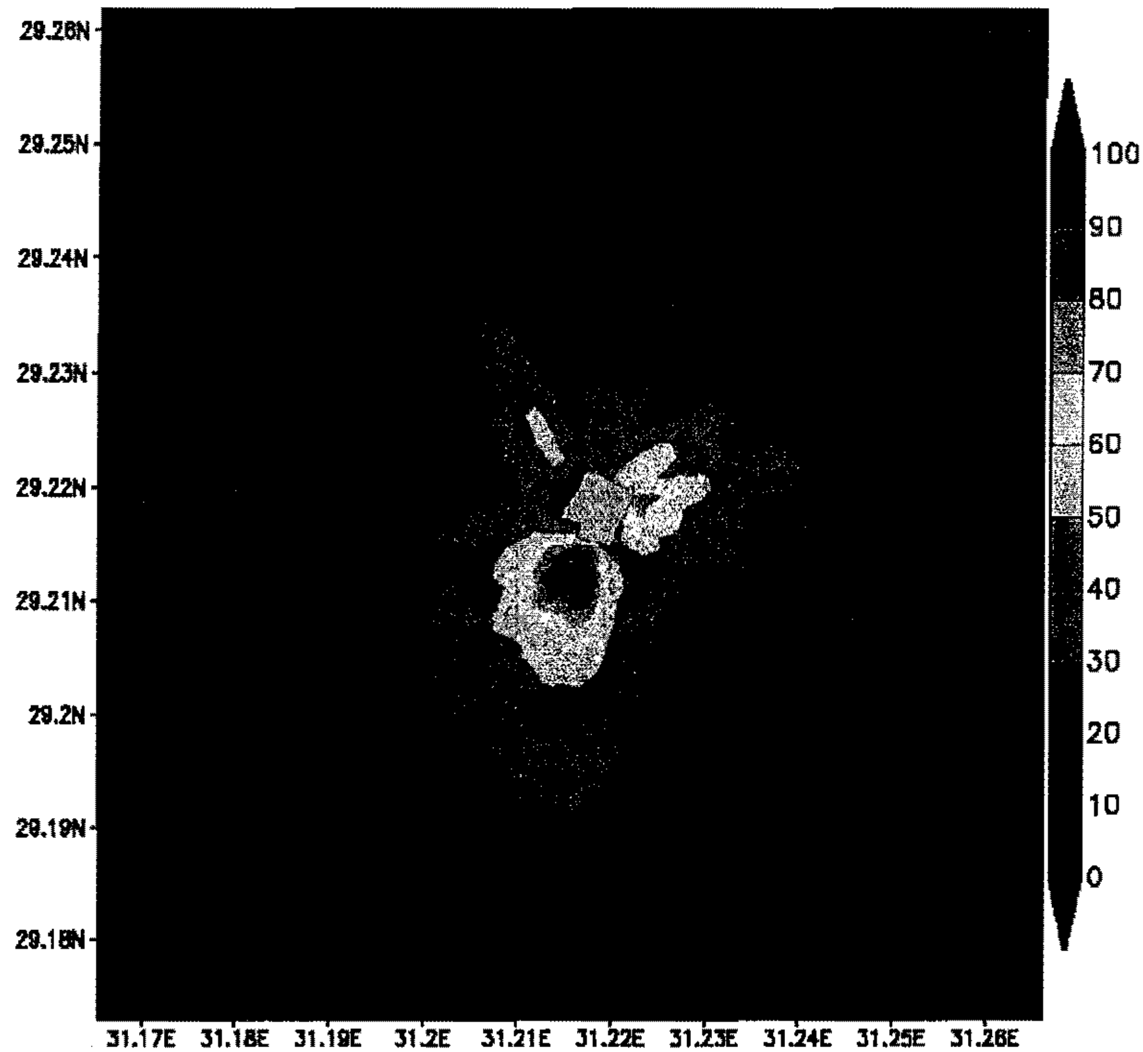


Figure 6-10(B)

NO_2-Maximum 24 Hrs (Daily) Mean Concentrations in $\mu g/m_3$
[Three Helwan South Units (3x650 MWe) Burning Natural Gas
with Low NOx Burners and Running as of BAU Scenario]

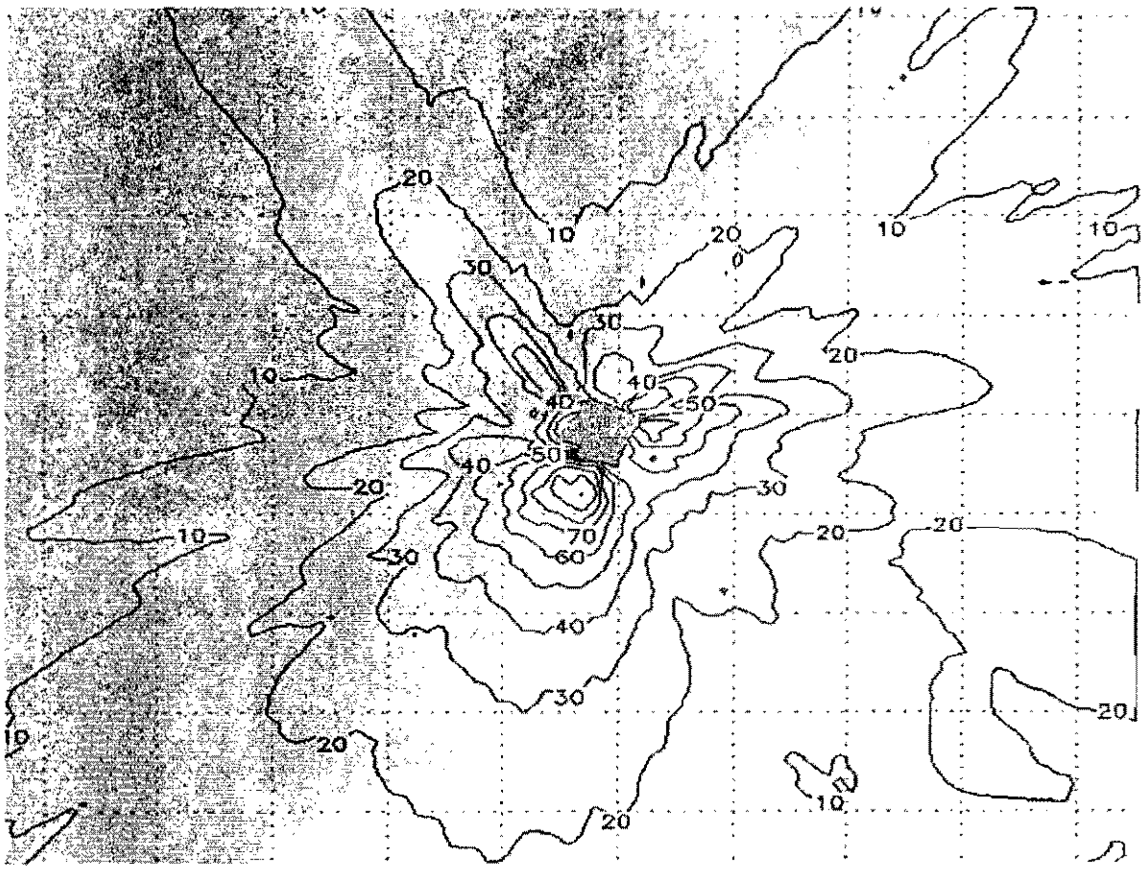


Figure 6-11(A)

NO_2-Maximum 1 Hr (Hourly) Mean Concentrations in µg/m3
[Three Helwan South Units (3x650 MWe) Burning Natural Gas with Low NOx Burners and Running as of BAU Scenario]

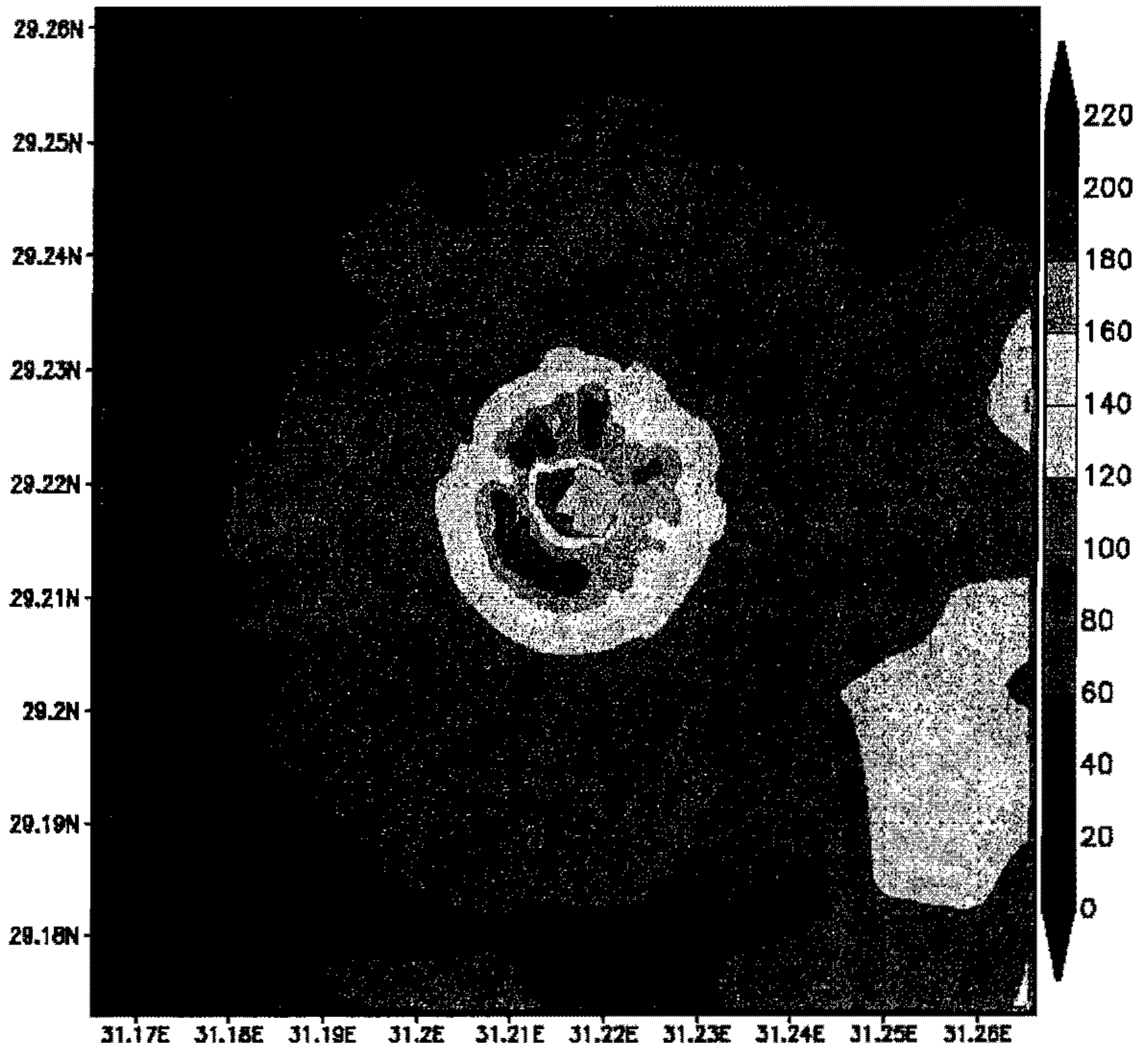


Figure 6-11(B)

NO_2-Maximum 1 Hr (Hourly) Mean Concentrations in $\mu g/m_3$
[Three Helwan South Units (3x650 MWe) Burning Natural Gas with Low NOx Burners and Running as of BAU Scenario]

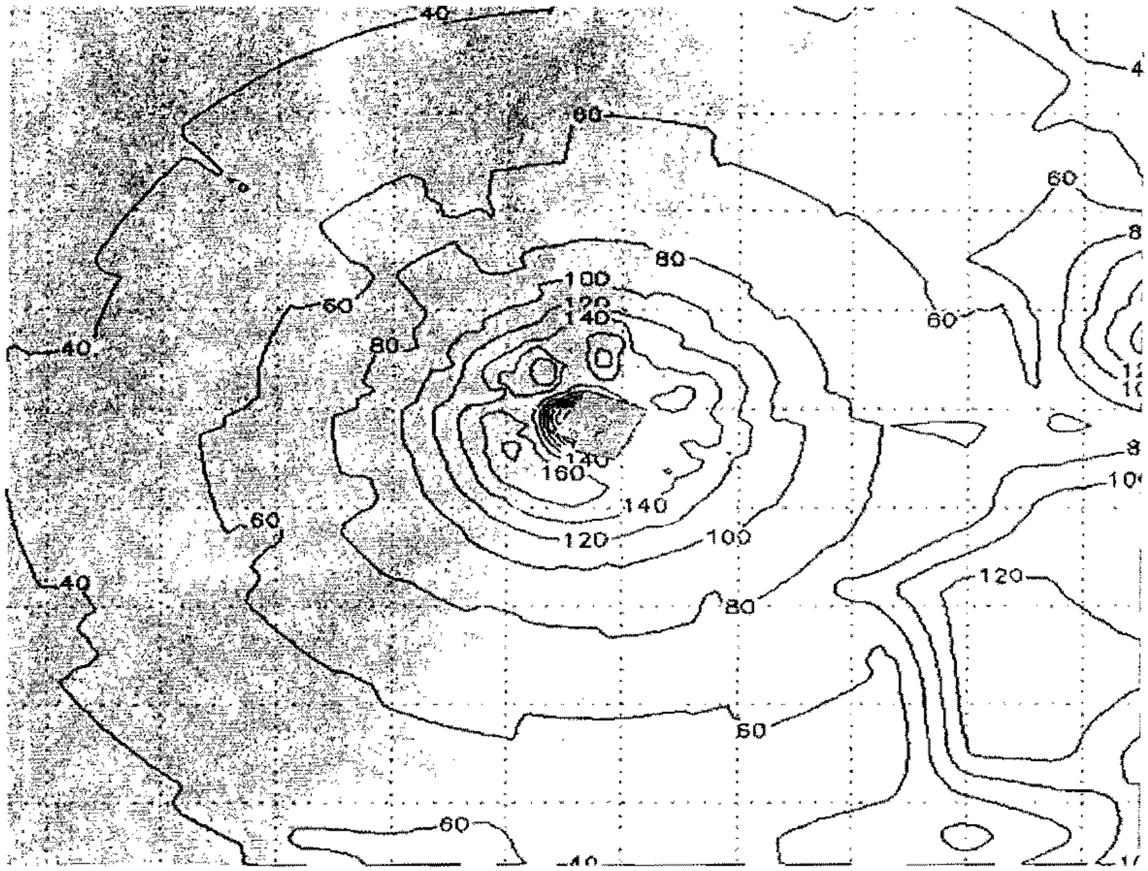
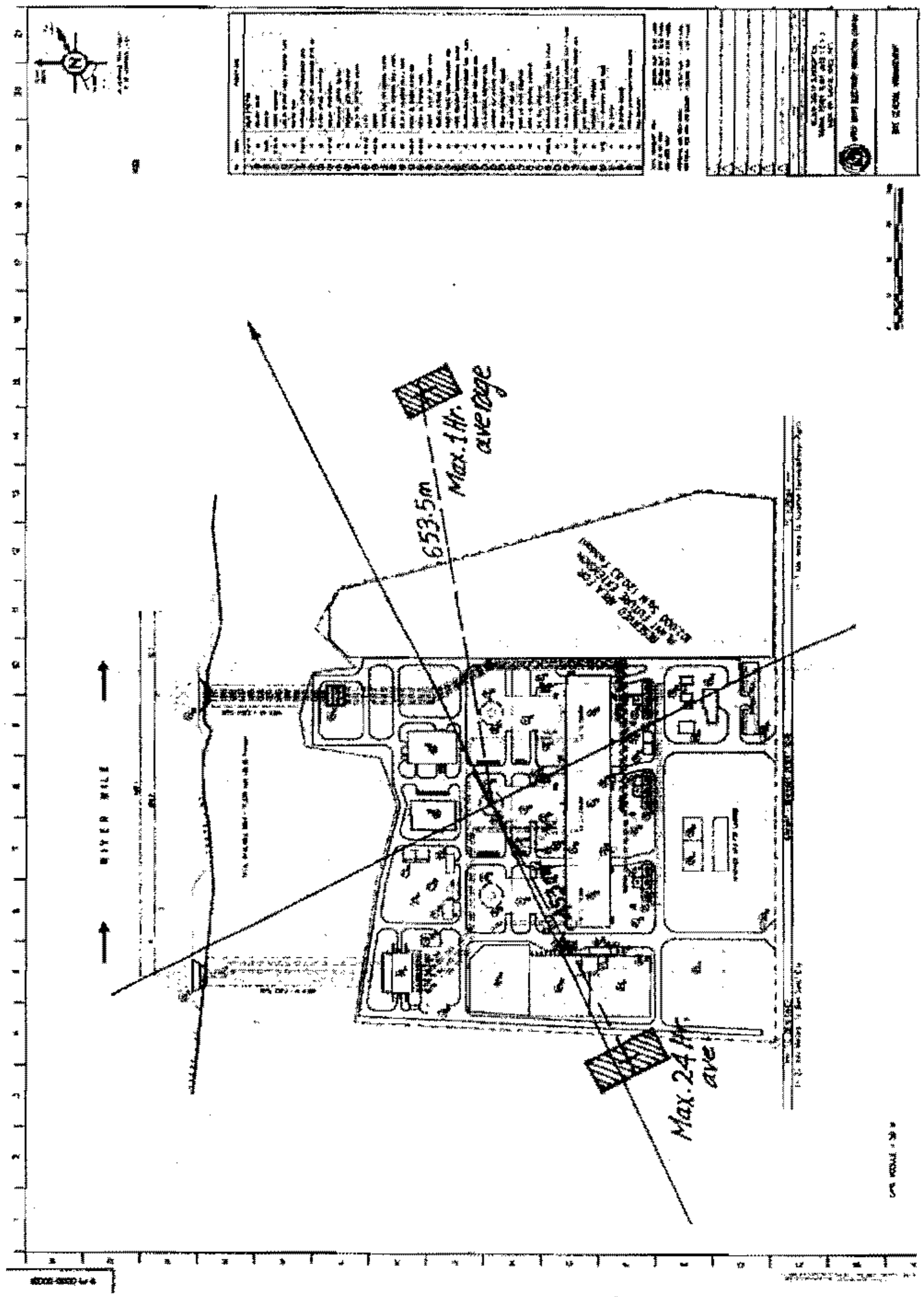


Figure 6-12

Proposed Locations of the Air Quality Monitoring Stations



6.3 AQUATIC ENVIRONMENT

6.3.1 Introduction

This section considers the significance of potential impacts to the aquatic environment from the construction and operation of the Helwan South power plant. The section is based on preliminary design work undertaken by the Consultant and survey and modeling work undertaken by the Hydraulics Research Institute (HRI).

6.3.2 Potential Construction Impacts

The potential impacts on the aquatic environment during construction are likely to occur as a result of:

- laying of pipes across the Nile bankline;
- dredging process for the intake and outfall structures;
- construction of the inlet and discharge structures;
- natural surface drainage of contaminants and sediments (if any) ; and
- discharge of solid wastes and industrial liquid effluents into the River Nile.

The potential impacts that can be anticipated as a result of these activities are summarized in *Table 6-8* below.

Physical Aquagraphy

The construction methodology for the discharge and intake structures remains to be defined. Dredging will, however, be required for both the intake and discharge structures. This is likely to result in very local alteration of the prevailing currents immediately adjacent to the dredging works. This in turn will result in some local and limited changes to scouring and deposition rates adjacent to the dredging works.

The impacts identified are considered acceptable and no mitigation measures are proposed. The construction method for the intake and discharge structures will include an acceptable operational procedure which will minimize the impacts from dredging and construction on sedimentation. This should be included in any contract which UEEPC commission.

During construction, soils dredged will be disposed of via a licensed contractor. No special permit is required and no significant impacts are anticipated.

Water Quality and Effluents

Construction activities could potentially also result in the release of solid wastes and effluents to the Nile river or ground water. A stormwater collection system, which is discussed in more details in Section 6.7.3, will be provided that will include oil interceptors. Sanitary effluents will be disposed of via plant sewer system. Solid wastes will be disposed of by a licensed contractor.

Aquatic Ecology

There are a number of impacts associated with the construction of the intake and discharge channels:

- temporary loss of bank habitat;
- permanent loss of aquatic habitat;
- new bank surface habitat will be generated due to the material used in the construction of the intake and outfall structures and will be colonized by algae and organisms and may encourage fish species; and
- disturbance of benthic and mobile fauna and flora as a result of settlement of suspended sediments through interference with feeding mechanisms, gills and reduction of photosynthetic activity.

With regard to the loss and disturbance to benthic fauna and flora the following should be noted:

- the area where losses may occur is relatively small in the context of the Nile river, the construction of the cooling water structures will disturb a very limited area. The sensitivity of the benthos in this area is low, since much of the riverbed being degraded with poor biodiversity;
- much of the losses are temporary in nature and it can be expected that dredged sediments will be re-colonized within a relatively small period; and
- field survey information did not identify any fauna, flora or habitats of conservation importance.

The impacts of the power plant on birds is discussed in Section 6.5.

Fish and Fisheries

The impacts on fish and commercial fisheries are expected to include the short term and local effects due to elevated concentrations of suspended sediments and pollutants in the water column. The natural dilution and dispersion in the area of construction will ensure that the suspended sediment load and elevated pollutant levels are rapidly reduced to background levels. The survey of the project indicated that the area was limited in fish populations.

In addition to suspended sediment and pollutant loads there may be physical disruption to fishing activity due to dredging. However, given that the area adjacent to the power plant is not currently used for commercial fishing, the overall impact is not considered significant.

The impacts identified relating to water quality are considered not significant and no mitigation measures are proposed.

With regard to river / bankal birds, construction activities will cross landflats from the Nile river to the steam turbine condenser during laying of water intake and discharge pipes. The Nile bank affected will however be restored, using material which has been excavated. Significant impacts to birds in this area are therefore considered unlikely (see Section 6.5).

Access to the Nile Bankline

The area of Nile Bankline affected by the construction of the cross bank pipelines and discharge / intake structures is not currently used for leisure or recreation. The construction activities are not therefore expected to affect the Nile River Bankline access.

6.3.3 Evaluation of Potential Construction Impacts

Construction of the Cooling Water Infrastructure

The cooling water will be abstracted from, and discharged to, the Nile River through offshore intake/outfall pipelines. The channels will be additional protected by layers of rocks. Construction of these structures will therefore require trenching as well as rock dumping.

The principal impacts of this activity will be as follows:

- Disturbance of a limited area of reiverbed will occur along the pipeline alignments. The disturbed area will be very limited for the intake and for the outfall. Given that the benthic fauna is impoverished in the area, this will not constitute a significant impact. Furthermore, it is understood that the Nilebed is relatively mobile and prone to natural seasonal disturbances. The biological community will therefore be pre-adapted to mechanical perturbations and is likely to recover rapidly once construction is completed.
- Nilebed sediments will be re-suspended during trenching, locally increasing turbidity and possibly re-mobilizing sediment associated contaminants. The sediments in the region are, however, predominantly mud & sand. This will not only reduce the time of suspension but also suggests that significant chemical remobilization is unlikely, as pollutants are generally associated with the finer sediment fractions. In any event, the limited duration and areal extent of trenching means that any sediment re-suspension will be minor and transient.
- Resettlement of suspended sediment and rock dumping will smoother approximately limited area of Nilebed. As previously stated, the absence of a rich benthic fauna indicates that no significant aquatic ecological impacts will occur.

The intake velocity cap and chlorination structure is planned to be prefabricated and installed by barge mounted crane, which will avoid the need for in-situ casting which might otherwise result in the release of cement into the Nile with subsequent toxicological impacts on flora and fauna. The intake velocity of the water combined with the chlorination of the intake should serve to minimize biofouling *(see Section 6.3.5)*, removing the need for additional antifouling coatings which, by their very nature, are toxic.

To minimize the potential for impacts on the aquatic environment during the construction of the intake and outfall pipings, the following measures will be undertaken:

Table 6-8

Summary of Potential Construction Impacts on the Aquatic Environment

Activity	Potential Impacts

Dredging	• Elevated suspended sediment levels. • Elevated concentrations of pollutants released from sediments into water column. • Loss of aquatic habitat. • Disturbance to benthic animals. • Disturbance to mobile animals including fish and birds. • Disturbance due to disposal of dredged materials. • Disturbance to fishing. • Navigational constraints.
Construction of discharge and intake structures	• Discharge of effluents to the Nile River. • Permanent loss of aquatic habitat. • Navigational constraints. • Disturbance to fishing. • Elevated suspended sediment levels. • Alteration of sediment transport regime. • Disturbance to birds.
Water runoff	• Elevated suspended sediment levels. • Oily water effluent discharge. • Elevated concentrations of pollutants released from sediments into water column.
Construction works across bankline	• Temporary disturbance to bankline habitat. • Elevated suspended sediment levels. • Elevated concentrations of pollutants released from sediments into water column. • Disturbance to birds.

- Construction works in the aquatic environment will be undertaken in consultation with the Competent Administrative Authority (CAA) and will be designed to minimize the area affected by the works, duration of construction and potential disturbance of the bankline, Nilebed and benthic communities;

- Following construction, areas which were affected will be reinstated in a manner which encourages the restoration of benthic communities;

- Dredging of material and Nilebed disposal will be carried out under the conditions agreed with the CAA, and licensed spoil disposal and borrow areas will be used;

- Construction methods in the aquatic environment will be agreed upon with the CAA prior to the development of the cooling system.

Due to the ability of the Nile bed to rapidly cover post-disturbance, the effects of the construction are predicted to be short-term and of minor significance.

Construction of the Power plant

There are no other surface water resources than the River Nile present on, or immediately adjacent to, the site, therefore there will be no direct impacts from landtake and the pollution risk from construction is low. The potential sources of impact on the aquatic environment during construction are as follows:

- Alteration of drainage and changes in volumes and flow rates of runoff. Alteration of drainage will be due to compaction of soil and increased hardstanding areas. This will reduce infiltration and increase runoff. In addition, existing drainage patterns may be altered.

- Discharge of potentially contaminated construction site drainage may occur, including from vehicle washing, refueling areas, etc.

- Dust from construction may be deposited in local watercourses.

The construction of the power plant will include a range of mitigation measures designed to prevent or minimize the above, as follows:

- As part of the site preparation and preliminary works, a temporary, engineered drainage system will be provided to collect and contain the construction site drainage. The drainage system will provide the opportunity to control the volume, rate and timing of the discharge, and incorporate the ability to monitor the drainage prior to discharge.

- Suspended solids and oil interceptors, such as settling lagoons or oil/water separators, will be installed for the removal of pollutants from site drainage and for the retention and containment of any accidental contamination of the site drainage.

- Fuel and other permanent liquid chemical storage tanks will be protected by bund walls to give a containment capacity of at least 110% of the tank volume. Temporary storage areas will be bunded by soil to give a containment capacity of at least 110% of the storage capacity.

- Fixed refuelling areas will be equipped with contained drainage systems and, if appropriate, designated oil interceptors.

- A storm water pond or similar measures will be provided to hold and balance flows during periods of high rainfall, allowing discharge to be made without increasing flood risks.

- All solid waste management practices, such as storage of spoil, will be undertaken with the incorporation of good house-keeping to prevent accidental release of dust or uncontrolled run-off.

- Dust suppression measures will be employed as set out in Section 6.2.2.

- Sanitary wastewater, comprising sewage and washing water generated by the construction workforce, will be disposed of through one of two routes:

  - chemical toilet or septic tank sanitary systems will be used, with the sewage being removed by contractors for off-site disposal;
  - sewage and washing effluent will be discharged to the local sewer system, if any.

Due to the absence of watercourses immediately on or surrounding the site (the Nile River is about 300-400m far from the western side of the site boundary) the sensitivity of surface water receptors to pollution is low. This low sensitivity, in association with the inclusion of the above mitigation measures, means that no adverse impacts on local surface water resources will occur.

6.3.3 Potential Impacts During Power Plant Operation

The potential impact of the power plant on the aquatic environment could be the result of:

- the presence of new structures;
- the temperature of effluents discharged into the Nile River; and
- the chemical composition of effluents discharged.

The potential impacts related to the operation of the power plant are summarized in *Table 6-9* and are discussed in further detail below.

Table 6-9

Operation Related Environmental Impacts

Issue	Impacts
Presence of new structures	• Sediment scour. • Disruption to sediment transport along Nile bankline. • Navigational constraints. • Fisheries constraints.
Discharge	• Impact of elevated temperatures on water quality and aquatic ecology (oxygen saturation in particular). • Discharge of chemicals.
Intake	• Entrainment of fish and mobile organisms.

6.3.5 Evaluation of Potential Operational Impacts

Abstraction of Cooling Water

The largest water requirement of the power plant is for cooling water, which will be abstracted at a rate of 69 m^3/sec. for both two units. The cooling water will be abstracted directly from the Nile River, and accordingly there will be no impact on any inland surface water resources. The principal potential impacts of large scale abstractions, such as the proposed cooling water, are as follows:

- entrainment of aquatic organisms;
- damage to fish at intakes.

Damage at intakes can occur to fish which escape as well as those that are actually entrained. Such damage is related to a number of factors including:

- fish swimming speed (variable according to species, age and condition of individual, etc);
- intake flow velocities;
- intake screening (eg mesh size, bar spacing etc).

The maximum flow velocity of the cooling water abstraction will be approximately 0.3 m s^{-1} at the entrance to the intake. These are fairly low intake velocities; typical flow velocities at power station intake screens vary between 0.5 and 6.0 m s^{-1} (Langford, 1983). In general, adult fish and fish in the order of 15 cm length are unlikely to be drawn into the intakes at such velocities. It is also notable that the area is not an important fishery, implying that significant commercial quantities of fish are not present.

Although fish entrainment at the intake is unlikely to be a problem due to the provision of intake structures and low intake velocity, screens will be provided to prevent impingement and subsequent entrainment of fish. The potential entrainment of smaller free-floating organisms with limited mobility (including adult and larval plankton, fish eggs and larvae, etc) results in exposure to elevated temperatures, biocide additives, and physical damage from contact with cooling system components and pressure changes. Generally, exposure to such impacts in transit through the cooling system results in high reductions in the populations of bacteria and some plankton (but by no means 100% kill-off). Other organisms have a wide range of survival rates dependent on factors such as species, age, individual condition.

The losses of free-floating biota will be dependent on the species present in the vicinity of the intakes and the degree to which flows to the intakes modify local circulation patterns. Since the cooling water infrastructure will cause little alteration in local circulatory currents, accordingly no significant impacts are predicted on free-floating biota.

The lower rim of the intake structures will be located approximately 2.5 m above the Nilebed; thus, it is extremely unlikely that benthic organisms will be drawn directly into the intake. Although changed circulation patterns in the immediate vicinity of the intakes may slightly alter sediment distributions, it is unlikely that the intake structures will cause a perceptible effect on the Nilebed, which is currently subject to existing mechanical perturbations.

Overall, given the design of the cooling water abstraction, limited zone of potential impact and the lack of any known sensitive or commercially important aquatic organisms at the proposed location, no significant impacts are predicted to occur.

Other Water Abstractions

The boiler system requires approximately 180 m^3h^{-1} of water, which will also be abstracted from the Nile River and desalinated and demineralised prior to use.

Potable water will be provided from the power plant water system at the rate of 3 m^3h^{-1}.

Neither of these abstractions will have any significant environmental impact, given their volume and the water resources available.

Discharge of Cooling Water

The principal potential issues regarding the discharge of cooling water relate to the following:

- The discharge plume will form an area of elevated temperature. This may potentially have ecological effects as well as impacting on the cooling water intake of Helwan South Units 1,2 & 3.
- The plume will contain biocides and other substances that have potential impacts on aquatic biota.
- The physical effects of the discharge plume may potentially alter local hydrography, thereby affecting sediment transport and bankal erosion processes.

The heated cooling water will be combined with other appropriately treated effluent streams prior to offshore discharge through the outlet pipeline. The concentration of the chemicals in the cooling water at the outfall, compared to relevant standards, is shown in *Table 6-10*.

All chemicals from the liquid waste stream are below the WB regulations and Egyptian standards and, subsequently, no toxic effects are predicted to occur. Potential damage to aquatic flora and fauna is further minimised by the use of an open channel design of the outfall which will enable the initial dilution of the plume and decrease the extent of the area that may be impacted by either excess temperature or residual chemicals. The use of chlorine and other treatment chemicals will be minimised by optimising dosing levels with respect to anti-fouling needs.

Table 6-10

Concentration of Process Chemicals in Combined Effluent Discharged to Nile River

Pollutant	Predicted Concentrations (1) (mgl^{-1})	Egyptian Standards (mg l^{-1})	World Bank Guidelines (mgl^{-1})
Biological Oxygen Demand (BOD)	<30 (2)	30	-
Chlorine (Free)	<0.2	-	0.2
Iron	0.6	1.0	1.0
Oil and Grease	< 5	5	10
Suspended Solids (Total)	<30 (3)	30	50
Zinc	<1	1.0	1.0
pH	6-9	6-9	6-9

Notes:

(1) Concentrations are for the combined wastewater stream. Values are a flow rate composite of the all the plant wastewater streams.

(2) Represents BOD in sanitary wastewater. The BOD levels in the combined effluent discharged into the aquatic environment will be negligible.

(3) Concentration is an average value - maximum concentrations will be <50 mg l^{-1}.

The proposed discharge of cooling water has been modelled using the SOBEK 1D mathematical model and the Delft-3D numerical model system that evaluates the dilution of a thermal plume from a submerged discharge. The modeling outcomes has been validated by the Hydraulics Research Institute (HRI). ***Even during the summer, the zone where the elevated temperature exceeds 5°C extends less than 100 m from the outfall.*** Moreover, the elevated temperature of the water at the edge of the mixing ***zone is predicted to be within the 5°C at a distance less than 100m from the point of discharge Egyptian practice and the 3 °C at a distance not exceeding 100 meter guideline as set out by the WB guidelines*** (modeling process and results are given at the end of this section, page 62).

The outfall pipes will be separated enough from the intake pipes and it is estimated that there will be no temperature increase at the intake.

Another, albeit relatively minor effect of cooling water discharges is related to the input of nutrients associated with dead or moribund organisms when the cooling water is discharged; this factor may potentially enhance biological productivity of the waters at the same time as entrainment of the intake is reducing individual numbers. It should be noted that the time when most individuals will be affected (*i.e.* during algal "blooms") is the time when regeneration of populations (*i.e.* productivity) is highest.

Hence, the overall impact of the discharge of cooling water is not considered to be significant.

Other Operational Effluent Discharges

Other than the main cooling water stream, the following effluents will also be generated by the operational power plant:

- concentrate from desalination process;
- effluent from boiler blowdown;
- backwash from boiler water filtration;
- processed effluent from the oil interceptors;
- treated domestic effluent and sewerage;
- wastewater neutralisation effluent;
- hardstanding drainage and runoff.

To minimise the potential impacts of these effluents, the following mitigation measures will be implemented:

- Process effluents will be collected in engineered, contained site drainage systems where they can be controlled, monitored and treated as appropriate prior to discharge to the Nile River via a Nile well.

- Bunds or blind sumps will be installed on-site to isolate areas of potential oil or other spillages, such as transformer bays, from the site drainage system. The segregated effluent will be monitored for contamination and the appropriate discharge to the site drainage system or separate treatment/disposal route, such as extraction for specialist disposal off-site, will be adopted accordingly.

- Washing water from washing operations will be treated by oil/grease and suspended solids removal prior to discharge.

- Drainage from process areas will be collected in a contained site drainage system and passed through oil interceptors and suspended sediment traps prior to discharge to the Nile River via the Nile well.
- Clean uncontaminated rainwater run-off from building roofs will be directly discharged to the Nile River via the Nile well;
- Storm and rainwater run-off from hardstanding and roads will be collected in a contained site drainage system and passed through oil interceptors and sediment traps prior to discharge into the Nile River via the Nile well.

Concentrations of pollutants entering the aquatic environment from the cooling system, and effluent treatment systems, supplemented by surface run-off, will be within the prescribed levels set out in the EEAA standards and World Bank guidelines as shown in *Section 2*. Hence, no significant impacts are predicted to occur.

Biocides (e.g. chlorine) will be added to the cooling water system to control bacterial and algal growth which otherwise would build up on various surfaces. In addition, biocides will be used to control the growth of larger invertebrates and algae in the cooling water intake. The cooling water discharge will contain residual quantities of biocide at concentrations below the World Bank standard for free chlorine of 0.2 mg/l. Over a 24 hour period basic chlorination treatment will be at a concentration of 2 ppm. Chlorine shocking will take place when required depending on the level of algal growth at a concentration of 10 ppm. This concentration will be rapidly dispersed by the local dilution and dispersion in the Helwan South Nile River segment.

In order to ensure compliance with Egyptian and World Bank water quality standards, an appropriate plant management system will be developed in order to monitor the quality of the discharge.

Within liquid effluent management measures which will be implemented on site, the oil/water separators will operate continuously. Sanitary water will be treated in the power plant sanitary wastewater treatment facility and the discharged wastewater will be directed to the plantation irrigation network. Other wastewater (except heated cooling water and condensate water) will be collected and treated before being discharged via the circulating water discharge structure (CWDS). Rain waters containing oil will be routed to the oil separator; rain waters without oil will be discharged to the Nile River as stated above.

Effects of Aquatic Structures on Nile Bankal Processes

The aquatic structures comprise the cooling water intake/velocity cap, the intake pipes and channel, and the outfall pipes and channel.

The intake and outfall structures may have a very localised hydrodynamic impact, but this will not result in any significant effect on currents or sediment movement in the wider context.

Overall, the infrastructure associated with the cooling water abstraction and discharge will not have any significant impacts on bankal processes.

Impact of Thermal Plume on Aquatic Ecology

The effect of raised water temperature on fauna and flora could include the following:

- lethal effects due to direct temperature increases;
- effects on physiological processes such as raised metabolic and breathing rates, grouped as stress effects; and
- changes in behavior of mobile species such as avoidance or attraction to water of a higher temperature.

Lethal temperatures for aquatic animals are related to the summer maximum temperature in which they live. Temperatures over and above that maximum may result in any of the three levels of effect described above. It is anticipated that lethal effects as a result of the thermal discharge will be limited to any non-mobile benthic fauna and flora adjacent to the outfall.

There will be limited, short term and local impacts on planktonic species affected by the warm plume and this may result in changes to the observed planktonic communities as more tolerant species displace less tolerant species. This in turn may impact the fish species present by sustaining larger populations or attracting some species whilst displacing others.

Mobile species will show a similar response to the warm water with some species avoiding the warm water and some species attracted (Young bass *"Dicentrachus labrax"* migrate into warm water plumes at Kingsnorth Power Station in the UK where they achieve 30% faster growth than comparable fish in unheated water (Turnpenny et al. 1985)).

In summary, the thermal discharge is predicted to impact aquatic flora and fauna both positively and negatively. At the point of discharge where water temperatures will not exceed 8 °C above ambient temperatures, it is unlikely that non- mobile flora or faunal species will survive, however the area is already relatively impoverished. The more marginal temperature increase experienced further from the discharge outlet, up to a distance of 50 m, however may sustain larger populations of some species or attract additional species to the area.

The intake and discharge structures will however also provide new habitats for some species. The hard structures of the submerged vanes will provide a surface for colonization which may support these communities. In turn, these species will attract planktonic and fish species into the newly created habitat.

Impact of Operational Discharges on Water Quality

During operation water will be withdrawn from the Nile River for condenser cooling and other plant uses. Most of the water will be returned to the Nile River in the form of cooling water discharge by the way of the discharge structure. The activities that are expected to generate waste water from the power plant include the following:

- cooling water;
- demineralization of water for plant uses;
- chemical cleaning of boilers and air heaters;
- oil/water interceptor effluent;
- equipment and floors cleaning; and
- recovery of rainfall runoff from oil storage areas and transformers.

Condenser cooling water, which corresponds to the most important water consumption of the power plant (~ 95%), does not need to be treated by chemicals. The water cooling condensers are designed in a type of metal alloy to avoid discharge in the Nile River of heavy metals such as copper and zinc coming from the wear of tubes of brass condensers. The power plant will be equipped with all water treatment facilities in order to keep waste water quality within the applicable regulations.

Sanitary water will be discharged to the plant sewer treatment system. Other waste water (except heated cooling water) will be collected and treated before being discharged via the water discharge system, which includes three separate pathways: circulating water discharge system (CWDS), plant sewer treatment system and the plantation irrigation network. The major water treatment steps include:

- neutralization of any waste water that has a pH outside the range of 6 to 9;
- oil separation of any waste water that may be contaminated with oil or grease; and
- flocculation and filtration of any waste water that may contain high concentrations of suspended solids.

The oil/water separators will operate continuously. Rain waters containing oil will be routed to the oil separator; rain waters without oil will be discharged to the plant sewer system.

All the process effluent, in combination with site drainage from areas at risk of contamination (power block areas, drains and sumps) will be treated and then discharged to the water discharge system. The discharge from the power plant will comply with the Egyptian and World Bank standards for discharge to Nile waters as a minimum (as per the *Law 48/1982*) (*Table 6-11*).

Table 6-11

Water Quality Guidelines and Standards Applicable to the Operation of the Plant (mg/1, unless otherwise stated)

Parameter	Egyptian Standards[1]	World Bank Guidelines	Estimated Characteristics of Discharge	Background Concentrations (where available)[2]
Biological Oxygen Demand	30	-	-	13.36
Chromium (total)	0.5	0.5	-	N/D[3]
Copper (ppb)	0.5	0.5	< 0.5	N/A[4]
Iron	1.0	1.0	<1	0.066
Oil and Grease	5	10	<5	356.6

Suspended Solids (total)	30	50	<30	23.4
Residual Chlorine (total)	N/A	0.2	<0.2	N/A
Zinc (ppb)	1.0	1.0	<1	0.02
Temperature Increase (°C) above the ambient with max absolute value of 35 °C	<8° Max. Amb. 35 °C	≤3° at 100 m	8°C at discharge point	N/A
pH (unitless)	6-9	6-9	6-9	7.4-7.6

Notes:

(1) Prime Minister's Decree No. 1741-2005; The modifying regulations to the Implementary Regulations for Law 4-1994 Regarding the Protection of the Environment, Annex I.

(2) Results of physico-chemical measurements of water samples collected by the National Research Center on 17th November 2010 at selected points in the power plant site bankline segment.

(3) N/D = Not Detected.

(4) N/A = Not Available.

Biocides (mainly chlorine) will be added to the cooling water system to control bacterial and algal growth which otherwise would build up on various surfaces. In addition, chlorine will be used to control the growth of larger invertebrates and algae in the cooling water intake. The cooling water discharge will contain residual quantities of biocide at concentrations below the World Bank standard for free chlorine of 0.2 mg/l. Over a 24 hour period basic chlorination treatment will be at a concentration of 2 ppm. Chlorine shocking will take place when required depending on the level of algal growth at a concentration of 10 ppm. This concentration will be rapidly dispersed by the local dilution and dispersion in the Nile River.

