12.8 Initial Environmental Examination

a) Existing situation

The existing water quality, sediment quality, and air quality were assessed by the site survey and the results were given in Chapter 7. Not all of these parameters are covered by standards but those which are subject to regulatory guidelines are discussed below.

The results obtained at Tartous are given in Table 12-8-1 and are compared with the relevant standard.

Temperature was consistent across the sites with little variation between 18.2 to 18.9°C. The standard requires that temperature of seawater should not be raised by more than 2°C although a mixing zone is allowed. Thermal discharges are normally expected from power stations or large industry that have cooling water requirements. These do not presently exist at Tartous and none are planned in the future. Therefore this parameter is acceptable.

Values for **pH** showed little variation between 7.62 and 7.96 which is normal given the large buffering capacity of the sea. An acceptable range is 7.0-8.3 This parameter is acceptable.

Salinity was consistently high ranging from 36.6 to 39.7 parts per thousand which is typical of Mediterranean waters. Salinity should not be allowed to change by more than 5% on the background level. There is no intention to introduce any new industrial discharges which would be high in total dissolved salts either now or in the future in Tartous. Therefore this parameter is acceptable.

Dissolved Oxygen varied between 8.0 and 10.5 mg/l compared with a conservative standard of 7.5 mg/l. At the time of the measurements the temperature of the water was quite cold and so these figures are approaching saturation at around 9 mg/l. This indicates a healthy oxygen regime for aquatic life particularly fish. Tartous is fortunate in the fact that the sewage outfalls from the town do not flow directly into the harbour but in general cross the beach and so discharge directly into the sea. Therefore the biological organic load is not as high as in other locations such as Latakia. Also the planned sewage treatment plant should ensure that the situation of sewage discharging into the harbour does not occur. This parameter is acceptable.

Transparency varied from 107cm to 200cm, against a standard of 250cm. This is considered to be a marginal infringement and for a port represents clean water.

Chemical Oxygen Demand (COD) varied between 6.3 mg/l and 9.3 mg/l. Although this represents a slight infringement of the standard of 8 mg/l at all of the sites the figures are low and indicates little organic or inorganic pollution load

TABLE 12-8-1 COMPARISON OF SITE DATA WITH STANDARDS-TARTOUS

ENVIRONMENTAL PARAMETERS FOR WHICH STANDARDS APPLY														
PORT:	TARTOUS													
			SITE 1	SITE 2	SITE 3	SITE 4	SITE 5	STANDARD	SOURCE	SITES WHICH EXCEED STANDARD				
PARAMETER	SAMPLE TYPE	UNITS								1	2	3	4	5
TEMPERATURE	WATER	°C	18.9	18.2	18.7	18.8	18.8	<+2 increase	AUS	-	-	-	-	-
pH	WATER	pH	7.7	7.6	8.0	7.8	7.7	7.0-8.3	JAPAN	-	-	-	-	-
SALINITY	WATER	PPTHOUSAND	36.6	38.5	38.7	38.7	39.7	<5% change	AUS	-	-	-	-	-
DISSOLVED OXYGEN	WATER	mg/l	10.5	10.4	8.1	8.0	8.0	7.5	JAPAN	-	-	-	-	-
TRANSPARENCY	WATER	cm.	125	116	200	133	107	250	JAPAN	O	O	O	O	O
COD	WATER	mg/l	6.3	9.3	8.9	8.9	9.3	8	JAPAN	-	O	O	O	O
SULPHIDE	WATER	ppm	1.6	1.6	0.0	0.8	0.0	0.002	USEPA	●	●	-	●	-
TOTAL NITROGEN	WATER	μg/l	0.06	0.07	0.07	0.06	0.07	60	AUS	-	-	-	-	-
TOTAL PHOSPHORUS	WATER	mg/l	0.05	0.13	0.05	0.05	0.06	0.01	AUS	O	●	O	O	O
PHOSPHATE	WATER	mg/l	0.15	0.41	0.17	0.15	0.20	0.015	JAPAN	●	●	●	●	●
SUSPENDED SOLIDS	WATER	mg/l	24	88	168	311	35	25	USEPA	-	O	O	●	O
OIL GREASE	WATER	mg/l	4.6	7.6	3.3	1.3	1.3	0.5	JAPAN	O	●	O	O	O
CHLORINE	WATER	mg/l	trace	trace	trace	trace	trace	2	MALAYSIA	-	-	-	-	-
COLIFORMS	WATER	N/100ml	6	19	7	13	1	1000	JAPAN	-	-	-	-	-
ARSENIC	SEDIMENTS	ppm(dry weight)	15	36	27	51	138	12.5	USA	O	O	O	O	O
COPPER	SEDIMENTS	ppm(dry weight)	23	29	27	24	24	45	CANADA	-	-	-	-	-
MERCURY	SEDIMENTS	ppm(dry weight)	8	9	20	37	82	0.15	USA	●	●	●	●	●
ZINC	SEDIMENTS	ppm(dry weight)	94	123	92	126	41	105	USA	-	O	-	O	-

Compliance with standard

"-" within standard

" O " Exceeds standard by small amount (less than 10)

" ● " Exceeds standard by large amount (more than order of magnitude) in the harbour.

