3.12.4 AMBIENT AIR QUALITY

The site of the proposed industrial complex is far from the existing residential area and the industries are not expected to be the factories that will consume much quantity of fuels, however it has been considered better to evaluate the impacts caused by the Development.

(1) Existing Data

(a) Wind

Data on the climatic conditions in the Suez Bay area for the past five years have been obtained from the Civil Aviation Organization of Egypt (meteorological authority), Navy, and the National Oceanographic Data Center (ENODC) at Alexandria. The data comprise wind speed and direction, air temperature, and atmospheric pressure. The frequency of sampling of these data is between 4 and 8 readings/day.

Data of the wind for the past five years have been statistically analyzed to find out the frequency distribution of wind speed at certain directions. The obtained results are shown in Table 3.12.4-1. Comparison of these results with those reported in published literature (Ref. No. 10) show that there is a good agreement between the analysis of five years and that of 50 years.

From Table 3.12.4-1, it is evident that the northerly wind are dominant all over the year, as it dominates over 78.7% of the year time. Among the different components of these wind, the N component accounts for 56% of the frequency, while NNW and NNE account for 13.6% and 9.1% respectively. Regarding the wind speed, it is found that frequency with speeds ranging between 4.0~5.9m/sec, and 6.0~7.9m/sec are accounting for 16.1%, and 14.1% of the total wind regime respectively.

The mean scaler wind speed fluctuates from 3.0m/sec during February to 5.2m/sec during September. The lowest values are recorded in winter, while the highest ones are found in summer.

(b) Ambient Air Quality

There is little data of air quality in Suez. Then, for the sake of comparison, data of the different pollutants measured at Alexandria have been obtained from the Institute of Public Health, Alexandria University. These data are shown in Table 3.12.4-2.

Table 3.12.4–1 Appearance Frequency of Wind Direction and Wind Speed

(Unit : %)

WIND DIR / SPEED (m/sec)	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
0.0-0.4	11.05	0.09												0.09		
0.5-0.9	0.09				0.09				0.09							0.09
1.0-1.9	2.47	0.57	0.38	0.09	0.28	0.66		0.38	0.76						0.28	0.85
2.0-2.9	3.24	1.23	0.57	0.28	0.38	0.57	0.57	0.47	0.76	0.09	0.09			0.09	0.28	0.76
3.0-3.9	6.86	2.09	0.47	0.19	0.47	0.76	0.28	0.19	0.66			0.09	0.38	0.09	0.09	2.19
4.0-5.9	16.11	3.43	0.47	0.19	0.28	0.57	0.28	0.76	0.95	0.19		0.19	0.47	0.19	0.38	4.76
6.0-7.9	14.10	1.62	0.19					0.28	1.23	0.09	0.09	0.09	0.47	0.19	0.28	4.38
8.0-9.9	1.90		0.09				0.19	0.19	0.28	0.09		0.09	0.57	0.09	0.19	0.28
10.-11.9	0.19								0.28	0.09		0.19	0.09			0.09
> 12									0.19							0.19

Note : Statistical Period is 1988~1992

Sources : Data from Civil Aviation Organization of Egypt, Navy and ENODC (Egyptian National Oceanographic Data Center)

Table 3.12.4-2 Monthly Average Concentrations of Air pollutants in Alexandria

POLLUTANT / MONTH	Suspended Matter ($\mu g/m^3$)	Sulphate ($\mu g/m^3$)	SO_2 (ppm)	NO_2 (ppm)
January	90	7.1	0.012	0.007
February	85	6.5	0.025	0.023
March	101	7.0	0.012	0.015
April	107	9.3	0.010	0.005
May	87	6.4	0.009	0.006
June	192	20.3	0.016	0.009
July	233	30.5	0.013	0.011
August	287	32.0	0.012	0.012
September	132	47.5	0.023	0.022
October	90	27.0	0.031	0.033
November	214	20.8	0.027	0.038
December	349	30.0	0.032	0.042
AVERAGE	164	20.4	0.019	0.019

Note : Statistical Year is 1992

Source : Ref. No. 2

(2) Survey

(a) Data Acquisition and Analysis

Data on the ambient air quality near the proposed site of the Development have been obtained from the field survey for the purpose of this study. The field survey was conducted at 3 stations around the proposed site, their locations are shown in Table 3.12.4-3 and Fig. 3.12.2-1.

At each station, the following items were measured:

- Air temperature;
- Wind speed and direction;
- Suspended matter;
- Sulphur dioxide;
- Nitrogen oxides; and
- Particulate sulphate.

The survey was conducted for six days between 18th and 25th of January, 1993.

Table 3.12.4-3 Locations of Air Quality Survey Stations

Station Number	Latitude (N)	Longitude (E)
8	29° 55' 20"	32° 28' 14"
9	29° 53' 26"	32° 27' 20"
10	29° 53' 11"	32° 27' 15"

The outlines of sampling and chemical analysis are show as follows.

i) Air temperature

Air temperature was recorded using an Aanderaa air temperature sensor No.2775 (a platinum air temperature sensor) coupled with an Aanderaa sensor read out unit No.3012.

ii) Wind speed and direction

Wind speed and direction were measured using an Aanderaa wind speed sensor No.2740 and a wind direction sensor No.2750 coupled with an Aanderaa sensor read out unit. Readings were taken twice a day.

iii) Suspended Particles

Suspended Particles were detected using a high volume air sampler. The sampler draws air through an 8~10 inch glass fiber filter that is practically capable of removing 100% of the particles of 0.3 micron or greater in diameter. As soon as possible after collection, the filter was folded carefully, weighed and divided into portions of suitable size for chemical analysis.

iv) Sulphur Dioxide

Two cubic meters of air were passed through a cooled H_2O_2 solution each 24 hours. The sulphur dioxide was completely oxidized to sulfuric acid which was then determined using a standard alkali according to the equation:

$$SO_2 + 2(OH) = H_2SO_4$$

The carbon dioxide was absorbed to avoid its interference.

v) Nitrogen Oxides (Saltzman Method)

This method of determination is based on the diazocoupling reaction between NO_2 and sample collected during a period of 24 hours with a mixture of N-(naphthyl)-ethylenediamine dihydrochloride and sulphanilamide. The developed color is measured at 545 μm.

vi) Sulphate

A standardized, turbidimetric barium sulphate method was used for the determination of sulphate in the suspended matter.

(b) Data Analysis

The results of analysis of air samples collected from three stations surveyed around the proposed site of industrial complex are shown in Table 3.12.4-4.

In comparison with the existing data of air quality in Alexandria, it becomes evident that the air in the area has much higher concentration of sulphur dioxide (SO_2), that is considered to be caused by a down wind from the existing industries located in the north direction. All of the obtained concentration of SO_2 for three stations exceed the Egyptian environmental standard (200 $\mu g/m^3$). Accordingly, the sulphate concentration in the suspended matter of air in the area is at least twice as that in Alexandria during January.

As for the nitrogen oxides, it is evident that their concentration in the area are similar to those in Alexandria during the same period of the year. All of the obtained concentration of NO_x for three stations are lower than the Egyptian environmental standard (200 $\mu g/m^3$).

The values of suspended matter in the air of the area are higher than those measured at

Alexandria during January.

In general, the surveyed air quality in the area indicate that the air quality is good for NO_X and more or less polluted for SO_2 in the proposed area of the Development.

Table 3.12.4-4 The Results of Air Quality Survey in the Proposed Area

ITEM / STATION	Suspended Matter ($\mu g/m^3$)	Sulphate ($\mu g/m^3$)	NO_X (ppm)	($\mu g/m^3$)	SO_2 (ppm)	($\mu g/m^3$)
8	131	27.4	0.010	21	0.081	231
9	133	23.6	0.017	34	0.138	394
10	172	22.3	0.009	18	0.133	380

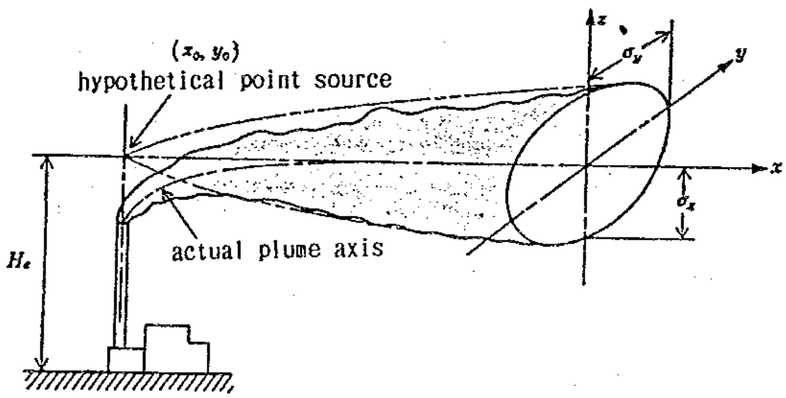
(3) Prediction of Impacts

(a) Methodology

•

i) Predictive Model

When air pollutants are emitted into the atmosphere, they are transported, dispersed, and/or chemically converted to other forms under the given meteorological and topographic conditions which vary spatially and temporally. It is extremely difficult to incorporate all of these factors quantitatively into mathematical representation of air pollution phenomena. Especially, various chemical reactions taking place in the atmosphere are in a large extent not understood yet on a quantitative basis. In air quality modeling, therefore, some factors that are considered to be essential to describe particular aspects of air pollution phenomena are chosen, and they are represented by simplified forms in mathematical air quality models.



Coordinate System for Plume Equation

The dispersion model consists of several equations including a plume equation as the principal equation. A general plume equation which allows to compute steady-state concentration of a pollutant at downwind zone is as follows:

$$C(x, y, z) = Q \cdot \exp\{-y^2/(2\sigma_y^2)\} \cdot [\exp\{-(z - He)^2/(2\sigma_z^2)\} + \exp\{-(z + H_e)2/(2\sigma_z^2)\}]$$

where,

C : concentration of the pollutant

x : downwind distance from the source

y : horizontal distance perpendicular to the x axis

z : height of the point from the ground where the concentration is to be calculated

Q : pollutant emission rate

σ_y : horizontal diffusion parameter evaluated in terms of downwind distance x

σ_z : vertical diffusion parameter evaluated in terms of downwind distance x

U : wind speed

H_e : effective stack height

When the long term average concentration is considered, an integrated form of the above equation as given below may be used.

$$C(x,z) = Q \cdot [\exp\{-(z - He)^2/(2\sigma_z^2)\} + \exp\{-(z + H_e)2/(2\sigma_z^2)\}]/\beta$$

$$\beta = \sqrt{2\pi}\,(\pi/8)\, x\, \sigma z\, U$$

This equation is used as the basic equation in the dispersion model. Pollutant emission rate Q is given based on the results of the source estimation, wind speed and diffusion parameter are determined based on the meteorological information and source characteristics.

ii) Conditions

The following conditions have been applied for the prediction of the impacts on the surrounding area.

Pollutant emission rate (Q)

The value of Q has been estimated by the expected site area, unit fuel consumptions and pollutant emission factors. The results for SO_2 and NO_x are shown in Table 3.12.4-5. Unit fuel consumptions have been obtained, referring the data in Japan and considering the productivity per unit site area. In this impact analysis, one point source is assumed to represent all sources and to emit total quantity of the pollutants in the proposed industrial complex.

Wind condition

The data of wind direction and speed have been arranged according to the appearance pattern of as shown in Table 3.12.4-1, and set for each dispersion field. Exhaust gas from a source in each dispersion field is assumed to be transported and dispersed according to the appearance ratio of wind direction and speed.

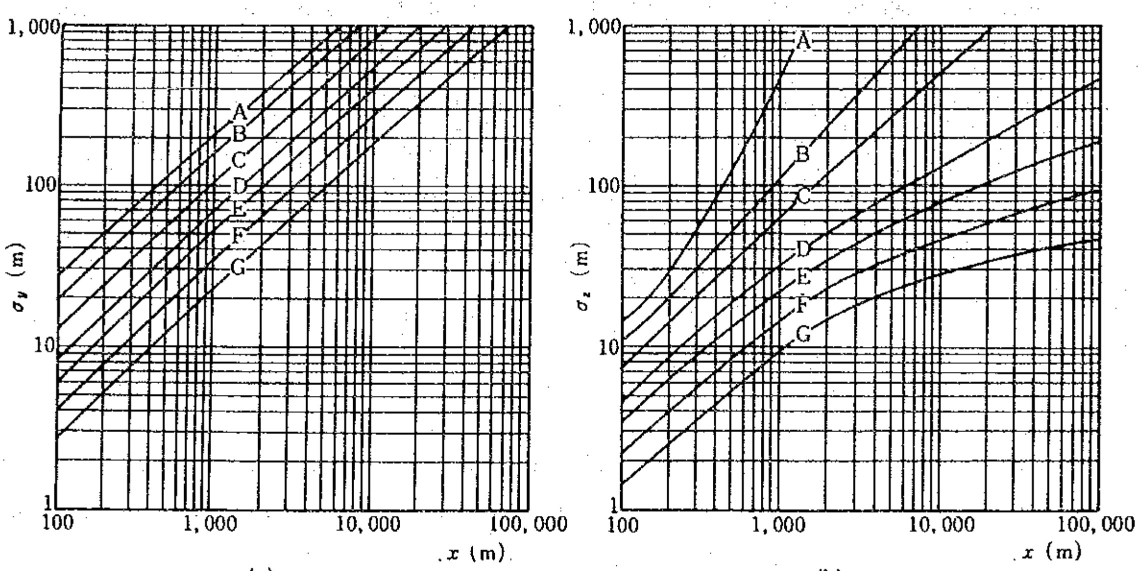
Effective stack height

H_e = 20 meters

Diffusion parameter

The diffusion parameters applied in the prediction have been chosen from the diffusion factor table obtained from the Pasquill-Gifford diagram.

Although the atmospheric stability class to obtain the parameters vary with height, period and time zone, it could be assumed that the class "C" is the most likely class judging from the average meteorological data.