In order to ensure compliance with Egyptian and World Bank water quality standards, an appropriate plant management system will be developed in order to monitor the quality of the discharge.

Water Quality Related Impacts on Aquatic Ecology

Impacts on aquatic ecology during plant operation will largely be due to increased water temperatures and the quality of the discharged water. The intake structure is also likely to cause entrainment of fish and other species. The impacts of the thermal plume on aquatic fauna and flora has been discussed above.

Chemicals, including chlorine, released into the discharge structure could potentially have both lethal and chronic effects on the flora and fauna surrounding the discharge point, if released in sufficient quantities. Water treatment technologies and management systems employed at the plant and described above, will however ensure that effluents released are strictly adhered to water quality standards stipulated by the *Law 4/1994 and Law 9/2009* and do not threaten the Nile River habitats and ecosystems.

Entrainment of Flora and Fauna

The cooling water intake will result in the entrainment of fauna and flora. Because of the presence of grills, entrainment may result in death and/ or damage to larger organisms including fish which may escape entrainment. Once entrained the fauna are exposed to physical damage, increased temperatures and process chemicals, including chlorine at concentrations intended to be lethal to fauna an flora whilst in the cooling system.

The potential for damage is related to the escape speed of the particular animal, the intake velocity and the size of the grills over the intake. It is the younger stages of fish species that are at particular risk from entrainment and damage.

The maximum velocity in the culvert of the intake structure will be around 0.3 m/sec. This velocity is able to minimize fish entrainment into the culvert, and is at similar orders recorded at other power plants (Langford, 1983). Fish catches on the trash screens will be monitored on a weekly basis in the first year of operation to assess the impact of intake operation on the fish community. Whilst the impact of entrainment has the potential to be highly negative, it will occur over a very localized area. In addition, the velocity of water drawn into the culvert is close to the minimum required for efficient power plant operation, which will further reduce the risk of fish entrainment.

Bankline Access

Once constructed, the intake and discharge structures will be buried in a pipeline across the Bankline and it is expected that there will be little or no impacts on the use of the Nile bankline as a result of the operation of the power plant.

Impact on Fishing and Navigation

The Nile River segment immediately adjacent to the project site is not considered to be of significant importance as a commercial fishery *(see Section 6.9)*. The plant is not therefore expected to have any significant impacts on fishing activities.

Given that the outfall and discharge structures extend from the bankline, the structures are not expected to present any hazard to shipping.

Modeling Conclusions and Recommendations

The field survey was carried out. The data obtained from the field measurements was used to develop and calibrate the hydrothermal three dimension hydrothermal numerical model.

After the model calibration three model scenarios were carried out to study the recirculation of the thermal plume from the plant outfall to its intake and the increased water temperature above the ambient water in the plant vicinity. In the model scenarios, three units of 650 MW were simulated with intake/outfall discharge of $23 m^3/s$ per unit and with design excess water temperature above the ambient water at the outfall of 8° C. The scenarios are as follows:

<u>Scenario 1:</u>
Simulates the flow condition in River Nile in the winter where the flow discharge is the minimum. In this scenario, and the next two scenarios, the total inflow of water to the plant is assumed conservative total value of 60.42 m^3/s for the three units, where as the river flow is 694.4 m^3/s, i.e. the water abstraction by the plant is about 8.7%of the main river flow. The flow pattern around the plant in the top and bottom layers is presented in *Figure 6-13*. The figure showed that the flow velocities in the top layer are higher than in the bottom layer. There is a small effect of the flow discharge from the plant on the flow velocity in front of the outfall. The distribution of the water temperature in the plant vicinity for this flow condition in the top and bottom layers is shown in *Figure 6-14*. The figure shows that the plume is concentrated near the water surface (top layer). The effect of the plume on the water temperature close to the bed is relatively small. The figure shows that there is no recirculation of the effluent discharge from the plant outfall to its intake.

The figures show that the plume effect in the top layer is larger than in the bottom layer. The excess water temperature above the ambient water outside the mixing zone (about 1/3 of the width of the cross section of the river in front of the outfall) is less than 5 degrees which complies with the Egyptian water quality standards.

Figure 6-13

Computed Flow Pattern in Top and Bottom Layer
(Case of Minimum Discharge)
Upper and Lower Plots are for Top and Bottom Layers, Respectively

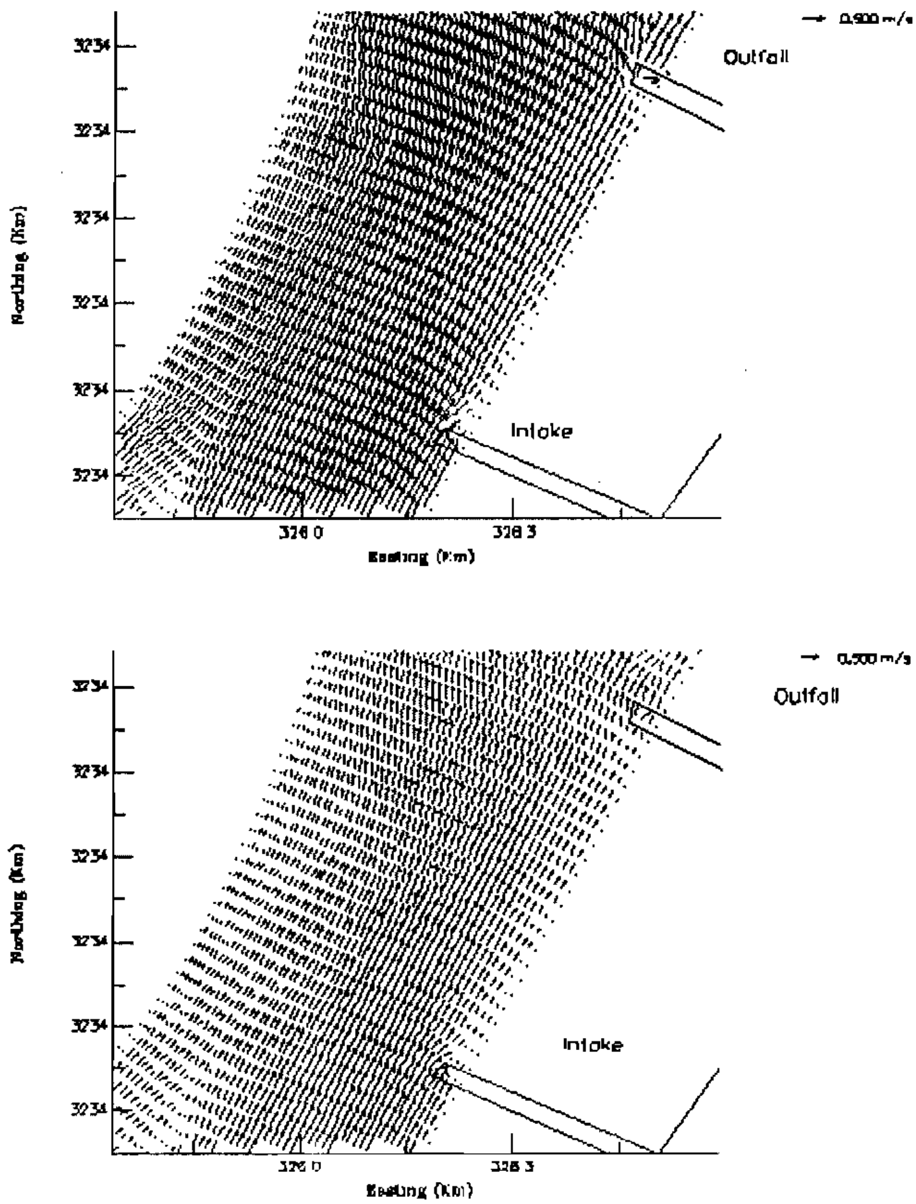
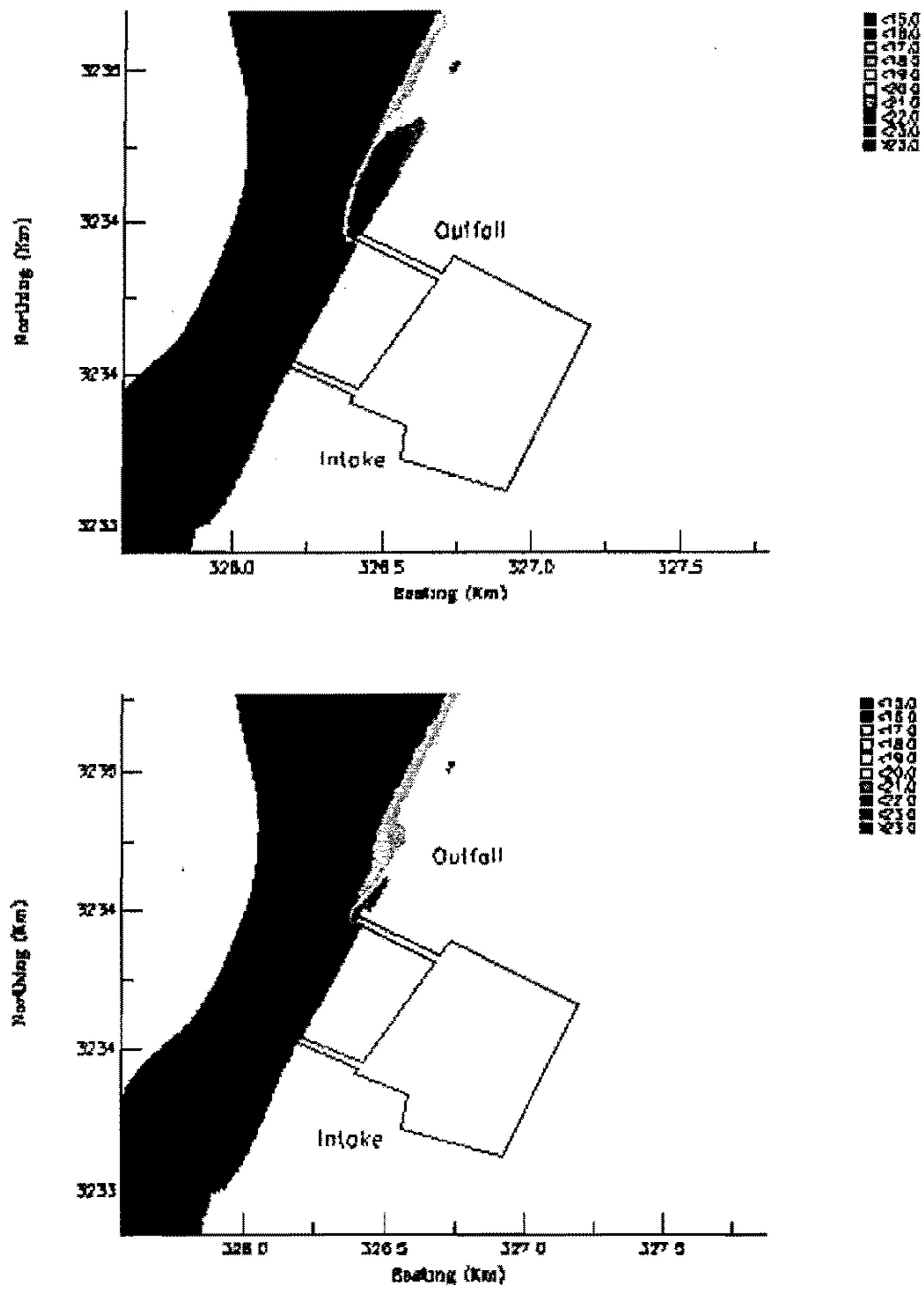


Figure 6-14

Water Temperature Distribution in Top and Bottom Layer (Case of Minimum Discharge) Upper and Lower Plots are for Top and Bottom Layers, Respectively

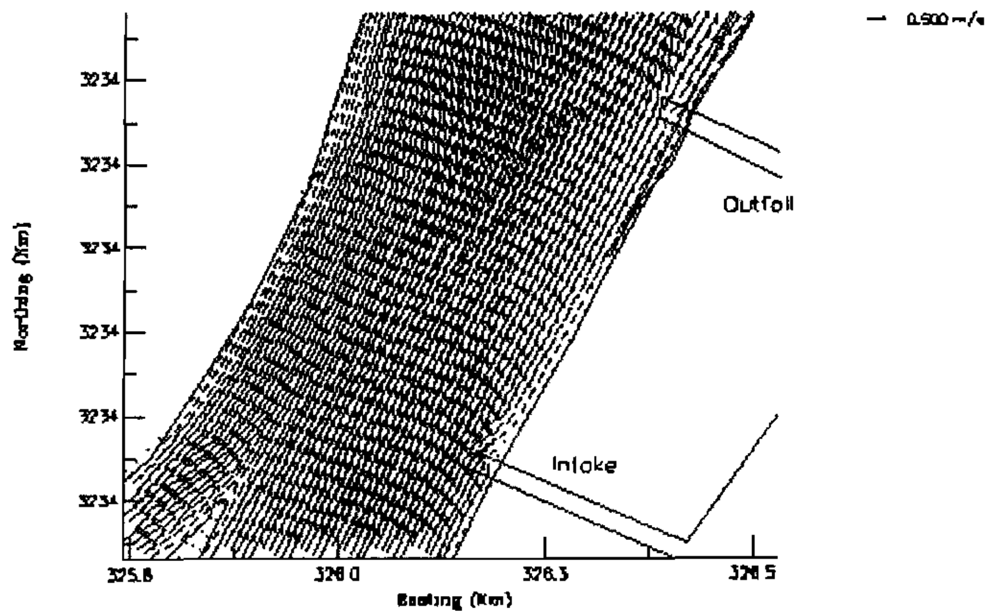


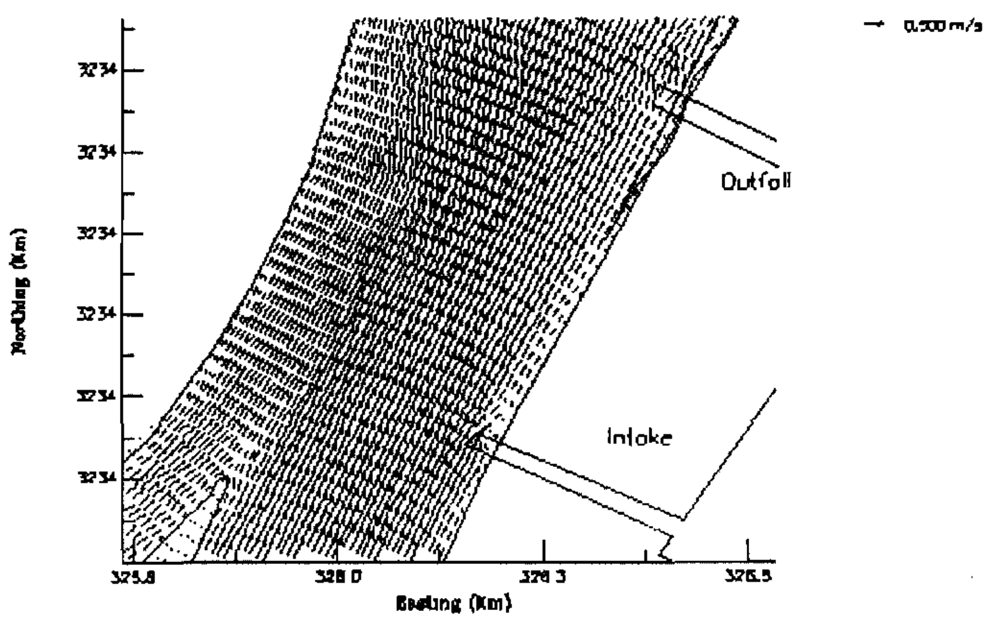
Scenario 2:

This scenario simulates the flow condition in River Nile in most of the year where the flow discharge is dominant. The plant inflow is 60.42m^3/s whereas the river flow is 1038 m^3/s, i.e. the plant inflow is about 5.8% of the main river flow. The flow pattern in the top and bottom layer under this flow condition is presented in *Figure 6-15*. The figure shows that the flow velocity in the top layer is higher than in the bottom layer. It can be seen that the flow velocity in this scenario is higher than the flow velocity in Scenario 1 with minimum discharge. The distribution of the water temperature in the plant vicinity and at the plant outfall in the top and bottom layers is shown in *Figure 6-16*. The figure shows that there is no recirculation of the effluent discharge at the plant intake. It can be seen from the figure that the area of the plume in case of the dominant discharge is smaller than the area of the plume in case of the minimum discharge. This can be explained by that fact that the dominant discharge causes higher water mixing in front of the outfall than the minimum discharge which increases the dilution process. The figures show that the plume effect in the top layer is larger than in the bottom layer. The excess water temperature above the ambient water outside the mixing zone is less than 5 degrees which complies with the Egyptian water quality standards.

Figure 6-15

Computed Flow Pattern in Top and Bottom Layer (Case of Dominant Discharge) Upper and Lower Plots are for Top and Bottom Layers, Respectively



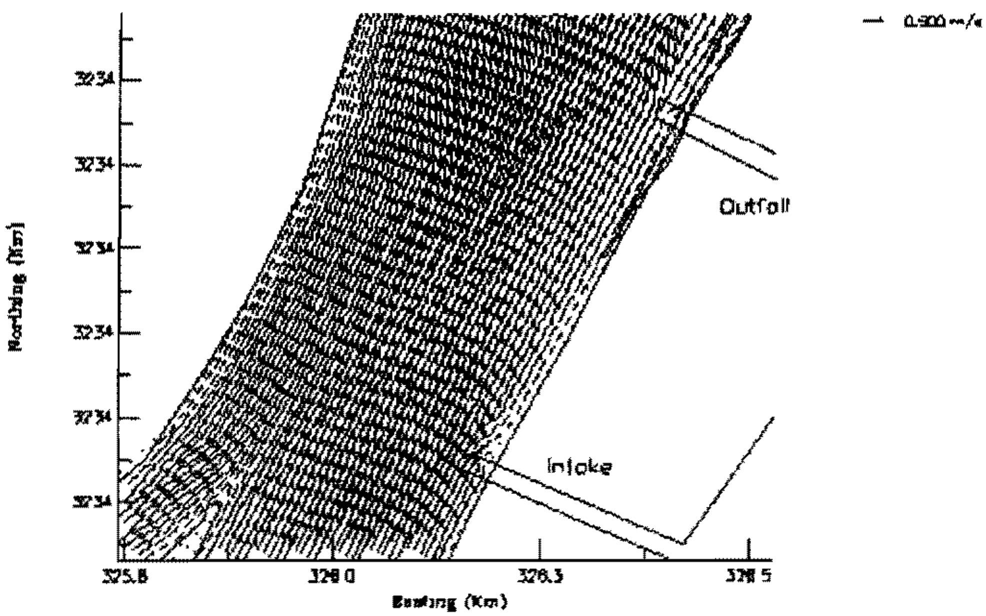


Scenario 2:

This scenario simulates the flow condition in River Nile in most of the year where the flow discharge is dominant. The plant inflow is 60.42m^3/s whereas the river flow is 1038 m^3/s, i.e. the plant inflow is about 5.8% of the main river flow. The flow pattern in the top and bottom layer under this flow condition is presented in *Figure 6-15*. The figure shows that the flow velocity in the top layer is higher than in the bottom layer. It can be seen that the flow velocity in this scenario is higher than the flow velocity in Scenario 1 with minimum discharge. The distribution of the water temperature in the plant vicinity and at the plant outfall in the top and bottom layers is shown in *Figure 6-16*. The figure shows that there is no recirculation of the effluent discharge at the plant intake. It can be seen from the figure that the area of the plume in case of the dominant discharge is smaller than the area of the plume in case of the minimum discharge. This can be explained by that fact that the dominant discharge causes higher water mixing in front of the outfall than the minimum discharge which increases the dilution process. The figures show that the plume effect in the top layer is larger than in the bottom layer. The excess water temperature above the ambient water outside the mixing zone is less than 5 degrees which complies with the Egyptian water quality standards.

Figure 6-15

Computed Flow Pattern in Top and Bottom Layer (Case of Dominant Discharge) Upper and Lower Plots are for Top and Bottom Layers, Respectively



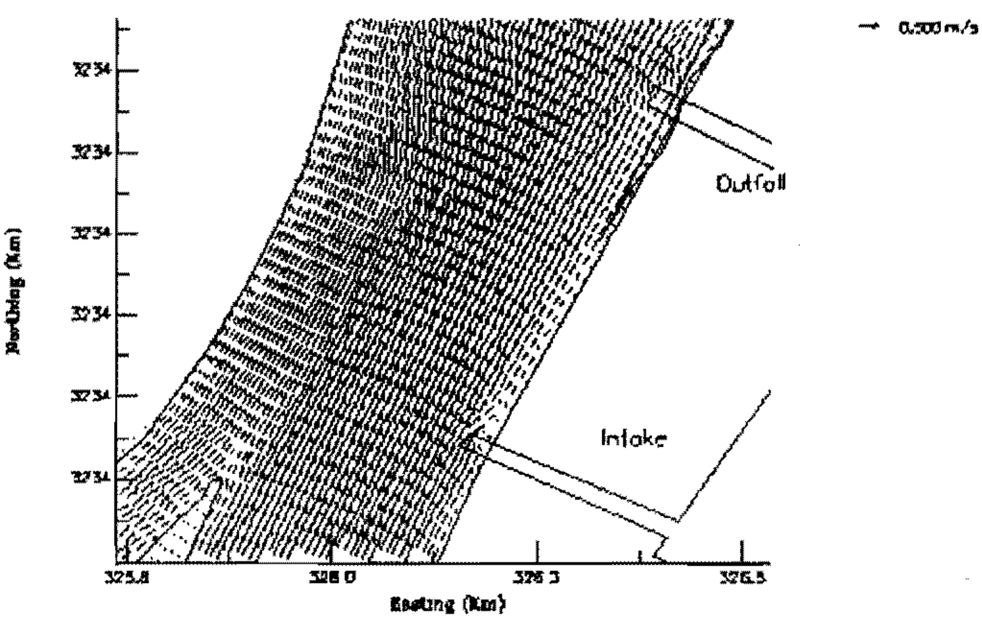
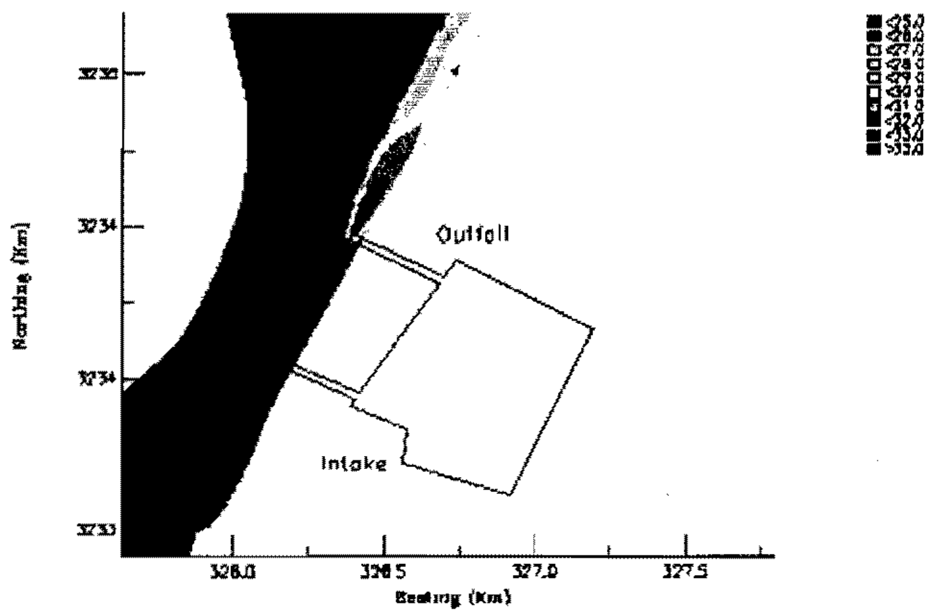
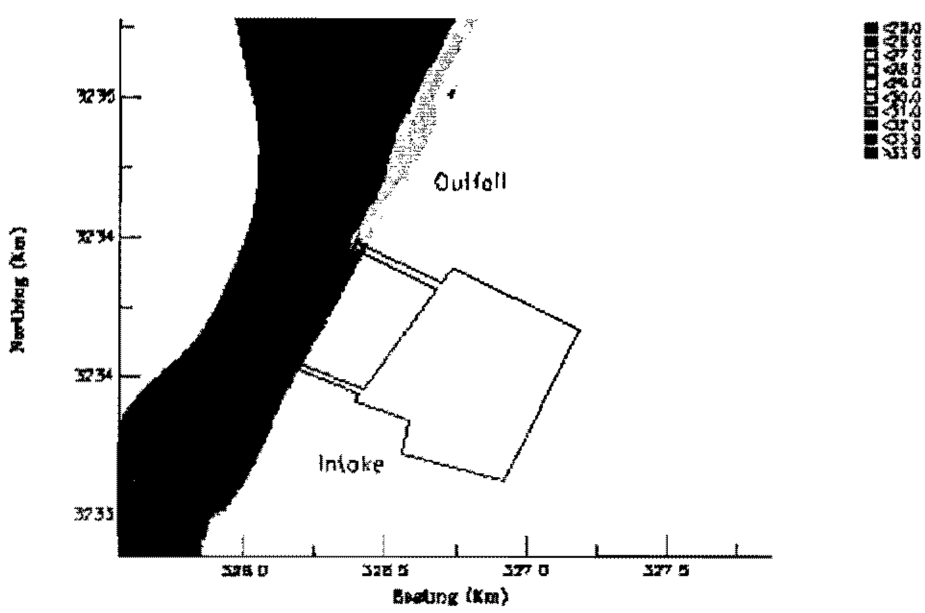


Figure 6-16

Water Temperature Distribution in Top and Bottom Layer
(Case of Dominant Discharge)
Upper and Lower Plots are for Top and Bottom Layers, Respectively





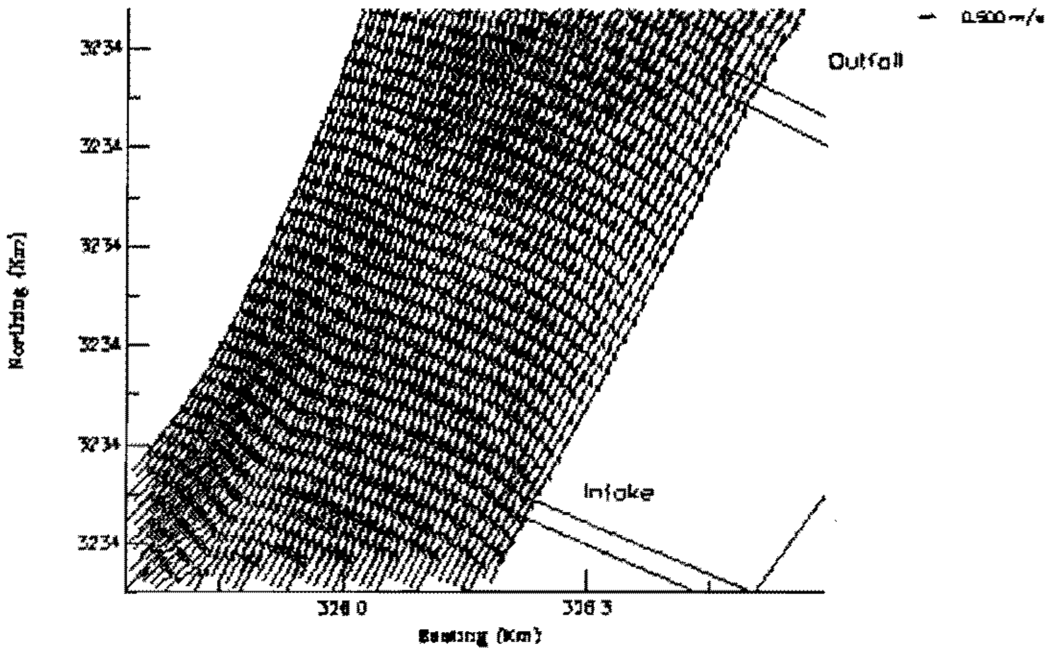
Scenario 3:

This scenario simulates the flow condition in River Nile in the summer where the flow discharge is the maximum. The plant inflow is $60.42m^3/s$ whereas the river flow is 2893.5 m^3/s, i.e. the plant inflow is about 2.08% of the main river flow. *Figure 6-17* shows that flow pattern in top and bottom layers under this flow condition. The figure shows that the flow velocities are higher than the other scenarios because of the higher discharge. *Figures 6-18 and 6-19* show the water temperature distribution in the plant vicinity and in front of the outfall. The figure shows that there is no recirculation of the effluent discharge to the intake. The size of the plume is small compared to the size of the plume in case of minimum and dominant discharges because of the higher flow velocities which cause more dilution of the effluent discharge and better mixing of the effluents with the fresh water. The figures show that the water temperature outside the mixing zone is less than 5 degrees which is in a good agreement with the Egyptian water quality standards.

Figure 6-19 shows the water temperature at the intake for Scenarios 1, 2 and 3. It can be seen that there is no recirculation at the intake for the three scenarios.

Figure 6-17

Computed Flow Pattern in Top and Bottom layer (Case of Dominant Discharge) Upper and Lower Plots are for Top and Bottom Layers, Respectively



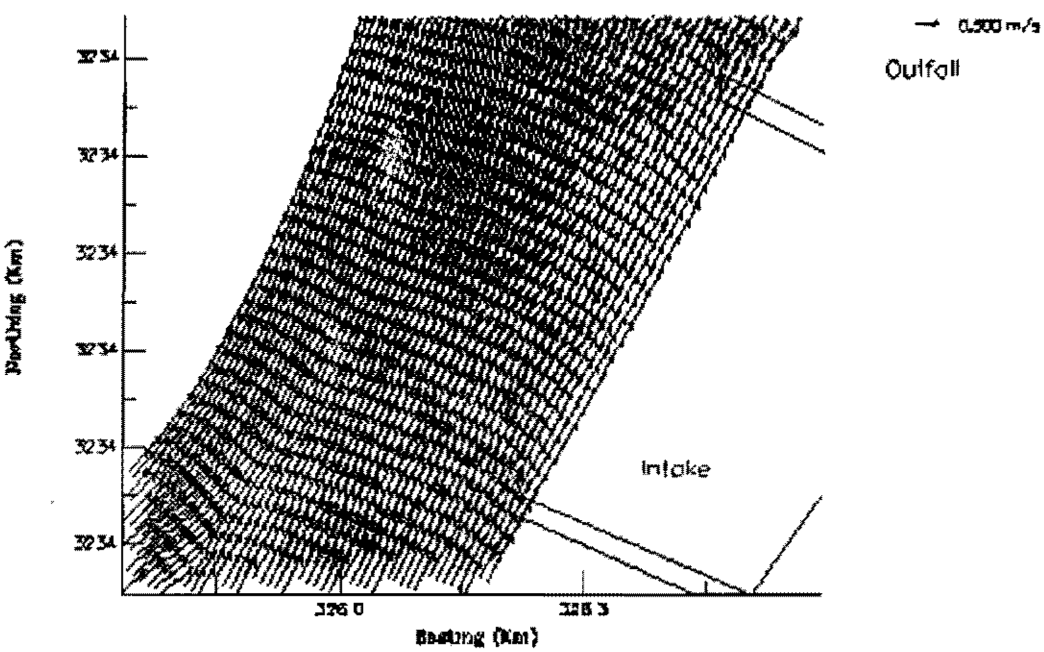


Figure 6-18

Water Temperature Distribution in Top and Bottom Layer (Case of Dominant Discharge) Upper and Lower Plots are for Top and Bottom Layers, Respectively

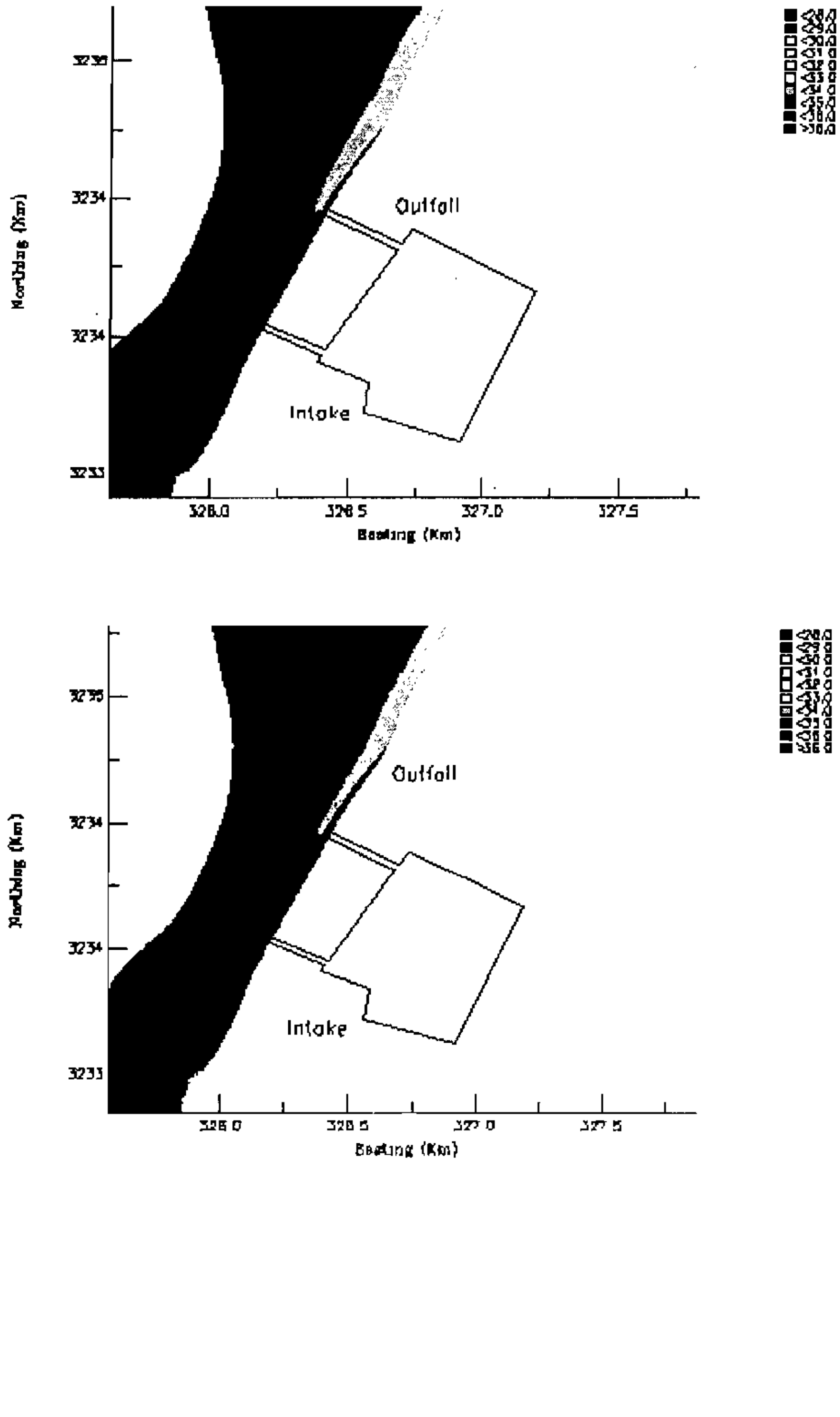
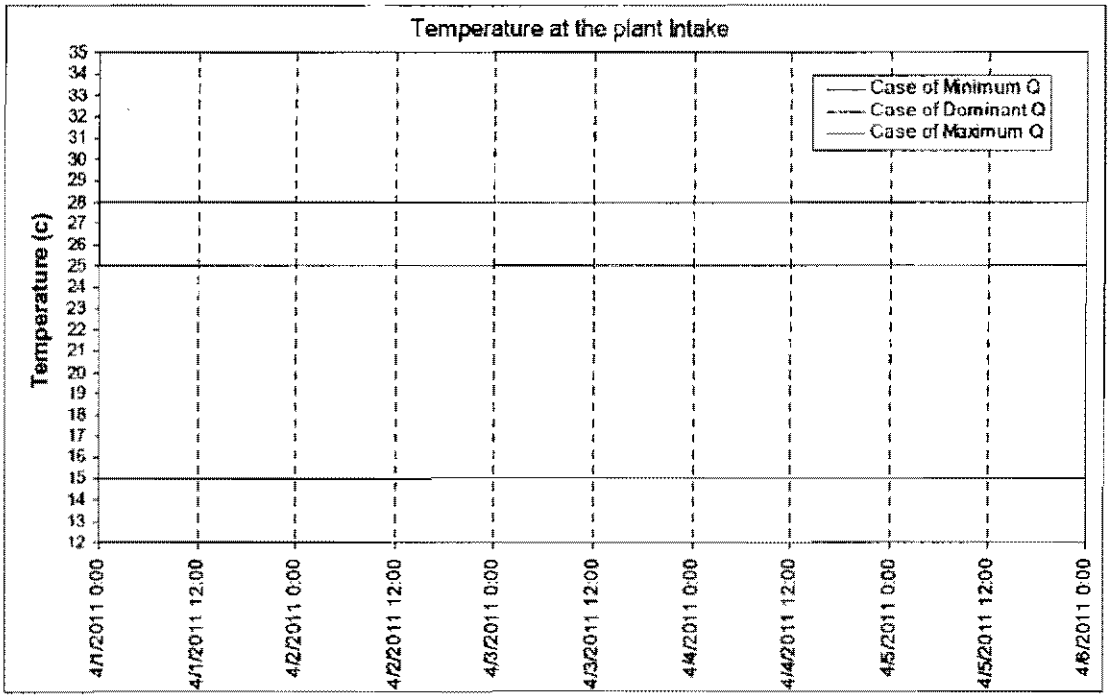


Figure 6-19

Water Temperature at the Plant Intake for Scenario 1, Scenario 2 and Scenario 3 Upper, Middle and Lower Plots are for Scenarios 1, 2 and 3, Respectively



VELOCITY DISTRIBUTION RESULTS

The flow pattern was simulated in the three scenarios. The flow velocity in the direction of the river flow and the cross velocity normal to the main flow in the river were obtained at three cross sections, *(see Figure 6-20)*. The first cross section is upstream the outfall structure at a distance of 20m. The second cross section is in the centreline of the outfall structure. The third cross section is downstream the outfall structure at a distance of 20m. At each cross section the flow velocity was obtained starting from the left bank to the right bank. The computed velocities show that the cross flow velocity exceeds the allowable velocity, which is 0.30 m3/s slightly only in the area surrounding outfall structures and is confined to less about 10% of the total river width (about 75 m) in the minimum case. More than 90% of the river width the cross velocity is less than 0.3 m/s which is suitable for navigation. The computed cross flow velocities for the three scenarios at the three cross sections are shown in *Figures 6-21 through 6-29*. The figures show that navigation is safe in River in the area of study in the presence of the power plant.

Figure 6-20

Layout of the Cross Sections for Measuring the Cross Flow

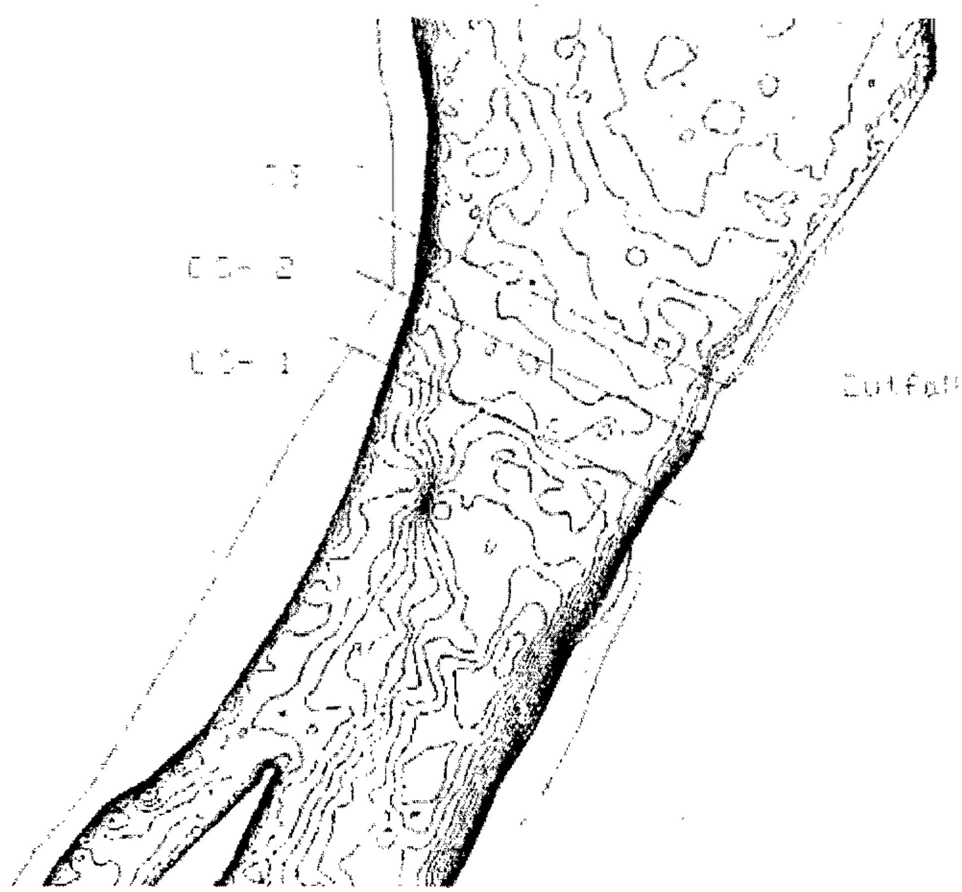


Figure 6-21

Cross Current Upstream the Outfall (Scenario-1)

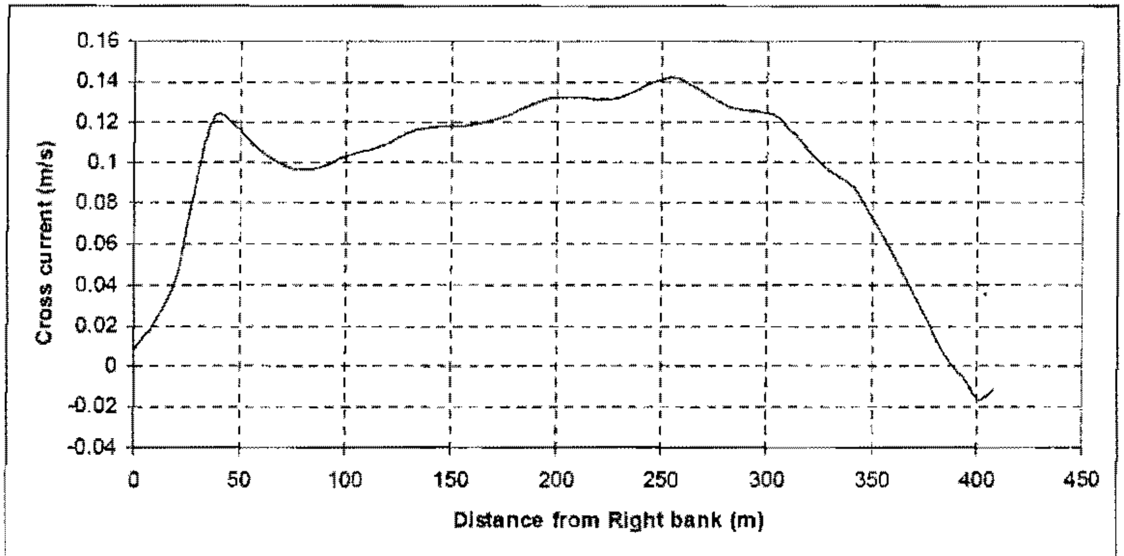


Figure 6-22

Cross Current at the Centerline of the Outfall (Scenario-1)

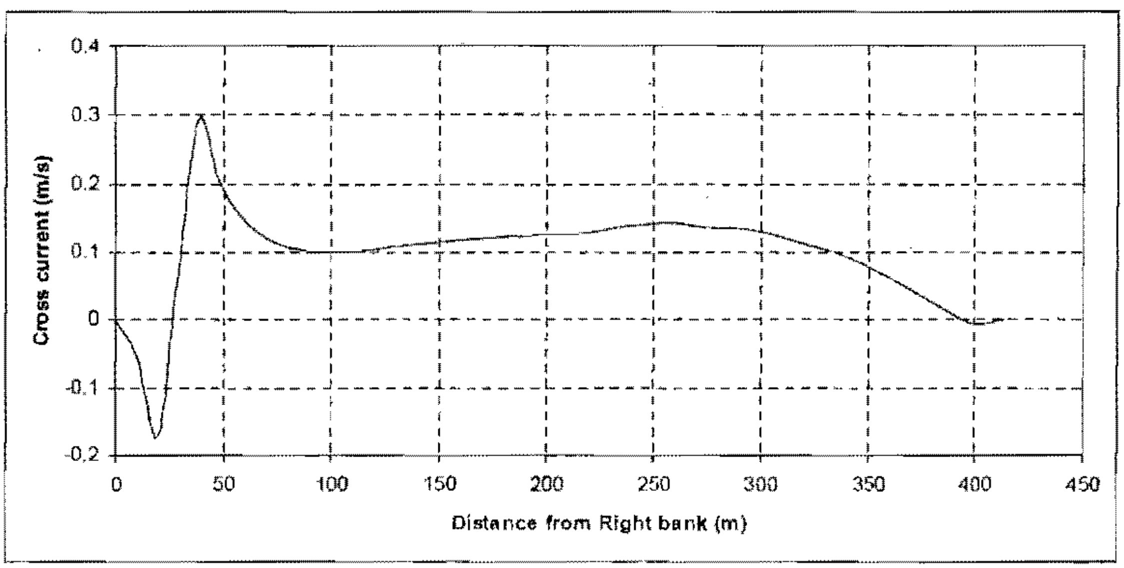


Figure 6-23

Cross Current Downstream the outfall (Scenario-1)

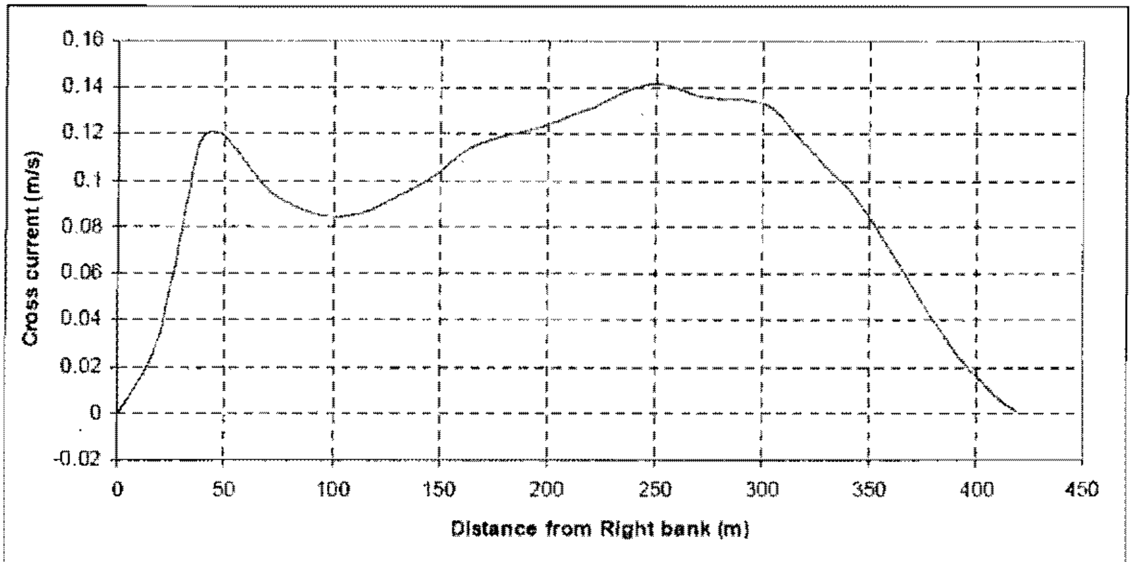


Figure 6-24

Cross Current Upstream the outfall (Scenario-2)

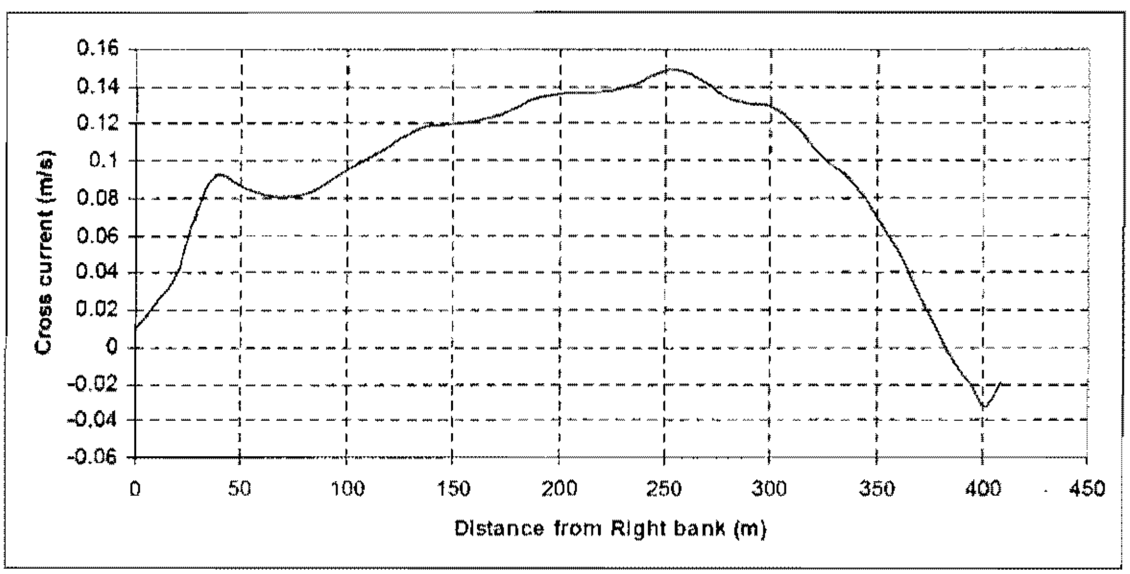


Figure 6-25

Cross Current at the Centerline of the Outfall (Scenario-2)

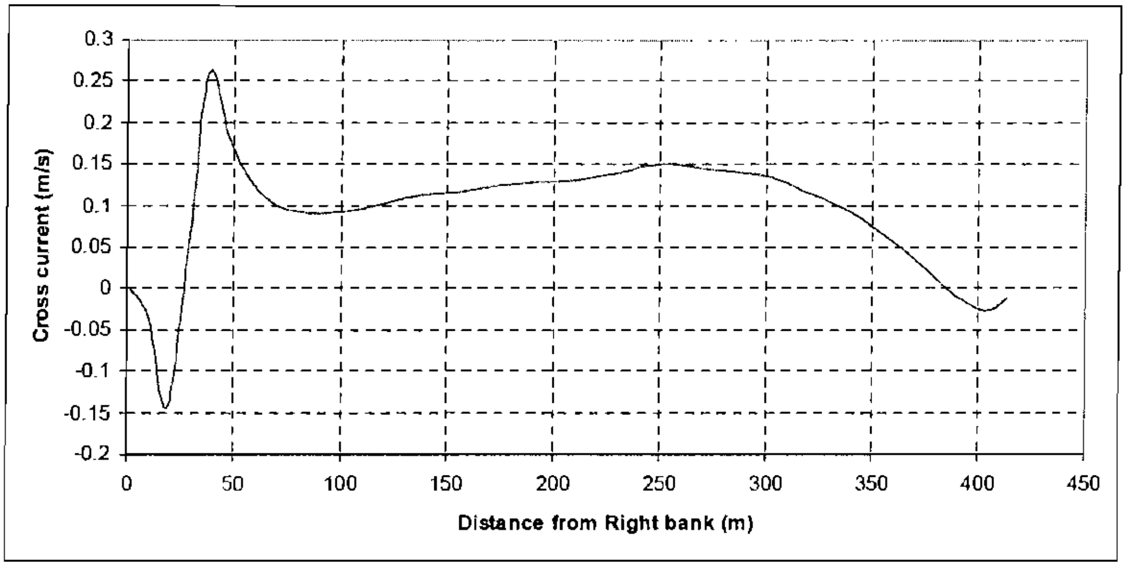


Figure 6-26

Cross Current Downstream the Outfall (Scenario-2)

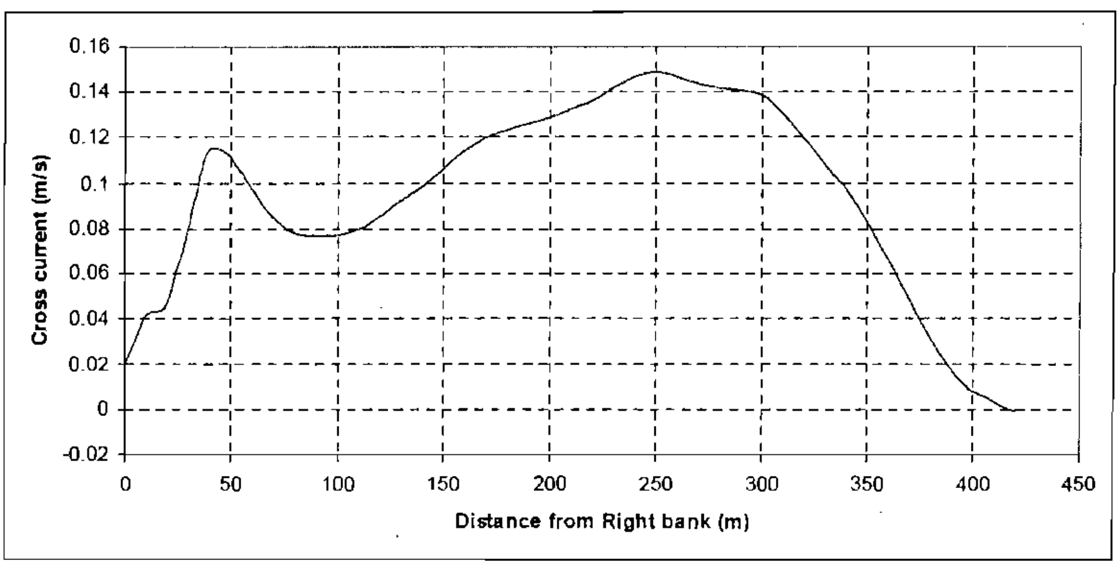


Figure 6-27

Cross Current Upstream the Outfall (Scenario-3)

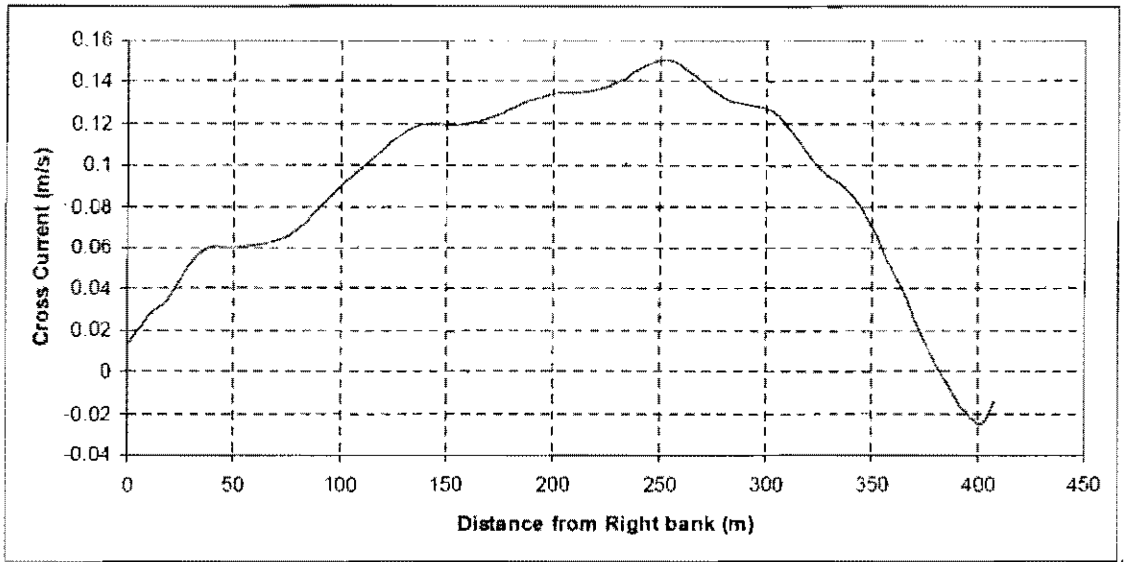


Figure 6-28

Cross Current Downstream the Outfall (Scenario-3)

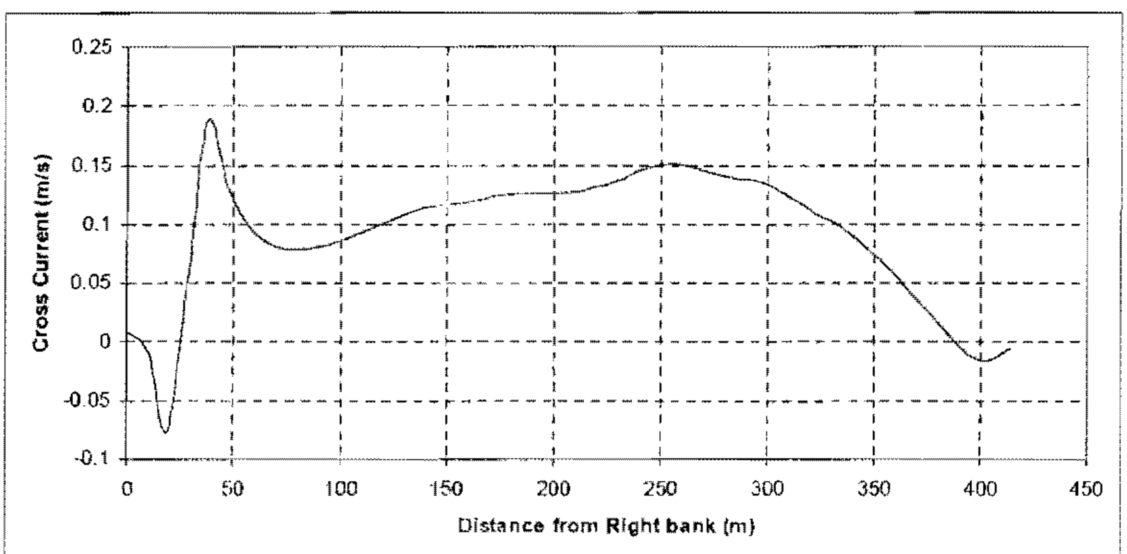
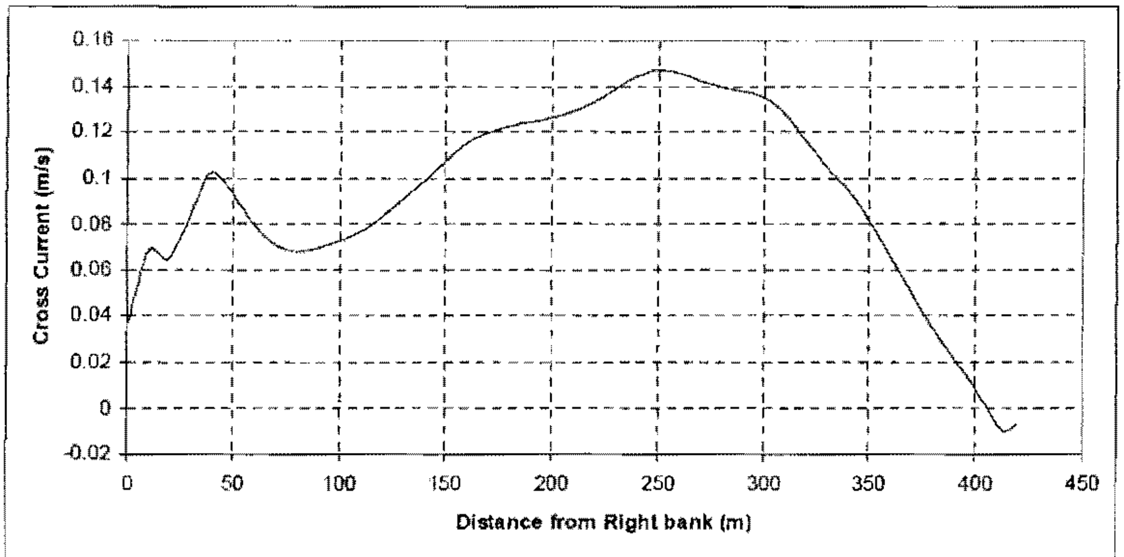


Figure 6-29

Cross Current Downstream the Outfall (Scenario-3)



Conclusions

The Egyptian Electricity Holding Company commissioned HRI to conduct hydraulic and circulation study to investigate the impact of the proposed South Helwan Plant with 3×650 MW on the recirculation, water environment and navigation. This study is an extension to the earlier study of South Helwan Plant of 2×650 MW; see HRI Report No. 50/2011.

The report presents the hydrodynamic three dimension modeling study. The study aims at investigating the impact of the plant on the recirculation of the effluents at its intake and the increased water temperature in the plant vicinity. The study on the impact of the plant on the cross current induced by the plant intake/outfall on the navigation was conducted within the framework of the study.

A three dimension model with five layers along the water column has been carried out to account for the stratification which may occur in front of the plant due to the density difference induced by the temperature variation. Three model scenarios were setup to account for the different flow regime in the river, minimum, dominant and maximum discharges. The water levels associated to theses discharges were obtained from the 1 dimensional model (1D SOBEK). The results of the model simulations show the followings:

- No recirculation of the effluent discharge at the plant intake for all scenarios.
- The excess water temperature above the ambient water outside the mixing zone (about 1/3 of the width of the cross section of the river in front of the outfall) is less than 5 degree which is in accordance with the Egyptian water quality standards.
- The flow pattern obtained from the model scenarios show that the cross flow velocities in front of the intake/outfall structures is less than 0.3 m/s, except in the area around the outfall which is less than 1/10 of the river width. About 90% of the river width in front of the intake/outfall structure is safe for navigation.
- The model results show that the dilution of the plume is better for the dominant and maximum discharges than the minimum discharge because of the good mixing of the effluents with the fresh water under relatively high discharges.
- The results show that the plume is concentrated near the water surface and its impact is reduced near the river bed.

Recommendations

Based on the study and the model results the following is recommended:

- The layout and the plant characteristics as simulated in the numerical model should be simulated in the physical scale model to confirm the results in the numerical model and are should be recommended with a condition of confirming the design with the physical scale model.
- The layout of the intake/outfall structures and the plant characteristics as simulated in the numerical model should be tested in the physical scale model. The aim of the physical scale model is to confirm the results of the numerical model.
- Warning signs are to be placed upstream and downstream the plant to avoid nay damage to the intake/outfall structures.
- All fishermen boats are to be kept about 75 m away from the outfall structures to avoid the effect of relatively high cross currents caused by the effluent discharge into the river in case of minimum.

6.4 NOISE AND VIBRATION

6.4.1 Introduction

The assessment of the potential noise and vibration impacts considers the following issues:

- noise and vibration from construction activities on the main site; and
- noise and vibration during operation, including from the main power plant and the pumping station.

6.4.2 Noise Sensitive Receptors

No residential community has been identified around the Helwan South power plant site and there are no population centres within five kilometers of the proposed site. The nearest land uses around the site are the grains silos to the immediate north of the Helwan South power project fence and the cemetery area to the immediate south of the proposed site in addition to the agricultural strip land with very few low-rise, rural type residential houses to the immediate west of the power plant site.

Due to the rural nature of the proposed site, the area is categorized as "residential-commercial" with respect to the Egyptian ambient noise standards and "residential, institutional and educational" with respect to the World Bank environmental guidelines.

6.4.3 Standards and Guidelines for Noise Assessment

In the absence of World Bank or Egyptian standards for construction noise, British Standard BS5228 has been considered to represent good international practice for assessing and controlling noise during the construction phase.

6.4.4 Evaluation of Construction Noise and Vibration

Noise Prediction Methodology

Noise levels from construction activities have been predicted and assessed based on the methods set out in the UK codes of practice (BS5228). Calculations of the combined sound power from all construction plant, adjusted for usage time, have been used to predict the highest potential noise levels for the peak period of construction.

Traffic noise predictions have been carried out using the methodology in the UK Department of Environment (as was) Calculation of Road Traffic Noise which is the standard method of predicting noise from roads in the UK and is considered to represent good international practice.
For the assessment, the following conservative assumptions have been made:

- fixed construction plant is located close to the center of the site;
- mobile construction plant has been assumed to use a haul route that follows the perimeter of the site;
- no account has been taken of the attenuation in noise levels due to acoustically soft ground or due to screening from intervening buildings; and

The type and number of plant assumed to represent the worst case during the peak period of construction, are presented in *Table 6-12*.

Noise from the Construction Site

Using the worst-case assumptions, the prediction of potential levels of construction noise at the nearest receptors during peak construction phase is presented in *Table 6-13*, together with applicable Egyptian noise standards. The Egyptian noise standards are applicable to long term (i.e. operational) noise levels, but are included for reference in assessing the potential magnitude of impacts from short term construction noise. Reference is also made below to construction noise criteria used in the UK. It should be noted that no construction noise limits are published in World Bank guidance.

Table 6-12

Major Construction Plant on Site During the Peak Construction Period

Equipment	Number	Utilization Factor (1)	Day (D) Night (N) (2)
Tracked cranes (cranes, elevators,	9	50%	D, N
hoists, etc.)	4	80%	80%D, 20%N
Air compressors	5	75%	D
Bulldozers (bulldozers, IT-28, .. etc.)	3	50%	50%D, 20%N
Truck cement mixers	(3)	-	D
Dump trucks (including rough terrain	3	20%	D, N
vehicles)	27	40%	60%D, 40%N
Diesel generators	1	80%	80%D, 20%N
Welding equipment and generators	1	40%	D
Batching cement plant	(3)	-	D
Grader (includes motor grader)	(3)	-	D, N
Wheeled excavator / loader trucks			
Lorries			

Notes:

(1) Utilization factor is the percentage of time equipment is engaged in productive work and may generate significant noise,

(2) 'D' indicates daytime shift (07:00-17:00 hours) and 'N' indicates night time shift (17:00-07:00 hours). Percentage indicates the level of use in each shift,

(3) Equipment has been assumed to use the haul route / on-site road adjacent to the site boundaries. An average flow of 20 vehicles per hour has been assumed.

From *Table 6-13* it can be seen that in the absence of noise mitigation measures, construction noise levels are predicted to comply with the Egyptian standards. In the UK a daytime construction noise criteria of LAeq 70 dB is generally used to assess construction noise in rural areas. This level is not predicted to be exceeded. Hence no construction noise impacts are expected.

Noise from Construction Traffic on the Site Access Road

Assuming that a haul route will pass the land around the power plant site at a distance of more than 60 m, the resulting predicted noise levels will be less than 60 dB(A). This noise level is within the Egyptian and UK standards and, hence, no significant impacts are predicted.

Noise from Construction Traffic on the Road Network

Noise levels from traffic on local roads have been predicted for the peak construction activity, both with and without the potential construction traffic. Predicted noise levels at the roadside are shown on *Table 6-14* below.

Table 6-13

Indicative Worst-case Construction Noise Levels at Nearest Receptors

Receptor	Distance from Power Plant Site (m)	Egyptian Standard (dB(A))		Predicted Noise Level[2] (dB(A))	
		Day-time	Night-time	Day-time	Night-time
Grains Silos structures (to the North)	700	60	50	35	31
Cemetery (to the South)	550	60	50	39	35
Residential Agricultural Area (to the West)	300	60	50	41	39

Notes:

(1) Categorized as Residential - Commercial Area in Egyptian Standards.

(2) Predicted and assessed based on the methods set out in the UK codes of practice (BS 5228), using calculations of the combined sound power from all demolition and construction plant adjusted for usage time.

Table 6-14

Roadside Noise Levels from Construction Traffic $_{LA10,\ 18hour}$ (1)

Receptor	Without construction	With Construction	Increasing
Kureimat/Beni-Suweif Arterial Road	66.2	66.5	+ 0.3

Notes:
(1) 18 hour traffic flows derived from average hourly flows.

The difference in noise levels at roadside receptors due to the construction traffic is only 0.3 dB(A). Increases in environmental noise levels of less than 2-3 dB(A) are not generally perceptible to the human ear, consequently no construction traffic noise impacts are predicted.

Vibration from Construction Activities

Measurements of vibration from construction plant have shown that, even from the worst case activity, i.e. percussive piling equipment, levels typically fall to imperceptibility beyond approximately 100m from the vibration source. Imperceptible levels are reached at much smaller distances from other sources of vibration, such as excavators, bulldozers and heavy goods vehicles (HGVs). Hence, because there are no receptors within 100 m of the site no vibration impacts are expected.

6.4.5 Evaluation of Operational Noise and Vibration

Noise Prediction Methodology

The potential noise emissions from the power plant have been modeled using the Bruel and Kjaer "Predictor" noise model. The noise model breaks the plant down into individual point sources representing each item of equipment or structure that may produce a significant amount of noise. Sound power levels were assigned to each point source based on field measurements of similar equipment in existing power plants as well as vendors, data on noise impacts generated by each piece of machinery, providing representative emission levels without the implementation of any unusual noise controls applied. The individual noise sources included in the model are shown in *Figure 6-30* and are listed below.

- Steam Generators (Boilers), units 1 & 2 ;
- Steam Turbines, units 1 & 2.
- LCI/Generator Excitation Compartments, units 1 & 2;
- Main Transformers;
- Auxiliary Transformers;
- Demineralization Plant;
- Water Treatment Area;
- various types of Pumps and Fans; and
- Gas Reducing Station.

Table6-15 shows noise data on the main noise sources depicted in *Figure 6-19.*

Operational Noise

The noise model has been used to predict noise contours in the area around the site. These are shown in *Figure 6-31* through *Figure 6-34*. *Table 6-16* gives the predicted noise levels at two locations relative to the site boundary.

Table 6-15

Noise Data of the Main Noise Sources in Helwan South Power Project

Source Type		Center Frequencies, Hz								LAeq	LAeq	Remarks
		63	125	250	500	1000	2000	4000	8000	dB	dB(A)	
Turbing source	Linear	100.7	93.1	82.4	75.0	84.0	80.8	85.0	77.1	101.7		Given by EEHC
	A-Weighted	74.7	76.1	75.4	72.0	84.0	82.8	86.0	75.1		90.0	
Main Transformer	Linear	92.0	87.0	87.0	83.0	83.0	80.0	77.0	56.0	95.0		Measured by MB
	A-Weighted	66.0	70.0	80.0	80.0	83.0	82.0	78.0	54.0		88.0	
Auxiliary Transformer	Linear	81.0	86.0	83.0	79.0	70.0	67.0	62.0	56.0	89.1		Measured by MB
	A-Weighted	55.0	69.0	76.0	76.0	70.0	69.0	63.0	54.0		80.3	
Boilers Feed Water Pumps	Linear	90.0	97.0	98.0	100.0	102.0	99.0	95.0	87.0	107.0		Given by EEHC
	A-Weighted	64.0	80.0	91.0	97.0	102.0	101.0	96.0	85.0		105.9	
C.C.W. Equipment	Linear	91.0	92.0	93.0	95.0	97.0	94.0	90.0	86.0	102.3		Given by EEHC
	A-Weighted	65.0	75.0	86.0	92.0	97.0	96.0	91.0	84.0		101.0	
Fuel Heater	Linear	99.6	92.9	91.2	94.8	88.2	85.2	86.8	72.5		88.9	Calculated by MB
Gas Reducing Station	Linear	68.2	68.9	69.5	70.7	75.5	80.4	70.7	62.3	82.9		Given by EEHC
	A-Weighted	42.2	51.9	62.5	67.7	75.5	82.4	71.7	60.3		83.7	

Table 6-16

Predicted Operational Noise Levels

Receptor	Egyptian Standard (dB(A))		World Bank Guideline (dB(A))[2]		Predicted Level (dB(A))
	Day-time	Night-time	Day-time	Night-time	
Fence of the Power Plant [1]	60	50	50	45	< 50
100 m away from the Fence of the Power Plant[1]	60	50	50	45	< 50

Notes:

(1) Categorized as "Residential- Commercial" in Egyptian standards and as "Residential, institutional and educational" in World Bank guidelines.

(2) If the specified noise criterion is not met, the plant must not give rise to an increase in background levels of more than 3 dB(A) in order to comply with the guidance.

Figure 6-30

Individual Point Sources of a Significant Amount of Noise in the Power Plant
[Main Sources Inside the Power Plant (2D view)]

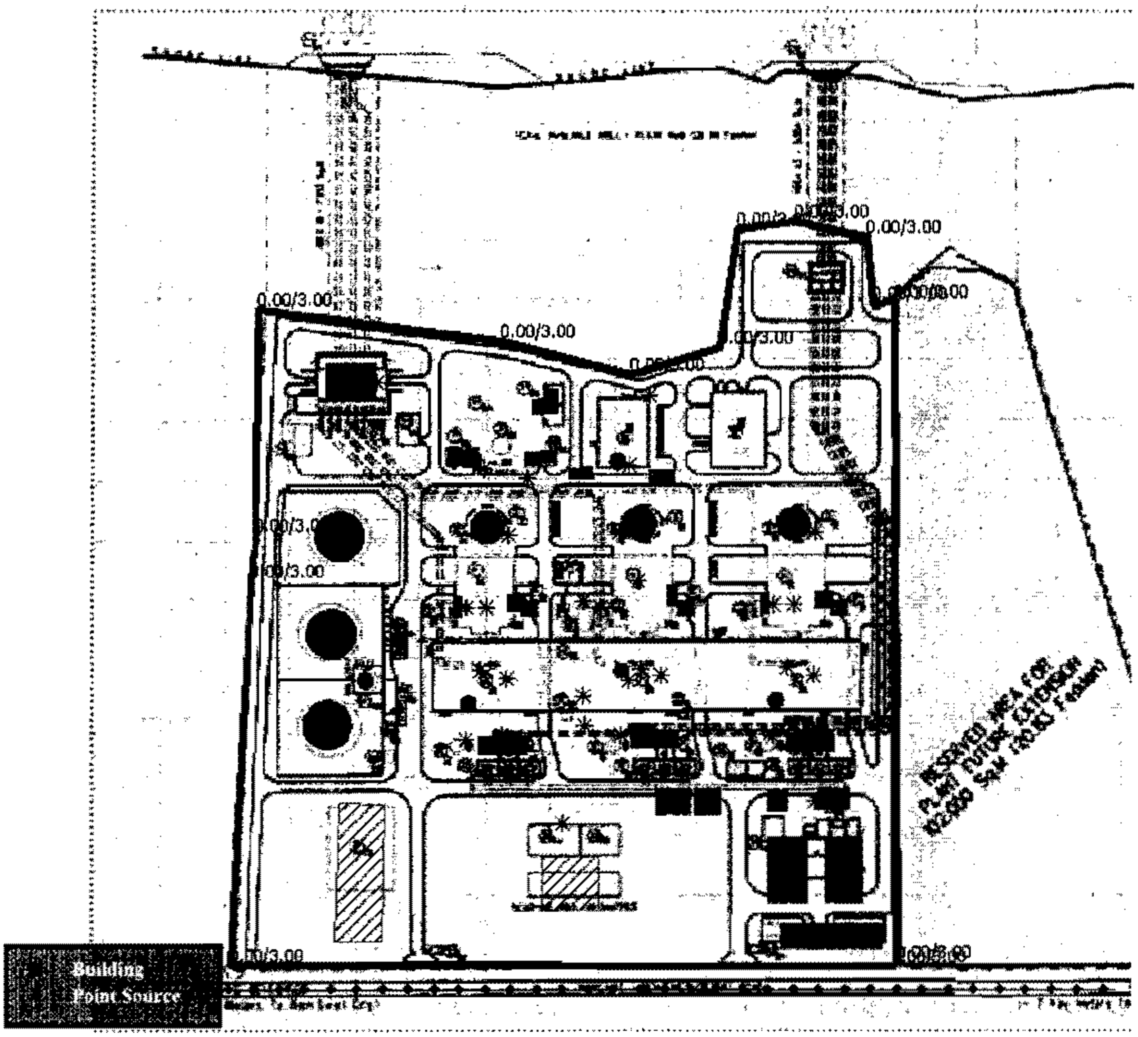


Figure 6-31

Noise Contours for South Helwan Power Plant in Lden

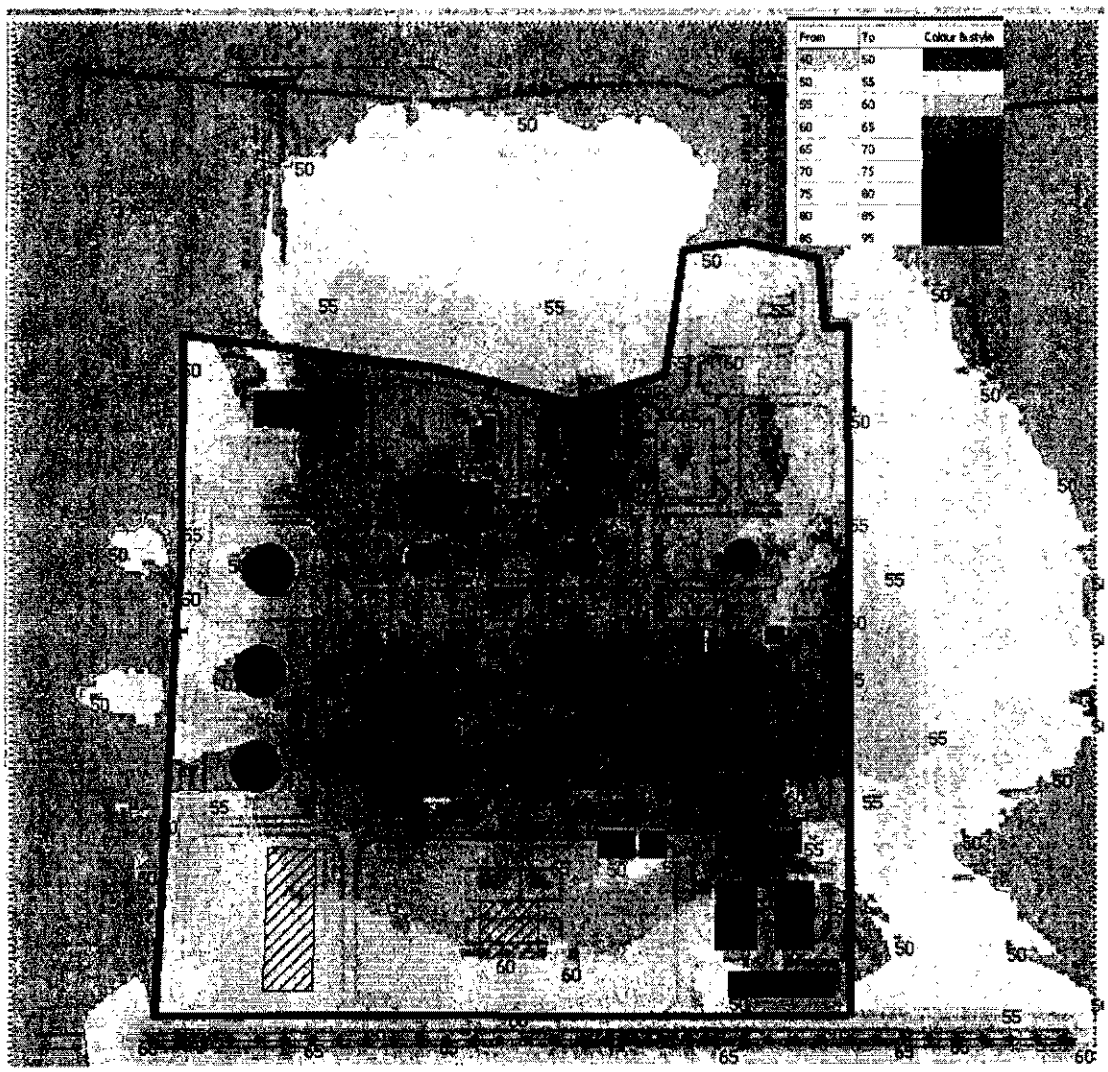


Figure 6-32

Noise Contours & isolines for South Helwan Power Plant in Lden

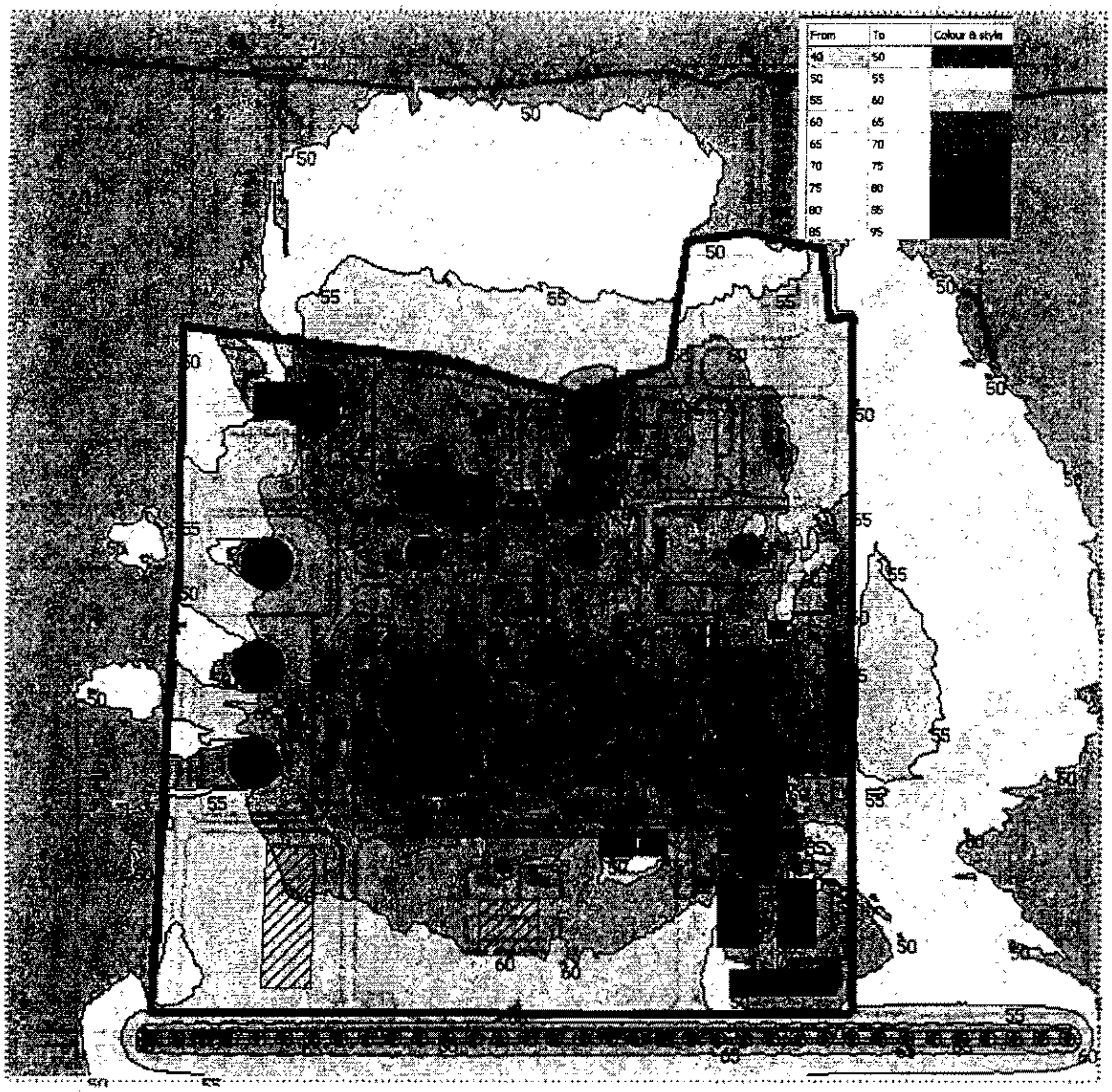


Figure 6-33

Noise Contours & Calculated Values for South Helwan Power Plant in Lden

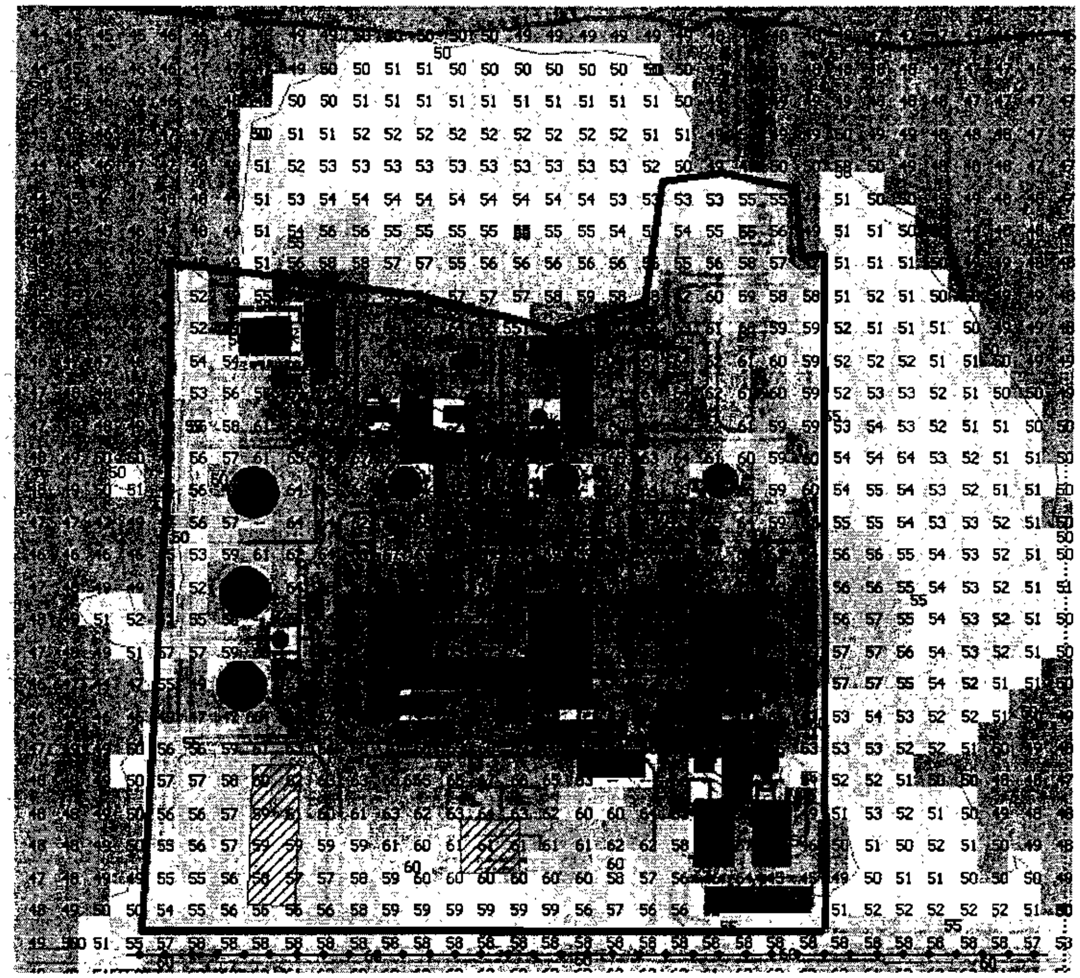
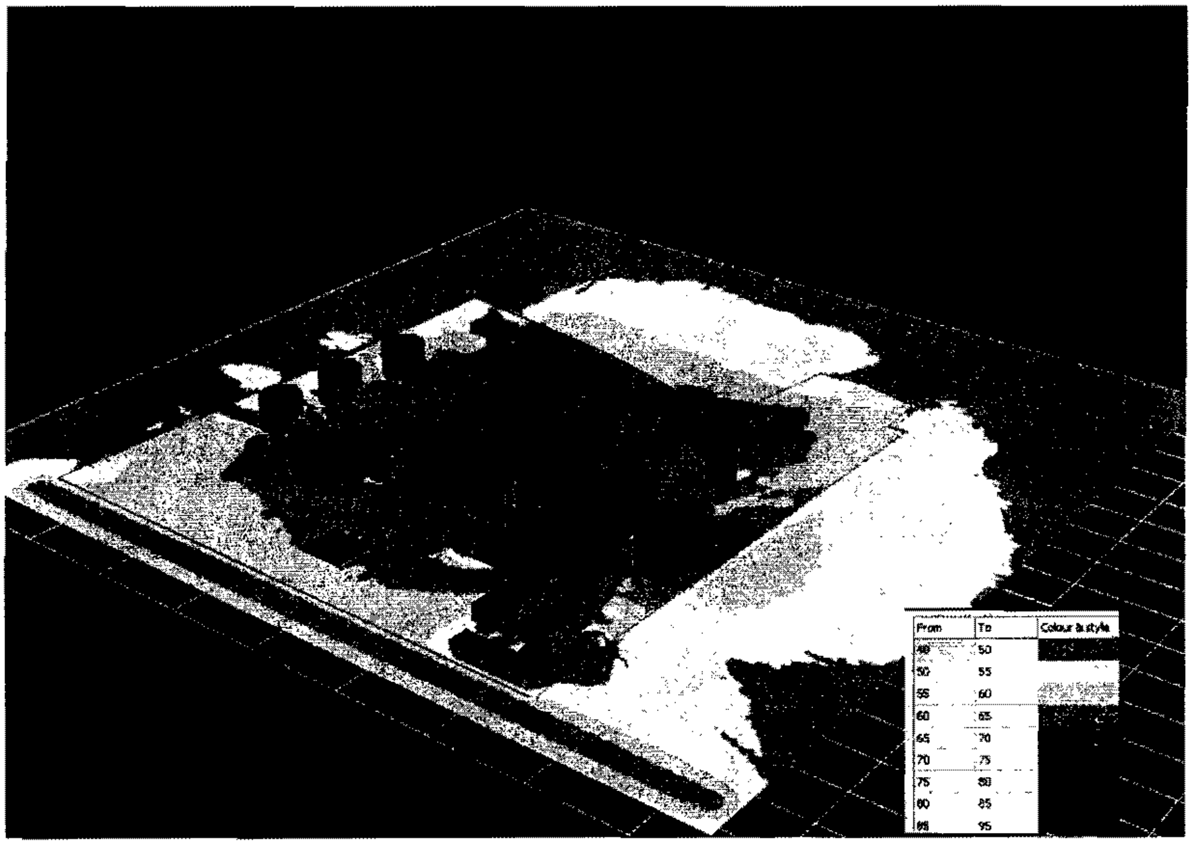


Figure 6-34

3D view Noise Gradient Contours for South Helwan power Plant in Lden



The predicted operational noise levels at the site boundary are below the Egyptian and World Bank Standards for daytime and night-time noise.