(a) σ_y (b) σ_z

Pasquil-Gifford Diagram

Table 3.12.4-5 Estimated Pollutants Emission from the Industries in the Proposed Industrial Complex

Zone	Type of Industry	Site Area (m2)	Unit Fuel Consumption (lit/m2/year)	Total Fuel Consumption (kilo lit/year)	Emission Factor SO2 (Nm3/kilo lit)	NOx (Nm3/kilo lit)	Total Emission SO2 (Nm3/year)	NOx (Nm3/year)
ADABIYA Industrial Free Zone	Food	10,000	59.7	597	11.71	1.69	6,989	1,008
	Wood Products & Metal Furniture	10,000	0.9	9	11.71	1.69	101	15
	Plastic	10,000	6.5	65	11.71	1.69	761	110
	Paper Products	10,000	31.4	314	11.71	1.69	3,678	531
	Spinning & Weaving	160,000	21.3	3,408	11.71	1.69	39,923	5,760
	Electrical & Engineering	160,000	-	-	11.71	1.69	-	-
	Mechanical & Metal	10,000	6.0	60	11.71	1.69	705	102
	Building Materials	40,000	-	-	11.71	1.69	-	-
	Chemicals & Pharmaceuticals	10,000	9.9	99	11.71	1.69	1,162	168
	Others	140,000	5.0	702	11.71	1.69	8,226	1,187
	Sub Total	560,000		5,254			61,546	8,879
ATAQA Industrial Estate	Food	280,000	0.2	51	11.71	1.69	593	86
	Wood Products & Metal Furniture	280,000	0.3	79	11.71	1.69	921	133
	Plastic	210,000	3.2	673	11.71	1.69	7,880	1,137
	Paper Products	250,000	6.7	1,680	11.71	1.69	19,679	2,839
	Spinning & Weaving	460,000	5.7	2,622	11.71	1.69	30,715	4,431
	Electrical & Engineering	350,000	-	-	11.71	1.69	-	-
	Mechanical & Metal	170,000	1.6	268	11.71	1.69	3,145	454
	Building Materials	560,000	-	-	11.71	1.69	-	-
	Chemicals & Pharmaceuticals	350,000	5.2	1,814	11.71	1.69	21,252	3,066
	Others	600,000	1.6	982	11.71	1.69	11,505	1,660
	Sub Total			8,168			95,690	13,805
Expansion Area of ATAQA I.E.	Plastic	40,000	3.2	128	11.71	1.69	1,501	217
	Electrical & Engineering	610,000	-	-	11.71	1.69	-	-
	Mechanical & Metal	40,000	1.6	63	11.71	1.69	740	107
	Building Materials	150,000	-	-	11.71	1.69	-	-
	Chemicals & Pharmaceuticals	40,000	5.2	207	11.71	1.69	2,429	350
	Sub Total			399			4,670	674
	GRAND TOTAL			13,821			161,905	23,357

(b) Results of Prediction

The results predicted for SO_2 and NO_x are shown in (Fig. 3.12.4-1, Table 3.12.4-6) and (Fig. 3.12.4-2, Table 3.12.4-7) respectively. The values in these Tables show the distribution of annual average concentration which is loaded by the industries in the proposed industrial complex.

i) SO_2

The distribution of isolines of concentration shows that higher values are found in the south of the proposed industrial complex. The maximum values are found around 200 meters south of the industrial complex. The concentration exceeding 0.01ppm are found as far as 1500 meters south. In the SSE and SSW directions, the predicted contribution show a little high concentration. In other directions, the predicted contribution of SO_2 rarely exceed 0.01ppm.

ii) NO_x

The distribution of isolines of concentration shows that higher values are found in the south as same as that of NO_x. The maximum value of 0.026ppm is found around 200 meters south, however, the isoline of 0.01ppm is never beyond 600 meters.

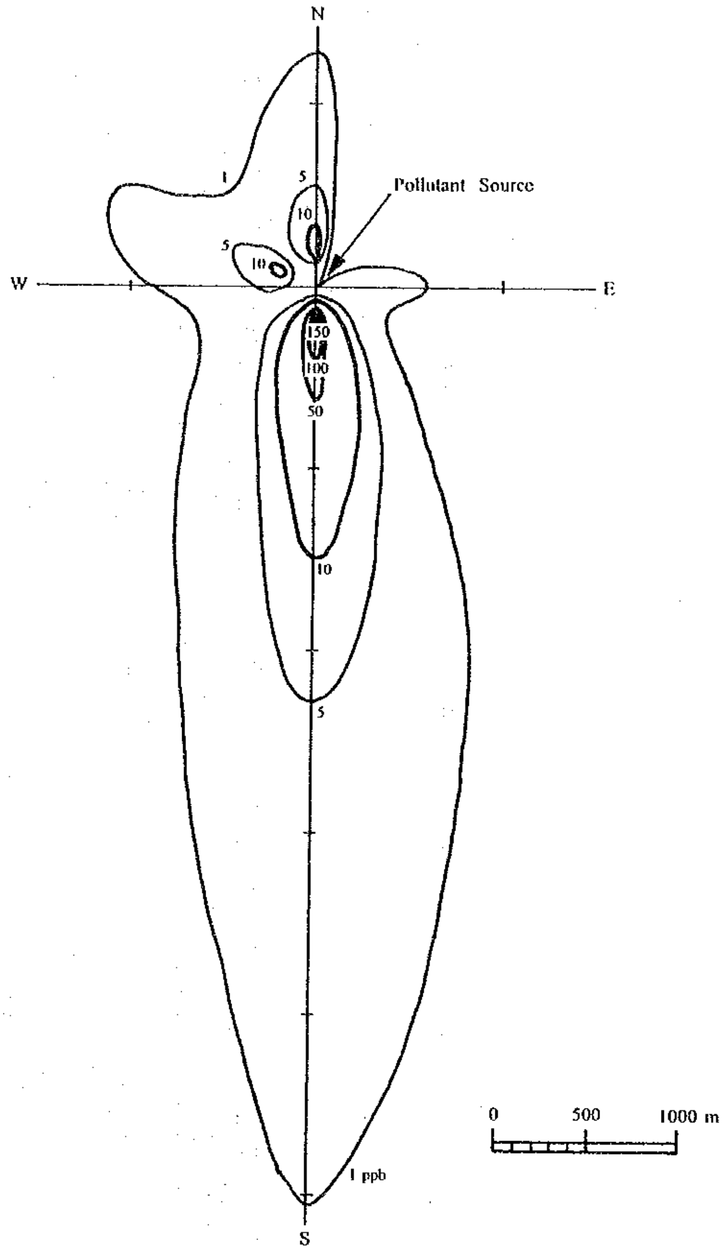


Figure 3.12.4-1 Predicted Distribution Patterns of SO_2 Concentration (unit:ppb) from the Proposed Industrial Complex

Table 3.12.4–6 Predicted Distribution of SO_2 Emitted from the Proposed Industrial Complex

Wind Direction	Average Wind Speed (m/sec)	x (m)	100	200	300	400	500	600	700	800	900	1000
		alpha-z	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918
		gamma-z	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068
		sigma-z	7.32	13.83	20.07	26.14	32.08	37.92	43.69	49.39	55.03	60.61
N	4.18	56.01	45.7	177.6	141.3	99.8	71.8	53.5	41.2	32.6	26.4	21.8
NNE	4.35	9.03	7.1	27.5	21.9	15.5	11.1	8.3	6.4	5.0	4.1	3.4
NE	3.7	2.17	2.0	7.8	6.2	4.4	3.1	2.3	1.8	1.4	1.2	1.0
ENE	3.22	0.75	0.8	3.1	2.5	1.7	1.2	0.9	0.7	0.6	0.5	0.4
E	2.94	1.5	1.7	6.8	5.4	3.8	2.7	2.0	1.6	1.2	1.0	0.8
ESE	3.05	2.56	2.9	11.1	8.9	6.2	4.5	3.3	2.6	2.0	1.7	1.4
SE	4.13	1.32	1.1	4.2	3.4	2.4	1.7	1.3	1.0	0.8	0.6	0.5
SSE	4.3	2.27	1.8	7.0	5.6	3.9	2.8	2.1	1.6	1.3	1.0	0.9
S	5.08	5.2	3.5	13.6	10.8	7.6	5.5	4.1	3.1	2.5	2.0	1.7
SSW	6.5	0.55	0.3	1.1	0.9	0.6	0.5	0.3	0.3	0.2	0.2	0.1
SW	4.7	0.18	0.1	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1
WSW	7.33	0.65	0.3	1.2	0.9	0.7	0.5	0.4	0.3	0.2	0.2	0.1
W	6.56	1.98	1.0	4.0	3.2	2.2	1.6	1.2	0.9	0.7	0.6	0.5
WNW	4.89	0.74	0.5	2.0	1.6	1.1	0.8	0.6	0.5	0.4	0.3	0.2
NW	4.62	1.5	1.1	4.3	3.4	2.4	1.7	1.3	1.0	0.8	0.6	0.5
NNW	5.19	13.59	8.9	34.7	27.6	19.5	14.0	10.4	8.0	6.4	5.2	4.3

Wind Direction	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2500	3000	4000	5000
	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918
	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068	0.1068
	66.16	71.66	77.12	82.55	87.95	93.32	98.66	103.97	109.26	114.53	140.57	166.18	216.40	265.60
N	18.3	15.6	13.5	11.7	10.3	9.1	8.2	7.3	6.6	6.0	3.9	2.8	1.6	1.0
NNE	2.8	2.4	2.1	1.8	1.6	1.4	1.3	1.1	1.0	0.9	0.6	0.4	0.2	0.2
NE	0.8	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.1	0.1	0.0
ENE	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
E	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.3	0.3	0.2	0.1	0.1	0.1	0.0
ESE	1.1	1.0	0.8	0.7	0.6	0.6	0.5	0.5	0.4	0.4	0.2	0.2	0.1	0.1
SE	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.0
SSE	0.7	0.6	0.5	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.1	0.1	0.0
S	1.4	1.2	1.0	0.9	0.8	0.7	0.6	0.6	0.5	0.5	0.3	0.2	0.1	0.1
SSW	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SW	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WSW	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W	0.4	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0
WNW	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
NW	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.0	0.0
NNW	3.6	3.1	2.6	2.3	2.0	1.8	1.6	1.4	1.3	1.2	0.8	0.5	0.3	0.2

(unit: %) (unit: ppb (=0.001ppm))

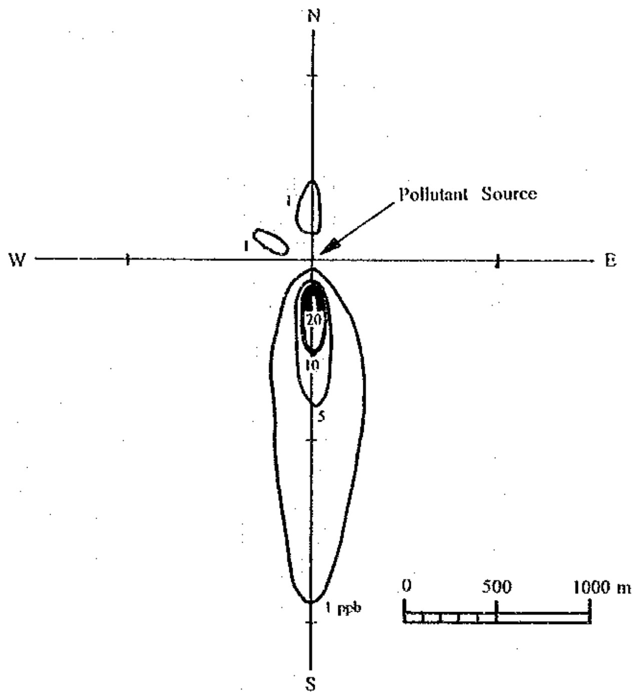


Figure 3.12.4–2 Predicted Distribution Patterns of NO_x Concentration (unit:ppb) from the Proposed Industrial Complex

Table 3.12.4–7 Predicted Distribution of NO_x Emitted from the Proposed Industrial Complex

Wind Direction	Average Wind Speed (m/sec)	x (m)	100	200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000
		alpha-z	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918	0.918
		gamma-z	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107	0.107
		sigma-z	7.32	13.83	20.07	26.14	32.08	37.92	43.69	49.39	55.03	60.61	66.16	71.66	77.12	82.55	87.95	93.32	98.66	103.97	109.26	114.53
N	4.18	56.01	6.6	25.6	20.4	14.4	10.4	7.7	5.9	4.7	3.8	3.2	2.6	2.3	1.9	1.7	1.5	1.3	1.2	1.1	1.0	0.9
NNE	4.35	9.03	1.0	4.0	3.2	2.2	1.6	1.2	0.9	0.7	0.6	0.5	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.1
NE	3.7	2.17	0.3	1.1	0.9	0.6	0.5	0.3	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0
ENE	3.22	0.75	0.1	0.4	0.4	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E	2.94	1.5	0.3	1.0	0.8	0.5	0.4	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
ESE	3.05	2.56	0.4	1.6	1.3	0.9	0.6	0.5	0.4	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
SE	4.13	1.32	0.2	0.6	0.5	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SSE	4.3	2.27	0.3	1.0	0.8	0.6	0.4	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
S	5.08	5.2	0.5	2.0	1.6	1.1	0.8	0.6	0.5	0.4	0.3	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
SSW	6.5	0.55	0.0	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SW	4.7	0.18	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WSW	7.33	0.65	0.0	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W	6.56	1.98	0.1	0.6	0.5	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
WNW	4.89	0.74	0.1	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NW	4.62	1.5	0.2	0.6	0.5	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NNW	5.19	13.59	1.3	5.0	4.0	2.8	2.0	1.5	1.2	0.9	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.3	0.2	0.2	0.2	0.2

,(unit : %) (unit : ppb (=0.001ppm))

(c) Evaluation

As for NO_X, the deterioration of the air quality would be minimum and of a very limited extent. Because, not only the present concentration but also the effect of the proposed industrial complex are lower than several air quality standards (0.04~0.10ppm for 24hrs maximum, 0.02~0.06ppm for annual mean) including Egyptian one.