It should be noted that the predicted noise levels are based on conservative assumptions for noise attenuation and weather conditions. Therefore, noise from the operating plant is not expected to give rise to any significant noise impacts at receptors in the area.

Superimposition of the background noise in the area on the predicted operational noise levels will result in the overall noise levels complying with the Egyptian Environmental Law 4/1994 and Law 9/2009. All predictions indicate a full compliance at the station fence.

Operational Vibration

The design of the power plant will ensure that all rotating machinery is correctly balanced and that reciprocating equipment is vibration isolated, to ensure that vibration will be imperceptible beyond the site boundary. Since the nearest receptor is some distance from the power compound within the site there will be no vibration impacts from the operating plant.

6.4.6 Conclusion

Predictions of unmitigated construction noise indicate that Egyptian and UK standards are met at all times and there will be no construction noise impacts. Neither will there be vibration impacts because the nearest receivers are distant from the working compound within the site.

Egyptian and World Bank standards for operational noise are met at all receptors during daytime and night-time. Therefore, no significant noise impacts are expected.

6.5 FLORA AND FAUNA

6.5.1 Introduction

The assessment has examined the potential impacts of land take and disturbance of the proposed power plant on flora and fauna.

6.5.2 Potential Impacts during Construction Phase

Ecological impacts usually arise through direct damage to biotic diversity or indirect disturbances to their habitats or their qualitative characteristics. The assessment process begins by identifying the activities during the construction and operation phases of the project. It then identifies the main significant biotic components of the receiving environment that may come under stress or damage due to those previously identified project activities. Interactions between the two groups of factors determines the types of impacts which then would be subject to a process of evaluation to determine which of the impacts are significant and which are not. Usually, only significant impacts would be subject to further analysis and suggestion of mitigation measures to reduce the impact effects.

Ecological surveys of the project site and its immediate surroundings have shown that all the floral species encountered are characteristic of this habitat and ecosystem. The project site represents one unit of the desert Nile bankal plain ecosystem that is replicated along the bankline of the Nile River.

This reveals that such flora is very common to this region and the project hinterland and that none of them are of any ecological significance.

In addition, the surveys have shown that the fauna of the site is of very poor diversity and includes species of very common occurrence and of low; or even none ecological significance as well

The site as a whole has a patchy and thin spotted vegetation cover. It does not seem to harbor any ecologically significant vegetation or fauna. However, this patchy vegetation cover may allow planners to avoid the spots where vegetation occurs as much as possible.

Best environmental practices mandate the avoidance of un-necessary destruction of habitats, vegetation or direct damage to existing fauna. This is true even if the faunal and floral species are of no ecological or conservational value.

Therefore, un-necessary clearance of vegetation specially those present in the salt marsh at the northern tip of the site will be avoided. Otherwise, it is not anticipated for the construction phase to cause any impacts of ecological significance on the terrestrial ecosystem.

6.5.3 Potential Impacts as a Result of Power Plant Operation

Based on the identified flora and fauna of the project area *(Section 5.7)*,it is not anticipated that there will be any further impacts to fauna and flora as a result of the operation of the power station.

The stack measuring 150 m in height would not present an obstacle given that the area is not an area of migrating birds. However, with the inclusion of measures such as lighting, to increase the visibility of stack at night or during weather conditions with poor visibility, this impact is not expected to be significant.

6.5.4 Mitigation Measures

The potential impacts of the proposed development on any existing flora and fauna will be minimized as a result of the following mitigation measures:

- noise will be controlled during construction and operation, and will dissipate rapidly with distance from source. Any disturbance during construction and operation will therefore be localized *(see Section 6.4)*;
- run-off from construction activities and any movement of contaminants disturbed along the land flats, will be attenuated and disposed of in a controlled manner (as described in Section 6.3) to ensure that surrounding species/habitats are not significantly affected;
- proper mitigation measures will be incorporated in the design of the water intake and discharge to avoid negative impacts. Such mitigation measures are currently standardized worldwide (e.g. World Bank, 1991 & 1996); and
- *Ficus elastica var decora* and *Ficus nitida* will be used for decorating and landscaping the site when completing the new power plant. This is actually an economic process because one may obtain 200-300 individual plants from a single tree.

6.5.5 Conclusion

Since the site itself and surrounding areas are poorly vegetated, the significance to flora and fauna is considered to be limited. Given that the potential impacts of construction and operation of the proposed power plant are localized, there are no predicted significant effects.

6.6 LAND USE, LANDSCAPE AND VISUAL IMPACT

6.6.1 Land use

The surrounding land uses in the area constitute mainly grains soils and El-Kureimat power complex to the north direction. To the west of the site is cultivated land, very narrow strip along the bankline of the Nile River. To the south is cemetery area and to the east wide extended desert land across the Kureimat / Beni-Suweif arterial Road.

No adverse impacts to the surrounding facilities or/and uses are anticipated. Potential impacts to the surrounding land uses include the effect of air emissions and the discharges to the aquatic environment, including any wastewater or thermal discharges. These impacts are addressed in the air quality and aquatic environment sections *(Sections 6.2 and 6.3)*. Landscape and visual impacts are discussed below.

6.6.2 Landscape and Visual Impact

The power plant will be a substantial structure with a stack height of 150m which, within the surrounding land uses, will be highly visible for 5-7km along the main arterial Kureimat/Beni-Suweif Road and few kilometers inland.

All existing views in the area will not be strongly influenced by the construction of the power plant and, although the proposed power plant will emphasize the industrial appearance and scale of the local area complex, the potential additional visual impact will be mitigated by the existing industrial infrastructure, particularly the existing Nile River BOOT power plant with its 152m height stack. The wider character of the area is also industrialized, due to the heavily industrialized area of Iron & Steel, fertilizers, ceramics, and cement factories such that the visual intrusion of the power plant will be reduced against this context and backdrop.

The one sensitive receptor in the area will be the residential complex of the power plant. From this premises the power plant will be seen in context with the existing industrial nature of the area, therefore although visible from this area the power plant is not regarded as being intrusive.

Thus, while the power plant will be visible, the sensitivity of the landscape is very limited. It is anticipated that the large scale of the industrial and surrounding landscape will be able to visually accommodate the structures of the power plant in an industrial context. Hence, the landscape impacts are predicted to be minor.

6.6.3 Conclusion

Due to the existing land uses in the area, the lack of any sensitive landscape resources or nearby receptors, the potential landscape and visual impact of the project will be minor and not significant.

6.7 SOILS, GEOLOGY AND HYDROGEOLOGY

6.7.1 Introduction

The assessment of the impact of the proposed development on the soil, geology and hydrogeology has considered the following issues:

- physical effects of construction activities on the soil profile;

- potential contamination from construction and operation of the proposed power plant; and
- effects on groundwater resources.

The risk of seismic activity is discussed in Section 6.11.

The assessment is based on information obtained from reports prepared by National Research Institute of Astronomy & Geographics, and Commercial Services Corporation (CSC) describing the geology and geophysical structure of the site and its surroundings.

6.7.2 Effects on Soils and Geological Features during Construction

There are no special, sensitive or protected soil or geological features or mineral deposits within the site, hence the development of this area of land will not have any significant impacts on soil or geological features or on mineral resources.

Construction activities can potentially alter the physical make up of the soil through a number of construction processes, including:

- site preparation;
- top soil removal and temporary mounding;
- excavation for foundations;
- provision of temporary drainage systems;
- excavation for laying of pipes; and
- excavation of trenching.

These activities can alter the soil's make up through evacuating and compacting the soil (e.g. reducing infiltration and aeration) and by changing the surface topography. These changes to the site may also potentially affect recharge and drainage rates to local groundwater resources. However, given that ground water recharge rates at and around the project site are minimal and groundwater is not abstracted in the vicinity of the project area, the impact of power plant construction on local water resources is considered to be insignificant.

The potential for the direct impacts on the soil mentioned above is, however, largely dependent on the management of the construction site and construction activities. A range of mitigation measures will be implemented to protect soils (and, as a result, the limited groundwater resources) from the direct impacts of constructing the proposed power plant. These measures include the following:

- engineered site drainage systems will be provided to collect, balance, treat as required and control the discharge of site run-off;
- vehicles and personnel will be restricted from accessing areas not designated for construction to prevent accidental or unnecessary disturbance or compaction of the soil;
- spoil from construction activities will be monitored and controlled; waste materials which are unsuitable for reuse on-site will be disposed of by a licensed contractor and the procedures for disposal will be audited by the project engineer and UEEPC.

The inclusion of the above mitigation measures means that there will be no significant direct impacts on soils or geological features from construction activities.

6.7.3 Risk of Ground Contamination

Following geotechnical investigations carried out by CSC, according to the Dutch Guidelines, the topsoil cover is considered to be uncontaminated. However, the construction and operation of the proposed power plant has the potential to cause some contamination through spillages and leaks, especially around fuel storage areas during construction and fuel and chemical storage areas and supply lines for any hazardous substances during operation.

Potential contaminating substances which will be present on the site during construction and operation will include fuels, lubricating oils, hydraulic fluids, water treatment chemicals, plant cleaning chemicals, sanitary effluent and detergents.

The risk of land contamination will be minimized through a range of mitigation measures. These are considered below as appropriate to the construction and operation phases of the power plant.

During Construction

Land contamination will be minimized through the following mitigation measures:

- provision of engineered site drainage systems during construction and operation to collect, balance, treat as required and control the discharge of site run-off;
- protection of the soil from accidental pollution by bunding around proposed storage areas for fuel and chemicals with the capability to store at least 110% of the volume of the storage facilities;
- provision of oil and suspended solid interceptors, such as oil/water separators for the removal of pollutant loading from the site drainage and for the retention and containment of any accidental discharges during construction and operation;
- removal of waste materials unsuitable for re-use on site during construction to appropriate licensed sanitary landfill sites;
- management of excavations during construction so as to avoid the generation of drainage pathways to underlying aquifers; and
- provision of impermeable bases in operational areas to prevent absorption of any spillage of process materials.

The potential for contaminated sediments to be excavated during construction of the cooling water discharge and inlet structures is discussed in more detail in Section 6.3.2.

During Operation

Ground contamination during operation will be minimized through implementation of the following mitigation measures:

- Bunds or sumps will be installed on-site to isolate areas of potential oil or other spillages, such as transformer bays, from the site drainage system.

- Oil and chemical storage tanks will have secondary containment structures that will hold 110% of the contents of the largest storage tank.
- Areas for unloading oil and hazardous chemical materials will be isolated by kerbs and provided with a sump, equipped with a manually operated valve.
- The transformers will be provided with pits to retain 110% of the coolant capacity of the transformers which will include fire fighting water. Alternatively, each main oil-filled transformer foundation will drain through a corner sump directly to an underground oil collection chamber sized to retain l10% of the coolant capacity of the transformers plus deluge water (for the worst single catastrophic failure). Adjacent to this collection chamber will be constructed an oil separator which will normally function to separate any oil contaminated to the storm water collected from within the transformer foundations and the clean water drained to the discharge structure. The transformers will not contain PCBs.
- Stormwater runoff from equipment slabs that may be subject to oil contamination exposure will be collected and channeled through an oil/water separator prior to discharge into the discharge structure.

With these mitigation measures in place, the construction and operation of the proposed power plant is not predicted to cause any ground contamination on-site or of the surrounding land.

6.7.4 Groundwater Quality and Recharge

The volume of water entering the aquifer from the proposed site is currently considered to be negligible. Creation of areas of impermeable hardstanding on the site will not therefore significantly affect groundwater recharge in the area.

The mitigation measures set out in Section 6.7.3 will minimize the risk of contamination of groundwater from the proposed power plant during its construction and operation. As a result, no significant impacts on groundwater resources under the site are predicted during construction or operation.

6.7.5 Conclusion

Due to the characteristics of the soils and geology of the site, in particular the lack of any sensitive features, and the mitigation measures proposed as part of the construction and operation of the power plant, no significant impacts are predicted to occur. In addition, geotechnical investigations and topsoil testing will have to be carried out so as to make sure that the site is uncontaminated.

6.8 TRAFFIC

6.8.1 Traffic Assessment Methodology

Analysis of traffic impacts during construction and operation of the power station utilized both historical and field data. The statistical analysis, outsourced on behalf of UEEPC/EEHC and reported in detail in baseline study performed by Prof. Dr. Ibrahim Mabrouk Ibrahim, Professor of Traffic and Transport Engineering, Al-Azhar University, Faculty of Engineering for this ESIA report requirements, considered an analysis of traffic speed and growth.

The assessment considers the main roads linking the site with the surrounding road network as well as the regional roads, as indicated in Section 5.10.

There are no Egyptian standards or World Bank guidelines with respect to assessing the significance of changes in traffic flow on road networks. The analysis presented here and undertaken by ENIT compares the anticipated impacts with guidance reported in the Highway Capacity Manual (HCM) of the US Federal Highway Administration (FHWA).

6.8.2 Traffic Analysis During Construction

The schedule for construction works, the anticipated volume of traffic generated and the routes used, is discussed in detail in Section 4.7 of this report.

Three mathematical models were developed in order to estimate projected growth of the existing traffic flows to the year during which peak construction activity is likely to occur (2011-2013) and the year of completion 2013/2014. The traffic growth rates derived from the models were used to estimate traffic volumes for 2012/2013.

The traffic analysis is based on estimating the Level of Service (LOS) of the Kureimat/Beni-Suwief Road. LOS is a qualitative measure that describes the operational conditions within a traffic stream and the perception by motorists and passengers. The LOS analysis was carried out by ENIT, as described by the Highway Capacity Manual (HCM), second edition, published by the US Federal Highway Administration (FHWA) in 1994 for two-way two-lane highways. In addition, speed analysis was used to estimate the average travel speed along the Helwan/Hurghada Road and to assess the variation of the average speed.

The LOS is classified using a lettering system as set out below.

To conceive the traffic operating conditions under any of the levels C, D or E, the following descriptions are used by the HCM.

- LOS A., the best level with high operating speed and very low density.
- LOS B., occurs in the zone of stable flow, with operating speeds beginning to be restricted somewhat by traffic condition.
- LOS C; average speed is about 85 km/hr on level terrain; unrestricted passing demand exceeds passing capacity; percent time delay up to 60%; service flow rate starts from 750 up to 1200 passenger car per hour (pcph) in both directions.
- LOS D; average speed of 80 km/hr can still be maintained under ideal conditions;

unstable traffic flow is approached; passing becomes extremely difficult because passing capacity approaches zero; percentage time delay approaches 75%; maximum service flow rates of 1800 (pcph) in both directions.

- LOS E; Speeds will drop below 80 km/hr under ideal conditions; passing is virtually impossible; capacity is 2800 (pcph) in both directions; percentage time delay exceeds 75%.

- LOS F; the forced flow and stop-and-go conditions at a low speeds, where volumes are above capacity.

The analysis was carried out at two levels: regional roads and surrounding roads.

Regional Roads

The peak hour factor for the regional roads [1] is ranged between 10% -15% of the daily traffic volume. This rate is applied to all regional roads within the study area of influence.

Table 6-17 shows the volume-to-capacity ratio for the regional highways during the peak hour, where this ratio illustrates that the level of service of Cairo/Alexandria Desert Highway, Cairo/Helwan Desert Highway and Cairo/Ain South Helwan Freeway is level (A) which considered being a good indicator of the regional road conditions. While the level of service of Cairo/Alexandria Agricultural Highway is Level (F).

(1) The Egyptian Code of Practice for Rural and Urban Roads, 1998.

Table 6-17

Peak Hour Volume and Volume-to- Capacity (V/C) Ratios for the National / Regional Roads in the Year 2010

National / Regional Road	Peak Hour Volume (Veh/hr/dir)	Volume-to-Capacity Ratio (V/C)
Helwan / Beni-Suweif Freeway	792	0.18
Cairo/Alexandria Desert Highway	2030	0.23
Cairo/Alexandria Agr. Highway	6330	More than 1
Cairo/Suez Desert Highway	1115	0.25
Cairo/Ismailia Desert Highway	1704	0.38
Port Said/Ismailia Highway	1663	0.25
Cairo/Ain Sokhna Freeway	984	0.15
International Highway	980	0.22

Volume-to-Capacity calculations in the *Table 6-17* are based on lane capacity as follows:

- Helwan / Beni-Suweif Freeway: 2200 veh/hour.
- Cairo/Alexandria Agricultural Highway: 2000 veh/hour.
- Cairo/Alexandria Desert Highway: 2200 veh/hour.

- Cairo/Suez Desert Highway: 2200 veh/hour.
- Cairo/Ismailia Desert Highway: 2200 veh/hour.
- Port Said / Ismailia Highway: 2000 veh/hour.
- Cairo/Ain Sokhna Freeway: 2200 veh/hour.
- International Highway : 2200 veh/hour.

Surrounding Roads

The regional highway capacities are found according to specification in Highway Capacity Manual (Transportation Research Board, USA, 2000), The level of service for regional roads is found by using the results of survey for these road and the volume-to-capacity was calculated during the peak hour as it is considered to be the critical hour in day for traffic on this road.

For four lanes two way direction roads the capacity is equal to 850pcu/hour/lane. This capacity depends on some factors such as design speed, engineering characteristics of the road, percentage of trucks and buses and pavement conditions. The capacity of the surrounding roads was taken according to Highway capacity Manual HCM 2000. The level of service is evaluated from (V/C) ratio in the morning peak hour which is considered the critical case for traffic volume during the day on this road.

Table 6-18 shows the volume to capacity ratios for Kureimat / Beni Suweif road. Traffic coming to Kureimat direction has a peak flow of 663 vehicle/hour which is equal to 730 pcu / hour. While the traffic in the opposite direction i.e. to Beni Suweif has a peak flow of 789 vehicle/hour which is equal to 868 pcu / hour. The capacity of this road is considered as 1800 pcu/hour/lane. The table below shows that the level of service during the peak hours for Kureimat / Beni Suweif road is level of service **(A)**.

Table 6-18

Volume-to-Capacity Ratios for Kureimat / Beni-Suweif Road

Road	Peak Hour Volume (V)(1)	Capacity (C)(2)	Volume-to-Capacity Ratio (V/C)
Coming from Beni-Suweif to Kureimat	663	1800	0.36
Coming from Kureimat to Beni-Suweif	789	1800	0.43

Notes:
(1) Peak hour flow during morning peak in normal day for each direction (pcu/hour/lane)
(2) The capacity of (1800 pcu/hour/lane)

6.8.3 Construction Traffic Assessment Conclusion

Traffic impact analysis depends on estimation of the peak hour volumes during both construction and after operation. A comparison of the level of service will show the amount of impact envisaged by the new station.

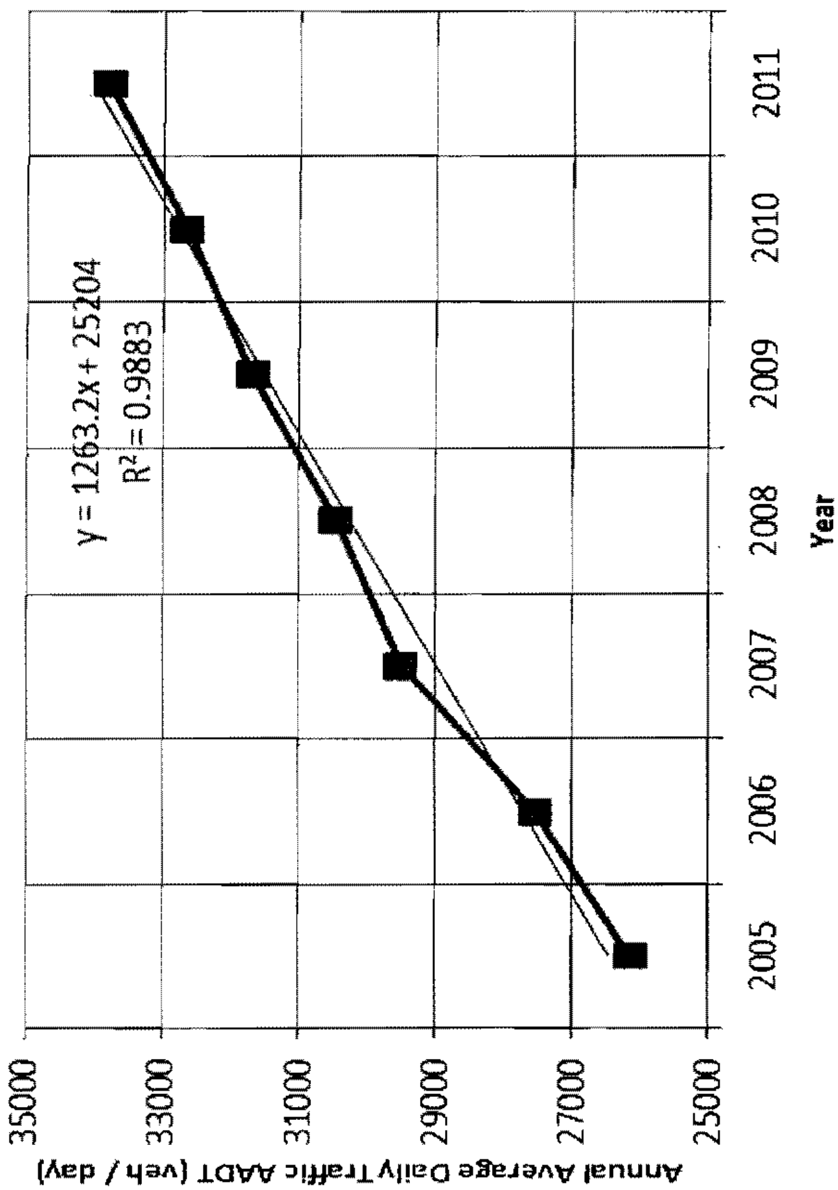
The analysis is conducted on the main road linking the station site with the surrounding road network as well as the regional roads. Roadway or traffic operational improvement would be addressed as alternative site improvements, and would be evaluated for peak hour effectiveness. The analysis will be carried out for two cases: during construction and post construction.

The analysis is conducted on four regional roads (Cairo/Alexandria Desert Highway, Cairo / Alexandria Agriculture Highway, Cairo/Suez Highway, Helwan/ Beni-Suweif Freeway and Cairo / Ain Sokhna Freeway). The improvement of the geometrical and working characteristics is evaluated to improve the traffic flow in the peak hours on this type of roads.

In the case of construction period, the generated traffic related to construction period will be superimposed on the existing traffic flow to produce the expected traffic during construction. The amount of peak hour traffic during construction was 789 vehicles/hour. The traffic growth was estimated using the traffic growth trend on the national Egyptian highways *Figure 6-35*. Therefore, the peak hour traffic on Kureimat / Beni Suweif road is expected to be increased by about 5% during the first year of construction (2010).

Figure 6-35

Annual Average Daily Traffic Growth and the Regression Curve



In the case of operation stage, traffic volumes for Kureimat / Beni Suweif road in year 2011 were estimated based on an annual rate of increase of about 5% to the existing traffic relative to the base year traffic counts at year 2010. This means that the traffic counts of 2010 were expanded to the expected future conditions, and then the generated traffic from the power plant was added to the forecasted traffic.

Traffic volume on Kureimat / Beni-Suweif road with and without the new power plant (vehicle/hour) is given in *Table 6-19*.

It is concluded from *Table 6-19* that during construction, the results show that the traffic volume is at its maximum level for Kureimat / Beni Suweif road in year 2010 and is equal to 883 veh. /hr in Beni Suweif direction. In the opposite direction (To Kureimat) the traffic volume is equal to 757 veh/hr. Therefore the V/C ratio will be increased from (0.43) to (0.53) which means that the level of service will be level (B). While during operation of Helwan power plant and after construction, traffic volume at its maximum will be 916 veh/hr in Beni Suweif direction. In the opposite direction (To Kureimat) the traffic volume is 784 veh/hr. During this period the volume-to-capacity ratio will be (0.56), and level of service will still be level (B).

Table 6-19

Traffic Volume for Kureimat/Beni-Suweif Road with and without the New Power Plant (in Vehicles/hr)

1. Expected Traffic Volume in the Year 2011

	Morning Peak Hour		**Evening Peak Hour**	
	Without Power Plant	**During Construction**	**Without Power Plant**	**During Construction**
To Kureimat	663	757	268	312
To Beni-Suweif	789	883	260	304

2. Expected Traffic Volume in the Year 2012

	Morning Peak Hour		**Evening Peak Hour**	
	Without Power Plant	**During Operation**	**Without Power Plant**	**During Operation**
To Kureimat	697	784	281	368
To Beni-Suweif	829	916	273	360

3. Expected Traffic Volume in the Year 2013

	Morning Peak Hour		**Evening Peak Hour**	
	Without Power Plant	**During Operation**	**Without Power Plant**	**During Operation**
To Kureimat	723	813	315	399
To Beni-Suweif	859	945	314	387

Table 6-20

Summary of Peak Construction Traffic

Vehicle Type	Traffic Generation			
	Day Shift		Night Shift	
	Peak (veh/hour)	Total during the shift	Peak (veh/hour)	Total during the shift
Heavy Goods Vehicles	10	100	0	0
Construction Workers Vehicles	82	164	44	88
Abnormal Loads	2	4	0	0
Total	94	268	44	88

A similar analysis carried out for the regional roads; Cairo/Alexandria Desert Highway, Cairo/Alexandria Agricultural Highway, Cairo/Helwan Desert Highway and Cairo/Ain South Helwan Freeway, considered in the study during the construction stage. *Table 6-21* shows the expected traffic volumes on the three regional roads in the years 2009- 2012 in both cases: without and during the construction and year 2013 without and post construction.

From the previous table it is obvious that the Average Daily Traffic for regional roads (AADT) during construction is considered critical case compared to post construction. However, the increase expected in traffic volume differs from highway to another, for instance the prospective increment on Cairo/Alexandria Desert Highway and Cairo/Helwan Desert Highway may lead to an increase in V/C ratio from (0.25) to (0.35) and from (0.30) to (0.41) respectively after the opening of the station in year 2013. This slight increase will not change the level of service of these roads which is level (A). Also, Cairo/Alexandria Agricultural Highway which has level of service (F) will never change its characteristics. While Cairo/Ain South Helwan Freeway the level of service will still the same .i.e. level of service (A). As in all cases it is clear that the effect of the increase in traffic volumes concerning the new power station either during or post construction is very small in case of Regional Roads.

Table 6-21

Traffic Volumes for Related Regional Roads with and without the New Power Plant (in vehicle/hour/direction)

Road Section	2011		2012		2013	
	Without Const.	During Const.	Without Const.	During Const.	Without Const.	Post Const.
Cairo/ Alex. Desert Highway	38069	38163	40[illegible]07	41001	43956	44043
Cairo/ Alex. Agr. Highway	166247	166341	185698	185792	[illegible]7425	207512
Cairo/Helwan Desert Highway	22456	22550	24032	24126	25719	25806
Cairo/Ain South Helwan Freeway	10116	10210	11330	11424	12689	12776

Traffic management system and mitigation measures

Although the effects of construction traffic are likely to be limited, a number of good management measures will be undertaken. These comprise:

- construction workers will be transported to the site by minibuses;
- prescribed routes for construction traffic will be agreed with the appropriate authorities, particularly with respect to HGV traffic and abnormal loads if required by the CAA; and
- abnormal load movements will adhere to prescribed routes to be agreed with the appropriate authorities - these will be scheduled to avoid peak hours on local roads and published in advance to minimize possible disruption if required by the CAA.

With the inclusion of the mitigation measures, the potential impacts upon the affected roads will not be significant.

6.8.4 Operational Traffic

Construction and commissioning of the power plant is expected to be complete in 2013/2014.

Operational Workers

The power plant will operate 24 hours a day, 7 days a week and will employ approximately 400-500 people. During a normal working day it is understood that 330-400 employees will access the site at the beginning and end of the working day. Peak vehicular activity of 56 movements will occur at the start and end of the normal working day, assuming that part of the workers travel to the power plant by private motor vehicle with a vehicle occupancy rate of 4 and another part of the workers travel to the power plant by van motor vehicle with a vehicle occupancy rate of 8-10. During night-time and official holidays, 60-72 employees will be on-site.

Heavy Goods Vehicles (HGVs)

All delivery of gas and heavy fuel oil will be via pipelines. Therefore, the only HGV movements arising from the operation of the power plant will be associated with the delivery of light fuel oil (sollar), process materials or maintenance equipment. Delivery of these materials is estimated to generate approximately two HGVs, or four HGVs movements, per day.

Assignment of Operational Traffic

Operational staff are likely to originate from Es-Saff, El-Bromble, Atfieh, Dayr El-Maymoun, Beni-Suweif and wider Helwan Governorate area and surrounding cities and will therefore access the site via the Kureimat/ Beni-Suweif road.

A summary of generated traffic is given in *Table 6-22.*

Table 6-22

Summary of Generated Operational Traffic

Type Vehicle	Peak Period	Daily
HGV	6	12
Car/LGV	81	162
Total	**87**	**174**

6.8.5 Operational Traffic Impacts

Percentage increases in peak hour traffic flows during the operation of the power plant are about 8-9% on the Kureimat/ Beni-Suweif Road to the site of the power plant.

These small increases in road usage are insufficient to cause any noticeable impacts during peak hours on traffic conditions, cyclists or pedestrians and, therefore, no significant effects are predicted.

6.8.6 Parking Demand

Parking demand differs, in general, by land use type and density. It is also affected by the presence of public transport modes and laws imposed and the zoning ordinances. Parking demand also changes by time due to changes in car ownership, traffic management measures and changes in employment densities. International references normally provide parking rates as a percentage of the land use area or number of employees. For instance, the parking rate for industrial parks is given as space per 100 or 200 m2 of the gross building area or 10% of the total employees.

In this study, the total expected employment of Helwan power plant is 400 employees covering all jobs (executive directors, engineers, accountants, technicians, etc). The plant works three shifts over the 24 hours, each shift is 8 hours (8.00 am-4.00 pm -- 4.00 pm-12.00pm – 12.00pm-8.00am).

According to the low possession of private cars to workers in the plant compared to International Measurements, the car ownership can be calculated from similar places by 1 car for every 10 workers. As the total number are 400 workers so we need a parking area for 40 cars, and 10% increase for visitors so the total becomes 45 places. Also parking places should be provided during construction.

6.8.7 Conclusion and Recommendations

A comprehensive reconnaissance was carried out to define the study area around the power plant. A video tape was recorded to identify the characteristics of the area under study.

The power plant is accessible from Cairo through the route: Helwan / Beni Suweif freeway – Kureimat / Beni Suweif road. The power plant is located adjacent to Kureimat / Beni Suweif regional road. The site is near to the Nile where there is cultivated land extending from the Nile to the site. There is only one entrance to the site from the Kureimat / Beni Suweif road there are not no obstacles to restrict the movement of heavy vehicles to and from the site.

Concerning the national Roads connecting the Power Plant to the main ports in Egypt the following roads are mentioned:

- Helwan / BeniSuweif Freeway.
- Cairo/Alexandria Desert Highway.
- Cairo/Alexandria Agricultural Highway.
- Cairo / Ismailia Desert Highway.
- Cairo/Suez Desert Highway.
- Port Said / Ismailia Highway.
- Cairo / Sokhna Freeway.
- International Highway

Manual counts were carried out, the traffic surveys taken proved that the prevailing traffic volumes are moderate to low even during peak periods.

The operational characteristics of the road section (5.0 Km) of the regional road (Kureimat / Beni Suweif road) passing by the power are identified. Ultimately the prevailing level of service of the subject road section proved to be level A.

To anticipate the future traffic condition taking into consideration the impact of the power plant during both construction stage and operation stage, the traffic growth was estimated using the traffic growth trend on the national Egyptian highways. The generated traffic from the power plant is then superimposed on the anticipated traffic volume of Kureimat / Beni Suweif road in year 2011. It was proved that the V/C ratio increased from 0.43 (prevailing) to 0.53 (future) which means that the LOS is kept at the level B.

The assessment process is completed by studying the traffic volumes, traffic composition and roadway conditions. Traffic studies showed that although the prevailing and future peak volumes are relatively moderate and the carriageway is well constructed and furnished with road signs and marking. Yet the traffic composition especially at night has a big truck percentage which might cause impedance to traffic and might be hazardous to heavy vehicles movement. As mentioned above it is highly recommended to construct the entrance with acceleration and deceleration lanes to direct the vehicles in and out the power plant.

For the completion of the study parking demand is considered. Parking demand differs, in general, by land use type and density. As the total number of employees in the plant is 400 workers so we need a parking area for 40 cars and 10% increase for visitors so the total becomes 45 places. The parking supply should be considered during the planning of the site. Also parking places should be provided during construction.

As a whole there is no traffic impedance on the regional road network due to constructing or operating the power plant.

It is recommended to consider the following:

1. Using the International Highway for linking the main ports to the power plant.
2. Upgrading the entrance proposed in the study by acceleration and deceleration lanes and using it as the main entrance to the power plant.
3. Supplying parking space of about 1000 m2 during the planning of the construction of the power plant.
4. The drivers, particularly the truck drivers, should be familiar with Nile adjacent roads which are characterized by heavy vehicles traffic and narrow right of way.
5. Avoid night driving as there is a great truck percentage (68%) using the road at night, which might be hazardous to traffic.

6.9 SOCIO-ECONOMIC EFFECTS

6.9.1 Introduction

The administrative structure within which the power plant is situated is explained in the First Section of this report.

This section addresses the socio-economic impacts associated with the construction and operation of the Helwan South Power Plant. The nearest permanent settlements to the proposed plant are the El-Kureimat, Atfieh, and Es-Saff residential communities to the north, east and west of the site area. The Entire Helwan Governorate, with its Districts, Marakez and Cities, is likely to experience the positive and negative socio-economic impacts from the construction and operation of the plant. However, El-Kureimat and Atfieh, particulary, may experience the greatest socio-economic impacts due to its proximity to the plant.

The assessment of impacts draws upon baseline data collected and provided by ECG, the Egyptian Electricity Holding Company (EEHC) and the Upper Egypt Electricity Production Company (UEEPC) during preparation for this socio-economic analysis and impact report. No information on existing income levels was available from the Governorate, the Helwan city and District Authorities.

6.9.2 Resettlement within the Power Plant Area

Involuntary Resettlement

The power plant will be constructed on an existing plot "belonging to UEEPC, and power will be evacuated through existing network transmission lines. In this context, the project does not impact on any settlements or assets belonging to other parties. This has been verified and validated by this ESIA findings that the project will have no direct impaction land use or terrestrial resources for communities around the project area. In cases where, during implementation, there may be impacts on third party property from off-site associated infrastructure, including natural gas pipelines, etc. provisions will be made in the Contractor's contract for payment of compensation and relocation of services in accordance with national and international policy guidelines.

As there are permanent staff settlements within the Kureimat, Atfieh and Beni-Suweif Region, no resettlement or displacement of people is envisaged.

6.9.3 Land Acquisition

The plant is sited on land allocated by the President of the Arab Republic of Egypt's Decree No. 43 of the year 2010 for the development oof the power plant. The land is formally the whole area allocated to the Helwan South Power Plant as a public benefit works. The land is located at 7.5 km south of the El-Kureimat existing Power Plant, approximately at the very south of the Helwan Governorate entire land, which is along the River Nile and about 23 km north of Benia Suweif Markaz and City, with a total area of 90 Feddans (i.e. 378,000 m2). Historically, all land in Egypt belongs to the state and is assigned to specific owners only via Governmental authorization.

While much of the land is bare desert land, the land parcels close to the Nile River are actively cultivated by some 4 family groupings representing roughly 20 people. The communities use the land to grow sugar cane, citrus and cereals. In addition, 2 fishermen have been using the land adjacent to the proposed project site. Access to the land between the power plant perimeter fence and the Nile River bank has been reviewed to ensure public access. According to the Lending Institutions' Policy on Involuntary Resettlement this will call for an Abbreviated Resettlement Action Plan (ARAP) to be prepared. The draft ARAP will be submitted to these Lending Institutions for review as an Annex to this ESIA.

6.9.4 Employment Generation

A key positive socio-economic impact of the development of the power plant will be the generation of employment during its construction and operation. UEEPC proposes to operate a policy of preferential employment of locally resident workers depending on skills and availability in order to maximize local employment benefits. This local workforce will be drawn from the Atfieh, Kureimat, Es-Saff and Beni-Suweif areas and their Districts and other neighboring Marakez and cities.

It should be noted that construction work within the Egyptian Governorates is traditionally undertaken by migrant labor from Upper Egypt. Migrants are normally attracted to the area of projects construction within Egypt by the availability of manual work, which is traditionally not undertaken by indigenous residents. Migrants find accommodation within the area and its surrounding districts and remain in the area until employment prospects elsewhere draw them away. Given the plethora of construction activity ongoing in the Helwan and Beni-Suweif areas, the number of workers available for construction of the power plant, is likely to be high.

Available employment data described in the First Section of this report suggests that unemployment in the whole Governorate of Helwan lies around 10% and in the Helwan Governorate, around 448,362 (2009 statistics) people form the active workforce. Statistics suggest that approximately 46% of this labor force is comprised of industry and commerce workers and around 58% of the Governorate's workforce are categorized as skilled, having been trained in various disciplines.

The estimated employment generated during construction of the plant is anticipated to be as follows:

- 80 workers provided by the Architect Engineer;
- 1200 local employees for the civil work; and
- 900 local employees for mechanical and electrical work.

Local workers will represent approximately 85% of the civil and mechanical construction work.

In addition, the Architect Engineer will provide approximately 35 persons who will manage 35 other local personnel who will in turn manage local teams. Local employees to cover management activities will represent approximately 75% of the staff.

The entire labor force will be daily commuters, thus there will be no worker housing or associated facilities to be erected on site during construction or operation. Following general practice in the area, minibuses will be provided to bring construction workers to the site from Helwan area and surrounding cities.

The contractors will be responsible for relevant temporary water/toilet facilities during operation and the need to provide appropriate services will be specified in their contracts.

Following construction of the power plant, the majority of manual jobs will become redundant, however given the large number of other construction activities in the wider area, this is not anticipated to present any negative impacts to the local workforce.

During operation, the power plant will employ approximately 700 people. Both skilled and unskilled staff will be recruited from the local workforce. Unskilled positions will include drivers, cooks, cleaners, clerks and secretaries and security guards. Many of these jobs could be filled by women. The project company will employ people with due regard to their equal opportunities policy.

The construction and operation of the power plant is therefore anticipated to provide significant employment opportunities within the Helwan area and to the workforce of the surrounding cities. The employment generated by the power plant will be an important positive impact of the proposed project.

6.9.5 Gender Analysis

The project is not expected to cause any major negative impacts on either women or men both during construction and implementation. At implementation stage, the project will offer employment opportunities to both men and women. While the nature of work and work environments may be viewed to disfavour women, never-the-less, and feedback received from the UEEPC, it is expected that approximately 5% of the total workforce will be women mainly working in administration and both formal and informal income generating activities associated with construction phases such as catering services and cleaning. Further indirect jobs of hospitality, cleaning and catering will be created to serve the 800 employees who will come into Dayr El-Maimoun from outside. This will create an estimated 160 jobs or 20%. During operation, approximately 700 jobs will be created out of which 10% will be women. At national level, the regular supply of affordable electricity will facilitate household chores generally reserved for women; expand access to education, including that of girls; improve the quality of health services, including for mothers and infants; and facilitate income generating activities undertaken by women such as animal husbandry, on-farm activities, food processing, clothes manufacturing and others.

The gender equity initiatives being implemented at EEHC and UEEPC are Significant. Much of what is being promoted is seen at EEHC and UEEPC where women are present in executive and managerial positions. EEHC and its companies apply equal employment opportunity in line with the Egyptian Labor law. The law stipulates equal wages, and includes gender-sensitive benefits such as paid maternity leave, unpaid child care leave for 2 years for a maximum of 3 children, shorter working hours for infant feeding purposes, and unlimited unpaid leave for accompanying spouse abroad. EEHC provides additional social benefits for its staff particularly for projects in remote areas, such as housing facilities, transportation services, schooling, medical centers, kindergartens and canteens/outlets for basic foodstuff. The package of benefits coupled with job security and pension, make employment in public sector and government entities such as EEHC attractive, particularly for women. Example of positions held by women within EEHC include secretarial, administrative and financial. There are women as Executive Board Members for Affiliate Companies; the Sector Heads of the following Departments are women: Strategic Planning; Costing, Commercial and Administrative Affairs for the Companies; Human Resources; Economic and Financial Studies for Companies; in addition to a large number of women holding general managerial positions. Within UEEPC, one of six board members is a woman. Furthermore, gender sensitization is being given greater prominence, with the recent creation of gender focal points within the EEHC and its affiliated companies. At UEEPC, a focal point has been nominated whose responsibilities will include training and creation of gender disaggregated employment data.

6.9.6 Direct and Indirect Income Effects

Direct Income Effects

The potential direct income effects during construction and operation of the power plant include:

- income from the permanent and temporary jobs that will be provided during the construction and operation of the plant. Market rates will be paid to all workers who will, in turn, spend the money in the local economy through goods and services bought in the area;
- income from locally placed orders for goods and services during construction and operation phases including contracts for the provision of construction materials and services, maintenance, repairs and equipment servicing, and the establishment of supply contracts (e.g. security, waste disposal, food, cleaning, catering, transport, laundry etc.).

Given an estimated average pay levels of USD 150 per month, for semi-skilled and unskilled labour, the total wage bill will be approximately USD 3.8 million per year for 3 years. Thereafter, during operation, the power plant will have a payroll (including benefits and overtime) of approximately US$ 1.9 million per year. The local economy will receive a stimulant, assuming that 70% of the income will be spent in project area.

The typical annual operational expenditure of the power plant will be in the region of US$ 4 million, although in years where substantial maintenance is carried out, expenditure can be expected to rise to US$ 7 million.

Approximately, 70% of this operational expenditure will be spent locally on labor, consumables, equipment and general maintenance.

Indirect Income Effects

Indirectly, the power plant is likely to raise the profile of the region, and in securing the supply of power to the region will attract additional industrial investment resulting in jobs, improved infrastructure and service provision. Whilst this could be perceived as having potential negative long-term effects on local culture, the area has a long established industrial culture associated with many of the industrial activities of the Region. In addition, long term development plans of the Government of Egypt have designated the area for some future developments. The power plant is therefore central to attracting this investment and the positive income-generating potential of these developments is likely to outweigh any negative impacts.

6.9.7. Pressure on Resources

The project area has within its vicinity, especially the Dayr Al-Maymoun village, which is approximately 700 meters far, potential for social tensions between project workers and local population. Much of such tensions emanate from employment policies adopted by the project contractors, use of facilities such as health centers and social integration dynamics. Means of mitigating such occurrences are in place. The Project will construct a dedicated project campsite where all facilities shall be provided to the incoming labour force to ensure that no pressure is exerted on local facilities and supplies. The local communities shall be given priority in supplying goods and services demanded by the project and its employees. Senior and professional staff of the construction companies will opt to reside in the near-by city of Beni-Suweif which has adequate facilities to cater for the project workers. The Power Company has already determined the lodging requirements of the operational staff and decided to use the El-Kureimat colony, 7.5 km north-east, where the availability of extending present colony facilities exist.

In conclusion, the project is not anticipated to exert any pressure on local resources such as accommodation. The workers that will come in from outside Helwan will be skilled labor and capable of renting in existing houses. These are in adequate supply. This will cater for accommodation, water and food.

6.9.8 Public Services

A potential adverse effect of the power plant is increased demand for public services, such as water and wastewater provision, housing, education, health services, etc. An assessment of these impacts however does not suggest that any negative effects will be experienced.

Drinking water during construction will be supplied to the plant with local water supply system of Kureimat area. During plant construction, sanitary water will be provided also via local water system. During operation, all water for sanitary purposes will be supplied by the local area water system. Sewage generated at the power plant will be disposed of via plant sewer system.

As discussed in the First Section, migrant labor is traditionally attracted to the region and public services are considered by public officials to be more than adequate to absorb them. No provision of additional services is therefore considered necessary during construction or operation of the power plant.

6.9.9 Off-site Activities During Construction

All construction related activities will take place within the area belonging to the Upper Egypt Electricity Production Company. The total area is 378,000 square meters have, already, designated for the new plant. In addition to the area specifically designated for the plant, there is a reasonable empty space inside the purchased land next to the power plant site area. All activities related to the construction of the new plant will therefore take place within the area belonging to the Upper Egypt Electricity Production Company, i.e. there will be no off-site activities or associated land acquisition during construction.

Transmission lines which will evacuate power generated by the Helwan South Power Plant will add limited connecting transmission lines to the Egyptian network. The same existing 500/220 kV lines will evacuate the power generated by the new power project. No resettlement will be associated to the power interconnecting lines.

6.9.10 Impacts on Local Fishermen

Fishing has long historic traditions along the River Nile. It represents one of the most important features of the life customs of people in many locations along the Nile, particularly Delta area, irrespective of its economic value.

General Authority for Fishery Development is the main body responsible of fishing activities in Egypt. Upper Egypt Zone for Fish Wealth – a zonal division of the General Authority – is responsible of fishery works in Upper Egypt areas, which include water surfaces extend along about 1,000 km Nile distances.

Almost no fishing activities exist in the Kureimat to Beni-Suweif waters. Agricultural, industrial and transport activities make fishing a not common activity in such an area.

The number of fishermen in the Helwan South area is estimated to about very few or engaged in fishing part time. Traditional practice has shown that the impacts of the warm water from a power plant are highly localized. At the point of discharge the water temperature is about 8 degrees above ambient. 20-50 meters from the discharge point the temperature is 5 degrees above ambient and at 100 meters 3 degrees higher. 300 meters downstream there is no longer any difference in temperature. The very few number of fishermen at Dayr El-Maymoun area rarely utilize a 5km stretch, roughly 2.5km in each direction from the point of discharge.

Most of the fisheries activities in Upper Egypt are concentrated at the southern part of the Nile River and the lake Nasser waters. The effects on the fisheries of warmer water returned to the water body from similar power plants along the Nile River and its branches as well as along the bankal and coastal zones of Egypt are well known. Experience from about eight power plants - located on the Nile River and its branches and about other eight power plants located on coastal areas of the Mediterranean Sea and Suez Gulf - that have operated for a number of years indicate that the overall impacts on fisheries of slightly warmer water actually are positive, and consultations with the fishermen indicate that the catches in these areas have increased rather than decreased. Since this is part-time, small-scale fisheries no statistics are available, but after many years the warmer water around the various points of discharge, is clearly perceived by the fishermen to have positive effects.

In line with this recognition, discussions have already been initiated between the EEHC/UEEPC and the General Authority for Fishery Development with a view to jointly take advantage of this, e.g. establishing a fry collection station near the edge of the mixing zone.

6.9.11 Communicable Diseases (HIV/AIDS, STD, TB, Hepatitis)

Impacts on HIV/AIDS, STDs, malaria, communicable diseases and other pandemics will not directly apply in the implementation of the project mainly because there will not be a specific colony created to accommodate project employees. However other diseases such as TB would be of potential danger to workers at the sites. Emission of dust during construction has a potential for exacerbating the intensity and hence the spread of TB. The ESMP has elaborated in detail measures for mitigating these impacts including any potential for exposure to harmful particles from asbestos. Among the communicable diseases of concern in the area are hepatitis B and C, and Tuberculosis (TB). The prevalence of TB was estimated to be 32 in every 100,000 people. Government is conducting programs to combat its spread through, among other programs, DOTS (Directly Observed Treatment Short courses) which in 2005 had coverage of 60%, and a treatment success rate was at 70%. The existence of HIV/AIDS in Egypt is very low at less than 0.1%. The current figures show approximately 2,900 to 13,000 people were living with HIV/AID (2009). Although the prevalence is low, development partners such as USAID, UNFPA, UNICEF and others are working with Government to enhance awareness which is very low. According to the EHDR (2010) only 7% of women and 18% of men had comprehensive knowledge about AIDS. On its part, the project has incorporated a component of HIV/AIDS, TB and hepatitis awareness and prevention through workshops for construction workers, information leaflets and peer education.

6.9.12 Traffic Congestion

The project will potentially cause traffic problems from generated traffic, especially during construction, and the potential for congestion on local roads, particularly Cairo/Kureimat / Beni-Suweif regional road. Such traffic will include that carrying staff, concrete materials; reinforcement, earth moving equipment, construction materials, paint, steel structure, concrete pipes; and oversize transport which will be used for special equipment such as turbines and stator alternators. The volume of heavy good vehicles (HGVs) traffic will vary between 100 HGV per day during peak periods to an average of 10-30 HGV each day throughout the period. In addition, approximately 35 abnormal loads are anticipated to arrive at the plant over the construction period. It is unlikely that any more than two such loads (i.e. four individual movements) would be necessary on any day during the construction of the power plant. To minimize any inconvenience, hazards and damage caused to other road users, local people and the local road network, the following mitigation and management measures shall be implemented:

(i) Abnormal load movements will be confirmed with the Competent Administrative Authority (CAA) and will adhere to prescribed routes. Their movement will be scheduled to avoid peak hours and notices will be published in advance to minimize disruption if required by the CAA;

(ii) Consideration will be given to staggering construction shifts to split arrival and departure times;

(iii) Scheduling of traffic will be undertaken to avoid the peak hours on the local road network wherever practicable; and

(iv) Construction workers will be transported to the site by contract bus.

6.9.13 Occupational Health and Safety

during Construction: UEEPC will ensure that "construction activities are undertaken ma manner which does not present hazards to workers' health and safety. In particular, the project company will establish and integrate policies and procedures on occupational health and safety into the construction and operation of the power plant. Emergency and accident response procedures will also be included in an Environmental Health and Safety (EHS) manual for the power plant. The following measures will be carried out during the construction phase: (i) compliance with international standards for good practice; (ii) adherence to local and international guidance and codes of practice on EHS management; (iii) management, supervision, monitoring and record-keeping as set out in the plants operational manual; (iv) implementation of EHS procedures as a condition of all contracts; (v) clear definition of the EHS roles and responsibilities of the companies contracted to work on site and to all their individual staff (including the nomination of EHS supervisors and coordinator); (vi) pre-construction and operation assessment of the EHS risks and hazards associated with construction and operation, including consideration of local cultural attitudes, education level of workforce and local work practices; (vii) provision of appropriate training on EHS issues for all employees on site, including initial induction and regular refresher training, taking into account local cultural issues; (viii) provision of health and safety information; (ix) regular inspection, review and recording of EHS performance; and (x) maintenance of a high standard of housekeeping at all times.

during Operation: The following mitigation and management measures will ensure that the health and safety of staff and any visitors on and to the site is not jeopardized during operation of the plant: (i) development and implementation of an Operational Health and Safety Plan with appropriate training; (ii) provision of training in use of protection equipment and chemical handling; (iii) clear marking of work site hazards and training in recognition of hazard symbols; (iv) installation of vapor detection equipment and control systems; (v) development of site emergency response plans; (vi) all personnel working or standing close to noisy equipment will be required to wear noise protectors; and (vii) drinking water will be supplied to the plant via local filtration facilities which will comply with drinking water standards published by the World Health Organization.

6.9.14 Training of Staff

Among the positive outcomes of the project will the integrated training for environmental and social management staff of the power company as part of capacity building but also imparting knowledge (skills transfer). The staff will be trained in the following areas:

- general operation of the power plant;
- specific job roles and procedures;
- occupational health and safety; and
- contingency plans and emergency procedures.

The staff training will comprise induction training on appointment; specialist training (as required for the prescribed job role); and refresher training as required (typically annually). The training program will be designed to ensure that appropriate skilled staff are available to operate the power plant at all times. Training and instruction of Construction staff will be given at the site to increase awareness and draw attention to waste management issues and the need to minimize waste generation. The training requirements will be included in a site waste management plan.

6.9.15 Monitoring of Social Impacts

The effectiveness of these social and environmental management and mitigation measures will be throughout the construction and operation of the power plant. The on-going consultation, planned in the project through an "open-door" policy during construction and operation of the power plant, will ensure the participation of local communities and other stakeholders. Most importantly these will include:

- Local Council and District Authorities;
- Government Regulatory Agencies;
- Local business and commercial interests;
- Local people including population representatives;
- Environmental research organizations; and
- NGOs and other environmental interests.

Specific responsibilities of monitoring will rest the Project Management Unit (PMU), Staff (EMS). The EMS will be analyzed and reviewed at regular intervals by the PMU/EMS and compared with the relevant standards so that any necessary corrective actions can be taken in a timely manner. Records of monitoring results will be kept in an acceptable format and reported to the responsible government authorities and relevant parties (including the Financiers and any other lending institutions). Monitoring during operation will continue to be with the PMU/EMS under direct supervising of the Assistant Plant Manager. This/position, will report directly to the Chairman/ General Manager of UEEPC/HSPP. Results of environmental monitoring as described above, shall be recorded and submitted the EEAA, EEHC and to any other party (i.e. the Financiers,.. etc.) as required. The EEAA, the Financiers and any other lending institutions are entitled to audit the project company in order to ensure conformity with environmental and social standards and requirements.

6.9.16 Cultural Effects

As the larger project area (i.e. the Helwan) is already dominated by variety scale development activity, no cultural impacts are anticipated as a result of the power plant development. In addition, migrant manual labor is traditionally welcomed in the region resulting in no social or community problems.

6.9.17 Enhance Project's Benefits for Local Community

Environmental and Social Management Plan requires that the consultation process remain ongoing during project implementation and operation. Such continued consultation between the power generation company (UEEPC) and the neighboring community be proactively maintained, including through public meetings held from time to time. Project implementing agencies - EEHC and UEEPC - should maintain various publicly visible channels for public access to ESIA and other project documents and activities, including through their websites, and through corporate and site offices and local municipal public institutions. EEHC and UEEPC should endeavor to undertake various measures and actions to diminish any adverse environmental and social impact of the project, enhance project's benefits for the local community, and build a good corporate social relationship. Such actions could include, inter alia, some of the following: regular awareness-building and consultative meetings with local communities and other stakeholders; assistance with improving local economic and social infrastructure (schools, places of worship, village roads, irrigation, shelters, health facilities, etc.); providing local employment and scholarships; developing a green belt around the power plant; reclaiming desert land for agricultural use; etc.

The project design has considered enhancing the project benefits through its social corporate responsibilities program. Resulting from the community requests that local population, both men and women, be considered for employment opportunities, the Power Company shall ensure that the construct companies recruit local people willing and able to participate in the implementation of the project. In addition, the project has undertaken to construction local clinic and a basic school for the communities of the project area in liaison with the Ministries of Health and Education, respectively. Provision of these social amenities will be implemented under the civil works contracts. Furthermore, social and recreational facilities for the staff of the Power Company shall be accessible by the local people upon request, including access to potable water within the project premises.

EEHC and UEEPC expressed their full commitment to implementing the ESIMP, developing good relationship with the local community, contributing to the local social and economic development, and properly discharging their corporate social responsibilities in general.

6.9.18 Conclusion

It is clear that the construction and operation of the Helwan South power facility will not result in any problem to the present workforce in the Helwan Governorate and surrounding area. It is, also, anticipated that the new power plant will provide a net positive socio-economic impact through the provision of employment opportunities and attraction of economic investment into the area.

In addition, the use of local labor wherever practicable, will maximize these positive impacts through the development of the local skill base and will also generate increased demand for local services, materials and products.

6.10 ARCHAEOLOGICAL, HISTORIC AND CULTURAL HERITAGE

6.10.1 Introduction

This section assesses impacts on archaeological, historic and cultural resources as a result of the construction and operation of the Helwan South power plant.

6.10.2 Known Archaeological, Historic and Cultural Remains

The baseline study completed before found no available information to identify any archaeological, historic or cultural remains on the site or in the direct surrounding area. No buildings or remains of archaeological, historic or cultural significance, are known to exist along the access road to the site or in the surrounding area. This is supported by consultation undertaken by ECG with local officials and experts, during which it was stated that there are no identified archaeological remains at the proposed power plant site.

6.10.3 Conclusion

It is concluded that the construction and operation of the power plant will have no impact on any known archaeological, historic or cultural resources. Consultation undertaken with local officials and experts in Cairo head offices verified that the site is not of archaeological interest.

In the event however, that remains being found construction will cease and the advice of the Supreme Council of Antiquities will be sought. Appropriate measures will be put in place to protect and/or excavate the remains, including the following procedures:

- where possible, remains will be protected in-situ;
- where identified remains cannot be protected, an excavation of the indicated area will be undertaken prior to the commencement of construction activities to record and remove vulnerable remains and features;
- any finds of archaeological, historic or cultural significance will be given to the Supreme Council of Antiquities; and
- preparation of a Chance Finds Procedure (see the BOX below) which lays out the steps to be taken if archaeological, historic or cultural remains or finds are discovered during construction activities. The procedures will clearly set out how the construction team will be briefed so that they are aware of what to look out for and the actions which must be taken should a potential find be uncovered.

The incorporation of these precautionary measures into the construction program will ensure that all potential remains of significance are recorded and are accorded the required protection where considered necessary.

BOX

CHANCE FINDS PROCEDURE[1]

Chance find procedures will be used as follows:

(a) Stop the construction activities in the area of the chance find;
(b) Delineate the discovered site or area;
(c) Secure the site to prevent any damage or loss of removable objects. In cases of removable antiquities or sensitive remains, a night guard shall be present until the responsible local authorities and the equivalent take over;
(d) Notify the supervisory Engineer who in turn will notify the responsible local authorities and the General Authority of Antiquities immediately (within 24 hours or less);
(e) Responsible local authorities and the General Authority of Antiquities would be in charge of protecting and preserving the site before deciding on subsequent appropriate procedures. This would require a preliminary evaluation of the findings to be performed by the archeologists of the General Authority of Antiquities (within 72 hours). The significance and importance of the findings should be assessed according to the various criteria relevant to cultural heritage; those include the aesthetic, historic, scientific or research, social and economic values;
(f) Decisions on how to handle the finding shall be taken by the responsible authorities and the General Authority of Antiquities. This could include changes in the layout (such as when finding an irremovable remain of cultural or archeological importance) conservation, preservation, restoration and salvage;
(g) Implementation for the authority decision concerning the management of the finding shall be communicated in writing by the General Authority of Antiquities; and
(h) Construction work could resume only after permission is given from the responsible local authorities and the General Authority of Antiquities concerning safeguard of the heritage.

These procedures must be referred to as standard provisions in construction contracts, when applicable. During project supervision, the Site Engineer shall monitor the above regulations relating to the treatment of any chance find encountered are observed.

Notes:
(1) Source: the World Bank.

6.11 NATURAL DISASTER RISK

6.11.1 Seismic Risk

The Helwan South area is vulnerable to earthquakes as shown in *Figures 5-14 through 5-16*. The power plant will be designed to conform to at least the Uniform Building Code Zone 2 seismic criteria, according to US regulations for earthquake. These design criteria should be checked by the Consulting Engineering Firm. The selected criteria must be considered sufficient to withstand the level of seismic activity experienced in the Area.

With safe selected criteria, the potential environmental impacts of a seismic event during power plant operation are not anticipated to be significant.

Also, as indicated in *Section 5.2*, the site is located in the Nile Valley plain area, mainly covered with mud and sand. This means that the area is characterized with its poor geotechnical and engineering properties which must be taken into consideration by the project Engineer.

6.11.2 Flood Risk

The risk of flash flooding in the project area, as indicated in Section 5.2 of this report, is considered to be low, hence the proposed power plant is largely located in an area classified as not representing Significant flood risk.

In order to further reduce any potential impacts of flooding during construction and operation, the following measures will be implemented:

- during the early stages of construction, a site drainage system will be built, equipped to protect the site against potential flooding;
- site drainage will be constructed in such a way so as to dissipate flood waters away from the main plant areas and to discharge clean waters to the sewer system and any potentially contaminated waters to the discharge structure via the oil interceptor;
- the access road will be culverted to allow adequate transit of flood waters.

With these provisions for controlling the impacts of the plant as a result of heavy rainfall, no significant flood risk impacts are predicted to occur.

6.12 MAJOR ACCIDENT HAZRDS

6.12.1 Introduction

A major accident is defined as a physical situation with a potential for harm to individuals, infrastructure and buildings, or for impairment and environmental damage. Major accident hazards of concern with respect to the construction and operation of the power plant are those with the potential for injury, impairment and/or damage external to the power plant perimeter.

6.12.2 Assessment of Major Accident Hazards

An assessment of major accident hazards associated with the construction and operation of the power plant should consider the following issues:

- the potential risk to third party hazardous industry, facilities or populations of the operation of the power plant; and
- the potential risk to the power plant posed by third party hazardous industry or facilities.

Given the measures incorporated into the design of the plant to minimize the risk from fire and explosion, the plant is not anticipated to pose a potential risk of any significance to any third party facilities. Furthermore, none of the third party industrial facilities and activities within 5 km of the site represent a significant risk of a major accident hazard to the power plant e.g. from fire, explosion, release of toxic gases etc.

In addition, since natural gas will be delivered to the plant by pipeline, there will be no natural gas storage facilities on site. Furthermore, no hazardous chemicals will be held on site in quantities sufficient to pose a major hazard.

Potential accidents may however occur as a result of ruptures to the gas pipeline during future development of the area. Whilst the pipeline connection is the responsibility of "City Gas", the following mitigation measures are recommended to avoid damage to the pipelines:

- the minimum reinstated cover should be 1.2m above the pipeline;
- above ground markers should be installed so as to clearly indicate the routes for all pipelines; and
- valves should be located within the pipeline at regular intervals so that flow can be halted in the event of a rupture.

6.12.3 Risk of Major Accidents on the Power Plant Site

Fire risks were identified during design of the power plant and in particular with regard to the following areas of the plant:

- the gas turbines;
- the boilers;
- fuel oil storage tanks [1];
- transformers;
- turbine oil tank; and
- electrical rooms.

The power plant has been designed to be in conformance with the international code of the National Fire Protection Authority (NFPA), which requires particular specifications for fire protection[2] and compliance with local fire protection systems. A Fire Safety Plan will be developed and will be implemented prior to power plant commissioning. A permit from the Egyptian Civil Defense Authority is required prior to plant operation.

An Industrial Hazard Assessment has not been undertaken and is not considered necessary since:

- measures will be incorporated into the design of the plant to minimize the risk from fire and explosion; and

- the third party industrial facility within 2 km of the site does not represent a significant risk of a major accident hazard to the power plant e.g. from fire, explosion, release of toxic gases etc.

A Quantitative Risk Assessment is conducted separately and submitted as a "stand alone" document with this ESIA study report.

(1) Flash Point is 55°C: Normal storage temperature for the fuel will be 35°C.
(2) NFPA 850: Recommended Practice for Fire Protection for Electric Plants and High Voltage Direct Current Converter Stations, 1996.

6.13 SOLID AND HAZARDOUS WASTE MANAGEMENT

6.13.1 General

Recycling, storage, transportation and disposal measures are recommended to avoid or minimize potential adverse impacts. The UEEPC will incorporate these recommendations into a Waste Management Plan that incorporates site specific factors, such as the designation of areas for the segregation and temporary storage of reusable and recyclable materials.

Waste management options can be categorized in term of preference from an environmental viewpoint. The options considered to be more preferable have the least impacts and are more sustainable in a long term context. Hence, the hierarchy is as follows:

- Avoidance and minimization by not generating waste;
- Reusing materials and therefore avoiding disposal;
- Recovery and recycling, avoiding disposal; and
- Treatment and disposal, according to relevant laws, guidelines and good practice.

For unavoidable wastes, reuse, recycling and optimal disposal are most practical when segregation occurs on the site, as follows:

- Public fill (inert) for disposal at public filling areas;
- Construction waste (non-inert) for landfill;
- Chemical waste for treatment at licensed facilities; and
- General refuse for disposal at landfill.

Specifically, it is recommended that:

- Wastes should be handled and stored in a manner which ensures that they are held securely without loss or leakage thereby minimizing the potential for pollution;
- Only reputable waste collectors authorized to collect the specific category of waste concerned will be employed;
- Appropriate measures will be employed to minimize windblown litter and dust during transportation by either covering trucks or transporting wastes in enclosed containers;
- The necessary waste disposal permits will be obtained from the appropriate authorities, if they are required, in accordance with the Waste Disposal Regulation and the

Government Land Ordinance;

- Collection of general refuse will be carried out frequently, preferably daily;
- Waste will only be disposed of at licensed sites and site staff and the civil engineering Contractor will develop procedures to ensure that illegal disposal of wastes does not occur;
- Waste storage areas will be well maintained and cleaned regularly; and
- Records will be maintained of the quantities of wastes generated, recycled and disposed, determined by weighing each load.

Training and instruction of construction and operation staff will be given at the site to increase awareness and draw attention to waste management issues and the need to minimize waste generation. Thee training requirements will be included in a site waste management plan.

6.13.2 Hazardous Materials and Wastes

Construction and Operation Phase

The management of hazardous materials and wastes will include the following measures:

- Classification, characterization and coding.
- On-site storage and handling.
- Transportation.

Management considerations involved in all these three main stages may be summarized as follows:

- ***Classification, Characterization and Coding***

According to the Egyptian classification system certain classes of chemical materials and wastes are specifically listed as being hazardous. Codes for these types of hazardous materials and waste have been defined. Wastes are known as "Listed Hazardous Wastes".

- ***On-Site Storage and Handling***

Improper storage of hazardous wastes can cause serious accidents, health and safety problems, and damage to the environment.

Hazardous waste storage facilities can be either on-site, at the property where the waste is generated, or off-site, at a common hazardous waste storage (plant warehouse, laboratory, ..etc.) and disposal facility. EEAA recommends the use of three types of on-site storage facilities:

- Storage in drums, containing small quantities of liquid or solid waste (easy to handle and allows for easy segregation of incompatible wastes such as corrosive and reactive wastes).

- Storage in tanks for bulk quantities of liquids. Tanks can be constructed above ground or buried underground. EEAA does not recommend underground tanks because of their complexity and the high risk of environmental damage. Liquids should be periodically pumped to on-site treatment systems or transferred to tankers for off-site treatment and disposal.

- Storage in large containers (generally of steel from 1 to 20 tons in capacity) for bulk quantities of solids. The containers are designed to be hauled by trucks to an off-site disposal facility and returned for refilling.

- ***Transportation***

Operational procedures include the following:

- Permitting for hazardous waste transportation
- Permitting requirements

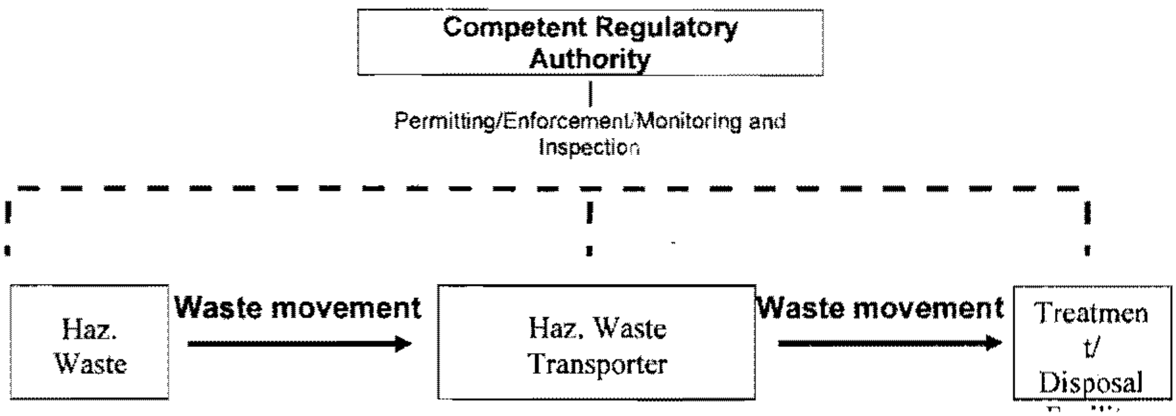
Article 26 of the Executive Regulations of Law 4-1994 identifies the requirements and conditions for permitting Hazardous Wastes (HW) handling.

Hazardous waste transportation can be carried out by road, railways or vessels. The transporter license application requires that the intended mode(s) of transportation be specified. In this respect, the means of transport used (vehicles, rail wagons or vessels) need to conform to set technical and safety specifications and equipment. *Figure 6-36* depicts HW transportation system.

With these management procedures, no significant impacts from the management of hazardous wastes, particularly during demolition phase, will occur.

Figure 6-36

Hazardous Wastes Transporting System



Hazardous Waste Generator:

- Proper waste identification and classification
- Waste labeling and packaging where applicable
- Ensure that transporter and TD[(1)] facility used have the necessary HW licenses
- Use of manifest

Regulator:

- Grant permits
- Implement permit conditions
- Revoke permits in case of violation
- Enforce and monitor use of manifest
- Carry out inspection to verify that generator/transporter and TDF[(2)] carry out their responsibilities

Hazardous Waste Transporter:

- Obtain necessary permits
- Use vehicles with proper specifications and placards
- Implement necessary safety procedures and use safety equipment
- Follow the agreed-upon routing
- Carry out vehicle maintenance and cleaning
- Training of all staff
- Only accept waste properly identified and where applicable packaged and labeled
- Use of manifest

Treatment/disposal Facility:

- Only accept waste properly identified and where applicable packaged and labeled
- Use the manifest
- Ensure that transporter has a HW transportation license
- Carry out vehicle cleaning before it leaves the facility

(1) TD = Treatment and Disposal
(2) TDF = Treatment and Disposal Facility

6.13.3 Solid Wastes

Construction and Operational Phase

A natural gas power plant produces no ash and only a low quantity of other solid wastes during construction and operation. These include the following:

- *Construction waste*: contaminated spoil, oil drums etc.;
- *General plant wastes*: oily rags, broken and rusted metal and machine parts, defective or broken electrical parts, empty containers, miscellaneous refuse;
- *Raw water pre-treatment sludge*: from build-up of solid residues in the raw water pre-treatment system;
- *Tank sludge*: solid residues which build up in process chemical storage tanks;
- *Oil Interceptor sludge*: from drainage interceptors used to remove solids and oils and grease from effluent;
- *Packaging waste*: from operational consumable supplies; and
- *Commercial wastes*: from offices, canteen and staff facilities.

Wastes generated at and by the plant will be evacuated from the site by licensed contractors. Final disposal of wastes will be to waste treatment plants or local landfill sites, as agreed by the relevant Competent Administrative Authority.

To ensure that impacts from solid waste generation and disposal are successfully avoided, the following mitigation measures will be undertaken during plant construction and operation:

- all waste taken off site will be carried out by a licensed waste contractor and UEEPC will audit the disposal procedure;
- all solid waste will be segregated into different waste types, collected and stored on site in designated storage facilities and areas prior to release to off-site disposal facilities;
- all relevant consignments of waste for disposal, will be recorded, indicating their type, destination and other relevant information, prior to being taken off site; and
- standards for storage area, management systems and disposal facilities will be agreed with the relevant parties.

The environmental engineer will be responsible for solid waste management at the site and will ensure that all wastes are managed to minimize any environmental risks.

With the adoption of these mitigation measures, the impacts of solid waste generated by the construction and operation of the power plant are not predicted to be significant.

6.14 PUBLIC HEALTH

6.14.1 Air Pollution

The key issue in relation to public health is the potential effects of air pollution from the plant's stack emissions. The assessment of air quality impacts presented in Section 6.2 demonstrates that ground level pollutant concentrations as a result of emissions from the power plant will not significantly affect air quality. Hence, the health risks from stack emissions are not considered to be significant.

6.14.2 Disease Vectors

The proposed power plant includes a range of mitigation which will prevent the encouragement of disease vectors, such as rodents or insects. These measures include the following:

- provision of sanitation during construction and operation;
- control and management of solid wastes;
- provision of potable and process water supplies; and
- disposal of site drainage and effluent.

With these mitigation measures, the potential for encouragement of disease vectors is low.

6.15 OCCUPATIONAL HEALTH AND SAFETY ISSUES

6.15.1 Safety Issues

The proposed Helwan South power plant site is currently unused empty land, and no environmental features or characteristics have been identified which could cause special occupational health and safety impacts. In particular, there is no soil contamination will be present and no special construction techniques are expected to be required to build the power plant.

In addition, there are no other activities bordering the site (only Sues Nile BOOT power plant to the immediate south and the southern fence of the Helwan South port area to the immediate north) and therefore no safety issues associated with third-parties are anticipated.

The project company will establish and integrate policies and procedures on occupational health and safety into the operation of the power plant. Emergency and accident response procedures will also be included in the operation manual for the power plant. In particular, construction and operation activities will be carried out on the following basis:

- compliance with international standards for good construction and operational practices;

- adherence to local and international guidance and codes of practice on EHS management during construction and operation;

- management, supervision, monitoring and record-keeping as set out in the plant's operational manual;

- implementation of EHS procedures as a condition of contract with contractors and their sub-contractors;

- clear definition of the EHS roles and responsibilities of the compaNiles involved in construction and to individual staff (including the nomination of EHS supervisors during construction and an EHS coordinator during operation);

- pre-construction and operation assessment of the EHS risks and hazards associated with construction and operation, including consideration of local cultural attitudes, education level of workforce and local work practices;

- provision of appropriate training on EHS issues for all construction and operation workers, including initial induction and regular refresher training, taking into account local cultural issues;

- provision of health and safety information;

- regular inspection, review and recording of EHS performance; and

- maintenance of a high standard of housekeeping at all times.

Given the provision of this high standard of health and safety management on site, construction and operation of the power plant in accordance with good industry practice and the lack of any adverse features/characteristics of the site, the occupational health and safety risks associated with construction and operation of the power plant will be minimized.

6.16 ASSOCIATED INFRASTRUCTURE

Connections to the national gas, and electrical infrastructure will be the responsibility of EGAS/GASCo, EETC/EEHC, and UEEPC respectively. Key potential impacts that will be considered include:

- land use; and
- existence of residential communities.

6.16.1 Gas Pipeline

A new gas pipeline will be constructed to extend from existing gas network joint at Dahshour and will run parallel to the western bank of the Nile and reach the Helwan South site from the west across the Nile River. EEHC/UEEPC has already submitted a request to EGAS / GASCo for their gas needs for the new plant which will necessitate an additional pipeline, and which will follow a proposed route and buried in the route trenching. Any required modification, including any environmental impact will be identified and mitigated/managed by EGAS/ GASCo. GASCo has already prepared a separate ESIA/RPF for the gas pipeline project. *Figures 6-37and 6-38* illustrate where this gas pipeline comes from.

6.16.2 Transmission Lines

The Helwan South power plant will be connected to the Egyptian Unified Power System (UPS), which is owned and operated by the Egyptian Electricity Transmission Company (EETC), an affiliate company to the EEHC, via connecting transmission lines. Connection methodology includes interconnection to the 500 kV network as follows:

- Construct 500 kV O.H.T.L double circuit SHPP(*) 500/ Minya East 500(proposed) with length of about 200 km.
- Construct 500 kV O.H.T.L double circuit SHPP 500/ Badr 500 (under constriction) with length of about 150 km.

Land expropriation is not likely. However, in order to handle any potential future changes a Resettlement Policy Framework (RPF) is prepared by ECG separately in a stand alone document to be attached with this ESIA report. Good compensation, if any, will be paid for the right of way according to the *Law 63 of the Year 1974*. *Figure 6-39* depicts the proposed single line diagram of the interconnection methodology set out by the EEHC and *Figure 6-40* presents an illustrative map for the new proposed transmission interconnecting lines. EETC and UEEPC will submit a Screening Form B to the EEAA concerning this interconnection. No significant impacts are anticipated.

(*) SHPP = South Helwan Power Plant.