On the other hand, as for SO_2, the deterioration of the air quality would be serious to some extent in the south of the proposed industrial complex. Fortunately, under the conditions of wind directions except for north direction, the effect of the proposed industrial complex would be very limited. Therefore, the emission from the industrial complex would not have serious effects on the existing residential area which are located from north to east of the proposed area.

The planned residential area next to the proposed industrial complex in the south would suffer the deterioration of air quality as for SO_2 to some extent. Therefore, it is recommended that newly planned industries shall use the natural gas as fuel. In general, sulphur content of natural gas is much lower than that of fuel oil, and natural gas would be able to reduce the predicted effect of SO_2.

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APPENDIX 3.12-1

PRELIMINARY ENVIRONMENTAL SURVEY

FROM
INTERIM REPORT (I)
(SECTION 11)

11. Preliminary Environmental Survey

11.1 General View

11.1.1 Regulation on Environment

1) Laws on ambient air pollution control

The environmental standards of air quality have been established for each source as shown in Table 11.1.

Table 11.1 Laws and Decrees and the Competent Ministry

Competent Ministry	Regulation Subject	Laws & Decrees	
Ministry of Health	Standards for ambient and workplace	Decree	470/1971 240/1979
Ministry of Development	Furnace, chimney, stacks	Decree	380/1975
Housing, Utilities and New Communities	Environment standard for industrial area	Law Decree	3/1982 600/1992
Ministry of Industry	Regulation of industry emission	Decree	380/1982
Ministry of Interior	Regulation of Motervehicle emission	Law	66/1972 210/1980 20/1983
		Decree	291/1974 407/1983

Table 11.2 shows the air quality standards of Egypt and the corresponding standards of Japan. According to the table, the standard values are not as strict as those of Japan except sulfer dioxide (SO_2) and carbon monoxide(CO). At the same time, the table gives the present situation in major cities in Egypt.

According to the data obtained, the pollution has become worse three to five times as high as the standard of Japan.

Table 11.2 Environmental Quality Standard and Present State of Air Pollution in Egypt.

Item/Unit	Egyptian Standard	Data Obtained			Japanese Standard
		Cairo	Helwan	Shobra	
SO_2/ppm	((50 micro gm/m^3)) Annual (0.018 ppm)	0.05-0.13 1983/1984			< 0.04 (ppm) Daily average
CO/ppm	< 2.5 (ppm) Daily	20 1978			< 10 (ppm) Daily average
Suspended Particulate Matter mg/m^3	0.15	0.5-0.7 1988	0.838 1988	0.557 1983	< 0.100 (mg/m^3) Daily average
NO_2/ppm	< 0.1	0.38 1979			<0.04-0.06 (ppm) Daily average
Smoke Concentration mg/m^3	WHO < 40	43-139 1988		195 1978	
Photochemical Oxidants/ppm		0.1 more 1979			< 0.06 (ppm) Hourly value
Lead mg/m^3	< 0.014 Daily	0.5-4.9 1983			
Dust fall (residential) (industrial)	(<20t/mile^2/month) (<40t/mile^2/month)	57* 1983	144* 1978	45* 1983	<20t/km^2/month <20g/m^2/month

*) : Unit (t / mile^2 / month)

2) Laws on water pollution control

At present, the pollution control law on public waters such as rivers, lakes and sea, has not been established. But the effluent standard for each industry was proclaimed in Law No.93 / 1962. Then Law No.48 was proclaimed in 1982 as the effluent standard from each industry to public waters.

Law No.48, Art 60 has substantially the same function as the Environmental quality Standards. However, it has not taken effect so far.

Table 11.3 shows the codes, standards and specifications for the discharge of treated liquid effluents into the public waters (waterways).

Table 11.3 Environmental Water Quality Standards in Egypt

Parameter		Standards & Specification (mg/litar unless otherwise noted)
Color		Not to exceed 100 degrees
Total Solids	TSS	500
Temperature	T	5°C above normal
Dissolved Oxygen	DO	not less than 5
Potential Hydrogen	pH	Within the range 7-8.5
Biochemical Oxygen Demand	BOD	Not to exceed 5
Chemical Oxygen Demand	COD	Not to exceed 10
Organic Nitrogen	ON	Not to exceed 1
Ammonia	NH_3	Not to exceed 0.5
Oils and Grease		Not to exceed 0.1
Total Alkalinity		Within the range 20-150
Sulphate	SO_4	Not to exceed 200
Mercury	Hg	Not to exceed 0.001
Iron	Fe	Not to exceed 1
Manganese	Mg	Not to exceed 0.5
Copper	Cu	Not to exceed 1
Zinc	Zn	Not to exceed 1
Synthetic Detergent		Not to exceed 0.5
Nitrate	NO_3	Not more than 46
Fluorides	F	Not to exceed 0.5
Phenol		Not to exceed 0.02
Arsenic	As	Not to exceed 0.05
Cadmium	Cd	Not to exceed 0.01
Chromium	Cr	Not to exceed 0.05
Cyanide	Cn	Not to exceed 0.1
Lead	Pb	Not to exceed 0.05
Selenium	Se	Not to exceed 0.01

References

Art 60: The fresh water bodies in which it is permitted to discharge treated industrial liquid effluents remain within the following (quality) standards and specifications.

Environmental Problems Study committee in Egypt: The private letter

Industrial Environmental Map Progress Report: Irene Matta- financially supported by the GTZ (Deutsch Gesellschaft fuer Technische Zusammenarbeit)

PRELIMINARY SURVEY OF ENVIRONMENTAL PROBLEMS IN EGYPT: Environmental Quality International, Oct. 1991. .pa

11.1.2 Present Situation of Environment in Suez

1) Air quality

The present air conditions in Suez City can be concluded by the Study reports[1,2] and the site survey. In the Suez City Air Quality Study, future amount of pollution exhaustion was predicted based on the amount of exhausted pollutant in 1978. And by using the prediction, the ambient air quality at present, in near future (1985) and long term (2000) were estimated by computer simulation. According to the results, annual average SO_2 ground level concentration in 1985, would be about 0.0035 ppm. It was calculated on the assumption that the significant sources of pollutants such as oil refinery factory, electric power station would have taken countermeasures to reduce pollutant emission. Though, it has not been practically applied. Furthermore, the background concentration was not taken into account because the air quality had not been measured. Therefore, the result should be reviewed to realize the actual pollution situation in Suez City.

The present SO_2 concentration at Ataqa Industrial Estate is also shown about 0.0018 ppm. However, it should be a tentative index of present situation. The studies of air pollution in Cairo City and other big cities have reported that all the pollutant concentrations exceed the environmental quality standards of Japan.

The main stationary pollution sources in Suez City are middle scale factories (include oil refineries) and a power station of 300 MW, while mobile sources are shipping traffics and motorvehicle traffics.

The exhaust smoke of stationary sources, which is the most significant source in Suez City, is possibly affecting the air condition at Ataqa Industrial Estate under the prevailing wind with the direction of north-east. But the actual state is not known so far.

References

1) Suez City Air Quality Study Vol.1 ~ 5:
INSTITUTE ECOPLAN GENEVA / in collaboration with SOCIETE GENERALE POUR L'INDUSTRIE GENEVA (SWITZERLAND), SABBOUR ASSOCIATES CAIRO (ARAB REPUBLIC OF EGYPT), Apr. 1979.

2) PRELIMINARY SURVEY OF ENVIRONMENTAL PROBLEMS IN EGYPT:
Environmental Quality International, Oct. 1991.

2) Water quality

(1) Objective

This study aims to grasp information about the present pollution conditions of Suez Bay and to collect basic data for pollution prevention plan in Suez Bay and Ataqa Industrial Estate, where there is a possibility of aggravation of pollution due to rapid growth of population and industry that is expected to happen as the consequence of the project.

(2) Methods of sampling

Suez Bay Surface Seawater was sampled with a polyethylene bucket on 29th May 1992. (Fig.11.1)

The samples were kept in a 10 litres polyethylene containers and immediately transported to the laboratory (National Research Center), where Heavy Metal and oily components were analyzed.

(3) Methods of determination

(i) Cadmium, Lead, Chromium and total Mercury were analyzed by an atomic-absorption spectrophotometry.

(ii) Cyanide and total Phosphorus were analyzed by a pyridine-pyrazolone; 4-pyridine carboxylic acid-pyrazolone method.

(iii) Oil and grease were analyzed by an infrared absorption method.

(4) Results

The results of the field measurement are shown in Table 11.4 and the compared with the standards of Art 60 of Law No. 48 in 1982, and the Environmental Standard in Japan.

(i) The results obtained from observations suggest that the concentrations of Cd, CN, Pb and Cr do not exceed environmental quality standard .

(ii) Total mercury and total phosphorus show relatively higher concentrations than the other heavy metals so that they will require a special consideration about present background of generation and diffusion.

(iii) Oil and grease show high concentration compared with average oil concentration of inland sea.

Average oil concentration of inland seawater have proved less than 20 ~ 30 ppb in the pilot project to investigate marine pollution by IOC and WHO.

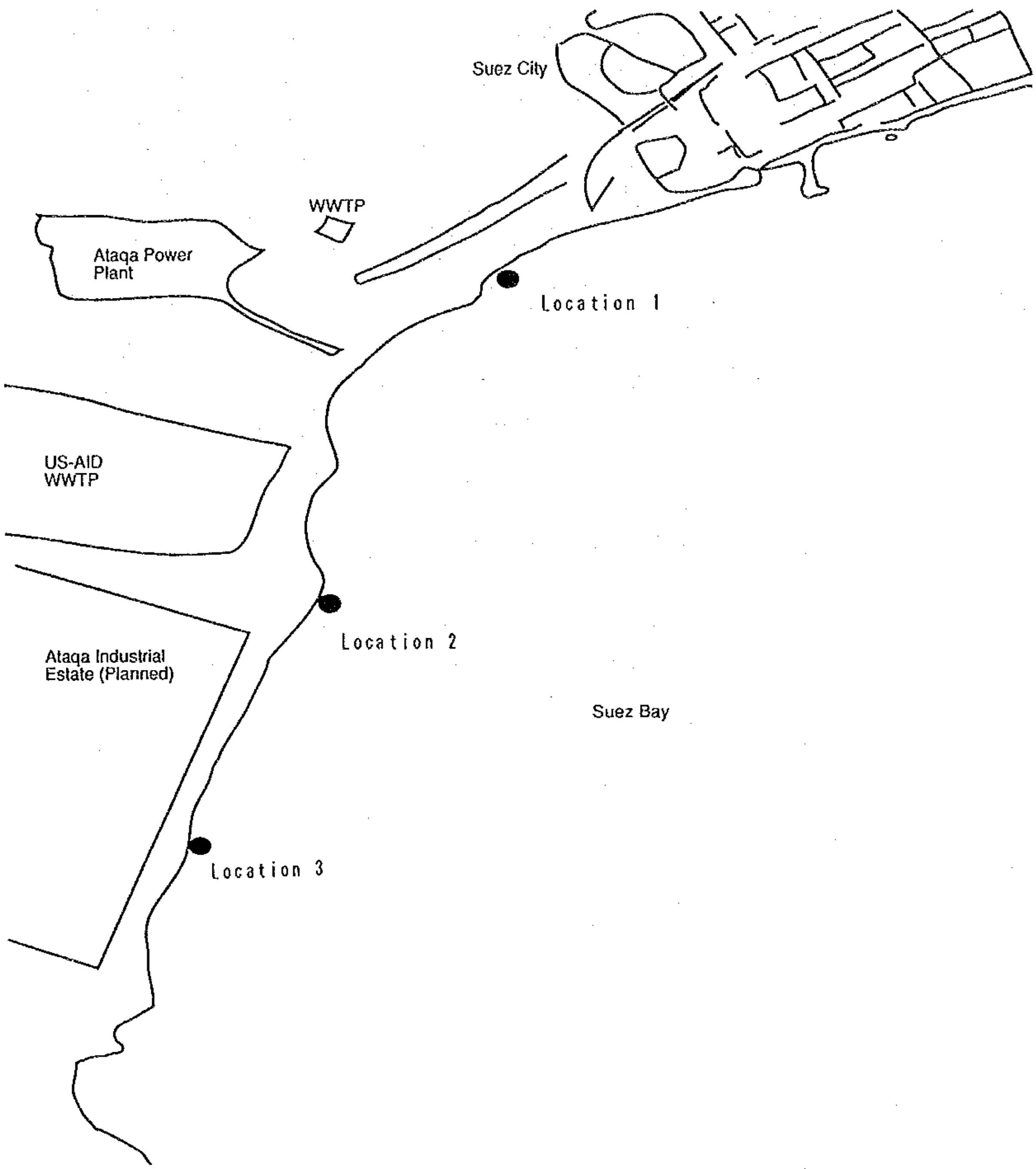

Fig.11.1 Location of sampling station in the Suez Bay

●: Sampling point

Table 11.4 Results of Seawater Analysis

Unit: ppm

Item	Result of Analysis 1	2	3	Standard of Egypt (Art 60)	Env. Stand (Japan)
Cadmium (Cd)	<0.001	<0.001	<0.001	Not to exceed 0.01	0.01
Cyanide (CN)	N.D.	N.D.	N.D.	Not to exceed 0.1	N.D.
Lead (Pb)	<0.050	<0.050	<0.050	Not to exceed 0.05	0.1
Chromium (Cr)	<0.025	<0.025	<0.025	Not to exceed 0.05	0.05
Total Mercury (Hg)	<0.001	<0.001	<0.001	Not to exceed 0.001	0.0005
Total Phosphorus	0.14	N.D.	N.D.	---	N.D. (Organic phosphorus)
Oil and grease	14.4	34.8	12.0	Not to exceed 0.1	---

N.D.: Not detected

References

Levy, E.M.(1976): Second IOC/WHO Workshop on Marine Pollution (Petroleum) Monitoring, Monte Carlo, 14 ~ 18 June 1976.

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11.2 Identification of Environmental Impacts

11.2.1 Matrix of Environmental Consequences

It is now requested for an executor of every kind of development project to secure the "sustainable development" that has become a world wide issue of dispute. This project of a JICA scheme is also expected to simultaneously attain two targets; namely, economical development and environmental conservation. For the achievement of the former target, various aspects of technical consideration has been already developed in the previous subsections of this report. For the achievement of the latter target, here will be presented a basic consideration in this subsection.

All the environmental elements which would be affected by the project are listed up and discussed in relation to the project activities on a so-called environmental impact matrix which consists of a list of environmental elements and a list of project activities. In the row headed as 'Environmental Impact Parameters' list the project activities in the construction phase and post construction phase while in the column headed as 'Environmental Factors' show environmental elements to be affected. The environmental matrix for the project is shown in Table 11.5. The cause-and-effect relationships will be explained with a symbol mark at each corresponding intersection of the matrix.

An intersection of the matrix which has ◎ shows the related project activity may cause a significant effect on the environmental element in the column. In the same manner, a symbol mark ○ indicates medium impacts or not serious influences may be caused. A blank intersection means there may be negligibly small or no influence. In this matrix, both positive and negative impacts were evaluated.

11.2.2 Major Issues to be Remarked

By using the matrix, Table 11.5, the critical environmental impact parameters which may have impacts by the project and the critical environmental elements which may be affected by these impacts were screened.

Major issues among those impacts are as follows;

1) Impact of land reclamation and dredging on water quality
2) Impact of earth work on air quality

Table 11.5 Environmental Impact Matrix

ENVIRONMENTAL IMPACT PARAMETERS \ ENVIRONMENTAL ELEMENTS		PHISICAL															SOCIO-ECONOMIC														
																	LAND USE					AETHETICS HUMAN INTEREST		MAN-MADE FACILITIES & ACTIVITIES							
		Construction Material	Soils	Topography	Groundwater	Water Quality	Air Quality	Noise, Vibration	Odor	Erosion	Sedimentation	Bathymetry	Sea Currents	Waves	Terrestrial Life	Aquatic Life	Residential Area	Commercial Area	Industrial Area	Port Area	Recreation Area	Scenic Views	Wildemass & Open Space	Fishery	Employment	Health & Safety	Fire Hydrant	Road Transportation	Rail Transportation	Sea Transportation	Fresh Water Resource
CONSTRUCTION STAGE	Construction Equipment & Pile Driving					○	○	○												○					○					○	
	Land Reclamation					◎					○																				
	Dredging		○			◎				○	○	○	○	○		○															
	Suez / Adabiya Trunk Road	○					○	○																				○		○	
	Railroad	○																		○									○		
	Incinerator						○		○																			○			
	Flood way																○	○	○	○	○										
	Earth Work		○				◎																								
	Dredged Soil Disposal		○	○		○																									
	Construction Materials Transport						○											○	○	○								○	○	○	
	Building Facilities	○																		○		○									
	Utilities	○																		○		○			○	○	○				
OPERATION STAGE	Industries					◎	◎	○	◎		◎														○						
	Water Supply																○	○	○	○	○	○		○	○	○	○				○
	Sewerage Wastewater Treatment					◎			◎			○				○								○							
	Incinerator						○		○																					○	
	Grain Terminal					○	○									○															
	Refuse Disposal					○	○																		○						
	Shipping & Sea Traffic					○														○					○					○	
	Trucking & Automobiles																	○	○						○			○			
	Railway																			○					○				○		
	Fire Protection																										○				

3) Impact on sea water uality by industrial waste water in operational period
4) Impact on air quality by gas emission from factories in operation
5) Impact of offensive odor caused by sewage wastewaters treatment plant

The issues 1) and 2) are to be discussed in chapter 11.3 Conclusions and Recommendations.This chapter deals items 3) to 5) so as to evaluate the impacts qualitatively and to suggest counter measures.

3) Impact on sea water quality by industrial waste water in operational period.

(1) Cause of the Impact

Water pollutants are generated by the kind of factories during the operation stage.
Type of industries and related to major pollutants are shown Table 11.6.

Table 11.6 Type of Industries and Related Water Quality and Sedimentation

Typical pollutants / Code for Type of Industry	Water Quality								Sedimentation			
	Chemical Oxygen Demand (COD)	Nitrogen (N), Phosphorus (P)	Dissolved Oxygen (DO)	Heat Effluent	Oil and Grease	Toxic Substance	Potential Hydrogen (pH)	Suspended Solid (SS)	Chemical Oxygen Demand (COD)	Ignition Loss	Sulfide (S)	Toxic Substance
Food Processing Industry	O	O	O				O	O	O	O	O	
Textile Industry	O	O	O		O			O	O	O	O	
Paper Making and Pulp Industries	O	O	O		O			O	O	O	O	
Chemical Industry	O	O			O	O	O	O	O	O	O	O
Petroleum Industry					O			O				
Leather Industry	O	O	O			O		O	O	O	O	O
Iron and Steel Making Industry	O	O	O					O	O	O	O	
Nonferrous Metal Industry						O		O				O
Metal Processing Industry						O						O
Power Supply				O								

Also, Table 11.7 shows major toxic substance related with the industries which may cause water pollution.

Table 11.7 Toxic Substances and Related Industries

Substance	Type of Industry
Cyanide (CN)	Organic Chemical Ind., Ammonia Synthetic Ind., Metal Refining,Electroplating Ind.
Alkylie Mercury	Medicinal Drug (Agricultural /Chemicals) Ind., Caustic Soda, Acetylene Ind.
Organic Phosphorous (OP)	Agricultural Chemicals Ind., Fertilizer Ind., Synthetic Resin Ind.
Cadmium (Cd)	Cosmetic•Vinyl Chloride Ind., Zinc Refining Ind.
Lead (Pb)	Cosmetic Ind., Coating Ind., Lead Refining Ind.
Hexavalent Chromium(Cr^{6+})	Dyeing•Coating Ind., Leather Ind., Chromium Refining Ind.,Electroplating Ind.
Arsenic (As)	Medicinal Drug Ind., Copper Refining Ind., Fertilizer Ind., Cosmetic, Leather Coating Ind.
Total Mercury (Hg)	Medicinal Drug Ind., Agricuitural Medicinal Ind, Caustic Soda, Acetylene Vinylchloride Monomer Ind.
Polychlorinated biphenyls (PCB)	Paper Making and Pulp Ind., Reuse old Paper Ind.

(2) Environmental effect

Toxic substances such as heavy metals, pesticides affect the acquatic organisms seriously.

Also, those substances may cause hazardous on human health by biological accumulation* through food chain.

*) Biological accumulation: Living things have the action to accumulate high concentration in living body of the substances intaken from outside.

(3) Countermeasures

a) Over View

The reduction method of water pollutants are roughly classified as follows:

(a) To reduce the amount of waste water by saving water consumption
(b) To reduce pollution load by selecting suitable production process.
(c) To reduce pollution load by installation of treatment facility.

b) Outline of Waste Water Treatment Technics

The methods to remove water pollutants may be roughly divided into two types: Solid Liquid Separation and Physical Chemical Method.

(a) Solid-Liquid Separation Method
  (i) Precipitator Separation
  (ii) Flotation Separation
  (iii) Filter Separation
  (iv) Centrifugal Separation
  (v) Activated Sludge
  (vi) Tricking Filter
  (vii) Anaerobic Digester
  (viii) Lagoon

(b) Physical-Chemical Method
  (i) Neutralizing-pH Control
  (ii) Oxidation-Reduction
  (iii) Extractive
  (iv) Evaporation

c) Treatment of Heavy Metals

Heavy metals contained in waste water are generally removed in the form of insoluble precipitate. Hydroxides are the form of precipitate most commonly used, but they can also be separated as carbonates or sulfides in some cases.

Converting to hydroxides is the most economical process, in which the amount of heavy metal ions remaining in solution is closely related to pH of the solution.

This amount is determined by the solubility product of hydroxides, which varies considerably depending on the kind of heavy metal.

A rough measure for optimum pH's for typical heavy metal ions is shown in Fig. 11.2.

As may be seen from this figure, hydroxides of Cr^{3+}, Pb^{2+} and Zn^{2+} dissolve again into water at high pH range by reactions with excess hydroxyl ion. This requires special attention.

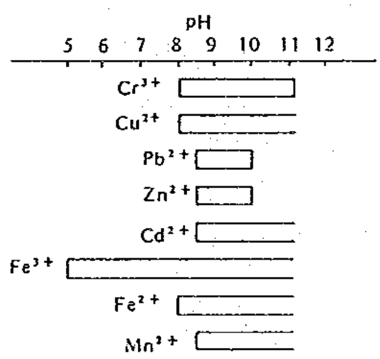

Fig. 11.2 Optimum pH range for sedimentation of various metal hydroxides

Separation of heavy metals as sulfide is another useful procedure. Generally, heavy metal sulfides are more insoluble than their hydroxides.

Mercury, cadmium, lead and copper can be sedimentated as their sulfides by addition of hydrogen sulfide gas or sodium sulfide solution.

Especially, this method is widely applied for removal of mercury ion since it is impossible to precipitate as its hydroxide.

Alkali xanthate (a kind of organic sulfer compound, $Na(C_2H_5OCS_2)$) can be also used as an effective precipitator.

4) Impact on air quality of gas emission from factories in operation

(1) Cause of the impact

Air pollutant is generated by combustion or heating fuels from factories in operation.

Type of industries and related major pollutants are shown in Table 11.8.

Table 11.8 Type of Industries and Related Typical Pollutants

Typical pollutants / Typical of Industries	Sulfur Oxides SO_X	Nitrogen Oxides (NO_X)	Particulate Matter (PM)	Dust	Hydrogen Fluoride (HF) Hydrogen Sulfide (H_2S)	Toxic Substance
Food Industries	○	○	○	○	○	○
Wood Product & Metal Furniture	○	○	○	○		○
Plastic Industries	○	○	○	○		○
Paper Product	○	○	○	○		○
Spinning & Weaveing	○	○	○	○		○
Electrical & Engineering Industries	○	○	○			○
Mechanical & Metal Industries	○	○	○	○		○
Building Materials	○	○	○	○	○	○
Chemical & Pharmaceuticals	○	○	○	○	○	○
Others	○	○	○			

(2) Environmental effect

Air pollutants invade human body through various channels and affect on it, paticularly on respiratory system.

Nitrogen oxides and fluorides will directly affect the organisms flora.

Cadmium and lead in toxic substances are sources of water and soil pollution rather than air.

(3) Countermeasures

a) Overview

Methods of removal of air pollutants are as follows (Fig.11.3) :

(a) Reduce of amount of exhaust gas in combustion process
(b) Reduce of pollution load by smoke control facility
(c) Reduce of ground level concentration by diffusion effect of high stack

In this subsection deals with all items mentioned above so as to evaluate the reducing method.

b) Desulfurization facilities

The methods to remove sulfur are roughly divided into two types, the dry and wet processes. Removal of SO_2 gas can be usually carried out more effectively by wet process, and the SO_2 reduction rate obtainable is from 80 to 90%. In general, the reducing method has been used practically with lime・Limestone method. This method uses low-cost limestone to absorb hazardous gas, and has advantage to produce gypsum as by-products.

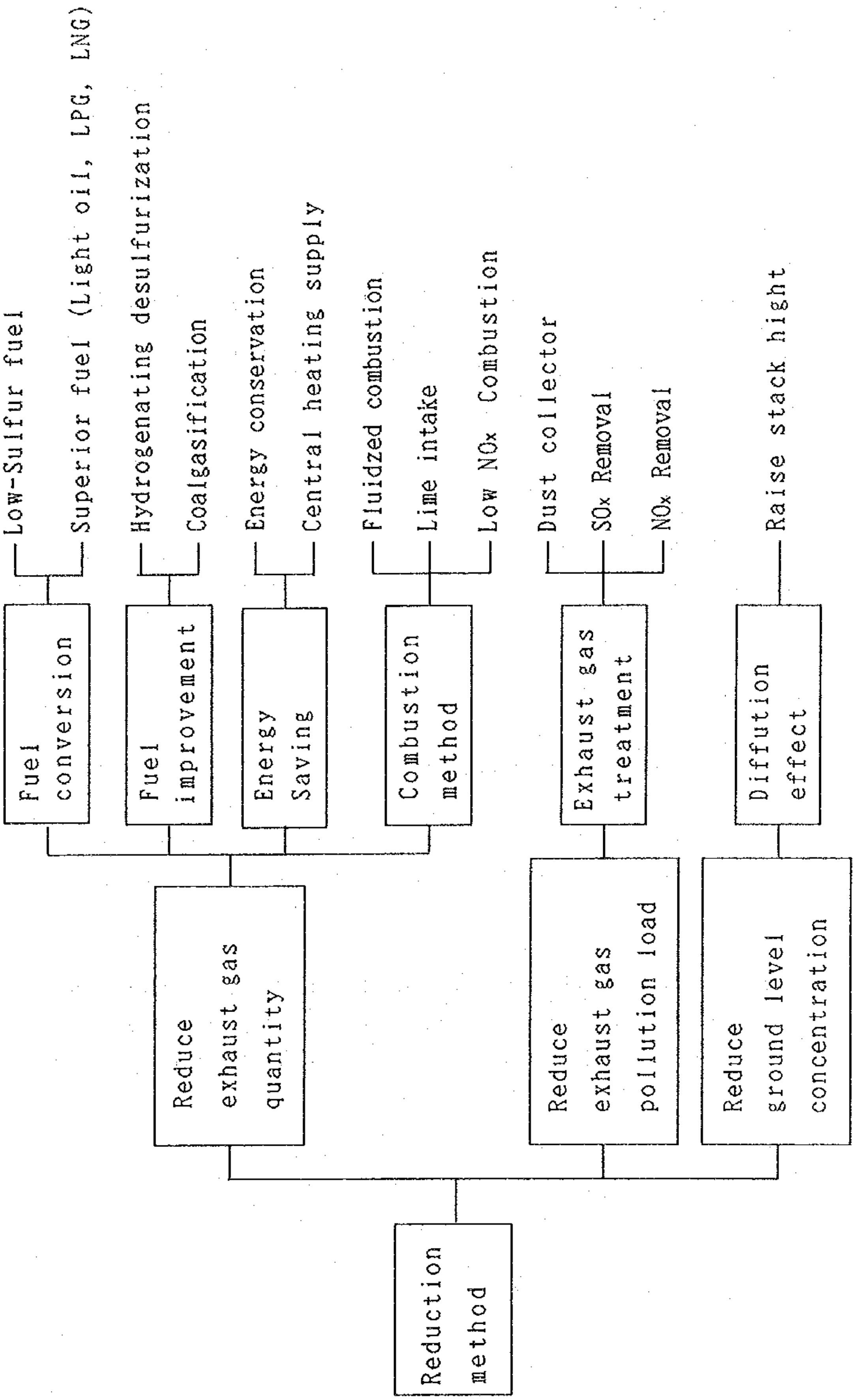

Fig. 11.3 Outline of reduction method

c) Denitration facilities

The methods to remove nitrogen oxides from flue gas are roughly divided into two types, the dry and wet processes.