Figure 6-37

Proposed Gas Supply Pipeline

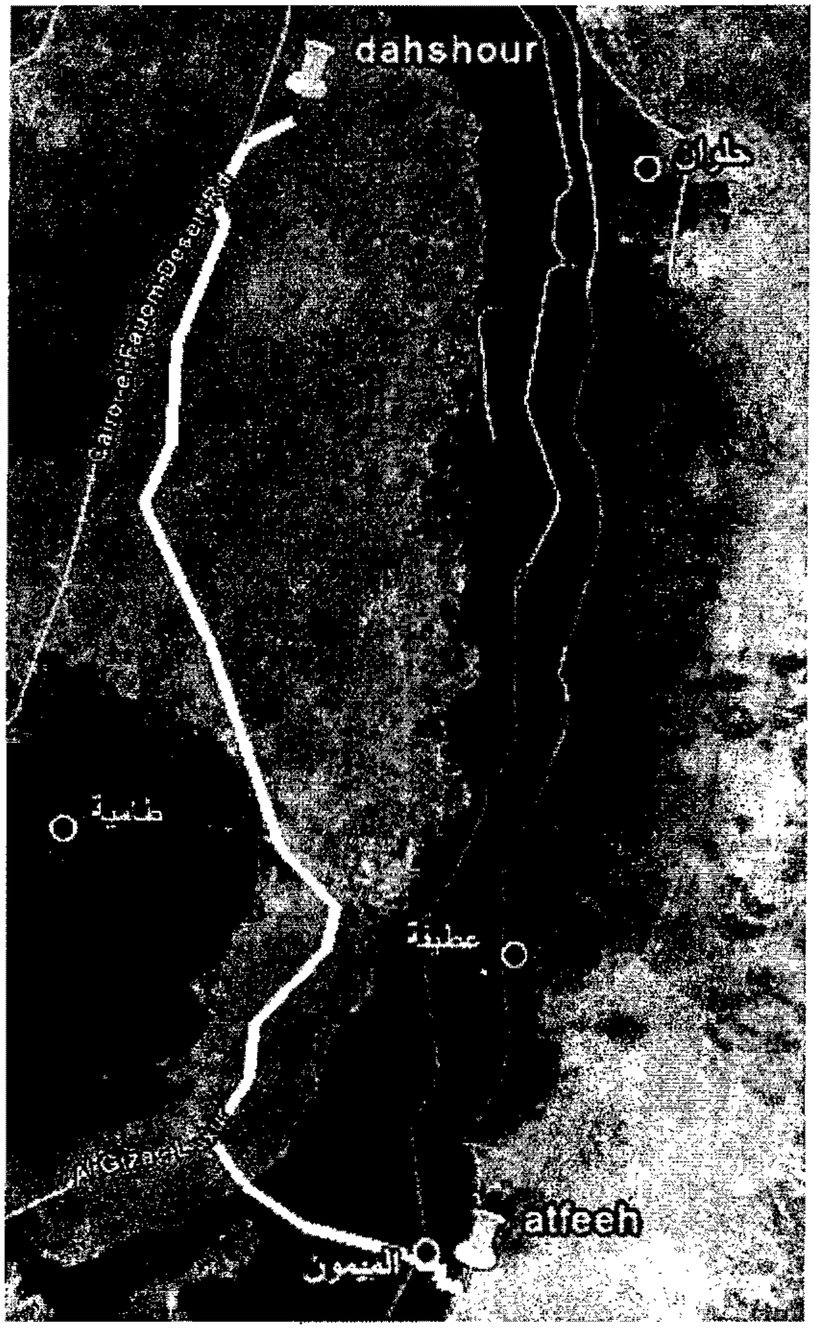


Figure 6-38

Topography of the New Gas Pipeline Routing

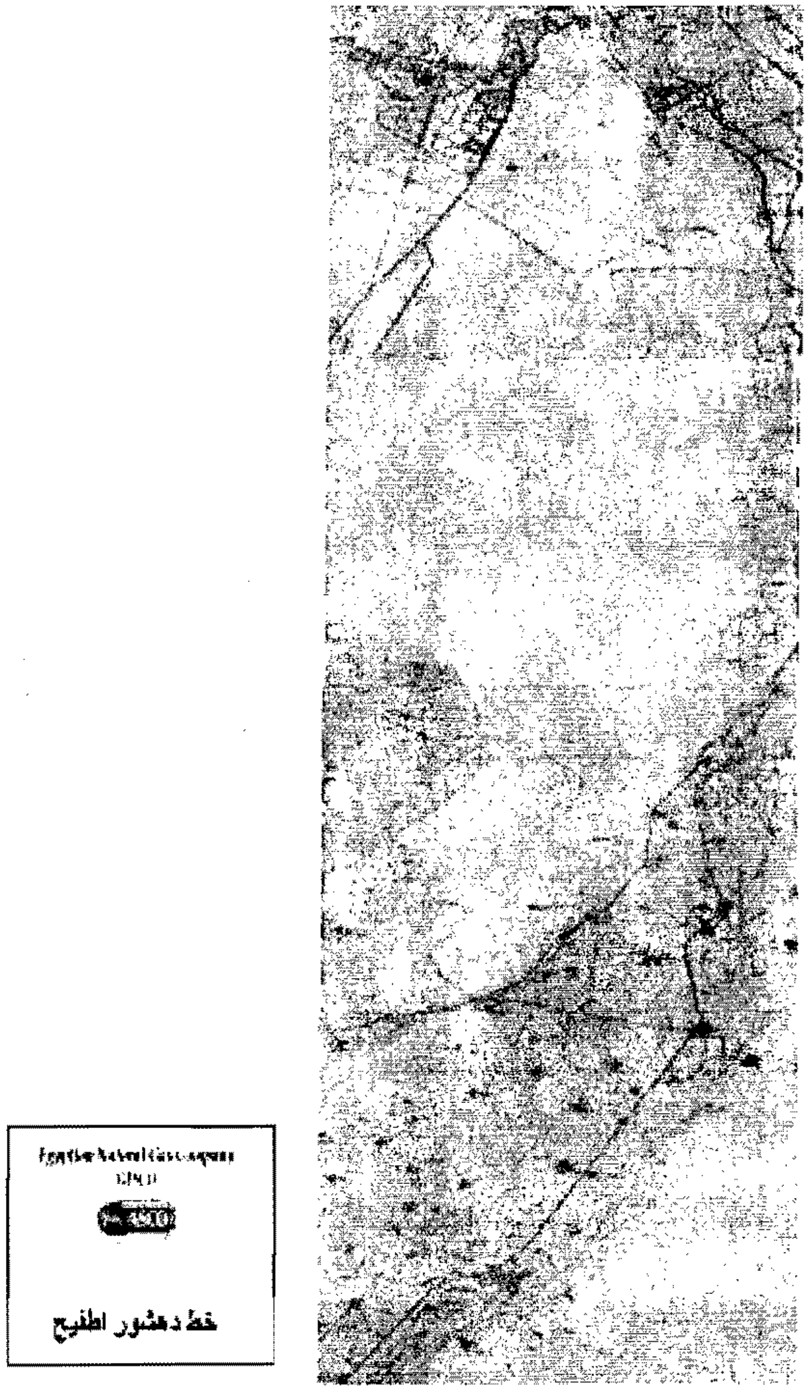


Figure 6-39

Schematic Diagram for the Electrical Interconnection of the Helwan South Power Project

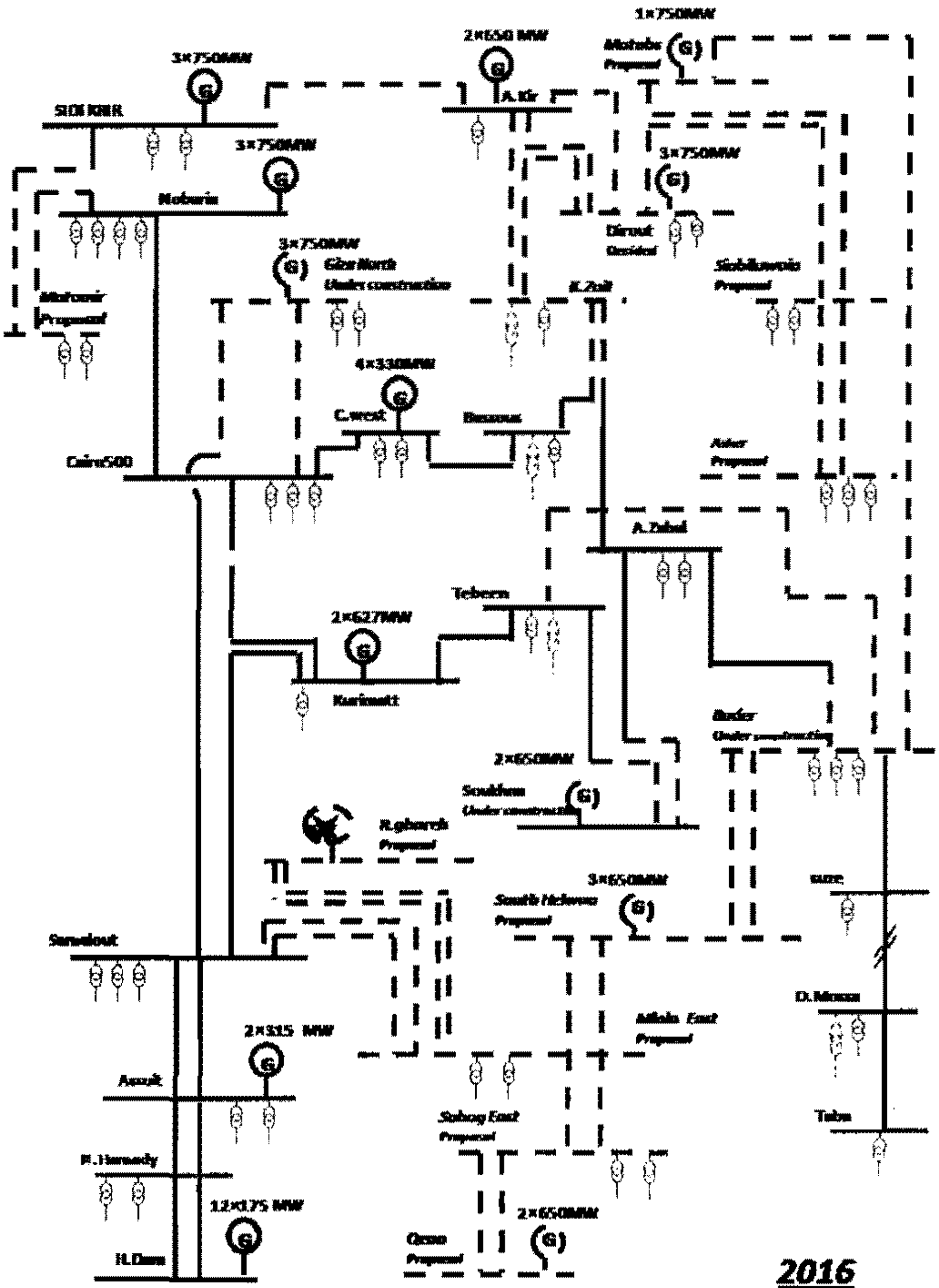


Figure 6-40

Proposed 500 kV Helwan South Transmission Interconnecting Lines

7. MITIGATION OF ENVIRONMENTAL IMPACTS

7.1 INTRODUCTION

Upper Egypt Electricity Production Company (UEEPC) is committed to constructing and operating the Helwan South power plant to high environment, health and safety (EHS) standards.

This section provides a summary of mitigation measures, as well as environmental enhancement opportunities, for the key EHS impacts which have been identified through the ESIA process. The mitigation measures represent a synthesis of those measures which are part of the basic power plant design and those that have been recommended in Section 6 of this report for construction and operational phases of the power plant.

The mitigation measures discussed in this section are summarized in *Tables 8-4, 8-5, 8-6 and 8-7* in *Section 8*, together with respective environmental monitoring and management arrangements. It should be noted that many of the mitigation measures presented below for the construction phase, will be carried forward into plant Operation.

All the mitigation, monitoring and management measures proposed below and in Section 8 of this report (the Environmental and Social Management Plan (ESMP)), will be adopted by the Project Company and imposed as conditions of contract on the contractors and any of sub-contractors employed to build or operate any part of the power plant. Since many of the mitigation measures presented are considered an essential, integrated component of the construction and operation works, it is not possible to separate the specific costs of their implementation from the overall construction and operation costs.

7.2 MITIGATION MEASURES DURING DESIGN AND CONSTRUCTION

7.2.1 Dust Emissions during Construction

As described in Section 6.2.2, dust generated by construction activities could be significant locally, not only in terms of air quality, but also with regard to visibility and traffic safety. To minimize dust nuisance, certain good site practices will be employed as follows:

- roads will be kept damp through use of water browsers;
- stockpiles of friable materials will be sited and maintained appropriately (including the use of sheets) so as to minimize dust blow (such as balancing of cut and fill operations);
- drop heights for material transfer activities such as unloading of friable materials shall be minimized;
- the construction phase will begin with the construction of access roads;
- roads created during construction will be compacted and graveled if necessary;
- roads used on site will be maintained in good order;
- access into the site will be regulated;
- vehicle speed limits of less than 35 km/hr on dust roads will be enforced on site; and
- lorries and vehicles will be sheeted during transportation of friable construction materials and spoil.

In addition, to ensure that pollutant levels resulting from transport operations are kept to a minimum during construction activities, all vehicles being used on site will meet pollutant emission standards.

7.2.2 Aquatic Environment during Construction

Construction impacts on the aquatic environment are likely to arise as a result of:

- dredging;
- construction of the discharge and intake facilities;
- surface water runoff; and
- pipeline construction across the Nile River bankline, if any.

As discussed in Section 6.3, these activities are likely to result in impacts to water quality and aquatic ecology.

Given the mitigation and management measures described below, impacts will be minimized and are not expected to be significant.

For construction activities in the Nile River:

- dredged areas will be limited to the minimum area required for construction purposes; and
- dredged sediments will be disposed of at a site agreed between the UEEPC's developers and the relevant local authorities prior to the commencement of construction activities.

For construction activities on site:

- no effluents will be discharged into the Nile River during normal construction activities;
- a site drainage plan will be developed to ensure that if any erosion occurs during storm events, minimal amounts of sediment will result by reducing the flow velocity and sediment load before discharge;
- temporary stockpiles of soil should be protected from erosion by using a reduced slope angle where practical and by incorporating sediment traps in drainage ditches. This can be addressed by a site drainage plan as described above; and
- good site management practices will be enforced to ensure that the construction site is kept clean and tidy.

In addition, to ensure access to the Nile River bankline is not restricted for public use (as decreed by Egyptian Law) and navigation activities are not jeopardized, the following measures will be implemented:

- the bankline across which the intake and discharge pipes are constructed will be returned to its original state following construction; and
- navigational signs will mark the navigation route fronting the outlet and discharge structures.

All construction teams employed and contracts commissioned will incorporate these mitigation measures as part of Operational Procedure in contracts and briefs (see the ESMP Section 8).

7.2.3 Noise Emissions during Construction

Specific noise mitigation measures for the construction phase reflect standard good site management practices and include:

- enforcement of vehicle speed limits, strict controls of vehicle routing and prohibition of heavy vehicle movements during nigh;
- diesel engine vehicles and compression equipment will be equipped with effective silencers;
- activities with highest noise emissions (e.g. piling) will be undertaken only during the day shift (0700 hours - 1800 hours) and between Saturday and Thursday and not during official holidays; and
- personnel will use hearing protection when using or working in the vicinity of noisy equipment.

7.2.4 Flora and Fauna during Construction

Negative impacts on flora and fauna during power plant construction were described in Section 6.5.2 and are not considered to be significant. However, species on or close to the site may be disturbed and displaced as a result of increased noise, dust and human activity. Good site management practices as discussed elsewhere in this section, and implementation of the following mitigation measures, will ensure that any disturbance is reduced to a minimum:

- run-off from construction activities will be attenuated to ensure that surrounding species/habitats are not significantly affected;
- sediments removed during construction across the Nile River bankline and Nile bed which may be contaminated, will be disposed of in a controlled manner, as described in Section 6.3; and
- personnel and vehicles will be restricted to within the boundaries of the construction site, lay down areas and access roads, and will not be permitted to enter surrounding land.

7.2.5 Soils and Hydrology during Construction

The potential for direct impacts on soil and groundwater during construction, is largely dependent on the management of the construction site and construction activities. A range of mitigation measures will be implemented to protect soils (and, as a result, the limited groundwater resources) from the direct impacts of constructing the proposed power plant. These measures include the following:

- engineered site drainage systems will be provided to collect, balance, treat as required and control the discharge of site run-off;

- vehicles and personnel will be restricted from accessing areas not designated for construction to prevent accidental or unnecessary disturbance or compaction of the soil; and

- spoil from construction activities will be monitored and controlled; waste materials which are unsuitable for reuse on-site, for example for landscaping, will be disposed of at an appropriately licensed sanitary landfill site.

In addition, the potential for any transfer of existing contamination will be minimized through the following mitigation measures:

- protection of the soil from accidental pollution by bunding around proposed storage areas for fuel and chemicals with the capability to store at least 110% of the volume of the storage facilities;

- provision of oil and suspended solid interceptors, such as oil/ water separators for the removal of pollutant loading from the site drainage and for the retention and containment of any accidental discharges during construction and operation;
- removal of waste materials unsuitable for re-use on site during construction to appropriate licensed landfill sites;
- management of excavations during construction so as to avoid the generation of drainage pathways to underlying aquifers; and

- provision of impermeable bases in operational areas to prevent absorption of any spillage of process materials.

7.2.6 Traffic and Transport during Construction

Construction activities will generate additional traffic on local roads and in particular, significant volumes of heavy plant traffic and occasional abnormal loads. To minimize any inconvenience, hazards and damage caused to other road users, local people and the local road network, the following mitigation and management measures shall be implemented:

- abnormal load movements will be confirmed with the Competent Administrative Authority (CAA) and will adhere to prescribed routes. Their movement will be scheduled to avoid peak hours and notices will be published in advance to minimize disruption if required by the CAA;

- consideration will be given to staggering construction shifts to split arrival and departure times;

- scheduling of traffic will be undertaken to avoid the peak hours on the local road network wherever practicable; and

- construction workers will be transported to the site by contract bus.

7.2.7 Socio-economic Effects during Construction

The assessment of impacts showed an overall positive impact on the local society, culture and economy. Given that the use of local labor will be prioritized during construction, no loss of jobs or livelihoods, no land-take or resettlement is attached to the project (if any, for instance, land-take for the foot area of the transmission lines' towers, fair compensation will be applied and RPF will be activated), no mitigation measures are proposed.

7.2.8 Archaeology during Construction

Whilst careful examination of existing literature and data did not reveal any sites of archaeological or cultural heritage importance on or around the site, the existence of archaeological remains cannot be ruled out. Remains could be unearthed and damaged during construction of the power plant and ancillary buildings, pipelines, cables and the intake and discharge facilities.

Construction works will therefore be monitored to ensure that in the event of remains being found construction activities will be stopped and the Supreme Council of Antiquities will be consulted on the most appropriate measures, which could include the following:

- where possible, remains will be protected in-situ from construction activities, by relocating non-essential activities ;
- where identified remains cannot be protected, an excavation of the indicated area will be undertaken prior to the commencement of construction activities to record and remove vulnerable remains and features;
- any finds of archaeological, historic or cultural significance will be given to the appropriate CAA; and
- preparation of a Chance Finds Procedure which lays out the steps to be taken if archaeological, historical or cultural remains or finds are discovered during construction activities. The procedures will clearly set out how the construction team will be briefed so that they are aware of what to look out for and the actions which must be taken should a potential find be uncovered.

7.2.9 Flooding during Construction

The site is not likely to be affected by occasional flash flooding. However, in order to reduce any potential impacts of flooding during construction, the following measures will be implemented:

- during the early stages of construction, a site drainage system will be built, equipped to protect the site against potential flooding; and
- site drainage will be constructed in such a way as to dissipate flood waters away from the main plant areas and to discharge clean waters to the Nile and any potentially contaminated waters to the site drainage system via the oil interceptor;

7.2.10 Solid Wastes during Construction

To ensure that impacts from solid waste generation and disposal are successfully avoided, the following mitigation measures will be undertaken during plant construction:

- all waste taken off site will be carried out by a licensed waste contractor and UEEPC will audit the disposal procedure;
- all solid waste will be segregated into different waste types, collected and stored on site in designated storage facilities and areas prior to release to off-site disposal facilities;
- all relevant consignments of waste for disposal, will be recorded, indicating their type, destination and other relevant information, prior to being taken off site; and
- standards for storage area, management systems and disposal facilities will be agreed with the relevant parties.

An engineer with responsibility for environmental aspects will be responsible for solid waste management at the site and will ensure that all wastes are managed to minimize any environmental risks.

7.2.11 Occupational Health and Safety during Construction

UEEPC will ensure that construction activities are undertaken in a manner which does not present hazards to workers' health and safety. In particular, the project company will establish and integrate policies and procedures on occupational health and safety into the construction and operation of the power plant. Emergency and accident response procedures will also be included in an EHS manual for the power plant.

The following measures will be carried out in both the construction and operational phases:

- compliance with international standards for good practice;
- adherence to local and international guidance and codes of practice on EHS management;
- management, supervision, monitoring and record-keeping as set out in the plants operational manual;
- implementation of EHS procedures as a condition of all contracts;
- clear definition of the EHS roles and responsibilities of the companies contracted to work on site and to all their individual staff (including the nomination of EHS supervisors and coordinator);
- pre-construction and operation assessment of the EHS risks and hazards associated with construction and operation, including consideration of local cultural attitudes, education level of workforce and local work practices;
- provision of appropriate training on EHS issues for all employees on site, including initial induction and regular refresher training, taking into account local cultural issues;
- provision of health and safety information;
- regular inspection, review and recording of EHS performance; and
- maintenance of a high standard of housekeeping at all times.

7.3 MITIGATION MEASURES DURING OPERATION

7.3.1 Introduction

Mitigation measures introduced into the design and construction phase of the power plant will be carried forward into the operational phase by the UEEPC Company. Many mitigation measures, as described in Sections 4 and 6 of this report, have already been integrated into the design of the power plant in order to minimize any operational impacts on the environment. Mitigation measures such as low NOx burners, noise silencers and water discharge controls are for example considered integral to the design of the power plant.

The following section builds on the design criteria for the power plant in order to reduce to a minimal level any further potential negative impacts. Areas where positive impacts can be introduced or maximized are also considered.

7.3.2 Air Quality during Operation

Emissions Guidelines

Several specific measures have been taken to reduce stack emissions from the power plant and to comply with Egyptian and World Bank standards. The power plant will fire natural gas as its main fuel which is the least polluting fuel available, (with negligible sulfur dioxide emissions and low particulate matter emissions). Heavy fuel oil (mazout) will only be used as an emergency fuel. In order to reduce NOx emissions when firing natural gas or heavy fuel oil, low NOx burners are used on the boilers. In addition, a stack measuring 150m high (as minimum, tentative but may be more elongated) has been designed to allow maximum dispersion of emissions into the surrounding atmosphere.

Stack emissions to the air from the proposed plant are therefore within the Egyptian, as well as the World Bank guidelines [(1)], with full compliance with SO_2 standards when firing the emergency heavy fuel oil (oil no.6/mazout).

However, the IFC has indicated that its emission guidelines must be met for at least 95% of operating time. Given that UEEPC is committed to burning heavy fuel oil for no more than 170 hours per year and only if natural gas is unavailable, (i.e. <2% of total operating hours), the plant will operate well within the SO_2 emission guidelines, and no further mitigation is proposed.

(1) World Bank Pollution Prevention and Abatement Handbook - Part III: Thermal Power - Guidelines for New Plants, July 1998.

Air Quality Guidelines

To investigate the issue of atmospheric emissions from the power plant and their impact on ambient air quality, dispersion modeling has been undertaken and the results of the modeling were presented earlier in Section 6.2. The modeling indicates that the predicted off-site maximum annual and 24 hour mean ground levels of NO_2 and PM concentrations, do not exceed the Egyptian as well as the World Bank ambient air quality guidelines when natural gas is burned. As described above, UEEPC is committed to using natural gas for more than 98% of operating time in a year.

No further requirement for mitigation of the emissions to air from the power plant is proposed.

7.3.3 Aquatic Environment during Operation

The main impacts of the power plant on the aquatic environment during power plant operation are likely to derive from:

- discharge of cooling and process water into the Nile River;
- disruption of navigational transport; and
- entrainment of fish and mobile organisms in the intake structure.

The design of the intake and discharge structures has incorporated measures to reduce impacts on the Nile River environment including minimizing the area affected by the discharge plume. These design measures include:

- water cooling condensers will be designed using titanium or stainless steel to avoid discharge of heavy metals such as copper and zinc into the Nile River;
- bunds or sumps will be installed on-site to isolate areas of potential oil or other spillages, such as transformer bays, from the site drainage system;
- oil and chemical storage tanks will have secondary containment structures that will hold 110% of the contents of the largest storage tank;
- areas for unloading oil and hazardous chemical materials will be isolated by kerbs and provided with a sump, equipped with a manually operated valve;
- transformers will be provided with pits to retain 110% of the coolant capacity of the transformers which will include fire fighting water. Alternatively, each main oil-filled transformer foundation will drain through a corner sump directly to an underground oil collection chamber sized to retain 110% of the coolant capacity of the transformers plus deluge water (for the worst single catastrophic failure). Adjacent to this collection chamber will be constructed an oil separator which will normally function to separate any oil contaminated to the storm water collected from within the transformer foundations and the clean water drained to the discharge structure. The transformers will not contain PCBs; and
- stormwater runoff from equipment slabs that may be subject to oil contamination exposure, will be collected and channeled through an oil/water separator prior to discharge into the discharge structure.

In order to minimize potential impacts to water quality, UEEPC will ensure implementation of good site management practices including the following measures:

- wastewater will be collected and treated before being discharged into the discharge system, the main water treatment steps include:
  - neutralization of any wastewater that has a pH outside the range of 6 to 9;
  - oil separation of any wastewater that may be contaminated with oil or grease; and
  - flocculation and filtration of any wastewater that may contain high concentrations of suspended solids.

- no solid wastes will be discharged into the Nile River;
- drainage systems have been designed on site to prevent any contaminated surface run-off from being discharged into the discharge system without prior oil separation and neutralization of any other contamination; and
- all effluent discharges will comply with local Egyptian and World Bank standards.

7.3.4 Noise Emissions during Operation

A number of noise mitigation measures have been built into the design of the plant in order to ensure that noise levels are minimized and that all items of plant are operating to local and international standards.

Specific design mitigation measures include:

- steam turbine generators, air compressors, pumps, and the emergency diesel engines are enclosed in buildings;
- air compressors are equipped with air silencers; and
- noisy outdoor equipment have been designed to a noise limit of 90 dB(A) at one meter.

In addition, all personnel working in noisy areas will be required to wear hearing protection.

7.3.5 Flora and Fauna during Operation

The potential impacts of the proposed development on any existing flora and fauna will be minimized as a result of the following mitigation measures:

- noise will be controlled during operation, and will dissipate rapidly with distance from source. Any disturbance during construction and operation will therefore be localized (see Section 6.4); and
- personnel and vehicles will be restricted to within the boundaries of the site and access roads, and will not be permitted to enter surrounding land.

7.3.6 Visual Impact during Operation

Landscaping will include tropical shrubs (trees, grass, palm groves) around the site. All plants will be indigenous species.

7.3.7 Soils and Hydrology during Operation

During plant operation, the main potential for impacts to occur to soils and hydrology (including run-off into the discharge system), are likely to arise as a result of spillages and storage of chemicals and fuels on site. Good site management practices such as those described under Section 7.3.3 "Aquatic Environment" will minimize potential impacts.

7.3.8 Solid Waste Impacts During Operation

The mitigation and management measures during construction described in Section 7.2.10 above relate to both the construction and operation phases.

7.3.9 Health and Safety during Operation

The following mitigation and management measures will ensure that the health and safety of staff and any visitors on and to the site is not jeopardized during operation of the plant:

- development and implementation of an Operational Health and Safety Plan with appropriate training;
- provision of training in use of protection equipment and chemical handling;
- clear marking of work site hazards and training in recognition of hazard symbols;
- installation of vapor detection equipment and control systems;
- development of site emergency response plans;
- all personnel working or standing close to noisy equipment will be required to wear noise protectors; and
- drinking water will be supplied to the plant via local filtration facilities which will comply with drinking water standards published by the World Health Organization.

In addition, the operational health and safety measures during construction described in Section 7.2.11 above, will be carried forward into the operational phase of the power plant.

7.4 COMPENSATION FOR AFFECTED PARTIES

No local populations or legally entitled landowners will be affected by the development of the power plant, therefore no affected parties require compensation. Day-to-day practice normally confirms fair compensations that should be paid to people who are likely to be affected by off-site associated infrastructure, including cooling water intake and discharge structure, natural gas pipelines and overhead transmission lines going out from the power plant to connecting it to the national unified power system. A separate volume, attached to this ESIA study report -"Resettlement Policy Framework"- has been prepared to address issues related to these off-site associated infrastructure.

8. ENVIRONMENTAL MITIGATION AND MONITORING: ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN (ESMP)

8.1 OBJECTIVES OF THE PLAN

The project company is committed to implementing an environmental and social management and monitoring plan which will ensure that the construction and the operation of the Helwan South Power Plant (HPP) involves full implementation of all proposed mitigation measures and complies with high environmental standards, the requirements of the environmental legislation and guidance notes as applicable in Egypt, and the procedures and guidelines of the World Bank and the African Development Bank.

Previous sections of this report have outlined the baseline environmental and socio-economic conditions in the area of the proposed development, have identified the potential impacts on these baseline conditions which could result from construction and operational activities and have proposed measures to minimize and mitigate against any negative impact identified. To complete the environmental evaluation, this section presents necessary Institutional Arrangements for the Helwan South power project (*Table 8-2*) as well as the Environmental and Social Management Plan (ESMP) which summarizes the mitigation measures suggested and discusses initial and ongoing monitoring and management of significant impacts of the proposed plant.

The ESMP covering construction and operation of the power plant as well as transmission system impact mitigation and management is summarized in *Tables 8-3, 8-4, 8-5, 8-6 and 8-7* respectively. The Egyptian Electricity Holding Company (EEHC) and its affiliated Upper Egypt Electricity Production Company (UEEPC) have a very good understanding of the contents of the ESIA reports, including these management tables and are committed to implementing the environmental management plane (EMP) requirements included therein. *Table 8-8* gives a summary of implementation cost of the ESMP. For further detail on the mitigation measures to be undertaken, reference should be made to Section 7 of this report. Details of construction and operations monitoring and management activities summarized in the tables are discussed in more detail below.

The ESMP includes the definition of the following measures to minimize environmental effects:

- **construction management,** including control of construction traffic, site drainage, construction waste and spoil etc.;
- **engineering design measures** directly incorporated into the power plant as good design practice, through the selection of appropriate plant and equipment and choice of construction materials;
- **specific mitigation measures designed to prevent or minimize releases** from the process, such as the use of low NOx burners, closed loop cooling system;
- **operational control systems,** such as the use of water treatment chemicals; and
- **operational management,** which includes staffing levels and staff training.

The effectiveness of these environmental management and mitigation measures will be monitored throughout the construction and operation of the power plant.

Monitoring will be carried out **by the Project Management Unit (PMU), which includes the Environmental Management Staff (EMS)** using standard techniques and equipment agreed with the Egyptian Environmental Affairs Agency (EEAA), which will be calibrated, operated and maintained in accordance with the manufacturers specifications. The EMS will be directly supervised by an Environmental Specialist, within the PMU, at the same level as FM / Procurement.

Monitoring data will be analyzed and reviewed at regular intervals by **PMU/EMS** and compared with the relevant standards so that any necessary corrective actions can be taken in a timely manner. Records of monitoring results will be kept in an acceptable format and reported to the responsible government authorities and relevant parties (including the WB & AfDB).

8.2 ENVIRONMENTAL MANAGEMENT

8.2.1 Environmental Management Organisation

During Design and Construction

Suitably qualified and experienced contractors will be responsible for the detailed design and construction of the power plant. Construction workers will be required to demonstrate appropriate skills, qualifications and/or experience prior to employment.

During construction, **PMU/EMS** will ensure that all contracts with Contractors and sub-contractors stipulate all construction management measures (as given in this ESMP), operational design criteria and environment, health and safety standards which must be implemented at the project site.

Implementation of these measures will be enforced and supervised by the Assistant Plant Manager who will have direct responsibility for the Environment, Safety and Quality Assurance program on site during construction and operation. The Assistant Plant Manager is responsible for ensuring that construction works comply with the requirements of the ESMP and all environmental permits. His key roles will be to:

- assume the interface with authorities for environmental authorizations and permits;
- act as the Assistant Plant Manager for local authorities, industrial and commercial interests and any other interested parties;
- ensure that mitigation measures to reduce impacts during the construction phase are implemented;
- ensure that monitoring to be undertaken during construction is implemented;
- ensure compliance with the environmental and social management plan; and
- ensure that health and safety requirements are respected.

During Power Plant Operation

During operation, direct responsibility for environmental compliance and the implementation of the mitigation, management and monitoring measures described in this section and in Section 7 of this report, will continue to be with the **PMU/EMS** under direct supervision of the Assistant Plant Manager. This position, will report directly to the Chairman/General Manager of UEEPC/HPP.

The Assistant Plant Manager will be based at the site and will be responsible for recruiting, training and managing his staff. He will be responsible for implementing the mitigation and management measures described above and for monitoring and record keeping of the following:

- stack emissions;
- air quality;
- noise emissions;
- quality of water discharge; and
- waste management.

In his role, the Assistant Plant Manager will also be responsible for maintaining any pollution control equipment and for developing and implementing procedures for safe handling and storage of any hazardous materials used on site.

The Assistant Plant Manager will also have lead responsibility for maintaining a written Environmental Register with respect to environmental impacts as required under Egyptian, World Bank and African Development Bank guidelines. The written records will identify the characteristics of discharges and emissions, details of periodic testing including results, procedures for follow-up environmental safety actions and the person in charge of this follow-up. Should any prescribed standards be breached, **PMU/EMS**, through the Assistant Plant Manager, will immediately inform the EEAA and disclose the procedures being taken to rectify non-conformity.

Results of environmental monitoring as described above, shall be recorded and submitted to the EEAA, EEHC and to any other party (i.e. WB, AfDB etc.) as required. The EEAA, WB and AfDB are entitled to audit the project company in order to ensure conformity with environmental standards and requirements.

In addition, the project company must keep a record of any significant environmental incidents occurring at the plant including accidents and occupational illnesses, spills, fires and other emergencies. The Assistant Plant Manager will be responsible for ensuing that these records are maintained up to date and are available on site.

The Assistant Plant Manager will supervise and lead the Environmental Department (ED) and the Environmental Management Staff (EMS) directed by the ED. *Figure 8-1* depicts the organizational structure of the Helwan South power plant including the ED and *Figure 8-2* illustrates the organization of the EMU.

8.2.2 Environmental Training

The Project Company will ensure that the power plant is manned 24 hours a day, 7 days per week. All staff employed at the plant will be trained in the following:

- general operation of the power plant;
- specific job roles and procedures;
- occupational health and safety; and
- contingency plans and emergency procedures.

Training will include:

- induction training on appointment;
- specialist training (as required for their prescribed job role); and
- refresher training as required.

The training program will be designed to ensure that appropriate skilled staff are used to operate the power plant at all times. Aspects of occupational health and safety and emergency procedures are described below.

In addition to this environmental training for all staff employed at the plant, special environmental training will be given to the staff employed for the EMU. They will receive training in the following:

- day-to-day monitoring activities;

- monitoring the stack emissions;
- collection and analysis of air quality data;
- monitoring the water effluents;
- collection and analysis of water quality information;
- use of monitoring equipment, operation and maintenance;
- industrial hygiene;

Figure 8-1

Environmental Department (ED) within the Organizational Structure of Helwan South Power Plant

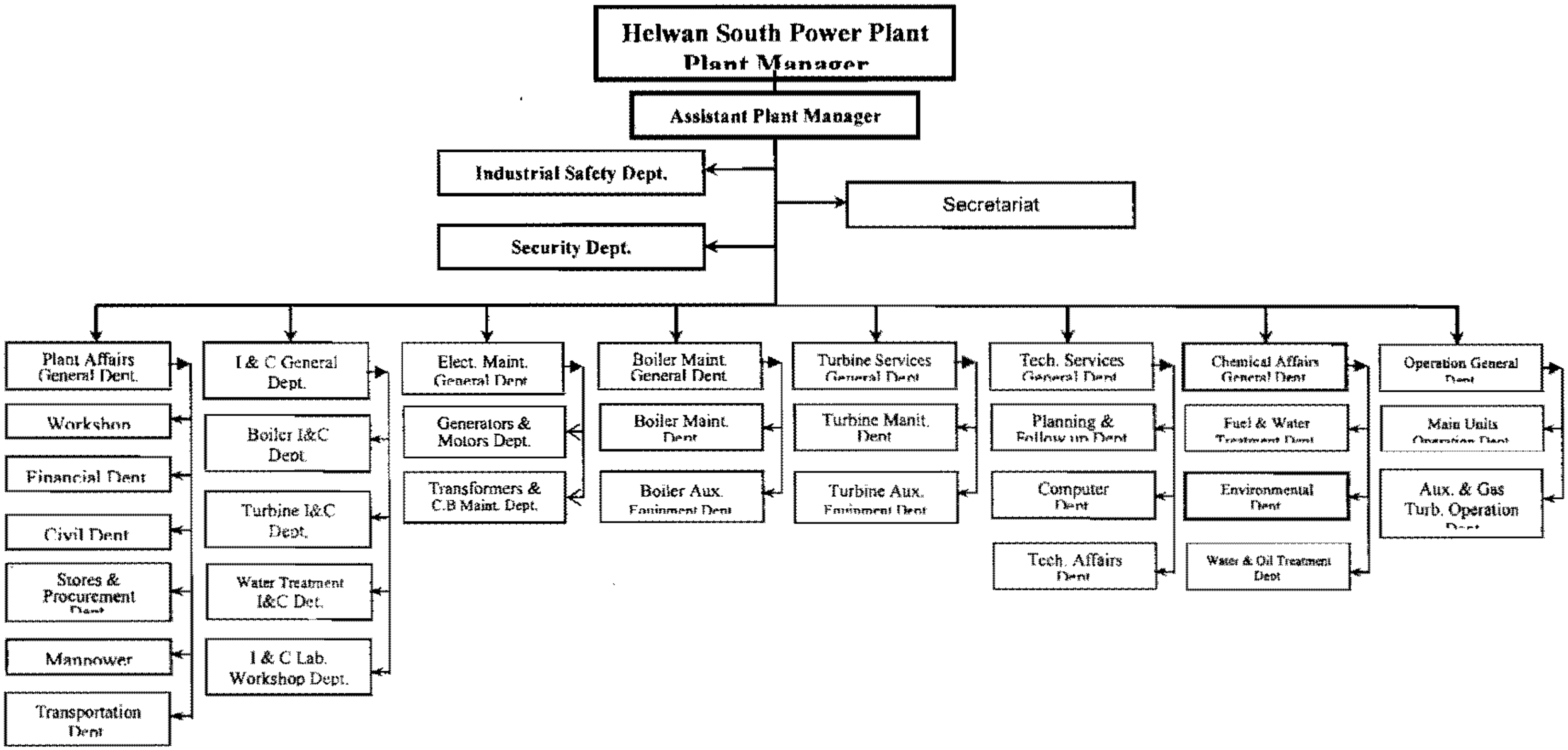
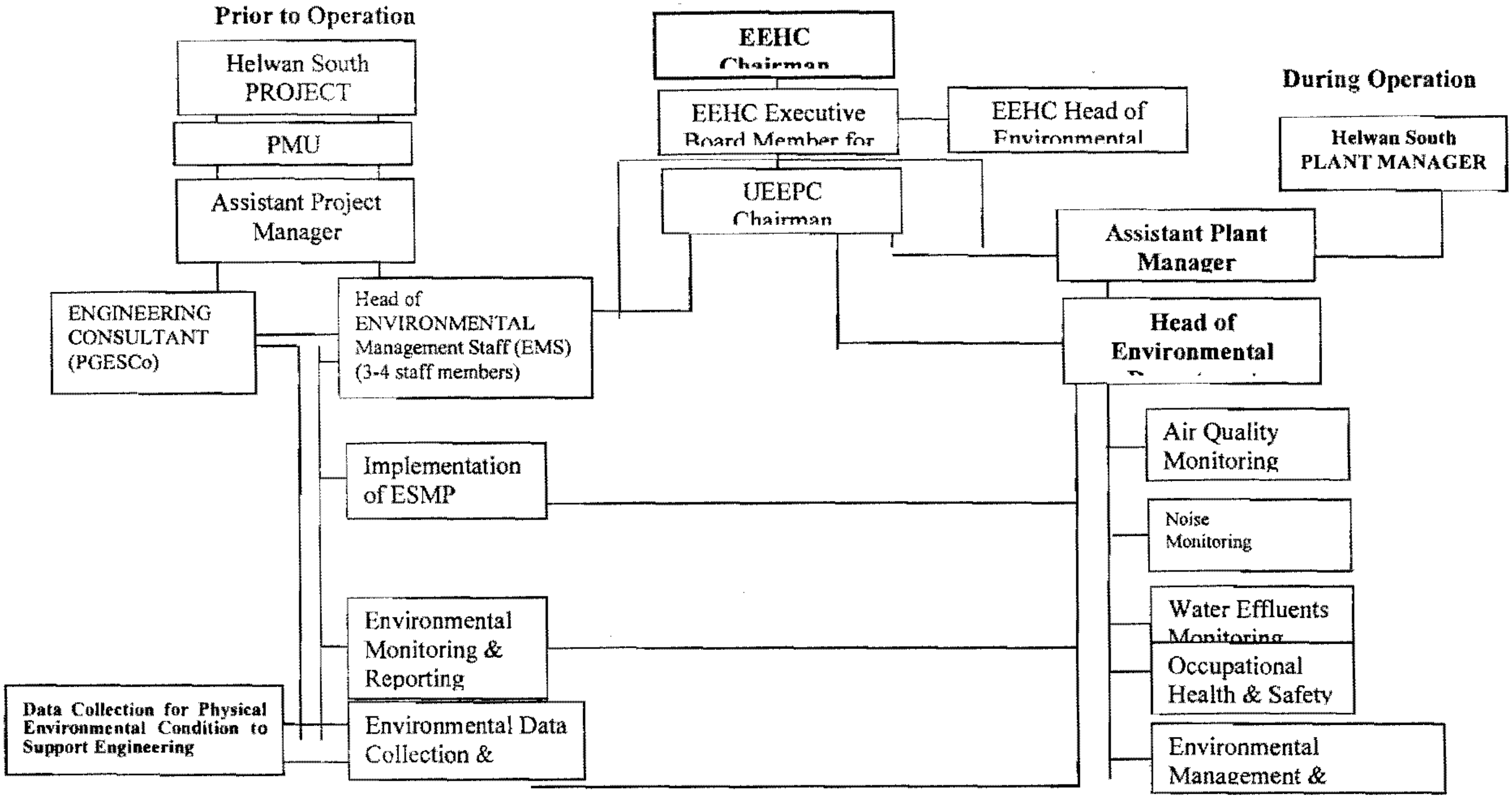


Figure 8-2

Environmental Management Staff (EMS) within the Project Management Unit (PMU)



- occupational health and safety; and
- emergency and contingency procedures.

8.2.3 Occupational Health and Safety

UEEPC/HPP will establish and integrate policies and procedures on occupational health and safety into the operation of the power plant which meet the requirements of Egyptian, World Bank and African Development Bank guidelines as given in Section 2 of the report. The policies and procedures will also be designed to comply with all manufacturers safety data sheets for chemical storage and usage, so as to provide a safe and healthy working environment.

Occupational health and safety programs will be supported by staff training for the power plant and the appointment of the Assistant Plant Manager. The training will include, but will not be limited to, the following:

- general area safety;
- specific job safety;
- general electrical safety;
- handling of hazardous materials;
- entry into confined spaces;
- hearing conservation;
- repetitive stress disorders;
- Code of Safe Practices;
- use of personal protective equipment; and
- first-aid.

The training will include induction courses when staff are first employed at the power plant, with specialist and refresher training as required by the job role. Training will be updated annually and occupational health and safety procedures will be included within the Operations Manual for the power plant.

The safety record at the power plant will be reviewed each month at a formal meeting, led by the Assistant Plant Manager, where the agenda items, comments and attendance will be recorded and kept on file.

In addition, periodic safety audits will be conducted to verify compliance with safe working practices, which will comprise physical inspections, review of plant records and interviews with staff. The audits will assign responsibility for any corrective action necessary to mitigate a potential hazard and allow the tracking of the completion of the corrective measure.

Table 8-1 summarizes the recommended training required for the PMU/EMS.

Table 8-1

Recommended Training Required for the PMU/EMS

Training Course	Contents	Type of Training	Participants	Proposed Scheduling	Cost Estimate (L.E.)
General EHS Training: • Induction Training on Appointment • Specialist Training • Refresher Training (as required)	• General operation of the power plant. • Specific job roles and procedures. • Occupational Health & Safety: - general area safety; - specific job safety; - general electrical safety; - handling of hazardous materials; - entry into confined spaces; - hearing conservation; - repetitive stress disorders; - Code of Safe Practices; - use of personal protective equipment; and - first-aid. • Contingency Plans & Emergency Procedures.	Classroom and On-job training.	All power plant staff, including EMS.	Once before project implementation and during operation for refresher training.	Included in construction & operation cost. (around US$ 145 k)
Special Environmental Training on Environmental Aspects of Power Generation and Monitoring.	• Allover Environmental Performance of the P.P. • Day-to-day monitoring activities. • Monitoring the stack emissions. • Collection & analysis of air quality data. • Monitoring the water effluents. • Collection & analysis of water quality information. • Use of monitoring equipment, operation and maintenance. • Industrial Hygiene.	Classroom and On-job training.	EMS. (3-4 staff members)	Once before project implementation and monitoring program.	Included in construction & operation cost. (around US$ 10 k)
Environmental Auditing and Inspection, including periodic safety audits	• Environmental Auditing Techniques. • Auditing Checklists. • Environmental Auditing Reports. • Safety Audits: - Physical inspections; - Review of plant records; - Interviews with staff.	Classroom and Field Exercises.	EMS.	Once after project implementation	Included in operation cost. (around US$ 10 k)
Social Communications	• Communications Skills. • Mass Communications.	Classroom and Field Exercises.	EMS.	Once before project implementation and monitoring program.	Included in construction & operation cost. (around US$ 10 k)

8.2.4 Emergency Procedures and Accident Response

Instructions on emergency measures necessary to safeguard employees and the wider environment will be prepared as part of the Operations Manual for the power plant.

Accident Response

As part of the preparation of emergency procedures and the plans for accident response arrangements, the project company will carry out the following:

- review industry-specific and Egyptian, World Bank and AfDB standards and regulations;
- establish general guidelines on potential safety and accident risks;
- prepare job-specific operating instructions where appropriate;
- establish safety and security notices for hazardous materials;
- prepare specific emergency operating instructions;
- provide protective equipment (including clothing, air and ear protection etc.) as required;
- evaluate information and feedback from employees; and
- record and investigate all accidents, injuries and incidents.