Removal of NO_X gas can be usually carried out more effectively by dry process, and the NOx reduction rate obtainable is from 80 to 90%. Many processes to remove NO_X contained in flue gas have been tried, and selective catalytic reduction method (SCRM) has achieved a notable progress among them. Combustion techniques such as two stage combustion, low-NO_X burner are also available by using special combustion equipment.

d) Dust collector

Dust collectors to separate and collect such particles from aerosol are roughly classified as follows:

(a) Gravity dust collector
(b) Centrifugal dust collector
(c) Filtering dust collector
(d) Electrostatic precipitator

Among these dust collectors, those adopting a structure that wets particles in the aerosol or collected particles with water or other liquids are called wet-type dust collectors, and those otherwise are called dry-type ones.

Generally, the above mentioned methods (a) and (b) are applied to small scale facilities, which (c) and (d) are applied to large scale facilities. The dust precipitating rate obtainable is from 70 to 95% by (a) and (b), and from 80 to 95% by (c) and (d).

e) To reduce ground level concentration by dispersion effect

When the wind speed is relatively high, a vertical elongated vortex is generated behind a stack and a cavity wake is generated in the downwind region of a mountain, hill, building and other structures, as illustrated in Fig.11.4.

In such condition, the downwash of smoke can be caused by these currents and high ground level concentrations may occur.

In order to reduce smoke downwash, the stack high should be at least higher than neighboring structures.

Also using high efluent velocity (> 5~6 m/s) or attaching a collar may be effective in abating smoke downwash behind a stack.

In general, the ground level concentration (GLC) is inversely propotional to the square of the effective stack height (He)*; i.e.

$$GLC \propto 1/He^2$$

In considering the increase in stack height as a pollution control measure, it should be remembered that this does not reduce the total quantity of stack gas released into the atmosphere, but marely increase dispersion.

*) $He = H_O + \Delta H$ H_O : actual stack height (m)
ΔH : plume rising height (m)

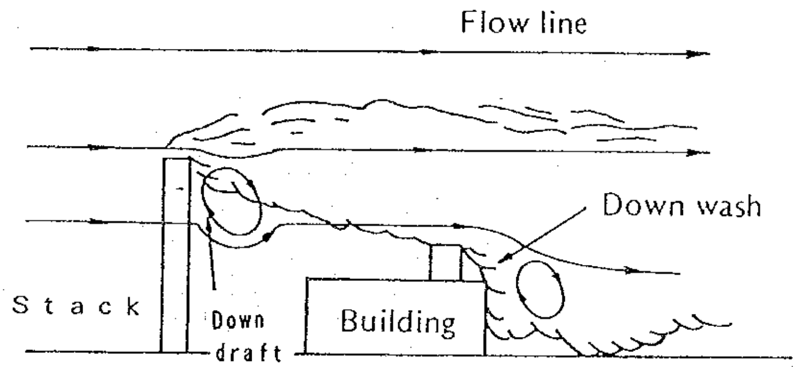

Fig. 11.4 **Downwash of smoke around stack and nearby building**

However, in this project, the location of factories and residential area seems to have air pollution problem on residents.

Because, Adabiya industrial free zone and residential area are possibly affecting the air condition by exhaust gas under the prevailing northerly wind with the frequency of appearance at form 75 % in the wind direction distribution.

With respect to various He, relation between dilution parameter Cmax ·(U/ Q)* and its occurring distance from source Xm is shown Fig.11.5.

If the effective stack height He is doubled without any other variation of conditions, maximum ground level concentration Cmax is reduced by 1/4.

Increasing He usually results in reducing Cmax and increase distance Xm.

*) C_{max} : maximum ground level concentration (m^3/m^3)
U : the wind speed (m / sec)
Q : the source intensity (m^3 / sec)

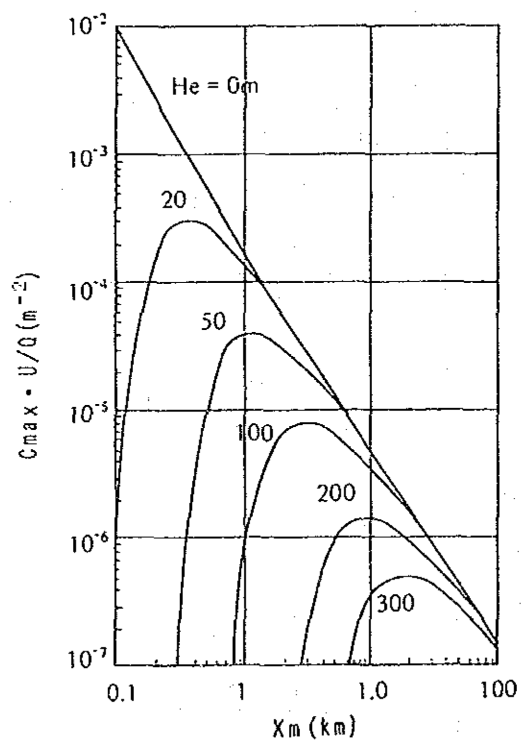

Fig. 11.5 Ground level concentration for different effective stack heights He

Maximum ground level concentration Cmax(ppm) and its occuring distance Xm(m) are given by the following formulas.

$$Cmax(ppm) = 0.234 \cdot \eta \cdot Q \cdot (Cz/Cy)/U/He^2 \cdot 10^6$$
$$Xm(m) = (He/Cz)^{2/(2-n)}$$

Where η is the time modification coefficient (one hour value of η~0.15 and 24 hours value~0.089), Cy, Cz and n are diffusion parameters of Sutton (typical value of Cy~0.15, Cz~0.15/0.07, and n~0.25), other smbols are same as used before.

5) Impact of offensive odor caused by sewage wastewater treatment and other industries

(1) Caused of the impact

Offensive odor is generated by treatment prossess of sewage waste water treatment plant and sludge of dumping site. It is also generated by raw materials and products in factories in operation.
In any case, the impact of offensive odor under the atomosphere have close relationships to the diffusion and transfer prosesses of odor substances.

Type of industries and related major pollutants are shown in Table 11.9.

Table 11.9 Types of Industries and Related Major Pollutants

Environmental Factors / Type of Industries	Hydrogen sulfide H_2S	Methyl mercaptan CH_3SH	Methyl sulfide $(CH_3)_2S$	Ammonia NH_3	Methyl disulfide CH_3S-SCH_3	Trimethyl lamine $(CH_3)_3N$	Acetaldehyde CH_3CHO	Styrene $C_6H_5CH_2CH$
Food Industries	O	O	O					
Paper Products	O			O		O		
Chemicals & Pharmaceuticals	O			O			O	
Petroleum Refining Ind.	O	O	O					O
Sewage Treatment Plant	O	O	O	O		O		
Dead Animals Processing Plants	O	O	O	O		O	O	

(2) Environmental Effect

The characteristics of offensive odor substances are shown in Table 11.10.

Table 11.10 Characteristics of Odor substances

Substances	Types of Industry	Characteristics of Odor
Ammonia	Chemical Industries	Stimulative
Methyl mercaptan	Pulp Ind., Raw Sewage, Oil Refinery Ind.	Addled pickled
Hydrogen sulfide	Pulp Ind., Raw sewage, Dead Animals Processing Plants	Addled egg
Trimethyl lamine	Marine Products Ind.	Addled cabbage
Methyl disulfide	Pulp Ind.	Addled fish
Acetaldehyde	Petro Chemical Ind.	Stimulative
Styrene	Petro Chemical Ind.	Unpleasant smell of a organic solution

a) Overview

Concerning the odor problems, it is necessary to place sensible areas to offensive odor such as residential area, school area, hospital area, distant from and/or windward to the sources, in zoning process of the project.

b) Outline of Deodorization Technique

Deodorization is carried out by combustion, gas cleaning, absorption, and oxidization by ozone.

Principles of deodorization techniques are classified as Table 11.11.

Table 11.11 Deodorization Method and Related Industries

Kind of Equipment	Principle	Application of Factories
Combustion Method	Pyrolysis at high temp reduced by oxidizing catalyst	Pulp Ind., Row Sewage, Chemical Ind., Petroleum Refinery Ind.
Ozone Method	Oxidation and masking effect by ozone	
Absorption	To deodorize gas by passing it through the absorption bed filled with absorbent as activated carbon, silica gel and activated clay	
Water Washing Method	Reduced by water flow catalyst and water as scrubbing solution	Food Ind., Others

References

Industrial Pollution Control :
Industrial Pollution Control Association of Japan

Environmental Consideration Study Report for Waterfront Facility Cooperation Project :
The Overseas Coastal Area Development Institute of Japan

11.3 Conclusions and Recommendations

11.3.1 Tentative Countermeasures of Pollution Control

1) Air pollution (fugitive dust) by earth work

The fugitive dust is generated by construction machines through the earth work. Coarse particles settle down in a short term due to gravitation effect, while fine particles (smaller than 10^{-6}m) have a longer stagnated period of time. Such fine particles contain other chemical substances than soil and have bad influence on human health through contamination in bronchi and lungs. Generation of fugitive dust can be prevented to some extent by periodical sprinkling around the working face.

2) Water pollution

Seawater contamination by dredging is generated by wash outflow of the grab bucket, effluent from the reclamation through a spillway in case of suction pump dredging, etc.

To minimize the sea water pollution with fine particles, silt protector may be applied enclosing the dredging point in case of bucket dredging, sedimentation process may be employed in case of hydraulic dredging and reclamation.

The effluent intensity of fine particles under construction is estimated in terms of the concentration of suspended solid and flow rate of the construction site . It is required to adopt the data of particle size composition and flow rate for the estimation of effluent intensity calculated by the formula below.

$$Q=Ro/Rs*Wo*V*1,000,000 \quad (gr/sec)$$

where:

Q: SS generation speed by dredging (gr/sec)
Ro : Contents (%) of finer particles than the critical size which

means the minimum particle size being stabilized on the seabed against normal tidal current force

Rs : Silt contents in the sample dredging (%) Contents of finer particles than the upper limit of silt, 0.074 mm in the sample dredging

Wo : SS generation norm for Rs by the sample dredging (t/m^3)

v : Flow rate (m^3/sec)

To mitigate the influence of reclamation, the site should be enclosed with enclosure dike and the excess water should be discharged through a limited spillway after spending enough time to precipitate the suspended fine particles.

11.3.2 Recommendations on Future Investigation

1) Environmental Impact Study

(1) Background

Egyptian Environmental Affairs Agency (EEAA) requested JICA Study Team to convey its request regarding the environmental assessment. EEAA wishes JICA Study Team to assess the environmental impacts which may accompany with the project implementation.

Following is the tentative contents of Environmental Impact Study (EIS) JICA Study Team may undertake when agreed upon by all the concerned particles.

(2) Contents of the EIS

The EIS is recommended to involve two items as follows: water pollution and air pollution, which are likely to be caused by the implementation of the Project if due preventive measures are undertaken.

a) Investigation of the present condition

(a) Water pollution

i) COD, SS, Oils and Grease

- Measuring Methods : Based on the standard methods of Egyptian or Japanese Environmental Standard
- Measuring Duration : High tide

ii) Tidal current

- Measuring Methods : Special float

(b) Air pollution

i) SO2, NOx, Particulates

- Measuring Methods : Based on the standard method for Egyptian or Japanese Standerd

ii) Wind direction , wind velocity and Solar radiation
- Data Acquisition : Hearing, reference to documents
- Analytical Method : Statistical analysis for 10 year observation period

b) Prediction and evaluation

(a) Water pollution

i) Analysis of water pollution mechanism

ii) Estimate of effluent volume from the new factories in future

iii) Simulation of sea water pollution

iv) Evaluation and Recommendation if necessary

(b) Air pollution

i) Analysis of air pollution mechanism

ii) Estimate of emission volume from the new factories in future

iii) Simulation of air pollution

iv) Evaluation and Recommendation if necessary

(3) Implementation Plan

The whole process of EIS will be entrusted to a local consultant on the contract basis with the JICA Study Team.

A tentative schedule for each work items will be as follows.

- Preparation and Mobilization	0.5 Month
- On-site Survey and Data Acquisition	1.0 Month
- Data Processing and Analysis	1.0 Month
- Forecast and Evaluation	1.5 Month
- Preparation and Presentation of Report	1.0 Month
- Totally	5.0 Month

2) Monitoring

(1) Monitoring of Ambient Air Quality

a) Measurement items at monitoring station

The purpose of monitoring stations is to collect the necessary basic information. The information will be utilized for implementation of proper measures to keep the local environmental air always clean.

The measurement items at the monitoring stations varies according to purposes as follows:

The general atmospheric environment items are SO_2, NOx, CO, Ox and suspended particulate matter (SPM). Particularly for the purpose to investigate pollution caused by industries, main items are SOx, NOx, SPM. The environmental assessment for location of a factory is commonly carried out regarding these 3 items.

In addition, it is also necessary to measure wind direction, wind speed, temperature, solar radiation and other meteorological observations.

b) Structure of monitoring stations

A part of an existing building may be utilized as a fixed station.

A fixed station is usually unmanned, and should preferably be made of Ferro-concrete, but it may be of concrete block or prefabricated.

In the case of a prefabricated building, the use of heat insulating materials and air condition system are essential and windows should be made as small and few as possible (A temperature higher than 30°C is undesirable for an ordinary measuring apparatus).

c) Standing monitoring center of air pollution

Data obtained at the aforementioned monitoring stations are transmitted by the telemeter system to the central station, where these data are processed, recorded and displayed with a computer on a sequential basis in compliance with the purposes.

Regarding the control system by a computer, a micro-computer-based-air-pollution-monitoring-system was developed, and the system comprises a micro-computer unit, modem units, data logger, and public telephone lines. The telemeter system collects the data from the monitoring station once an hour, immediately processed and output tables and graphics.

The system is suited for a medium and small scale monitoring system may be sufficient for the purposes. An example of the monitoring system is illustrated in Fig. 11.6.

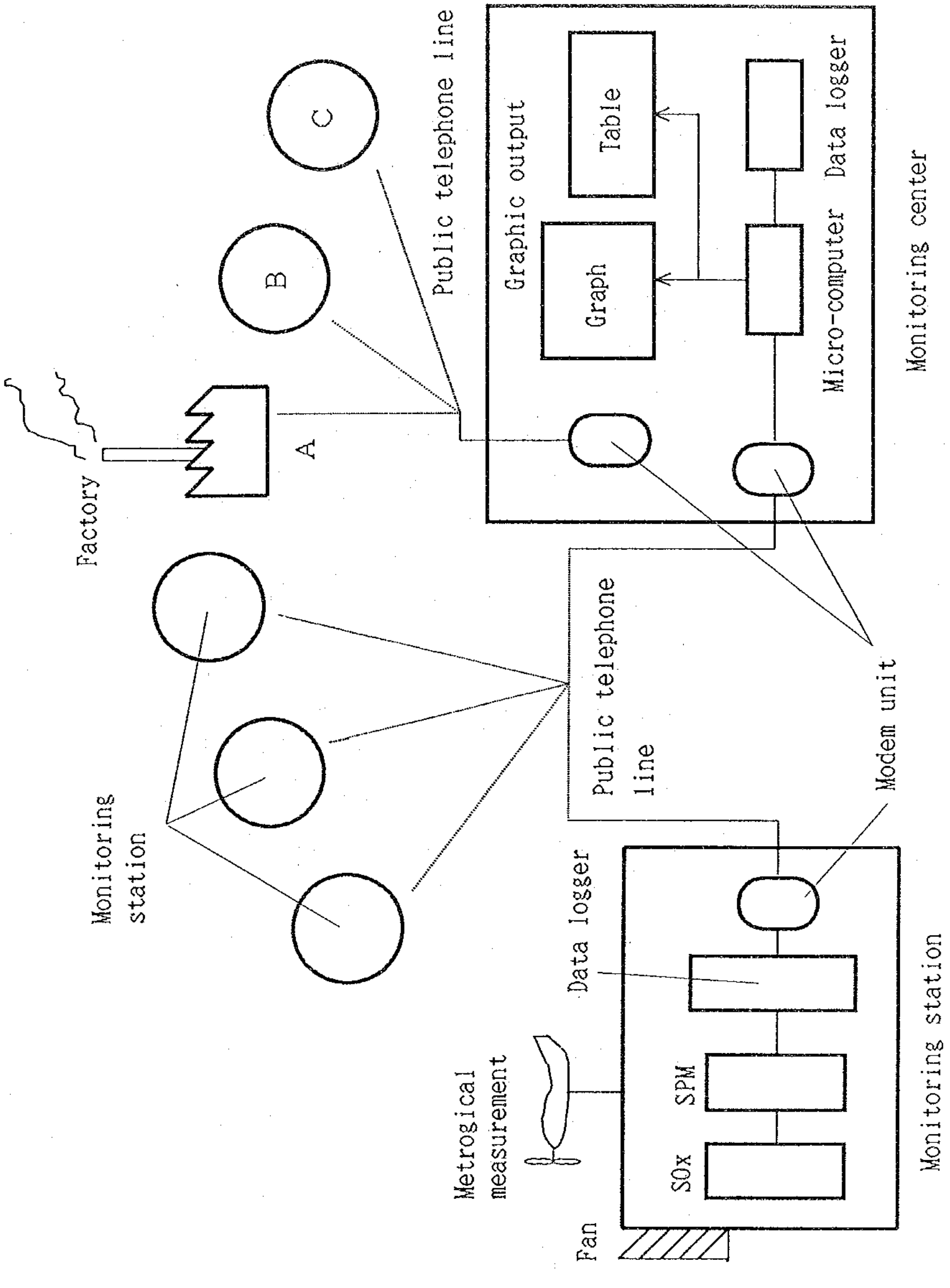

Fig. 11.6 Telemeter system of air pollution monitoring

(2) Monitoring of Water Quality

a) Method of sampling

There is a measuring method of water quality, in which the sensor is dipped in water to obtain data directly.

However, in this method, the measurable water quality items are limited in number. So, in many cases, a method is adopted in which the sample is pumped up for sampling and transferred to the laboratory, and it is applicable to this project.

b) Measurement items of water quality

The types of measuring equipment are diversified. Generally, the following equipment and measurement items are normally used.

Water temperature	:	Thermister-type, Thermometer
pH	:	Glass electrode pH meter
Electric conductivity	:	Electric conductivity meter
Turbidity	:	Scattered light turbidity meter
Dissolved oxygen	:	Membrane electrode DO meter
CN^-, NH_4^+, Cl^-, etc.	:	Ion selective electrodes

For pollution prevention plan in Suez Bay, the following items will be measured regularly.

- COD, Suspended solids (SS)
- Oils
- Phenol
- Chemical substances

Occupational health and safety of workers at the plant will be monitored on a continual basis.

Reference

Industrial Pollution Control : Industrial Pollution Control Association of Japan

CHAPTER 4 CONTRACT PACKAGES AND TENDER DOCUMENTS

4.1 Contract Packages

All civil work contracts under the Urgent Development Plan of the Suez Bay Coastal Area Development Project are divided into eleven major Work Components from A1 through A11, which are subdivided into several sub-components. Each of these sub-components consists of several work items. The major Work Components are arranged in such a manner that those having high priority and other factors are brought forward so that their implementation may be realized at an early stage and to complete the whole components within a time frame work established.

In addition to the civil work contracts, procurement contracts for grain Unloaders, Tugboats and Radar System are included in the project.

The tender will be sought on an international competitive tendering basis from pre-qualified contractors and suppliers in orderly sequence on each major component or combination thereof as needed in lieu of calling for tenders for the whole components at one time.

These components and contract packages are shown below.

(1) Civil work Contracts

A1. Ataqa I.E. & Adabiya I.F.Z.

- 1.1 Roads
- 1.2 Green Belt on the Boundary with US-AID Project
- 1.3 Water Supply Distribution Pipelines
- 1.4 Wastewater Collection Pipelines
- 1.5 Power Supply Network
- 1.6 Road Lighting
- 1.7 Telephone Conduit Network

A2. Water Treatment Works

- 2.1 Intake Pump Station
  - Structural Works

- Mechanical & Electrical Works
- Power Supply
- Buildings
- Utilities
- Gates & Fence
- Pavement & Outdoor Lighting

2.2 Aquepipeline

2.3 Water Treatment Plant

- Structural Works
- Mechanical & Electrical Works
- Power Supply
- Buildings
  - Utilities
  - Gates & Fences
  - Pavement & Outdoor Lighting

A3. Wastewater Treatment Works

3.1 Wastewater Treatment Plant

- Structural Works
- Mechanical & Electrical Works
- Power Supply
- Buildings
  - Utilities
  - Gates & Fences
  - Pavement & Outdoor Lighting
  - Drying Bed

3.2 Two Sewer Relay Pump Stations

- Structural Works
- Power Supply
- Mechanical and Electrical Works
- Buildings
- Utilities
- Gates and fences
- Pavement & Outdoor Lighting

3.3 Disposal Pipeline & Outfall

A4. Dredging and Reclamation/Quaywall

- 4.1 Dredging and Reclamation
- 4.2 Revetment and Slope Protection
- 4.3 Concrete Caisson Quaywall for Grain and Bulk
  - Cargo Berths
- 4.4 Small Boat Basin
  - Concrete Block Quaywall
  - Breakwater
- 4.5 Navigation Aids
- 4.6 PVC Pipe and Manhole for Radar

A5. Grain Silo Terminal

- 5.1 Silos
- 5.2 Mechanical, Electrical Works and Machinery Towers
- 5.3 Power Supply
- 5.4 Buildings
- 5.5 Yard and Road Pavement
- 5.6 Water Supply Pipeline
- 5.7 Sewer Collection Pipeline
- 5.8 Telephone Conduit
- 5.9 Outdoor Lighting
- 5.10 Fence
- 5.11 PVC Pipes for Radar

A6. Bulk-Cargo Terminal

- 6.1 Yard and road Pavement
- 6.2 Buildings & Watching Tower
- 6.3 Power Supply
- 6.4 Water Supply Pipeline, Telephone Conduit
- 6.5 Gate & Fence
- 6.6 Incinerator
- 6.7 Outdoor Lighting
- 6.8 Low Tension Feeder and PVC Pipe for Radar

A7. Railway

- 7.1 Railway Works incl. Signaling System and Telecommunications

7.2 Buildings
7.3 Pavement
7.4 Power Supply
7.5 Water Supply Pipeline
7.6 Outdoor Lighting

A8. Center Areas
8.1 Center A
- Buildings
- External Work
- Power Supply
8.2 Center B
- Buildings
- External Work
- Power Supply
8.3 Center C
- Buildings
- External Work
- Power Supply
- Gate and Fence

A9. Ataqa I.E. Coastal
9.1 Road
9.2 Water Supply Distribution Network
9.3 Wastewater Collection Network
9.4 Power Supply Network
9.5 Telephone Conduit Network
9.6 One Sewer Relay Pump Station
- Structural Works
- Mechanical and Electrical Works
- Power Supply
- Buildings
- Utilities
- Gate and Fence
- Pavement & Outdoor Lighting
9.7 Road Lighting

A10. Coastal Road

10.1 Road Works

10.2 Draw-off Water Supply Pipeline

10.3 Box/Pipe Culverts

10.4 Lighting

A11. Storm Water Drainage

11.1 Open Drainage Ditch

11.2 Box Culverts/Siphon/Outfall

(2) Procurement Contracts

B1. Grain Unloaders

B2. Tugboats

B3. Radar System

4.2 Contract Documents

Tender Documents for civil works contracts and procurement contracts are tabulated in Table 4.2-1 and Table 4.2-2 respectively.

Table 4.2-1 Tender Documents for Civil Works Contracts

Tender Documents	Civil work contract										
	A1.	A2.	A3.	A4.	A5.	A6.	A7.	A8.	A9.	A10	A11
Vol. I Instructions to tenderers Vol. II General Conditions of Contract	O	O	O	O	O	O	O	O	O	O	O
Vol. III Technical Specifications A	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
Vol. IV[A] General Technical Specifications (Civil Works)	O	O	O	O	O	O	O	O	O	O	O
Vol. IV[B] General Technical Specifications (Building Works)	/	O	O	/	O	O	O	O	O	/	/
Vol. V Bill of Quantities A	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11
Vol. VI Drawings A0 (General Conditions)	O	O	O	O	O	O	O	O	O	O	O
Vol. VI Drawings A	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10	A11

Table 4.2-2 Tender Documents for Procurement contracts

Tender Documents	Procurement Contract		
	B1 Grain Unloaders	B2 Tugboats	B3 Radar System
Part I Instruction to Tenderers (including Bill of Quantities)	O	O	O
Part II General conditions of the Contract	O	O	O
Part III Technical Specifications	O	O	O
Part IV Drawings	O	/	O

CHAPTER 5. PROJECT COST AND IMPLEMENTATION PROGRAMS

5.1 PROJECT COST

5.1.1 Conditions of Cost Estimation

PRICES ;

Prices of Local Currency are expressed in Egyptian pounds (L.E.), based on market prices in June, 1993.

Prices of Foreign Currency are expressed in U.S.Dollars (US$), based on market price in June, 1993.

EXCHANGE RATE ;

The exchange rate set forth as us$ 1 = L.E. 3.30

DUTIES AND TAXES ;

Customs duties for the imported equipment and materials are excluded from the cost estimation.

Duties and taxes for the dredger(s), floating dock, floating equipment and sliding form etc. to be re-exported are not included in the cost estimation.

CONTINGENCY ;

Price escalation and physical contingency are not considered.

5.1.2 METHOD OF COST ESTIMATION

(1) Composition of estimate cost

Composition of civil work cost is shown in Fig 5.1.1.

(2) The ratio for Indirect Cost for Civil Work

No standard or code for the ratio of indirect cost and general management expense is available in Egypt. However, the ratio of 25% to 40% from direct cost is generally applied for general construction in Egypt

For the Project, the standards for cost estimation of Ministry of Construction and Ministry of Transport in Japan have been applied as follows ;

(a) Common Temporary Work

Common temporary work is composed of mobilization cost, Preparation cost, Work loss prevention facility cost, temporary work cost, Security cost, Service cost, Technical management cost and injury insurance.