Contingency plans and emergency procedures are being developed to cover events due to operational failures, natural causes and acts of third parties. The plans and procedures will cover, as a minimum, the following:

- fire;
- explosion;
- bomb alerts;
- leaks and spills of hazardous materials;
- structure or equipment failures;
- injuries and illnesses;
- risk from natural disasters (wind, sandstorm, earthquake); and
- third-party risks (potential impacts of an accident occurring at another industrial facility which may impact upon the power plant).

Oil Spill Contingency Plan

As Good practice and part of the ESMP, UEEPC/HPP will prepare an Oil Spill Contingency Plan.

Heavy fuel oil and light fuel oil will be delivered to the site by road trucks and stored in:

- two 45,000 m^3 tanks for the heavy fuel oil (oil no. 6/mazout).
- one 2,000 m^3 tank for the light fuel oil (oil no. 2 / sollar).

These tanks are surrounded contained within separate retention area which is designed to contain 110% of one tank.

The plan will cover the following activities.

- delivery;

- handling;
- spills; and
- cleanup.

The plan will detail procedures, responsibilities, chains of command, information flows, monitoring and documentation.

8.3 SCHEDULE AND COSTS FOR PREPARATION AND IMPLEMENTATION OF EHS PLAN

Table 8-2 **below provides a time schedule and approximate costs for the preparation and implementation of the Environment, Health and Safety Plans.** ***Table 8-3 through 8-7 illustrate the ESMP.***

Table 8-2

Schedule and Cost Estimates for EHS Plans

Plan	Responsibility	Schedule for Submission	Schedule for Implementation	Approx. Cost (US$)
Occupational Health and Safety Plan (Construction)	HPP Assistant Plant Manager	4th Quarter 2011	2nd Quarter 2012	Within Construction Contracts
Occupational Health and Safety Plan (Operation)	HPP Assistant Plant Manager	2nd Quarter 2012	3rd Quarter 2012	(a)
Emergency Procedures and Accident Response Plan	HPP Assistant Plant Manager	4th Quarter 2011	4th Quarter 2011	(a)
Oil Spill Contingency Plan	HPP Assistant Plant Manager	2nd Quarter 2012	3rd Quarter 2012	(a)
Chance Finds Procedure	HPP Assistant Plant Manager	4thQuarter 2011	4th Quarter 2011	(a)
Monitoring Plan	HPP Assistant Plant Manager	Already prepared, see Tables 8-3 through 8-7 of ESMP	Start of Construction	(a)

Notes:

(a) The cost of the preparation of these plans will amount to around US$ 50,000. The costs of maintaining and implementing the requirements of these plans on-site cannot be determined at this stage until the contents and requirements of the plans are known. However, the cost of air quality monitoring system may be estimated at this stage for about US$ 1,500,000.

Table 8-3

Institutional Arrangements for Helwan South Power Project

Issue/Impact	Mitigation Measures	Implementation Schedule	Type and Frequency of Reporting / Monitoring	Responsibility		Monitoring Indicators	Budget In US$
				Implementation	Supervision		
Construction Phase							
Institutional capacity to address environmental and social issues	Establishment of the Project Management Unit (PMU), including the Environmental Management Staff (EMS) (will include 3-4 staff members, B.Sc. and/or 5 years high technical education), construction phase. Basic training of persons employed to operate the monitoring activities. Basic induction training for all employees on good construction and site management practice.	Prior to starting construction. Ongoing training	Quarterly to EEHC Environmental Management (EEM) and EEHC Chairman	PMU / EMS	UEEPC Project Manager in collaboration with the Consultant Site Manager	Training programs Compliance with ESMP	Environmental Quality quarterly monitoring will start with the commencement of construction phase. Basic Training Basic Induction Training Air quality continuous monitoring will start 6 months ahead of commissioning. Training since that time is included in air quality monitoring package Training time and cost (included in construction cost) (around US$ 155 k) UEEPC responsibility
Operation Phase							
Institutional capacity to address environmental and social issues	Establishment of the Project Management Unit (PMU), including the Environmental Management Staff (EMS) (will include 3-4 staff members, B.Sc. and/or 5 years high technical education), operation phase. Basic training of persons employed to operate the monitoring activities. Induction, specific and refresher training for all employees on good operation management practice. Training methods, facilities & manuals	Prior to starting operation. Ongoing training	Quarterly to EEHC & EEHC Environmental Management (EEM)	PMU / EMS	UEEPC Project Manager in collaboration with the Consultant Site Manager	Training programs Compliance with ESMP	Included in air quality monitoring package Training time and cost (included in operation cost) (around US$ 20 k) UEEPC responsibility

Notes:
(*) UEEPC responsibility: means that training and capacity building activities are included in the company organizational structure and budget.

Table 8-4

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility: Implementation	Responsibility: Supervision	Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
Air Quality Dust emissions caused by construction activities, construction vehicle movements, and transport of friable construction materials.	Implementation of good site practices including: ● appropriate siting and maintenance of stockpiles of friable materials so as to minimize dust blow; ● minimizing drop heights for material transfer activities such as unloading of friable materials; ● construction phase to begin with construction of access roads; ● roads will be kept damp via a water bowser; ● roads will be compacted and graveled if necessary; ● site roads will be maintained in good order; ● regulation of site access; ● sheeting of lorries transporting friable construction materials and spoil; ● enforcement of vehicle speed limits on unmetalled roads to <35 km/h.	Before construction and during construction	<u>Before Construction and during Construction until 6 Months ahead of Commissioning:</u> Initiate baseline air quality survey of main pollutants, particularly NO2, SO2, CO, TSP and PM10 using third party measurements on a quarterly basis. <u>During Construction, 6 Months ahead of Commissioning:</u> Initiate baseline air quality survey of NO_2, SO_2, CO, TSP and PM_{10} using air quality monitors and continue during 6 months. Two analyzer stations will be electronically connected to the EEAA ambient monitoring system. Measurements and analysis of these pollutants to be made on a continuous basis by a trained staff assigned by UEEPC/HPP and submitted to EEHC for reporting to any concerned authority.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the PMU / EMS and the Assistant Plant Manager.	UEEPC Project Manager in collaboration with the Consultant Site Manager	Dust levels (TSP, PM_{10}) NO_2, SO_2, CO levels.	Quarterly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority. (e.g. EEAA, WB, etc.).	UEEPC/PMU responsible for management of the air quality monitoring system. Submission of annual summary reports to EEHC and any other concerned authority. Basic training of persons employed to operate and maintain the monitoring system. UEEPC/PMU to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice.	Mitigation Measures, Management time and costs (included in construction costs) Baseline Air Quality Monitoring: First construction period; third party monitoring (e.g. National Research Center), four times a year until using continuous monitoring: US$70K Second construction period; 6 months ahead of commissioning: Permanent Continuous Monitoring System-approx. US$ 1000-1500K plus management time & reporting.

(*) Environmental regulations are to be included in all construction contracts.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting / monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Aquatic Environment Dredging and construction of the intake structure and water discharge structure. Increased suspended sediment and pollutant loads, permanent loss and disturbance to aquatic flora and fauna.	The following measures will be taken: • Construction Method Statement to be produced by the Contractor; • dredged areas limited to minimum area required; • disposal of dredged sediments to an agreed site; • all works will be made clearly visible using flags, beacons and/or signals; • bank area will be reinstated following construction.	During construction of intake and discharge structures	Off bankline survey undertaken October 2010 along 5 profiles fronting the site. Report to be maintained for later monitoring and evaluation during operation. Continuous visual inspection During dredging sediment and surface water will be monitored at four locations (two downstream of the intake and two upstream of the discharge) twice a month. During construction sampling will be conducted at two sites, unless preliminary monitoring campaign shows strong variations in water quality. Water samples will be tested for temp., PH, COD. BOD, TOC, DO, TSS, oil & grease, residual chlorine and light metals . Sediment will be tested for oil & grease and light metals.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the PMU / EMS and the Assistant Plant Manager.	UEEPC Project Manager in collaboration with the Consultant Site Manager.	Actual parameters to be measured.	Quarterly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority. (e.g. EEAA, WB, etc.).	UEEPC/PMU to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practice. These mitigation measures must be a condition of any construction contracts commissioned.	Mitigation Measures: Management time and costs (included in construction cost). Water quality measurement costs (between US$ 30-45K)

(*) Environmental regulations are to be included in all construction contracts.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting / monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Contamination of the aquatic environment as a result of construction activities on land e.g. spillages, disposal of liquid wastes; surface run-off, exposure of contaminated soils (see also under "Soils and Hydrology").	Mitigation activities will include the following: ● no discharge of effluents into the El-Rayyah El-Beheiry - all effluents shall be collected and removed off site for treatment by approved firms; ● development of a site drainage plan which reduces flow velocity and sediment load; ● protection of temporary stockpiles of soil from erosion by using a reduced slope angle where practical, sheeting and by incorporating sediment traps in drainage ditches; ● maintenance of well kept construction site.	During construction	Continuous visual inspection will be conducted.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the PMU/EMS and the Assistant Plant Manager.	UEEPC Project Manager in collaboration with the Consultant Site Manager.	Fluid effluents within the site. Soil erosion. Surface water run-off. Sewage effluents. Earth, mud and debris depositions on roads.	Quarterly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	UEEPC/PMU to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time and costs (included in construction cost).

(*) Environmental regulations are to be included in all construction contracts.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Noise Increased noise in the project area as a result of the use of noisy machinery and increased vehicle movements.	Implementation of good site practices including: ● enforcement of vehicle speed limits; ● strict controls of vehicle routing; ● diesel engine construction plant equipment to be fitted with silencers; ● limited noisy construction activities at night; ● prohibition of light vehicle movements at night; ● use of protective hearing equipment for workers.	During construction	Monthly monitoring and supervision by UEEPC is required to ensure the implementation of good site management practices by all contractors during construction. Third party audit, conducted every 4 month.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the PMU/EMS and the Assistant Plant Manager. Auditor (Noise Expert)	UEEPC Project Manager in collaboration with the Consultant Site Manager.	Noise complaints register to identify concerns. Check validity using noise measuring devices.	PMU/EMS will produce a Quarterly log of valid complaints and actions taken to EEHC. Quarterly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB etc.), if required.	UEEPC/PMU to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time and costs (included in construction cost). Third party noise measurement costs (about US$ 23K).
Flora and Fauna Site Clearance-Vegetation removal and habitat disturbance.	● Good site management practices will be observed to ensure that disturbance of habitats off-site are minimized. ● Specific mitigation measures include restricting personnel and vehicles to within construction site boundaries, lay down areas and access roads.	During construction.	Periodic inspection and supervision by UEEPC is required to ensure the implementation of good site management practices by all contractors during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the PMU/EMS and the Assistant Plant Manager.	UEEPC Project Manager in collaboration with the Consultant Site Manager.	Good conservation of floral wealth.	Quarterly reporting No. of floral species conserved or planted, if any.	UEEPC/PMU to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time and costs (included in construction cost)

(*) Environmental regulations are to be included in all construction contracts.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility: Implementation	Responsibility: Supervision	Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
Soils and Hydrology Site clearance, excavation and disposal of material, exposure of potentially contaminated soils, spillage or leakage of substances on land, movement of equipment and vehicles on site.	The potential for impacts are largely dependent on management of the construction site and activities. The following mitigation measures will be implemented: • development of effective site drainage systems; • restriction of access only to construction site areas; • monitoring and control of spoil; • disposal of waste materials unsuitable for reuse on-site, (e.g. for landscaping) at appropriately licensed sites; • provision of oil and suspended solid interceptors; • management of excavations during construction to avoid the generation of drainage pathways to underlying aquifers; • provision of impermeable bases in operational areas to prevent absorption of spillages.	During construction.	Daily visual inspection is required to ensure the implementation of good manegement practices during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the PMU/EMS and the Assistant Plant Manager.	UEEPC Project Manager in collaboration with the Consultant Site Manager.	• site drainage. • access only to construction site areas. • spoils. • waste materials. • oily waters. • drainage pathways. • potential spillage in operational areas.	Quarterly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB etc.), if required.	UEEPC/PMU to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Costs for mitigation measures and management time included in construction costs. Any additional features (e.g. bunding, interceptors etc.) may incur additional costs of between US$ 30-50K dependent on the measure.

(*) Environmental regulations are to be included in all construction contracts.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Traffic and Transport Disruption, noise and increased air pollution due to increased traffic, light loads and abnormal loads.	Standard good practice measures will be implemented as follows: ● adherence of abnormal load movements to prescribed routes, outside peak hours and advance publication of movements if required; ● construction shifts will be staggered; ● scheduling of traffic to avoid peak hours on local roads; ● transportation of construction workers by contract bus.	During construction.	Monitoring traffic entering the site during morning & evening peaks to ensure the implementation of good site management practices by all contractors during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the PMU / EMS and the Assistant Plant Manager.	UEEPC Project Manager in collaboration with the Consultant Site Manager.	Increased congestion Travel time (compared to reasonable daily commute)	Three times per month Quarterly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB etc.), if required.	UEEPC/PMU to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time

(*) Environmental regulations are to be included in all construction contracts.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Socio-Economic Environment Positive impacts identified.	All activities related to the construction of the new plant will take place within the area belonging to UEEPC, i.e. there will be no off-site activities or associated land acquisition during construction. Most of the labor force will be daily commuters, thus no worker housing or associated facilities will be erected on site during construction. The Project will construct a dedicated project campsite where all facilities shall be provided to the incoming labour force to ensure that no pressure is exerted on local facilities and supplies. The local communities shall be given priority in supplying goods and services demanded by the project and its employees. Senior and professional staff of the construction companies will opt to reside in the near-by city of Beni-Suweif which has adequate facilities to cater for the project workers. Lodging requirements of the operational staff will be covered through extensions available to residential community of the Kureimat Power Complex, 7.5 km north-east of the project site. No additional land acquisition is needed. The contractors will be responsible for relevant temporary water / toilet facilities during construction and the need to provide appropriate services will be specified in their constrects.	During construction.	Record local employment provided by the project.	PMU/EMS and the Assistant Plant Manager	UEEPC Project Manager in collaboration with the Consultant Site Manager.	Workers satisfaction as measured by staff interviews and complaints submitted.	Editing a special report	Responsibility of UEEPC/PMU.	Responsibility of UEEPC.

(*) Environmental regulations are to be included in all construction contracts.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Socio-Economic Environment Positive impacts identified.	***Transmission lines will connect the power plant to existing substations following new routes. Also, a new gas pipeline route will have to be identified from the nearest point of supply within the gas network.*** ***However, since the transmission lines and gas pipeline are likely to require some land acquisition (and possibly resettlement), a Resettlement Policy Framework (RPF) is prepared separately, as part of this ESIA work. A separate ESIA for the transmission lines is being implemented. Also, a separate ESIA and RPF for the Gas Pipeline Project has been already prepared by GASCo.***	During construction.	Record local employment provided by the project.	PMU/EMS and the Assistant Plant Manager	UEEPC Project Manager in collaboration with the Consultant Site Manager.	Workers satisfaction as measured by staff interviews and complaints submitted.	Editing a special report	Responsibility of UEEPC/PMU.	Responsibility of UEEPC.
Continued Public Consultation	Public and Industry Relations will be maximized through open dialogue between UEEPC (through the Assistant Plant Manager who has direct responsibility for EHS Liaison) and local authority, public and industry representatives.								

(*) Environmental regulations are to be included in all construction contracts.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Complementary Initiatives and Project Benefits	The project design has considered enhancing the project benefits through its social corporate responsibilities program. Resulting from the community requests that local population, both men and women, be considered for employment opportunities, the Power Company shall ensure that the construction companies recruit local people willing and able to participate in the implementation of the project. The project has undertaken to construct local clinic and a basic school for the communities of the project area in liaison with the Ministries of Health and Education, respectively. Provision of these social amenities will be implemented under the civil works contracts. Social and recreational facilities for the staff of the Power Company shall be accessible by the local people upon request, including access to potable water within the project premises.	During construction contract.	Record activities and procedures	Implementation of Good Site Management practices and the safeguard and protection policies shall be the responsibility of the contractor and subcontractors on site under supervision of the UEEPC/HSPP.	UEEPC top management EEHC top management	People satisfaction Community leaders opinions and satisfaction	Editing a special report	UEEPC to ensure the contractor and subcontractors for workers on site include reference to the requirements of the ESMP and are aware of the safeguard and protection policies and plans. All employees will be given basic induction training on safeguard and protection policies and practices.	Training and awareness will require management time plus costs of up to US$ 60K.

(*) Environmental regulations are to be included in all construction contracts.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Involuntary Resettlement	The land parcels close to the Nile River are actively cultivated by some 4 family groupings representing roughly 20 people. Access to the land between the power plant perimeter fence and the Nile River bank has been reviewed to ensure public access. According to the Lending Institutions' Policy on Involuntary Resettlement this will call for an Abbreviated Resettlement Action Plan (ARAP) to be prepared. The draft ARAP will be Annexed to the ESIA.	Before /during Construction.	Record resettlement procedure and activity	Implementation of Good Site Management practices and the safeguard and protection policies shall be the responsibility of the contractor and subcontractors on site undar supervision of the UEEPC/HSPP.	UEEPC top management EEHC top management	People satisfaction	Editing ARAP	UEEPC to ensure the contractor and subcontractors for workers on site include reference to the requirements of the ESMP and are aware of the safeguard and protection policies and plans. All employees will be given basic induction training on safeguard and protection policies and practices.	Training and awareness will require management time plus costs of up to US$ 60K.

(*) Environmental regulations are to be included in all construction contracts.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Communicable Diseases	Training programs and health and safety measures will include knowledge about HIV/AIDS awareness, prevention and treatment. Specialized service provider will be sub-contracted by the Consulting Engineer and included in the BoQ depending on the approach The service provider would also talk about other communicable diseases such as STD, TB and Hepatitis B and C. The information would be imparted to construction workers especially those coming in from outside the project area through seminars, pamphlets and peer discussions.	During construction contract.	Daily inspection is required to ensure the implementation of safeguard and protection plans and practices during construction.	Implementation of Good Site Management practices and the safeguard and protection policies shall be the responsibility of the contractor and subcontractors on site under supervision of the UEEPC/HSPP.	UEEPC /HSPP Assistant Plant Manager Consultant Engineer Site Manager EEHC	Management procedures in place. Workers health and safety as measured by no. of ill cases.	Daily 6- monthly reporting of summary results and submitted to the EEHC and other concerned authority (e.g. EEAA, Financiers, etc.) if required.	UEEPC to ensure the contractor and subcontractors for workers on site include reference to the requirements of the ESMP and are aware of the safeguard and protection policies and plans. All employees will be given basic induction training on safeguard and protection policies and practices.	Training and awareness will require management time plus costs of up to US$ 60K.

(*) Environmental regulations are to be included in all construction contracts.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Archaeology Potential chance finds of archaeological remains during construction.	The project site does not lie on, or in the immediate vicinity of any known archaeological areas of interest. If remains are found UEEPC is committed to: ● cease activities and consult Antiquities authority; ● protection in situ if possible; ● excavation of areas where protection not feasible, ● preparation of a Chance Finds Procedure and Method Statement.	During construction.	Supervision of construction activities.	Construction contractors PMU/EMS and the Assistant Plant Manager will allocate responsibilities in accordance with the Chance Finds Procedure.	UEEPC Project Manager in collaboration with the Consultant Site Manager.	Chance finds (see annex II)	Daily inspection Quarterly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB etc.), if required.	UEEPC/PMU to ensure that all workers on site are aware of the importance of archaeological remains and must report any potential finds immediately. Immediate liaison with Competent Administrative Authority should a potential find be uncovered.	Mitigation measures require management time. Should chance finds occur, protection & excavation could add significantly to the cost.
Natural Disasters Flash flooding.	Good engineering design will incorporate the following mitigation measures: ● drainage system designed to direct flood water from main plant areas into the Nile and direct potentially contaminated waters through the oil interceptor.	During construction.	No monitoring measures are envisaged.	PMU/EMS and the Assistant Plant Manager	UEEPC Project Manager in collaboration with the Consultant Site Manager.		Quarterly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB etc.), if required.	UEEPC/PMU to ensure that all workers on site receive training in emergency preparedness and response procedures.	Relevant costs are included within the construction costs

(*) Environmental regulations are to be included in all construction contracts.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility: Implementation	Responsibility: Supervision	Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
Solid Waste Management	Good practice measures such as the following: (1) all waste taken off-site will be undertaken by a licensed contractor and UEEPC will audit disposal procedure; (2) collection and segregation of wastes and safe storage; (3) recording of consignments for disposal; (4) prior agreement of standards for storage, management and disposal with relevant authorities. **It is of highest importance that final disposal of wastes shall be strictly adhered to environment friendly disposal Contract.**	During construction.	Periodic inspection is required to ensure the implementation of good management practices during construction.	Implementation of Good Site Management practices shall be the responsibility of all contractors on site under supervision of the PMU/EMS and the Assistant Plant Manager.	UEEPC Project Manager in collaboration with the Consultant Site Manager.	Management contract in place Functional transfer station.	Quarterly reports from management contractor to UEEPC and then to EEHC. These reports are to be submitted to any other concerned authority (e.g. EEAA, WB, etc.), if required.	UEEPC/PMU to ensure all contractors and subcontractors working on site are aware of ESMP and all employees are given basic induction training on good construction and site management practices.	Management time plus costs (< US$ 20K)

(*) Environmental regulations are to be included in all construction contracts.

Table 8-4 (Contd.)

Construction Impact Mitigation, Monitoring and Management Measures(*)

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility: Implementation	Responsibility: Supervision	Monitoring Indicators	Type and Frequency of Reporting / monitoring	Management and Training	Indicative Cost Estimate (US$)
Occupational Health & Safety	Good local and international construction practice in Environment, Health and Safety (EHS) will be applied at all times and account will be taken of local customs, practices and attitudes. Measures include: • implementation of EHS procedures as a condition of contract all contractors and sub-contractors; • clear definition of the EHS roles and responsibilities of all construction companies and staff; • management, supervision, monitoring and record-keeping as set out in plant's operational manual; • pre-construction and operation assessment of the EHS risks and hazards; • completion and implementation of Fire Safety Plan prior to commissioning any part of the plant; • provision of appropriate training on EHS issues for all workers; • provision of health and safety information; • regular inspection, review and recording of EHS performance; and • maintenance of a high standard of housekeeping at all times.	During construction.	Daily inspection is required to ensure the implementation of EHS Policies, plans and practices during construction.	Implementation of Good Site Management practices and the EHS policies shall be the responsibility of all contractors on site under supervision of the PMU/EMS and the Assistant Plant Manager.	UEEPC Project Manager in collaboration with the Consultant Site Manager.	Management procedures in place. Workers health and safety as measured by no. of incidents.	Daily inspection Quarterly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	UEEPC/PMU to ensure all contractors and sub-contractors for workers on site include reference to the requirements of the ESMP and are aware of the EHS policies and plants. All employees will be given basic induction training on EHS policies and practices. Contractors are responsible for ensuring that a Fire Safety Plan, which conforms to NFPA 850, is prepared and implemented prior to commissioning of any part of the plant under supervision of PMU/EMS and the Assistant Plant Manager.	Mitigation measures will require management time plus costs of up to US$ 50K for implementation of EHS Plans.

(*) Environmental regulations are to be included in all construction contracts.

Table 8-5

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Air Quality Emissions from stack are not expected to exceed standards. Ambient air quality affected by emissions from the power plant.	Mitigation measures have already been included in the design of the plant and, given UEEPC/HPP's strict commitment to use sollar fuel oil for <2% of operating time, no further mitigation measures are proposed. UEEPC/HPP will however demonstrate the validity of the conclusions drawn in the ESIA report. UEEPC/HPP will demonstrate the validity of the conclusions drawn in the ESIA report. If ground level concentrations are found to be above local and World Bank standards options for further mitigation will be discussed.	During first three years of operation.	**Automatic monitoring** of stack emissions for NOx, SO_2, particulate matter and carbon monoxide (CO) via test ports installed in the main stacks. **Install two continuous** NOx, SO_2, CO, PM_{10} & TSP **monitoring stations** to monitor short-term concentrations in the area predicted to have the highest impacts on humans (as there are no other sensitive environments). The analyzer station near or within the site boundaries will include a continuous monitor of meteorological conditions (temperature, wind speed, wind direction and mixing heights). The analyzer stations will be electronically connected to the EEAA ambient monitoring system.	The analyzer stations will be owned and operated by UEEPC/HPP/ EMS. Assistant Plant Manager	UEEPC Top Management EEHC Environmental Management & Studies Sector. Report introduced to EEAA as requested. Third party inspection.	Stack emissions (at least PM_{10}, NOx, SOx and CO). Ambient air pollutants concentrations (at least TSP, PM_{10}, NOx, SOx and CO).	Continuous Hourly data acquisition. Quarterly reporting to EEHC. Reports are to be available to any of the concerning authorities (EEAA, WB, etc.).	Records must be kept and summary data (including any deviations from Egyptian and World bank standards) will be submitted to the Government and WB on annual basis (or more frequently if required). Annual reporting by UEEPC/ HPP/EMS to Government and WB etc. (or more frequently if required) highlighting key features and comparing results with air quality standards and prediction in ESIA report	Automatic stack monitors: included in the project cost. Management time for compilation of reports and performance monitoring: included in operation cost. Purchase of Continuous Monitors (see construction management table). Annual servicing, calibration & running costs: included in operation cost.

Table 8-5 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility: Implementation	Responsibility: Supervision	Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
Aquatic Environment Discharge of process and cooling water.	The design of the intake and cooling water structures have already incorporated measures to reduce impacts. In addition, good site management practices including the following will be implemented: 1) neutralization, oil separation, flocculation and filtration of any contaminated water before discharge to either plantation irrigation network or the El-Kata sewer network (if close to the site); 2) no disposal of solid wastes or waste water into the discharge structure; 3) regular maintenance of site drainage system to ensure efficient operation; 4) all discharges will comply with local Egyptian and World Bank guidelines. In addition, UEEPC/HPP will demonatrate the validity of the conclusions drawn in the ESIA report. If pollutant concentrations in the discharge or impacts to the surrounding aquatic environment are found to be above local and World Bank standards or unacceptable, options for further mitigation will be discussed.	Lifetime of the plant	Prepare regular water quality monitoring program including: 1) quality of all water prior to discharge (continuous monitoring of all discharged water for temperature and pH, daily monitoring of process water for COD, TSS, oil & grease and residual chlorine and monthly monitoring of light metals and other pollutants) 2) ambient water quality in the area affected by the discharge plume (3-monthly monitoring of temperature, pH, COD, BOD, TOC, DO, TSS, oil & grease, residual chlorine, light metals and other pollutants. Annual monitoring of benthic environment within a 2 km radius of the discharge point (over a 3 year period) Weekly monitoring of fish catches on intaka screens inclu-ding species, num-bers and size (over a 1 year period).	UEEPC/HPP/ EMS Assistant Plant Manager.	UEEPC Top Management EEHC Environmental Management & Studies Sector.	Basic parameters as per the Law 48/1982 and Law 93/1962	Monthly reports from UEEPC/HPP/ EMS to EEHC Continuous monitoring of water quality etc. Monthly monitoring of light metals and other pollutants. 3-monthly monitoring of the plume. Annual monitoring of benthic environment (over a 3 year period). Weekly monitoring of Fish Catches on intake screens (over a 1 year period. Reports are to be available to any of the concerning authorities (EEAA, WB, etc.).	Records will be kept and compared on regular basis against Egyptian and World Bank standards and impacts predicted in ESIA. Summary reports (with any exceptions identified) will be submitted to the Government and WB etc. on annual review basis (or more frequently if required). UEEPC/HPP/EMS to ensure thet all employees are given basic induction training on the requirements of the ESMP, good site management practices and H&S procedures. The Assistant Plant Manager will ensure implementation of procedures.	Management time for implementation of site management practices. Included in operation cost All costs are included in operation cost.

Table 8-5 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Noise	Specific design mitigation measures to minimize noise impacts include: ● gas turbines, steam turbine generators; air compressors, pumps and emergency diesel engines are enclosed in buildings; ● air compressors are equipped with silencers; ● noisy outdoor equipment are designed to a noise limit of 90 dB (A) at 1 m. In addition, plant workers will be provided with protective wear in plant areas with high noise levels. The plant will operate in accordance with internationally accepted health and safety measures.	During first year of operation.	When the plant is fully operational, noise audit measurements are to be carried out at noise sources and at the fence of the power plant as well as at noise receptors around the plant.	UEEPC/HPP/EMS Third party audit supervised by Assistant Plant Manager	UEEPC Top Management EEHC Environmental Management & Studies Sector.	Power plant compliance with ESMP.	Quarterly to UEEPC and EEHC. Monthly reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	Should any complaints be received regarding noise, these will be logged and the Assistant Plant Manager will investigate problem. UEEPC/HPP/EMS to ensure that all employees are given basic induction training on the requirements of the ESMP, good site management practices and H&S procedures. The Assistant Plant Manager will ensure implementation of procedures.	Minimal costs (up to US$ 10K per annum) required for provision of protective wear (included in operation cost). No further mitigation or monitoring costs envisaged with the exception of management time. Noise audit US$ 10-20K (included in operation cost).

Table 8-5 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility: Implementation	Responsibility: Supervision	Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
Flora and Fauna Disturbance to habitats as a result of noise, vehicle and personnel movements.	The following mitigation measures will be implemented: ● restrict personnel and vehicle movements to access roads and within boundaries of site only; and ● control of noise during operation.	Lifetime of the plant.	No monitoring is envisaged.	UEEPC/HPP/ EMS Assistant Plant Manager	UEEPC Top Management EEHC Environmental Management & Studies Sector.	Good plantation	Yearly	UEEPC/HPP/EMS to ensure that all employees are given basic induction training on the requirements of the ESMP, good site management practices and H&S procedures. The Assistant Plant Manager will ensure implementation of procedures.	Management time
Visual Impact Visual image of power plant from surrounding areas.	The visual effect of the power plant will be improved through: ● creation of landscaped boundary along the fence of the power plant. ● *Ficus elastica var decora* and *Ficus nitida* will be propagated and the resulting plants will be used for decorating and landscaping the site when completing the new power plant. One may obtain 200-300 individual plants from a single tree.	Lifetime of the plant.	No monitoring is envisaged.	UEEPC/HPP/EMS Assistant Plant Manager	UEEPC Top Management EEHC Environmental Management & Studies Sector.	Improved visual image		Considered management of landscaped areas to maximize visual image and habitat creation. UEEPC/HPP/EMS to contract a suitable firm to manage landscaped areas.	Approx. US$ 20-35K for landscaping measures (included in operation cost)

Table 8-5 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility: Implementation	Responsibility: Supervision	Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
Soil and Hydrology Spillage of oils, chemicals or fuels on site.	Good site management measures as described under Aquatic Environment will minimize any potential risks. As part of this, regular checks of bunds and drainage systems will be undertaken to ensure containment and efficient operation.	Lifetime of the plant	The Assistant Plant Manager will continuously monitor application of ESMP and good site management practices and take corrective action if required.	UEEPC/HPP Assistant Plant Manager	UEEPC Top Management EEHC Environmental Management & Studies Sector.	Quality of bunds and drainage systems. Efficiency of operation.	6-monthly reports from management to EEHC. Annual reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	UEEPC/HPP, through the Assistant Plant Manager, will implement a Spills Response Plan and all employees will receive corresponding training.	Management time
Solid Waste	Good practice measures undertaken during the construction phase will be continued into the operation phase (see Table 6). It is of highest importance that final disposal of wastes shall be strictly adhered to environment friendly disposal Contract.	Lifetime of the plant	Continuous monitoring is required to ensure the implementation of good management practices during operation.	UEEPC/HPP Implementation of Good Site Management practices shall be conducted under supervision of the Assistant Plant Manager.	UEEPC Top Management EEHC Environmental Management & Studies Sector.	Management contract in place. Functional transfer station.	3-monthly reports from management to EEHC. Annual reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	UEEPC/HPP to ensure all employees are given basic induction training on good operation and site management practices.	Management time and costs (<US$ 10K per annum) (included in operation cost)

Table 8-5 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Occupational Health and Safety, ***Risks and Hazards***	Standard international practice on EHS issues shall be employed on site. The mitigation measures summarized in construction management Table apply. In addition, the following measures will be undertaken: (1) Provision of training in use of protection equipment and chemical handling. (2) Use of protective equipment. (3) Clear marking of work site hazards and training in recognition of hazard symbols. (4) Installation of vapour detection equipment and control systems. (5) Development of site emergency response plans.	Lifetime of the plant	Regular on-site training. Regular staff checks, system checks and field tests of emergency procedures by on-site management.	UEEPC/HPP/EMS Assistant Plant Manager	UEEPC Top Management EEHC Environmental Management & Studies Sector.	Management procedures in place. Workers health and safety measured by incidents, injuries and illnesses.	Monthly reports from management to EEHC Annual reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, WB, etc.), if required.	UEEPC/HPP/EMS to ensure that all employees are given basic induction training on H&S policies and procedures, Emergency Preparedness and Response Plan and a Spills Response Plan. The Assistant Plant Manager is to ensure implementation of procedures. UEEPC/HPP/EMS is responsible for ensuring that the site emergency response plan is complete and implemented prior to commissioning any part of the power plant.	Management time and costs (< US$ 15K per annum) (included in operation cost)

Table 8-5 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility: Implementation	Responsibility: Supervision	Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
Socio-Economic Environment Positive impacts identified	Fish Catch: based upon experience with similar plants elsewhere along the Nile River and its branches and the opinions of the fishermen, impacts are very likely to be positive.	First year of operation. (possibly 2 other years)	In collaboration with the Fishery Authorities, monitor any changes to the fish catch	UEEPC/HPP/EMS Assistant Plant Manager	UEEPC Top Management EEHC Environmental Management & Studies Sector.	Fish catch no. & quality	Monthly reports from management to EEHC		Included in operation costs.

Table 8-5 (Contd.)

Operational Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Communicable Diseases									
	Training programs and health and safety measures will include knowledge about HIV/AIDS awareness, prevention and treatment. Specialized service provider will be sub-contracted by the Consulting Engineer and included in the BoQ depending on the approach. The service provider would also talk about other communicable diseases such as STD, TB and Hepatitis B and C. The information would be imparted to construction workers especially those coming in from outside the project area through seminars, pamphlets and peer discussions.	Lifetime of the plant	Regular on-site training. Regular staff checks, system checks and field tests of safeguard and protection procedures by on-site management.	UEEPC/HPP/EMS Assistant Plant Manager	EEHC Environmental Management & Studies Sector.	Management procedures in place. Workers safeguard and protection measured by illnesses.	Monthly reports from management to EEHC Annual reporting of summary results (or more if requested) and submitted to the EEHC and any other concerned authority (e.g. EEAA, etc.), if required.	UEEPC/HPP/EMS to ensure that all employees are given basic induction training on safeguard and protection policies and procedures.	Management time and costs (< US$ 30K per annum)

Table 8-6

Transmission System Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				

Direct Vegetation damage, habitat loss, and invasion by exotic species along the ROW and access roads and around substation sites. Habitat fragmentation or disturbance. Increased access to sensitive lands.	• Utilize appropriate clearing techniques, (e.g., hand clearing versus mechanized clearing). • Maintain native ground cover beneath lines. • Replant disturbed sites. • Manage ROWs to maximize wildlife benefits. • Select ROW to avoid important natural areas such as sensitive habitats. • Maintain habitat (i.e., native vegetation) beneath lines. • Make provisions to avoid interfering with natural fire regimes. • Select ROW to a avoid sensitive lands. • Develop protection and management plans for these areas. • Use discontinuous maintenance roads.	During Construction and Operation	Visual inspections of the materials being used, the construction practices and mitigation measures. Short-term monitoring to assure that negative land use and/or ecological impacts are avoided and proper mitigation measures are employed. Occurs along the line as it is constructed. Monitoring of ROW maintenance activities to assure proper control methods.	Egyptian Electricity Transmission Company (EETC) UEEPC / PMU / EMS	EEHC management EETC management UEEPC Project Manager in collaboration with the Consultant Site Manager.	Effects on environmental and human resources involved (negative land uses, ecological damage) Degree to which they are affected.	Weekly (during construction). Maintenance time (during operation)	Environmental training and management will be warranted for ROW maintenance techniques, including the proper use of chemical and mechanical clearing methods. Training will be conducted by EETC and UEEPC/PMU with assistance from environmental consultant. Staff workers should have an understanding of the rational for the recommended mitigation and monitoring that they may be implementing.	Included in construction and operation cost.

Table 8-6 (Contd.)

Transmission System Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Runoff and sedimentation from grading for access roads, tower pads, and substation facilities, and alteration of hydrological patterns due to maintenance roads. Loss of land use and population relocation due to placement of towers and substations. Chemical contamination from chemical maintenance techniques.	• Select ROW to avoid impacts to water bodies, floodplains, and wetlands. • Install sediment traps or screens to control runoff and sedimentation. • Minimize use of fill dirt. • Use ample culverts. • Design drainage ditches to avoid affecting nearby lands. • Select ROW to avoid important social, agricultural, and cultural resources. • Utilize alternative tower designs to reduce ROW width requirements and minimize land use impacts. • Adjust the length of the span to avoid site-specific tower pad impacts. • Manage resettlement in accordance with World Bank & AfDB procedures. • Utilize mechanical clearing techniques, grazing and/or selective chemical applications. • Select herbicides with minimal undesired effects. • Do not apply herbicides with broadcast aerial spraying. • Maintain naturally low-growing vegetation along ROW.	During Construction and Operation	Visual inspections of the materials being used, the construction practices and mitigation measures. Short-term monitoring to assure that negative land use and/or ecological impacts are avoided and proper mitigation measures are employed. Occurs along the line as it is constructed. Monitoring of ROW maintenance activities to assure proper control methods.	Egyptian Electricity Transmission Company (EETC) UEEPC / PMU / EMS	EEHC management EETC management UEEPC Project Manager in collaboration with the Consultant Site Manager.	Effects on environmental and human resources involved (negative land uses, ecological damage) Degree to which they are affected.	Weekly (during construction). Maintenance time (during operation)	Environmental training and management will be warranted for ROW maintenance techniques, including the proper use of chemical and mechanical clearing methods. Training will be conducted by EETC and UEEPC/PMU with assistance from environmental consultant. Staff workers should have an understanding of the rational for the recommended mitigation and monitoring that they may be implementing.	Included in construction and operation cost.

Table 8-6 (Contd.)

Transmission System Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Avian hazards from transmission lines and towers. Aircraft hazards from transmission lines and towers. Induced effects from electromagnetic fields. Impaired cultural or aesthetic resources because of visual impacts.	• Select ROW to avoid important bird habitats and flight routes. • Install towers and lines to minimize risk for avian hazards. • Install deflectors on lines in areas with potential for bird collisions. • Select ROW to avoid airport flight paths. • Install markers to minimize risk of low-flying aircraft. • Select ROW to avoid areas of human activity. • Select ROW to avoid sensitive areas, including tourist sites and vistas. • Construct visual buffers. • Select appropriate support structure design, materials, and finishes. • Use lower voltage, DC system, or underground cable to reduce or eliminate visual impacts of lines, structures, and ROWs.	During Construction and Operation	Visual inspections of the materials being used, the construction practices and mitigation measures. Short-term monitoring to assure that negative land use and/or ecological impacts are avoided and proper mitigation measures are employed. Occurs along the line as it is constructed. Monitoring of ROW maintenance activities to assure proper control methods.	Egyptian Electricity Transmission Company (EETC) UEEPC / PMU / EMS	EEHC management EETC management UEEPC Project Manager in collaboration with the Consultant Site Manager.	Effects on environmental and human resources involved (negative land uses, ecological damage) Degree to which they are affected.	Weekly (during construction). Maintenance time (during operation)	Environmental training and management will be warranted for ROW maintenance techniques, including the proper use of chemical and mechanical clearing methods. Training will be conducted by EETC and UEEPC/PMU with assistance from environmental consultant. Staff workers should have an understanding of the rational for the recommended mitigation and monitoring that they may be implementing.	Included in construction and operation cost.

Table 8-6 (Contd.)

Transmission System Impact Mitigation, Monitoring and Management

Issue/Impact	Mitigation Measures	Implementation Schedule	Monitoring	Responsibility		Monitoring Indicators	Type and Frequency of Reporting/ monitoring	Management and Training	Indicative Cost Estimate (US$)
				Implementation	Supervision				
Indirect Induced secondary development during construction in the surrounding area. Increased access to sensitive lands.	• Provide comprehensive plans for handling induced development. • Construct facilities to reduce demand. • Provide technical assistance in land use planning and control to local governments. • Route ROW away from sensitive lands. • Provide access control.	During Construction and Operation	Visual inspections of the materials being used, the construction practices and mitigation measures. Short-term monitoring to assure that negative land use and/or ecological impacts are avoided and proper mitigation measures are employed. Occurs along the line as it is constructed. Monitoring of ROW maintenance activities to assure proper control methods.	Egyptian Electricity Transmission Company (EETC) UEEPC / PMU / EMS	EEHC management EETC management UEEPC Project Manager in collaboration with the Consultant Site Manager.	Effects on environmental and human resources involved (negative land uses, ecological damage) Degree to which they are affected.	Weekly (during construction). Maintenance time (during operation)	Environmental training and management will be warranted for ROW maintenance techniques, including the proper use of chemical and mechanical clearing methods. Training will be conducted by EETC and UEEPC/PMU with assistance from environmental consultant. Staff workers should have an understanding of the rational for the recommended mitigation and monitoring that they may be implementing.	Included in construction and operation cost.

Table 8-7 (A)

Gas Pipeline System Impact Mitigation

Impact	Mitigation Measures	Project Phase	Responsibility: Implementation	Responsibility: Supervision	Means of Supervision	Estimated Cost
1. During Construction						
Reduction Traffic Flow	- Construction during off peak periods	Preconstruction and Construction	Traffic department to grant conditional license and Contractor to implement	Town Gas HSE + Traffic Department	Ensure contractor has valid conditional permit+ Filed supervision	- Contractor management costs that shall be included in normal bid price. - Town Gas management costs
	- Signage and marking	Tender and Construction	Contractor	Town Gas HSE + Traffic Department	Ensure inclusion in tender+ Filed supervision	- Contractor management costs that shall be included in normal bid price. - Town Gas management costs
	- Traffic detour	Preconstruction and Construction	Traffic Department	Traffic Department	Ensure detouring efficiency	- Cost by Traffic Department
	- Road restricting	Construction	Traffic Department	Traffic Department	Ensure adequate traffic flow	- Cost by Traffic Department
Air Emission	- Sound storage, transportation and disposal of stockpiles	Construction	Contractor	Town Gas HSE supervisor	Field supervision	- Contractor management costs that shall be included in normal bid price. - Town Gas management costs
	- Ensure that air emissions of construction machinery within legal standards	Tender and preconstruction	Contractor	Town Gas HSE	Review vehicle exhaust certificate	- Contractor management costs that shall be included in normal bid price. - Town Gas management costs
Noise	- Protect construction workers on site	Tender and Construction	Contractor	Town Gas HSE	Ensure inclusion in tender+ Field supervision	- Contractor management costs that shall be included in normal bid price. - Town Gas management costs
	- Avoid night noisy works whenever possible	Construction	Contractor	Town Gas HSE	Field supervision	- Contractor management costs that shall be included in normal bid price. - Town Gas management costs
Risk of Damaging Infrastructure	- Collect infrastructure maps and site tracing	Construction	Town Gas HSE Department and Governorate Information Center	Town Gas HSE Manger	Review HSE site report	- Town Gas management costs
	- Use trial pits	Tender and Construction	Contractor	Town Gas HSE Supervisor	Ensure inclusion in tender+ Field supervision	- Contractor management costs that shall be included in normal bid price.
	- Prepare and Analyze accident reports	Construction	Town Gas HSE Research	Town Gas HSE Manger	Review periodic HSE reports	- Town Gas management costs

Table 8-7 (A) "Contd."

Gas Pipeline System Impact Mitigation

Impact	Mitigation Measures	Project Phase	Responsibility		Means of Supervision	Estimated Cost
			Implementation	Supervision		
Effect on Structures by Dewatering Activities	- Screening of areas / Sectors	Design	Town Gas Technical Committee	Town Gas Design Manager + HSE Manager	Review committee's reports	- Town gas management costs
	- Tight dewatering schedule	Construction	Contractor	Town Gas HSE Supervision	Field supervision	- Contractor responsibility: Included in normal contractor bid. - Town gas management costs
Effects on Monuments	- Locate problematic areas of the network	Design	Supreme Council for Antiquities through permitting procedure of Local Council	Town Gas HSE Manager	Review permitting procedures and ensure review of Council	- Cost by supreme council for antiquities
	- Supervise construction	Construction	Expert from Supreme Council of Antiquities	Town Gas HSE Manager + HSE supervision	Review field reports+ site supervision	- L.E. 3,000 / site for supervision and measurement of vibration. - Town gas management costs
	- Control dewatering process	Construction	Contractor	Supreme Council Expert + Town Gas HSE supervision	Field supervision	- L.E. 15,000 / site above normal contractor bid price. - Town gas management costs
	- Reduce vibrations	Tender + Construction	Contractor	Supreme Council Expert + HSE supervision	Ensure inclusion in tender + Field supervision	- L.E. 10,000 / site above normal contractor bid price. - Town gas management costs
	- Preserve architecturally valuable sites	Construction	Contractor	Town Gas HSE supervisor	Field supervision	- Normal contractor bid price - Town gas management costs
	- Preserve any found antiquity	Construction	Town Gas HSE supervisor	Town Gas HSE manager	Review field reports	- Normal contractor bid price - Town gas management costs

Table 8-7 (A) "Contd."

Gas Pipeline System Impact Mitigation

Impact	Mitigation Measures	Project Phase	Responsibility		Means of Supervision	Estimated Cost
			Implementation	Supervision		
Waste Disposal	- Control over construction waste	Construction	Contractor	Town Gas HSE supervisor	Field supervision	- Contractor responsibility: Included in normal contractor bid
	- Prevent fueling, lubricating and any activity that would entail production of hazardous materials empty contains	Construction	Contractor	Town Gas HSE supervisor	Field supervision	- Contractor responsibility: Included in normal contractor bid
	- Transfer empty hazardous waste containers, if generated under unusual circumstances, to Governorate's landfill	Construction	Construction	Town Gas HSE supervisor	Field supervision and review manifest documents	- About L.E. 1,300 / yr above normal contractors bid[1]
	- Adequate management of asbestos and any possible hazardous waste	Construction	Water Authority	Town Gas HSE supervisor + HSE Manager	Field supervision + review of Water authority manifests	- Costs by Water Authority - Town gas management costs
	- Arrange effective drainage during dewatering	Construction	Construction	Town Gas HSE supervisor	Field supervision	- Contractor responsibility: Included in normal contractor bid
	- Transfer any contaminated water resulting from dewatering to an adequate facility such as Governorate's Landfill	Construction	Construction	Town Gas HSE supervisor	Field supervision	- About L.E. 1,000/yr above normal contractors bid[2]

Notes:

(1) This figure has been derived assuming 2 loads of contains are generated each load is 0.5 ton which costs L.E. 650 including shipment and landfill fee. (landfill fee is L.E. 300/ton and rent of peak-up vehicle is about L.E. 500/trip)

(2) This figure has been derived assuming 1 load of contaminated water barrels is transferred each year weighing 1 ton at a cost of L.E. 1,000 including transportation and landfill fee in addition to supervision and administrative costs.

Table 8-7 (A) "Contd."

Gas Pipeline System Impact Mitigation

Impact	Mitigation Measures	Project Phase	Responsibility		Means of Supervision	Estimated Cost
			Implementation	Supervision		
2. During Operation						
Improper management of odorant during operation	- Evacuating of odorant in holding tank and send empty contains to Governorate's hazardous waste facility on the same day	Operation	Pressure Reducing Station (PRS) staff	Town Gas HSE staff	Quarterly auditing for each PRS	- L.E. 16,300/yr for transportation and disposal of waste
Noise of PRS operation	- Locate noisy pressure reducers away from PRS borders in residential areas	Design	Town Gas Design Department	Town Gas HSE Manager	Review of PRS layout	- Town Gas management costs
	- Build barrier walls between reducers and sensitive receptors when needed.	Design and construction	Contractor	Town Gas HSE Manager	Field supervision of PRS construction	- Contractor costs which shall be included in normal bid price
Potential safety risks due to PRS Operation	- Remote actuation of isolation and slam-shut valves by Town Gas for different PRS's as well as the transmission pipelines.	Design	Designer	Project Department	Document Review	- Design Phase
	- Produce hazardous area classification drawings for all pressure reduction station	Design	Designer	Eng. / Elect. Department	Document Review	- Design Phase
	- Preventive maintenance policy and station manual	Design	Town Gas	Engineering Department		- Preventive maintenance program and operating manual
	- Proper design of control room exit	Design	Designer	Projects Department	Document Review	

Table 8-7 (A) "Contd."

Gas Pipeline System Impact Mitigation

Impact	Mitigation Measures	Project Phase	Responsibility		Means of Supervision	Estimated Cost
			Implementation	Supervision		
	- Provision of self contained breathing apparatus (2 pieces for each station) for handling odorant leaks	Operation	Town Gas	HSE Department	By Operators	- $ 4000 each
	- Apply jet fire rated passive fire protection system to all critical safety shutdown valves ESDVs or solenoid valves (as applicable)	Design	Designer	Projects Department	Document Review	
	- Place marking signs indicating in Arabic and in English "Do Not Dig" and "High Pressure Pipeline Underneath"	Operation	Town Gas & GASCO	Engineering Department	Document Review	
	- Install an elevated wind sock and provision of portable gas detectors	Operation	Town Gas	HSE Department		- $ 3000 each
	- The design should fully comply with IGE TD/3 code requirements	Designer	Designer	Projects Department		- Town Gas management costs
Social Impacts	- Raising the level of awareness of the people in PRS areas.	Construction	NGOs in the districts	EGAS	Supervise awareness undertaken by NGO	- About L.E. 5,000/PRS area

Table 8-7 (B)

Gas Pipeline System Monitoring Matrix

Impact	Monitoring Indicators	Responsibility	Duration	Location	Methods	Estimated Cost
1. During Construction						
Reduction Traffic Flow	- Comments and notifications from traffic department	Town Gas HSE department	During construction reporting in monthly reports	Construction site	Documentation in HSE monthly reports	- Town Gas management costs
Air Emission	- HC, CO% and opacity	Contractor	Once before construction + once quarterly for each vehicle	Vehicles licensing department	Measuring exhaust emissions in an authorized institution	- L>e> 200/ Vehicles
Noise	- Noise intensity, exposure durations and noise impacts	Town Gas HSE department	Once quarterly during construction, with at least one measurement per contractor per sector	Construction site	Noise meter	- Town Gas management costs
	- Complaints from residents	Town Gas HSE supervisor	During construction reporting in monthly reports	Construction site	Documentation in HSE monthly reports	- Town Gas management costs
Risk of Damaging Infrastructure	- Accidents Documentation	Town Gas HSE department	During construction reporting in monthly reports	Construction site	Documentation in HSE monthly reports	- Town Gas management costs
Effect on Structures by Dewatering Activities	- Duration of dewatering and lowered water level	Town Gas HSE department	During dewatering activities. Reported in monthly reports	Construction site	Documentation in HSE monthly reports	- Town Gas management costs
Effects on Monuments	- Vibration	Supreme council for antiquities	During construction near sites identified by the council	Construction site	Vibration test	- Including in supreme council expert's input
	- Buried antiquities	Supreme council for antiquities	Once before construction if required by the council	Streets identified by the council	Geophysical survey	- L.E. 3000/km of street
	- Documentation	Town Gas HSE supervisor	During construction. Reporting in monthly reports	Construction site	Documentation in HSE monthly reports	- Town Gas management costs
Waste Management	- Accumulated waste	Town Gas HSE supervisor	During construction. Reporting in monthly reports	Construction site	Observation and documentation	- Town Gas management costs
	- Existence of hazardous waste in waste piles or at site	Town Gas HSE supervisor	During construction. Reporting in monthly reports	Construction site	Observation and documentation	- Town Gas management costs
	- Existence of water ponds from dewatering	Town Gas HSE supervisor	During construction. Reporting in monthly reports	Construction site	Observation and documentation	- Town Gas management costs

Table 8-7 (B) "Contd."

Gas Pipeline System Monitoring Matrix

Impact	Monitoring Indicators	Responsibility	Duration	Location	Methods	Estimated Cost
2. During Operation						
Improper management of odorant during operation	- Number of treated containers	Town Gas HSE department	Quarterly for each PRS	PRSs	Reviewing environmental Register, compare with odorant delivery forms, observation of site	- Town Gas management costs
Noise of PRS operation	- Noise intensity	Town Gas HSE department	Quarterly for each PRS	PRSs	Noise meter	- Town Gas management costs

Table 8-8

Summary of Implementation Cost of the ESMP

No.	Phase of Implementation	Cost in US$		Source of Funding
		Measures	**Monitoring**	
1	Construction Phase	120 K		UEEPC
	• Pre-commissioning Monitoring (ambient air quality monitoring equipment)		1325 K	UEEPC (with possible support from the Arab Funds)
	• All others		138 K	UEEPC
	• Training	155 K		UEEPC
2	Operation Phase	70	20	UEEPC
	• Training	20 K		UEEPC
	Sub. Total	**190 K**	**1658 K**	
	Grand Total	**1848 K**		

Table 8-7 shows that the total implementation cost of the environmental and Social Management Plan is about US$ 1.5 million, which amounts to about 0.18% of the total project cost.

8.4 BASELINE MONITORING OF THE PRE-CONSTRUCTION ENVIRONMENT

8.4.1 Baseline Air Quality Survey Using Air Quality Monitoring System

Objectives

Monitoring of air quality parameters such as NO_2 and SO_2 offers an appropriate method of obtaining hourly, daily, monthly and annual mean pollutant concentrations over a wide spatial area. A continuous monitoring program continued over an extended period, enables measured 1 hr, 24 hr and annual mean pollutant concentrations to be compared with relevant Egyptian, AfDB and World Bank guidelines. It provides a baseline against which to evaluate short-term impacts measured using continuous NO_2 , SO_2, CO and TSP analyzers.

The main objective of the proposed air quality monitoring program is to determine the effect of effluent emissions from the Helwan South Station. Prior to the commencement of a monitoring program, the number and location of monitors that are required to provide adequate aerial coverage need to be determined. Consideration should be given to the effects of existing sources, nearby terrain, meteorological conditions, and the pollutant to be monitored as well as their associated averaging times.

Natural gas will be used as the primary fuel, and no. 6 fuel oil will be used for emergency purpose only with a total firing period not to exceed 7 days per year. For the siting study of permanent monitoring stations, only the normal gas-fired scenario was analyzed.

Methodology

Based on the U.S. Environmental Protection Agency guidance (EPA, 1987), air dispersion modeling should first be performed to determine the general locations(s) of maximum air pollutant concentrations from the proposed source.

To determine the magnitude and locations of maximum background air quality impacts, the EPA-approved Industrial Source Complex (ISC-Prime) was used for the study. The ISC-Prime mode was also used for a stack height determination analysis conducted for the Helwan South Project (see Section 6.2).

In addition, as indicated in Section 5.4, there were five existing background air quality monitors located within the Helwan South plant site. These five onsite monitors have collected sufficient ambient records to form a good base of representative background data (National Research Center, October 2010).

In general, air quality monitors should be placed at (a) the expected area of the maximum concentration from the new source, and (b) the maximum combined impact area(s).

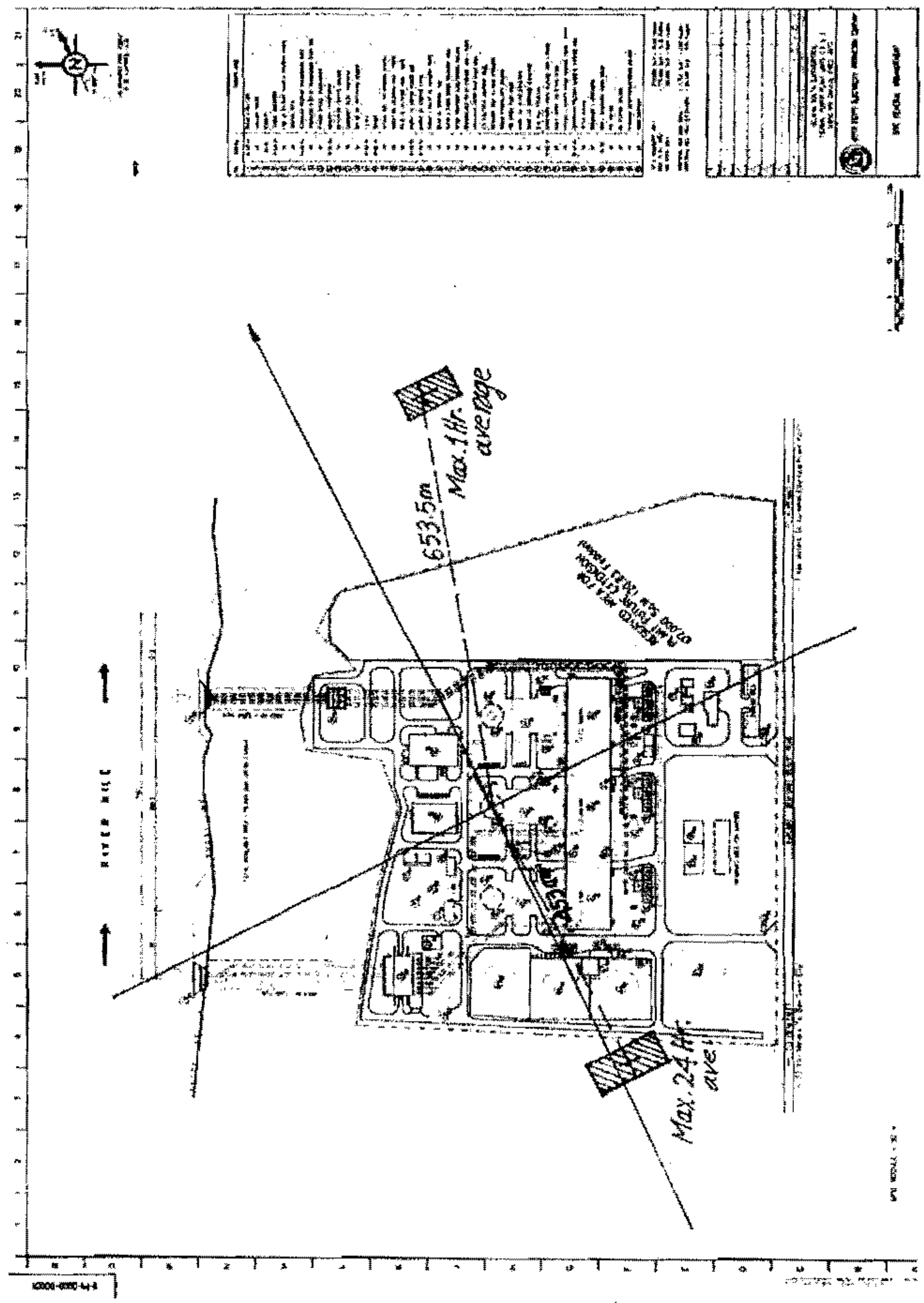
Generally, two to three sites would be sufficient for most situations in multi-source areas. In areas where there are no significant existing sources, one or two sites would be sufficient.

For convenience, the maximum impact locations derived in Section 6.2 are presented by the polar coordinate and the conventional x-y coordinate. Both coordinates use the same origin as shown in *Figure 8-3.*

1-hour, 24-hour and annual maximum impact areas were considered in the design of the monitoring network.

Figure 8-3

Helwan South Air Quality Monitoring Locations



As indicated in *Table 6-7*, the maximum total combined 24-hour impact level (138.79 $\mu g/m^3$, including the background level) is under the Egyptian 24-hour limit of 150 $\mu g/m^3$. The maximum 24-hour impact level of the Helwan South power project is 126.7 $\mu g/m^3$ (excluding the background level).

The maximum combined 1-hour impact level, including the highest value during 2008, is 397.52 $\mu g/m^3$. The Helwan South plant contributed 367.3$\mu g/m^3$ at this location.

Based on the results presented in *Table 6-7*, the maximum annual impact area consistently occurred between 180° and 200° to the south - south - west from plant north at a distance of 630.1m from the origin point intermediating all the Helwan South power stack group locations. The majority of the 24-hour maximum impact areas due to the operation of the three Helwan South thermal supercritical units occurred between 175° and 180° at a distance 623 m. The maximum 1-hour impact levels are very similar among the three years (2007, 2008 & 2009) considered. The majority of the maximum impact areas occurred between 310° and 320° at plant north – west and at a distance of about 608.9m. A comparison of the estimated maximum concentrations with the relevant standards is given in *Table 6-7*.

Figure 8-3 depicts the locations of the Maximum of daily average of NO_2 concentrations and the Maximum of annual average of NO_2 concentrations. The suggested monitoring locations are presented in *Figure 8-3*. Areas, instead of the precise points, are suggested because in some cases, it is simply not practical to place monitors at the indicated modeled locations. However, it is recommended that an air quality monitoring system composed of 2 or 3 monitoring stations will be utilized. The monitoring station equipped with meteorological monitoring system will be located near to, or within, the Helwan South power plant site, the other one or two stations will be located one down wind within the designated area and the other (if any) upwind.

Reporting

Reports will be prepared by UEEPC/HPP on a quarterly basis, and be prepared as continuous monitoring concentration summaries.

8.4.2 Aquatic Environment

At the request of the UEEPC/EEHC/ECG a field survey was undertaken by Hydraulics Research Institute representatives and by National Research Center staff of the Helwan South bankline segment area fronting the power station site. The results of this survey shall be retained as a baseline comparison for Nile monitoring during power plant operation.

In addition, site management practices and site drainage systems will be continuously monitored by the site Assistant Plant Manager to ensure that no pollutants reach the aquatic resources.

8.4.3 Archaeology and Cultural Heritage

Throughout construction, activities will be closely supervised by personnel trained to recognize potential archaeological finds. Should a potential find be uncovered, the mitigation measures described in Section 7.2.8 will be employed.

8.5 MONITORING OF IMPACTS DURING POWER PLANT OPERATION

8.5.1 Stack Emissions

Stack emissions will be monitored continuously during plant operation at a representative point in the stack. Operational monitoring of stack emissions shall comprise monitoring the levels of:

- Oxides of Nitrogen;
- Sulfur Dioxide;
- Carbon Monoxide; and
- Total Suspended Particles and PM_{10}.

The automatic monitoring system used will be linked to an alarm to warn when emission limits (as stated in Section 2) for each pollutant are being approached.

Concentrations will be recorded as hourly rolling averages and reports on stack emissions monitoring will compare recorded emissions against predicted levels and Egyptian, AfDB and WB guidelines (as given in Section 2). Reports will be submitted to the EEAA, the WB and any other concerned authority on an annual basis (or as required).

8.5.2 Ambient Air Quality - Validation of Modeling Predictions Using Continuous NOx, SO_2 and TSP Analyzer

Objectives

The use of a continuous NOx, SO_2, CO and TSP analyzer allows for baseline air quality monitoring on a continuous basis. The provision of two continuous monitors (or three: one at the site, one upwind and the third downwind) will provide the basis for "validating" the predictions made in the ESIA. The monitors will also include a weather station providing data on air temperature, wind speed, wind direction and mixing heights on a continuous basis. These monitors shall, also, be connected electronically to the EEAA ambient monitoring system.

Methodology

The monitors will be purchased and installed as far in advance of plant start-up as possible so that baseline data can be collected for the two (or three) sites, using equipment capable of measuring short-term averages.

Training will be provided to the nominated operatives in relation to use, maintenance and troubleshooting for the equipment. The equipment will be monitored on a daily basis by UEEPC/HPP to ensure that it is working correctly. Daily maintenance monitoring can be undertaken remotely by downloading the recorded results from the analyzers at upwind and downwind locations to the shelter at the project site (i.e. the analyzers do not need to be physically checked daily). The results will be checked by UEEPC/HPP to ensure they are realistic and also to check against anomalies. Daily down-loading of data will also ensure that continuous records are maintained in the event of equipment failure or power shortage.

The Helwan South construction and operational monitoring of air quality around the power project will include the parameters summarized in *Table 8-9*.

Reporting

The equipment measures air quality on a continuous basis and is capable of calculating and reporting on short-term averages. Twenty-four hour and 1-hour averages would be appropriate measurements to record.

Annual reports will be provided to the EEAA and to the WB, AfDB or any other concerned authority (via UEEPC/HPP) (or more frequently if required), highlighting key features and comparing the results with air quality standards (as presented in Section 2), with the predictions in the ESIA report, with respect to gas supply failure and subsequent emergency use of heavy fuel oil (mazout), baseline air quality and worst case air quality predictions, once the plant is operational.

8.5.3 Aquatic Environment

Monitoring of impacts of the power plant on the aquatic environment will include monitoring of the quality of the discharge water, Nile bankline and benthic sediments, ambient water quality and the impact on aquatic flora and fauna. The survey techniques and areas will be comparable to the survey undertaken by both of the Hydraulics Research Institute and the National Research Center during October-December 2010. The survey will include the area affected by the thermal plume (i.e. 100m from the discharge point).

The operational monitoring of cooling water and effluent discharge will include the parameters summarized in *Table 8-10* below.

Monitoring data will be analyzed and reviewed at regular intervals and compared with Egyptian, AfDB and World Bank guidelines (as given in Section 2). Records of monitoring results will be kept in a suitable format and will be reported (in summary format with any exceptions identified) to the responsible government authorities and the WB, AfDB or any other concerned authority as required. As a result, the project company, in discussion with the EEAA, EEHC and the WB, AfDB or any other concerned authority, will review the need to implement any additional mitigation features, such as provision of further water treatment facilities on site and also on the need to continue monitoring.

8.5.4 Waste Monitoring

Wastes generated on site and collected for disposal by skilled firms will be referenced, weighed and recorded. Environmental audits will be undertaken which will assess the quality and suitability of on- and off-site waste management procedures.

Table 8-9

Monitoring Program for Ambient Air Quality, Noise and Vibrations

Item	Monitoring Parameters	Sampling Frequency	Monitoring Locations	Indicative Cost Estimate (US$)
Construction Phase				
Air Quality Dust emissions caused by construction activities, construction vehicle movements, and transport of friable construction materials.	NO_2 , SO_2 , CO, TSP and PM_{10}.	Quarterly during most of the construction period. Continuous monitoring during 6 months ahead of commissioning.	On site of the project and its surroundings. 2 locations minimum: at maximum predicted pollution concentration and downwind. Third location, if any, will be 1 km upwind.	Measurement cost, US$70K Approx. US$ 1000-1500K
Noise	Decibels (dB) A	Monthly	6 locations minimum: at nearest residences	Management time and costs (US$ 10k)

Table 8-9 (Contd.)

Monitoring Program for Ambient Air Quality, Noise and Vibrations

Item	Monitoring Parameters	Sampling Frequency	Monitoring Locations	Indicative Cost Estimate (US$)
Operation Phase				
Air Quality Emissions from stack are not expected to exceed standards.	**Automatic monitoring** of stack emissions for NOx, SO_2, particulate matter and carbon monoxide (CO) via test ports installed in the main stack. In addition, conduct surrogate **performance monitoring.**	Continuous and/or 24 hour average Continuous and/or passive samples every 2/4 weeks	2 locations minimum; at maximum predicted pollution concentration and downwind. Third location, if any, will be 1 km upwind.	Included in the plant operation
Ambient air quality affected by emissions from the power plant.	**Install (at least) two continuous** NOx, SO_2, CO, PM_{10} & TSP **monitoring stations** to monitor short-term concentrations in the area predicted to have the highest impacts on humans (as there are sensitive environments). The analyzer station near or within the site boundaries will include a **continuous monitor** of meteorological conditions (temperature, wind speed, wind direction and mixing heights).	The analyzer stations will be electronically connected to the plant controlling room and may be connected to the EEAA monitoring system.		
Noise		Bi-annually to annually	6-10 sites at nearest receptors and fence around the plant	Noise audit US$ 10-20K (included in operation cost) Third party (e.g. NRC) Measuring instruments and equipment.

Table 8-10

Monitoring of the Aquatic Environment During Operation

Issue	Parameter	Method	Frequency of measurements
Water Quality	Temperature & pH of all discharged water	Continuous automatic monitor in discharge structure	Continuous
	COD, BOD, TSS, Oil & Grease, residual chlorine of effluent	Sample taken from water in discharge structure and submitted for lab. Analysis	Daily
	Heavy metals & other pollutants of effluent	As above	Monthly
Ambient Water Quality	Temperature, pH, COD, BOD, TOC, DO, TSS, oil & grease, residual chlorine, heavy metals & other pollutants	Grab sampling and analysis within the area predicted to be affected by the discharge plume	3-monthly
Flora & Fauna (1)	Benthic flora & fauna	Transect sampling (following same method as in baseline monitoring) within a 2 km radius of the discharge point	Annual
Entrainment (2)	Fish entrainment on screens	Removal and analysis of any debris caught in intake screens	Weekly

Notes:

(1) To be undertaken for the first 3 years of plant operation.
(2) To be undertaken for the first year of plant operation.

Abbreviations:

COD: Chemical Oxygen Demand
BOD: Biological Oxygen Demand
TOC: Total Organic Carbon
DO: Dissolved Oxygen
TSS: Total Suspended Solids

9. CONSULTATION AND DISCLOSURE

9.1 INTRODUCTION AND GENERAL APPROACH

In order to ensure that the views and interests of all project stakeholders are taken into accounts, public consultation has been carried out according to the World Bank and African Development Bank guidelines and EEAA requirements which require coordination with other government agencies involved in the ESIA, obtaining views of local people and affected groups. This consultation has been undertaken as part of the Environmental Impact

Assessment process. The process of this consultation is also implemented in accordance with World Bank and African Development Bank requirements for Phase I and Phase II consultations.

This section summarizes the activities which have been undertaken in Phase I, the results of consultation and a summary of the activities which have been undertaken as a complementary procedure (Phase II). It, also, summarizes the activities which may be undertaken, under this condition, during the construction and operation of the power plant.

9.1.1 Public Consultation Regulations and Requirements

In accordance with World Bank requirements, namely the Bank's Operational Policy (OP) 4.01 Environmental Assessment and other key documents, and the African Development Bank regulations namely Environmental and Social Assessment Procedures for African Development Bank's Public Sector Operation, June 2001, affected groups and NGOs must be consulted as part of the environmental assessment of projects. The primary purpose of this provision is to protect the interests of affected communities. Therefore, the ESIA and RPF process should include consultation and disclosure of information to key stakeholders involved in and/or affected by the Helwan South power plant project.

The objectives of consultation and disclosure are to ensure that all stakeholders and interested parties, are fully informed of the proposed project, have the opportunity to voice their concerns and that any issues resulting from this process are addressed in the ESIA and incorporated into the design and implementation of the project.

Egyptian Law number 4 of 1994, which addresses the environment, does not stipulate or refer directly to public consultation within the ESIA process. However, its importance may be inferred from the inclusion of representatives of environmental non-governmental organizations on the Board of Directors of the EEAA. Furthermore, the EEAA "Guidelines for the Basis and Procedures of Environmental Impact Assessment (EIA) – Sector Guidelines" (Jan. 2009) suggest discussions with local stakeholders and interested parties during scoping and preparation of the ESIA.

9.2 CONSULTATION METHODOLOGY

The adopted methodology for the public consultation comprises two phases, including four elements, namely:

Phase I

- discussions with local stakeholders and interested parties during preparation of the environmental documents for local permitting requirements;
- discussions with local stakeholders during scoping and preparation of this ESIA-Report, including the organization of a Public Scoping Meeting in the Helwan Governorate;

As far as public disclosure is concerned, major activities to inform the public and interested parties about the Helwan South project include the following:

- press advertisement describing the project and inviting interested parties to attend the scoping meeting.
- distribution of an invitation and a copy of summary leaflet about the main concerns of ESIA study (in Arabic).

Phase II

- the organization of a Public Consultation Meeting in the Helwan Governorate, and
- on-going consultation through an "open-door" policy during construction and operation of the power plant.

Again, as far as public disclosure is concerned, major initiatives to inform the public and interested parties about the Helwan South Power project include the following:

- press advertisement describing the project and inviting interested parties to attend the public meeting and review the Draft Final ESIA Report;
- distribution of an invitation and copy of the Non Technical Summary (in Arabic) describing the context of the power plant, the technology employed, the impact on the environment, the mitigation measures and the ESMP; and
- disclosure of the Draft Final ESIA Report, including the Executive Summary, locally and via the World Bank and the African Development Bank Infoshops.

A Public Consultation and Disclosure Activities (PCDA) are designed and implemented in accordance with World Bank and the African Development Bank guidelines. The purpose of the Activities is to establish the process by which UEEPC/HPP will consult and involve stakeholders in the planning, development, construction and operation of the power plant.

9.2.1 Stakeholders

During the ESIA process, stakeholders for the project have been identified and include the following:

- Local Council and District Authorities;
- Government Regulatory Agencies;
- Local business and commercial interests;
- Local people including population representatives;
- Environmental research organizations; and
- NGOs and other environmental interests.

A full list of primary stakeholders is presented in *Table 9-1* (a full list of primary and secondary stakeholders is presented in Annex A).

Table 9-1

Primary Stakeholder Organizations

Organization
• Helwan Governorate
• Markaz Atfieh and El-Kureimat Zones
• Egyptian Electricity Holding Company (EEHC)
• Egyptian Electricity Transmission Company (EETC)
• Local Electricity Authority (Upper Egypt Electricity Production Company "UEEPC")
• Egyptian Environmental Affairs Agency (EEAA)
• Ministry of Water Resources and Irrigation (MoWRI)
• Helwan population representatives (Helwan, Atfieh, Es-Saff, El-Kureimat and Dayr El-Maymoun)
• Ministry of Transport
• Helwan Transport Department
• Egyptian General Petroleum Corporation (EGPC)
• Egyptian Natural Gas Holding Company (EGAS)
• Helwan "City Gas" Company
• Supreme Council of Antiquities
• Egyptian General Authority for Shore Protection
• National Research Center, State Ministry of Scientific Research and Technology
• General Authority for Fishery Development, Ministry of Agriculture
• Egyptian General Authority for Meteorology
• National Authority for Remote Sensing and Space Sciences (NARSS)
• Active NGOs in the project wider area.

9.2.2 Management and Participation

Public consultation and disclosure is managed and undertaken by Environmental Consultant ECG and UEEPC with participation from EEHC. Phase II of the consultation and disclosure process, which includes local disclosure of the Draft Final ESIA-Report and a public meeting, is undertaken in close collaboration with the local authorities, namely the Helwan Governorate. Concerned stakeholders including local industry, economic representatives and local people, have been, and will continue to be, requested to actively participate in this process.

It was not anticipated that any further notification will be required, for example, the posting of notices locally, since local communities or settlements near the power station site were notified by the UEEPC/HPP. Further, it was very evident from the scoping session that the attendance of the representative of the Helwan Governor, Mr. Kadry Abu-Hussein, the UEEPC's Chairman, Eng. Abdel-Mohsen Abdel-Ghaffar Abdel-Hady and the President of Promble Local People Council, Dr. Eweis Sayyed Ali at the public meeting will ensure media coverage.

9.3 PHASE 1 CONSULTATION

9.3.1 Consultation Undertaken by ECG, EEHC and UEEPC

During the preparation of an ESIA-Report for local permitting requirements, ECG, EEHC and UEEPC undertook consultations with a variety of organizations to assist them in the identification of environmental and social concerns and the overall development of the project. These stakeholders included the Egyptian Electricity Holding Company (EEHC), Upper Egypt Electricity Production Company (UEEPC), Egyptian Environmental Affairs Agency (EEAA), the Helwan Governorate and the Markaz Council of Atfieh, including Kureimat zone, Egyptian General Authority for Shore Protection, Hydraulics Research Institute and local population leaders.

The purpose of these consultations was primarily to provide information regarding the project, identify published and non-published sources of relevant data and information relating to the site and surrounding area, obtain views on the scope of the project, and open channels for ongoing discussions.

The key environmental and social issues raised during this consultation process are summarized in *Table 9-2* and these issues were subsequently taken into account in the preparation of ESIA documentation both for local permitting requirements and this ESIA report.

Table 9-2

Key Environmental Issues Associated with the Development of the Proposed Power Plant Identified During Local ESIA and RPF Consultation

Subject	Description of the Key Issues
Air Quality	• Level of stack emissions from the power plant and the resulting compliance with air quality standards during normal operation and emergency periods, i.e if the gas supply is interrupted. • Potential for cumulative air quality impacts due to the simultaneous operation of the proposed New Helwan South power plant and Kureimat Power Complex.
Aquatic Ecology	• Vulnerability of aqua-culture from liquid effluents and the cooling water.
Nile River bankline & Riverbed Morphology	• Vulnerability of bankline and riverbed due to erosion and sedimentation processes resulting from intake and discharge system.
Noise	• Levels of noise which will be experienced at local receptors.
Hazardous Waste	• Vulnerability of human health from materials containing hazardous matters, if found, during construction and operation.
Traffic	• Traffic generation, especially during construction, and the potential for congestion on local roads, particularly Kureimat / Beni-Suweif arterial road.
Socio-economic	• Employment. • Demand for Local Services.

Land Acquisition/ Compensation	• Level of compensation in case of land acquisition (if any).

9.3.2 Consultation during the ESIA Process

A scoping session for this ESIA undertaken by ECG in collaboration with the EEHC and UEEPC, took place on Wednesday, 24 November 2010 during which a wide selection of personnel from different orientations contributed actively to its activities.

The key objectives of this consultation were to identify primary and secondary stakeholders, ensure that they had received sufficient information about the project during earlier consultation activities and to identify their immediate concerns.

The session was organized to include the following activities:

- Presentation of the ESIA scope as per the TOR, including the RPF;
- Breakdown of the activities to highlight the issues that the attendees might comment on;
- Explain the environmental issues and invite the participants to raise their concerns about possible negative impacts; and
- Conduct the discussions and invite the owner, local authorities and agencies to participate in the discussions.

The full documentation for the scoping meeting is presented in Annex B.

The issues raised during the scoping session are summarized in *Table 9-3* below.

9.3.3 Mini-meetings with Affected Stakeholders

In addition to the scoping meeting, several mini-meetings were held with some particular affected stakeholders for taking their viewpoints into consideration.

The purpose of taking these viewpoints into account was to improve project viability. The World Bank (1991) has found that where such views are seriously considered and incorporated in the EA process, projects are likely to be more successful. The Bank provides some useful guidance regarding the extent and level of stakeholder involvement in the EA process in its Sourcebooks (World Bank, 1991-Chapter 7).

Mini-meetings were held with fishermen on the Es-Saff area, the Helwan South representatives, Atfieh village Administration, Kureimat Power Plant and Helwan South project staff, General Authority for Fishery Development and two active NGOs in wider Helwan zone, namely Al-Safaa Charity Association, Environment Development and Local Community Development (North of Helwan).

These mini-meetings were seen important for:

- informing interested groups and individuals about the proposed development, its potential impacts, and measures which will lessen impacts and protect the environment;

Table 9-3

Key Issues Raised During ESIA and RPF Scoping

Key issue discussed	*Comments*
Overall Project	All parties consulted expressed their overall approval for the project. Local Stakeholders commented that the power plant will be central to securing power supply for the industrial and commercial activities in the area and will benefit the local economy through labor opportunities.
Social and Economic Impact	Local stakeholders and council leaders considered the social and economic impact of the plant to be wholly positive.
Land Acquisition/ Compensation	There was a clear and common appreciation when fair compensation rules were explained.
Waste water discharge and the aquatic environment	All local stakeholders expressed concern about the quality and quantity of water in the Nile River Helwan South segment and the quality of water which will be discharged from the power plant. It was however acknowledged that there are no significant aquatic ecosystems close to the power plant. The suggestion was made that treated sanitary wastewater could be used for irrigation of landscaped areas and treated industrial wastewater would be directed to the circulating water discharge system.
Air Quality	There was big concern over the following issues: • compliance with air quality standards and the effect that non-compliance and subsequent plant closure could have on security of employment in the area; • accumulated effects of the relatively degraded air quality in the Kureimat and South Helwan atmosphere and the impact of the power project; • back-up heavy fuel oil is prohibited in residential areas, but Helwan South, as identified in several physical planning schemes for Helwan Region, belongs to an industrial setting.

Ecology of the Site	There was significant attention to keeping a landscape area inside the power plant fence.
Bankline & Riverbed Morphology	Some parties expressed their fears of causing damaging effects due to sedimentation and erosion processes associated with cooling water abstraction and discharge.
Environmental Compliance	An underlying concern expressed by all local stakeholders was compliance with environmental regulations. Assurances from UEEPC are sought to the effect that UEEPC will guarantee implementation of the environmental compliance measures which will be stated in the Environmental and Social Management Plan.

- providing opportunities for timely feedback;
- identifying problems, needs and values;
- minimizing misunderstandings about the scope and impacts of the project and increase public confidence in the proposed development; and
- contributing to an increased awareness and understanding of project plans and activities.

Memorandums of Mini-meetings that were held with some affected groups are given in Annex C.

9.3.4 Conclusions from Phase 1 Consultations

The main results of Phase I consultation was to successfully raise the level of local awareness about the plant, to identify the immediate local concerns and to seek stakeholder involvement in the implementation of the project.

The three issues of key concern to the stakeholders consulted were the impact of the plant on pollutant loads in the South Helwan Zone air shed, compliance with environmental standards, particularly with regard to air and wastewater discharge quality and the potential economic impacts on the local community. These concerns have been addressed within the ESIA process and measures to ensure compliance are incorporated into the Environmental and Social Management Plan (ESMP). The ESMP will be implemented by UEEPC/HPP as a condition of compliance with the EEAA regulations and of financing from the World Bank and the African Development Bank.

9.4 PHASE II CONSULTATION AND DISCLOSURE

Phase II of the public consultation and disclosure process included the disclosure of information about the project (advertisement, invitation including a copy of the Non-Technical Summary (in Arabic) and public access to the Draft Final ESIA Report) and organization of a public meeting.

The Draft Final ESIA report, together with the Non-Technical Summary in Arabic, has been disclosed locally for 30 days at the offices of the UEEPC at the Kureimat power plant, EEHC offices and at the offices of the local environmental consultant in Cairo.

In order to make people aware of the disclosure of the Draft Final ESIA Report, an advertisement was placed in the national newspaper Al Ahram in Arabic on Monday, 7 March 2011. The advertisement also drew readers attention to the date and venue of the proposed public meeting.

Finally, a public meeting was held in the Helwan Governorate on Wednesday, 16 March 2011. The aim of the meeting was to present and explain the results of the Draft Final ESIA Report to local stakeholders, to provide them with the opportunity to raise any further or additional concerns and to ensure that all issues are taken into account in the Final ESIA Report and corresponding ESMP. Further concerns raised during Public Consultation Meeting are summarized in *Table 9-4* below.

Phase II Consultation and Disclosure activities and the Public Consultation Meeting Report are reported in Annex D.

9.5 ONGOING FACILITY FOR PUBLIC CONSULTATION AND DISCLOSURE

The World Bank and the African Development Bank also require that the consultation process is ongoing during the construction and operation phases of the project. To this effect, UEEPC/HPP has stated its commitment to maintaining long term and mutually beneficial open dialogue with local authorities, industrial and commercial interests and local people, through its Safety and Environment Officer during construction and Assistant Plant Manager during operation. A key role of this post consultation will be to ensure that local stakeholders have an opportunity to raise questions, comments or concerns and that all issues raised are answered promptly and accurately.

The site of the power plant is relatively remote from areas of dense population, being situated in the area of the South Kureimat, an area designated for industrial development use. The nearest populations during the operational life would be the residential colony of the power plant itself. It is not considered necessary therefore, to recommend any further public consultation measures over and above those committed to above.

Disclosure of information will also continue throughout project construction and operation. The primary emphasis here will be to assure stakeholders that the environmental mitigation, monitoring and management practices established in the ESIA and its ESMP are being implemented and the environmental standards and guidelines dictated by the Egyptian government, the World Bank and the African Development Bank are being met through a comprehensive monitoring and reporting process. UEEPC/HPP is required under Egyptian law, to maintain an Environment Register of written records with respect to environmental impacts from the power plant. In addition, an annual report containing technical data relating to the monitoring program will be prepared by the UEEPC/HPP and submitted to the EEHC, EEAA, the WB and the AfDB.

Table 9-4

Further Concerns Raised During ESIA Public Consultation Meeting

Key issue discussed	Comments
Cooling Water	Local Council's representative raised the issue of algae suppression at the intake structure using Sodium Hypochlorite. There was a recommendation to the Engineering Consultant of the project to review and check chlorine dosage system on the basis of local Egyptian aquatic environment.
Air Quality	Impact of the Kureimat Power Complex, in addition to the new Helwan South Power Project on air quality in the South Helwan region.
Nile Water Abstraction and Discharge System	Concerns raised about the construction effects of the intake and discharge structures.
Socio-economic Impact of the Project	There was an emphasize on the necessity of hiring most of the plant workers from the Helwan Region because many of project's employment in the South Helwan Region have been drawn from the outside of the area.

Complementary Initiatives and Project Benefits	There was a concern that the project design should consider enhancing the project benefits through its social corporate responsibilities program. Resulting from the community requests that local population, both men and women, be considered for employment opportunities, the Power Company shall ensure that the construction companies recruit local people willing and able to participate in the implementation of the project. The project will undertake to construct local clinic and a basic school for the communities of the project area in liaison with the Ministries of Health and Education, respectively. Social and recreational facilities for the staff of the Power Company shall be accessible by the local people upon request, including access to potable water within the project premises.

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