The Ratio ;

For Marine Structure

3.1 % of Total Indirect Cost

For Dredging and Other works

1.5 % of Total Indirect Cost

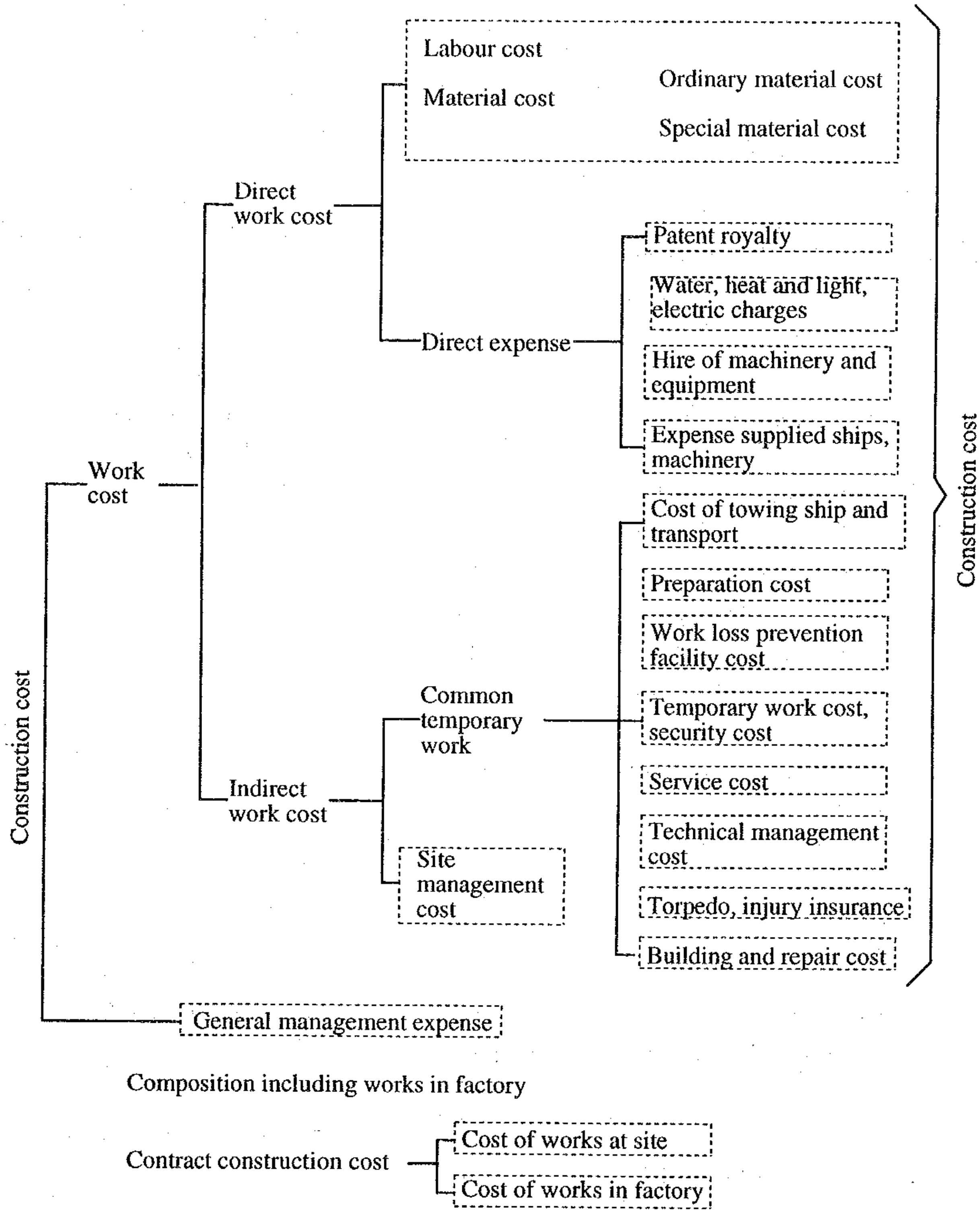

Figure 5.1.1 Composition of civil work estimate cost

(b) Site Management Cost

The Ratio ;

For marine structure
11.7 % of Total Indirect Cost

For Dredging and Other works
10.7 % of Total Indirect Cost

(c) General Management Expanses

The Ratio ;

9.4 % is applied for all civil works of each Component Cost exceeds 10 Million US$.

(d) Total Ratio of Overhead

	Indirect Cost	(1.000)
+	Common Temporary Work	(0.015)
+	Site Management Cost	(0.107)
		1.122
X	(1 + General Management Cost =	0.094)

(1 + 0.015 + 0.107) X (1 + 0.094) = 1.227

23 % is applied for total ratio of overhead.

(e) For cost estimates for mechanical and electrical works, machinery and product costs are calculated based on internal market prices.

Cost of installation of mechanical and electrical works are calculated based on direct cost plus overhead cost (23% of direct cost).

(3) Surveyed Price and Applied Price

Prices necessary for the Construction works were surveyed in May - June, 1993. Applied Price includes Sales Tax (10% of material cost).

(a) Labor Wage

Items	Surveyed price	Description	Taxes duties	Over head	Applied price
Labor Wages	(Per Month)				(L.E./Day)
1. Foremen	1,000		include	23 %	50
2. Operator	800	Heavy equip.	include		40
3. Operator	600	Light equip.	include		30
4. Carpenter	700		include		35
5. Mason	700		include		35
6. Welder	800		include		40
7. Shop Electrician	800		include		40
8. Mechanician	800		include		40
9. Skilled Labor	800		include		40
10.Common Labor	500		include		25
11.Crew of Floating equipment	600		include		30
12.Diver Class A	4,500	Local	include		40
13.Diver Normal	1,500	Local	include		30
14.Chief Admini	1,000		include		35
15.Clerk	600		include		35
16.Draftsman	500		include		40

The labour wage includes taxes, duties, insurance, social change, etc.

(b) Fuel & Energy

Items		Surveyed price	Description	Taxes duties	Over head	Applied price
Fuel & Energy						(L.E.)
1.	Gasoline	0.9/L	Regular	include	23 %	1.1/L
		1.0/L	Premium			1.2
	Diesel	0.3/L				0.4
	Bunker oil	0.1/L				0.1
	Lubricant	2.9/kg				3.6
2.	Asphalt	88/ton	Solid			108
	Joint Filler	3/kg				3.7
3.	Welding Rod	6.0/kg	Steel			7.4
4.	Oxygen	20/pcs				24.6
5.	Acetylene	50/PC				61.5
6.	Fresh Water	15.0/ton	for ship			18.5
		10.0/ton	for rolley			12.3
7.	Power supply	0.20/Kwh	220 volt			0.25

* Fresh Water

Transportation cost to Jetty 10 L.E./ton

Transportation cost in Land 5 L.E./ton

(c) Material & Secondary Products

Items	Surveyed price	Description	Taxes duties	Over head	Applied price
Stone Material					(L.E.)
1. Aggregate	19 /cu.m	3-12 mm	10 %	23 %	25.7
	14 /cu.m	12-22 mm	10 %	23 %	19.0
	11 /cu.m	22-32 mm	10 %	23 %	14.9
2. Gravel	12 /cu.m	Sub base	10 %	23 %	16.2
	17 /cu.m	Grade 1	10 %	23 %	23.0
	14 /cu.m	Grade 2	10 %	23 %	18.9
3. Armor Stone	26 /cu.m	5- 50 kg/pcs	10 %	23 %	35.2
	29 /cu.m	50-200 kg/pcs	10 %	23 %	39.2
	34 /cu.m	200-500 kg/pcs	10 %	23 %	46.0
	44 /cu.m	1- 3 kg/pcs	10 %	23 %	59.5
4. Sand	10 /cu.m	First class	10 %	23 %	13.5
	7 /cu.m	Second class	10 %	23 %	9.5
	4 /cu/m	Third class	10 %	23 %	5.4
Steel Re-bars					
1. Plain Bar	1,230/t	Dia. 10 mm	10 %	23 %	1,664
ST37	1,200/t	Dia. 12 mm			1,623
	1,190/t	Dia. 16 mm			1,610
	1,180/t	Dia. 19-25 mm			1,597
2. Deformed Bar	1,280/t	Dia. 10 mm			1,732
ST52	1,250/t	12 mm			1,691
	1,240/t	16 mm			1,678
	1,230/t	19-25 mm			1,664
	1,300/t	28 mm			1,759
Steel Shapes & Pipes					
1. Steel Shape					
ST37	1,420/t	H 100-200	10 %	23 %	1,921
ST44					
ST37	1,400/t	L 100-200			1,894
ST44					
ST37	1,400/t	Channel			1,894
ST44		100-200			
2. Steel pipe	3.5/m	Dia. 15 mm			4.7
ST37	3.5/m	25 mm			5.3
	7.1/m	50 mm			9.6
	14.3/m	80 mm			19.3
	17.6/m	100 mm			23.8
3. Steel pipe pile		Dia.400-600 mm			
ST42		700 mm			
	4,300/t	800-900 mm			5,818
		1,000 mm			
		1,200 mm			

Items	Surveyed price	Description	Taxes duties	Over head	Applied price
Cement and Concrete Products					(L.E.)
1. Cement Type I	140.05/t	Porte	10 %	23 %	190
Type III	150.25/t	High Strength			203
Type V	180.00/t	Sulpher Resist			244
2. R.C.	Pipe 7/m+ 3	Dia. 150 mm	13.0%	23 %	10+ 4
	13/m+ 4	250 mm			18+ 5
	20 m+ 8	350 mm			27+ 9
	23/m+14	500 mm			31+16
	53/m+29	700 mm			72+39
	81/m+57	900 mm			111+75
	119/m+69	1,100 mm			150+93
	148/m+-	1,300 mm			200
	161/m+-	1,400 mm			218
	232/m+-	1,500 mm			314
	387/m+-	2,000 mm			524
Building Fitting & Timber					
1. Cement Block	520/1000	40X40X40	10 %	23 %	703
	320/1000	40X20X12			493
	130/1000	25X12X6			176
2. Aluminum Window	666/pcs	280X70			901
	311/pcs	180x85			421
3. Tile (Floor)	20/sq.m	300X300X30			27
	14/sq.m	200X200X20			19
4. Painting	7/kg	O & E Paint			9
5. Bath facilities	2,000/set	Unit Type			2,706
6. Air Conditioner	4,365	3 HP			5,905
7. Timber(Sweden)	900/cu.m	100X100X6000mm include		23 %	1,107
(Chile)	800/cu.m	100X100X4000mm			984
8. Plywood(Korea)	85/pcs	12X122X2440mm			105
(Yugo)	130/pcs	18X122X2440mm			160
9. PVC Pipe	4.0/pcs	Dia. 50, 2.4 mm			5
	17.0/pcs	110, 5.3 mm			21
	35.0/pcs	160, 7.7 mm			43
	54.0/pcs	200, 9.6 mm			60

(d) Rental Charge for Equipment

Items	Surveyed price	Description	Taxes duties	Over head	Applied price
Equipment Cost					(L.E.)
1. Pump Dredger	4,400/D	1,000 HP	include	23 %	5,412
2. Grub Dredger		6 cu.m bucket			
3. Flat Barge	550/D	400 tons			676
4. Floating Crane	3,500/D	100T lifting			4,305
5. Tug Boat	1,200/D	300 HP			1,476
6. Passenger Boat	250/D	20-50 HP			307
7. Stone barge	1,500/D	300 tons			1,845
8. Grab Barge	300/D	2 cu.m bucket			369
9. Floating Crane	1,000$/h	500 ton			1,230
10.Tug Boat	500$/h	3,000 HP			615
11.Compactor Roller	450/D	25 tons			553
12.Bulldozer	800/D	D-7			984
13.Grader	450/D	100 HP			553
14.Back Hoe	800/D	1.25 cu.m			984
15. Cargo Truck	200/D	10ton			246
16.Dump Truck	250/D	12 cu.m			307
17.Crawler Crane	900/D	40 ton			1,107
18.Truck Crane	700/D	40 ton			861
19.Trailer	350/D	40 ton			430
20.Concrete Mixer	500/D	1-bagger			615
21.Water Truck	300/D	12 cu.m			369
22.Pile Hammer	1,200/D	5 ton			1,476
23.Pile Driver	1,100/D	35 t (3t hammer)			1,353
24.Pile Driver	1,200/D	45 t (5t hammer)			1,476
25.Welding Machine	250/D	400 A			307
26.Concrete Pump	1,650/D	95 HP			2,030
27.Air Compressor	350/D	120 HP			430
28.Transit Mixer	450/D	6 cu.m			553
29.Batching Plant	450/D	35 cu.m			553
30.Wheel Loader	400/D	2 cu.m			492
31.Driver Boat	-----	with winch			2t
32.Power Shovel	1,000/D	1.5 cu.m			1,230
33.Bulldozer Rigger	1,200/D	D-9 ripper			1,476

* Operator, Driver, crew included, but fuel cost excluded.

(4) Unit cost for construction works

(a) Earth work

Cost Items	Surveyed unit cost	Description	Applied price
1. Excavation			(L.E.)
1.1 Excavation soil	6.0/cu.m	*	7.4/cu.m
1.2 Ditto, soft rock	10.0/cu.m	*	12.3/cu.m
1.3 Ditto, ripper	20.0/cu.m	D-9 work	24.6/cu.m
1.4 Ditto, gunpowder	35.0/cu.m		43.0/cu.m
2 Transport Soil			
2.1 Transport soil	1.5/cu.m	by bull. L=30m	1.8/cu.m
2.2 Ditto,	2.0/cu.m	within 1 km	2.5/cu.m
2.3 Ditto,	2.5/cu.m	ave. 3 km	3.0/cu.m
3. Back filling	3.0/cu.m	*	3.6/cu.m
4. Grading	0.5/sq.m		0.6/cu.m
5. Compaction	1.5/sq.m		1.8/cu.m

Breakdown :

Earth Work

Item	Unit	Quantity	Unit Price	Amount	Remarks
1.1 Excavation soil	m3	3.5			
Common labour	day	1.0	25	25	
Material etc.	LS	1		0.9	
Total	m3	3.5		25.9	
	m3	1.0		7.4	
1.2 Excavation,soft rock	m3	9			
Common labour	day	4	25	100	
Material etc.	LS	1		10	
Total	m3	9		110	
	m3	1		12.3	
3 Buck filling	m3	7			
Common labour	day	1	25	25	3.6L.E./m3
Material etc.	LS	1		0.25	3.6/10
Total	m3	7		25.25	=1.20
	m3	1			3.6

(b) Road & Pavement

Cost Items	Surveyed unit cost	Description	Applied price
1. Sub Soil			(L.E.)
1.1 Sub-soil cutting	6.0/cu.m	Soil	7.4/cu.m
1.2 Ditto	10.0/cu.m	Soft rock	12.3/cu.m
1.3 Sub-soil Banking	6.0/cu.m	by bulldozer	7.4/cu.m
1.4 Sub-soil Grading	2.0/cu.m	2.5/cu.m	
2. Sub base course			
2.1 Sub Base Course	3.0/sq.m	200mm	3.5/sq.m
2.2 Ditto	4.0/sq.m	250 mm	4.6/sq.m
2.3 Ditto	5.0/sq.m	300 mm	5.8/sq.m
2.4 Ditto	6.0/sq.m	350 mm	7.0/sq.m
3. Base Course			
3.1 Base Course	4.0/sq.m	100 mm	4.6/sq.m
3.2 Ditto	5.0/sq.m	150 mm	5.8/sq.m
3.3 Ditto	6.0/sq.m	200 mm	6.9/sq.m
3.4 Ditto	8.0/sq.m	350 mm	9.2/sq.m
4. Coating			
4.1 Prime Coating	1.8/sq.m		2.2/sq.m
4.2 Tug Coating	1.5/sq.m		1.8/sq.m
5. Asphalt Pavement			
5.1 Asphalt Pavement	22.0/sq.m	100 mm	33.0/sq.m
5.2 Ditto	32.0/sq.m	150 mm	48.0/sq.m
5.3 Ditto	53.0/sq.m	250 mm	80.0/sq.m
6. Concrete Pavement			
6.1 Concrete Pavement	70.0/sq.m	200 mm	66.0/sq.m
6.2 Ditto	105.0/sq.m	300 mm	98.0/sq.m
6.3 Ditto	125.0/sq.m	350 mm	118.0/sq.m

Breakdown ;

Road Pavement

Item	Unit	Quantity	Unit Price	Amount	Remarks
2.3 Sub base course D=300	sq.m	100		0	
1) Gravel/sand	cu.m	40.50	11.5	165.75	u.p.13.5+9.5/2
2) Motor spreader	dr	0.52	92	47.84	
3) Roller	hr	0.44	92	40.48	
4) Compactor Roller	hr	0.29	92	26.68	
Sub Total				580.75	5.8 L.E./m2

Item	Unit	Quantity	Unit Price	Amount	Remarks
3.3 Sub base course D=200	sq.m	100			
1) Crusher run Grade 2	cu.m	18	18.9	340.2	
2) Crushed stone Grade 1	cu.m	10	23	230	
3) Motor grader	hr	0.52	92	47.84	
4) Roller	hr	0.44	92	40.48	
5) Compactor Roller	hr	0.29	92	26.68	
Sub Total				685.2	6.9 kg/m2
5.2 Asphalt pavement D=150	sq.m	100			
1) As-Con ton	35.3	108	3,812.4		
2) Asphalt finisher 300 kg/cm2	hr	0.46	140	64.4	
3) Tag prime coat	L	160	3.7	592	
4) Labor men	1.6	30	48		
5) Roller	hr	2.8	92	257.6	
6) Fuel etc.	sum	1	0	0	
Sub Total				4,774.4	48 L.E./m2
6.2 Concrete pavement D=300	sq.m	100			
1) Concrete on site 300 kg/cm2	cu.m	30.9	185	5,716.5	
2) Labor men	16.7	92	1,536.4		
3) Spreader, etc.	hr	1.2	180	216	
4) Steel mesh 4.6 150X150	m2	110	12	1,320	3.1kg/m2X3.6LE
5) Reinforced bar D16X80mm	kg	128	2	256	u.p.1.67+0.32
6) Joint bar	m	30	22.5	675	u.p.4.5kgX5
7) Curing	san	1			
Sub	Total			9,719.9	98 L.E./m2

(c) Concrete works

Cost Items	Surveyed unit cost	Description	Applied price
1. Material on site			
1.1 Type I 150 kg/cm2	120/L.E./m3		120/L.E./m3
1.2 Type I 180 kg/cm2	125/L.E./m3		125/L.E./m3
1.3 Type I 210 kg/cm2	130/L.E./m3		130/L.E./m3
1.4 Type I 240 kg/cm2	140/L.E./m3		140/L.E./m3
1.5 Pavement	150/L.E./m3		150/L.E./m3
1.6 Type V 150 kg/cm2	135/L.E./m3		135/L.E./m3
1.7 Type V 180 kg/cm2	140/L.E./m3		140/L.E./m3
1.8 Type V 210 kg/cm2	145/L.E./m3		145/L.E./m3
1.9 Type V 240 kg/cm2	160/L.E./m3		160/L.E./m3
1.10 Pavement	170/L.E./m3		170/L.E./m3

Cost Items	Surveyed unit cost	Description	Applied price
2. Casting			(L.E.)
2.1 Mass con. H<2.5m	8/cu.m		8/cu.m
2.2 Wall etc. H<2.5 m	12/cu.m		12/cu.m
2.3 Casting by pump	15/cu.m		15/cu.m
2.4 Casting by hopper	10/cu.m		10/cu.m
2.5 By pump offshore	20/cu.m		20/cu.m
3. Shuttering work			
3.1 Easy	12/sq.m		14/sq.m
3.2 Normal	15/sq.m		17/sq.m
3.3 Sliding form etc.	20+10$/sq.m	with Royality	23LE + 10$
3.4 Staging	3/sq.m	without mat	3.5/sq.m
+ Renral Stage	+ 1.5/m2/day	Height=15m	+1.7/m2/day
4. Reinforcement			
4.1 Less than 13 mm	350/ton	without Materi	350/ton
4.2 More than 13 mm	300/ton	-a	300/ton
4.3 Ditto, with welding	450/ton	450/ton	

Breakdown :

Item	Unit	Quantity	Unit Price	Amount	Remarks
1.4 Material 240kg/sq.m	cu.m	10			
1) Aggregate 12-22mm	cu.m	4.7	19	89.3	
2) Aggregate 3-12mm	cu.m	2.1	25.7	53.97	
3) Natural sand First Class	cu.m	3.9	13.5	52.65	
4) Water	cu.m	2.2	10	22	
5) Cement Type I	ton	1		47	
Sub Total				929.92	93L.E./m3
1.4 Mixing/Transport(Common)	cu.m	10			
1) Bathing plant	day	0.1	553	55.3	
2) Wheel dozer	day	0.2	492	98.4	
3) Transit mixer	day	0.4	553	221.2	
4) Labor cost	men	2	30	60	
5) Miscellaneous	sum	1			35.1
SubTotal				470	47 L.E./m3
1.4 Material on site Type I (240kg/cm2)					
1) Material	cu.m	1	93	93	
2) Mixing / Transport	cu.m	1	47	47	
Sub Total				140	

5.1.3 Project Cost

Project cost is calculated based on the conditions set forth in 5.11 and 5.1.2. The summary of total project cost is shown in Table 5.1.1.

Table 5.1.1 Summary of Project Cost

Unit: million L.E.&US$

Items	Foreign Currency Portion (US$)	Local Currency Portion (LE)
Civil Work Contract A_1-A_{11}	188.4	477.9
Procurement Contract B_1-B_2	27.4	5.0
Total	215.8	482.9

Note: 1) Project cost was calculated based on the market price in 1993.

Table 5.1.2 Project Cost

Unit: million L.E. & US$

Items	Foreign Currency Portion (US$)	Local Currency Portion (LE)
A1	5.2	126.2
A2	63.6	59.6
A3	49.1	60.9
A4	22.6	69.3
A5	41.2	65.9
A6	0.4	10.6
A7	4.5	12.2
A8	-	17.2
A9	1.7	22.6
A10	0.1	26.2
A11	-	7.2
Sub total	188.4	477.9
B1	12.9	4.0
B2	12.2	0.3
B3	2.3	0.7
Sub total	27.4	5.0
Total	215.8	482.9

5.2 IMPLEMENTATION PROGRAMS

5.2.1 General

The implementation period for the project, "The Urgent Development Project", is considered to require 7 years as discussed with MODANC.

For the preparation of the implementation schedule, it is assumed that the project will be commenced at the beginning of fiscal year 1994/1995. Tender procedure will need for one year. The construction will be started at the beginning of fiscal year 1995/1996.

5.2.2 Construction and Supply Period of Components

Construction and supply period of each component is estimated as follows:

	Component	Construction/Supply Period (years)
A1	Ataqa I.E. & Adabiya I.F.Z.	2.0
A2	Water Treatment Works	2.5
A3	Waste Water Treatment Works	2.5
A4	Dredging and Reclamation/Quay wall	3.5
A5	Grain Silo Terminal	3.0
A6	Bulk-Cargo Terminal	2.0
A7	Railway	2.0
A8	Center Area (Buildings)	1.5
A9	Ataqa I.E. Coastal	1.5
A10	Coastal Road	2.0
A11	Storm Water Drainage	2.0
B1	Grain Unloaders	2.0
B2	Tugboats	2.0
B3	Radar System	2.0

Note: A = Civil and Building work contracts, B = Procurement contracts

5.2.3 Implementation Programs

Implementation Programs are prepared taking into account the following factors:

(a) Land Demand Factors

- As evidenced by locations of the three factories at the area along the Cairo-Adabiya Coastal Road (Suez-Ain Sukuna Road) in the proposed Ataqa I.E., there are ever increasing demands for industrial land which allows earlier occupancy. Their activities do not depend on the proposed port facilities of Ataqa.
- Those industries that depend of the Ataqa port will be come in after completion of the said facilities.

(b) Supply Factors of Necessary Infra Structures

Implementation programs are established based on the following supply factors.

- Coordination with the external facilities (ports, water, electricity, etc.)
- Optimization of phased water supply and waste water treatment plant.
- Consideration of dust control, noise, traffic jam, etc. during construction of the buffer green belt along the US-AID waste water treatment plant prior to locating of factory buildings in the northwestern area of the Estate.
- Continuous labour supply during construction

Ataqa I.E. will be developed at the beginning stage since factories have been located in the area. Adabiya I.F.Z. is also to be developed at the beginning stage considering the size of development required, location, availability of services at the Adabiya Port and operation and management guidelines of the General Authority for Investment (GAFI).

According to the information obtained from the Red Sea Port Authority, Adabiya Port will be extended to the total quay length of 2,060m (The first stage of the Ministry of Maritime Transportation Plan) by the end of 1997. Therefore, export/import of cargoes to/from Adabiya I.F.Z. will be possible through Adabiya Port at the beginning of year 1998.

Regarding the development of Ataqa I.E. Coastal, the timing for commencement of development should be decided in accordance with the tendency of investors request.

In the implementation schedule, it is assumed that these areas are to be developed in the period from the middle of fiscal year 1997/1998 to the end of fiscal year 1998/1999.

According to the discussions with MODANC and authorities concerned, the grain products to be handled at the Ataqa Port will be 1.3 million ton in the year 2000.

If the dredging/reclamation works and the construction for the quay of grain terminal are commenced at the beginning of fiscal year 1995/1996, the grain handling at the Ataqa Port will be possible from the middle of year 2000.

Based on the factors mentioned above, the implementation schedule has been prepared as shown in Table 5.2.1.

Annual disbursement schedule of the construction costs is shown in Figure 5.2.2.

Fiscal Year	94-95	95-96	96-97	97-98	98-99	99-00	00-01	Remarks
Project Calendar Year	1	2	3	4	5	6	7	
Items								
Tendering	━							
A1 Ataqa I.E. and Adabiya I.F.Z.		━	━					
A2 Water Treatment Works		━	━	━				
A3 Wastewater Treatment Works		━	━	━				
A4 Dredging and Reclamation/ Quay wall		━	━	━	━			
A5 Grain Silo Terminal				━	━	━		
A6 Bulk-Cargo Terminal					━	━		
A7 Railway					━	━		
A8 Center Areas (Buildings)		━	━					
A9 Ataqa I.E. Coastal				━	━			
A10 Coastal Road						━	━	
A11 Storm Water Drainage		━	━	━				
B1 Grainage Unloaders					━	━		
B2 Tugboats					━	━		
B3 Radar System					━	━		

Figure 5.2.1 Implementation Schedule of the Project

Table 5.2.1 Disbursement Schedule

Unit: million L.E./US$

Fiscal Year	'94-95	'95-96	'96-97	'97-98	'98-99	'99-00	'00-01	Total
Project calender year	1	2	3	4	5	6	7	
Foreign currency portion (US$)	-	31.70	54.00	65.70	34.35	30.00	0.05	215.80
Local currency portion (L.E.)	-	114.80	146.00	99.20	60.80	49.00	13.10	482.90

Note: Project cost was estimated based on the market price in 1993.

Table 5.2.2 Disbursement Schedule of Local Currency Portion

Unit: Million L.E.

Project Year	1	2	3	4	5	6	7	Total cost
A 1		63.10	63.10					126.20
A 2		12.00	23.80	23.80				59.60
A 3		12.30	24.30	24.30				60.90
A 4		19.80	19.80	19.80	9.90			69.30
A 5				21.90	22.00	22.00		65.90
A 6					5.30	5.30		10.60
A 7					6.10	6.10		12.20
A 8		5.80	11.40					17.20
A 9				7.60	15.00			22.60
A 10						13.10	13.10	26.20
A 11		1.80	3.60	1.80				7.20
Sub Total		114.80	146.00	99.20	58.30	46.50	13.10	477.90
B 1					2.00	2.00		4.00
B 2					0.15	0.15		0.30
B 3					0.35	0.35		0.70
Sub Total					2.50	2.50		5.00
Total		114.80	146.00	99.20	60.80	49.00	13.10	482.90

Table 5.2.3 Disbursement Schedule of Foreign Currency Portion

Unit: Million US$

Project Year	1	2	3	4	5	6	7	Total cost
A 1		2.60	2.60					5.20
A 2		12.80	25.40	25.40				63.60
A 3		9.90	19.60	19.60				49.10
A 4		6.40	6.40	6.40	3.40			22.60
A 5				13.70	13.70	13.80		41.20
A 6					0.20	0.20		0.40
A 7					2.25	2.25		4.50
A 8		0.00	0.00					0.00
A 9				0.60	1.10			1.70
A 10						0.05	0.05	0.10
A 11		0.00	0.00	0.00				0.00
Sub Total		31.70	54.00	65.70	20.65	16.30	0.05	188.40
B 1					6.45	6.45		12.90
B 2					6.10	6.10		12.20
B 3					1.15	1.15		2.30
Sub Total					13.70	13.70		27.40
Total		31.70	54.00	65.70	34.35	30.00	0.05	215.80

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