Sulphide content was recorded at a maximum of 1.6 mg/l which is considerably above the standard of 0.002ppm although in two cases none was detected. This indicates localised areas of possibly anaerobic degradation although not prevalent throughout the harbour.

Total Nitrogen was consistently around 0.07 µg/l which is low but typical for these waters.

Total Phosphorus was high and indicates a significant pollution load. This is not necessarily arising within the harbour as the sewage pipes from the city do not enter the harbour but discharge across the beaches. Also the level measured outside the harbour was as high as some of those measured in the harbour and indicates a generally high level in the coastal waters. This situation should improve with the implementation of the new sewage master plan.

Phosphates were consistently much higher than the standard as would be expected from the phosphate loading operation. The standard was exceeded by more than an order of magnitude.

Suspended Solids varied between 24 mg/l and 168 mg/l which corresponds to a range of clear to moderately turbid water quality. In general for a port the water was of high clarity.

Oil and Grease was significantly above the standard at all locations including outside the port. As the oil loading terminal is nearby to the north of Tartous this is perhaps understandable. The levels are not so high as to give cause for concern but would suggest that tighter controls could be exercised over ships discharging small amounts of oil which is contrary to the policy of the port authorities.

Free Chlorine was only detected in trace concentrations of no significance.

Coliform counts were very low indicating that the bacterial contamination from the sewage flows from the town are subject to a high mortality rate by the time they reach the waters of the harbour. The waters are within the standards required for recreation and bathing.

Sediments

There are no generally accepted standards for sediments as their ability to effect the surrounding waters varies with local conditions. A major concern is heavy metals which can pass into the water and result in biomagnification and bioaccumulation in the various trophic layers of the food chain. These are discussed below. Standards which can be applied relate to dumping of sludge and are drawn from USEPA, Canada and Japan. This would be a similar situation to dredging or dumping of dredged material.

Arsenic varied from 15ppm to 138ppm against a standard of 12.5ppm. In general this is considered to be a borderline case of exceeding the standard, except for the highest value which is over ten times the standard and which occurs outside the port. This would suggest the heavy metals concentration is due to activities not connected with the port.

Copper was consistent at 23ppm to 29ppm against a standard of 45ppm. This is within the standard.

Zinc varied from 92ppm to 126ppm inside the port with a level of 41ppm outside the port. The standard is 105ppm. This is considered to be a borderline case of exceeding the standard.

Total Mercury varied from 8ppm to 37ppm against a standard of 0.15ppm, with the highest level of 82ppm occurring outside the port. This represents a serious exceedance of the standard at all locations and suggests that large concentrations of mercury are present in the harbour bottom sediments. If dredging were to take place these sediments could be disturbed, reentrained into the water, and the mercury could then pose a potential environmental threat. It is significant that the highest level occurred outside the port suggesting that an industrial activity is responsible for the large concentrations measured.

b) **Air Quality**

In order to assess air quality, monitoring was carried out at three locations around the port, designated Sites A, B, and C. One of these was in close proximity to the phosphate loading pier, the other two were on the perimeter of the port.

Air quality was measured in accordance with standard practices to assess total suspended particulate matter using High Volume Samplers. The details are given in Chapter 7.

The standard for air quality based on USEPA requirements is 260$\mu g/m^3$ for a 24 hour period. The standard based on WHO requirements is 150$\mu g/m^3$. The levels measured in the port were 81$\mu g/m^3$ to 788$\mu g/m^3$. This indicates that the levels in the port are in excess of the standard. The levels measured at the boundary of the site are within the standard.

The results indicate that the dust within the port is arising from the phosphate loading operation and dust from traffic movements.

Environmental Concerns over Phosphate Handling

Phosphate ore is mined near Palmyra and transferred by rail to the handling facility at Tartous port. The shipment of phosphate ore has three environmental aspects of concern. These are:

- o Air pollution and dust from handling which can pose a threat to health
- o Water pollution due to phosphate entering the water and acting as an excessive supply of nutrient and so leading to eutrophication
- o Phosphate rock being treated as hazardous waste

These are addressed below.

Air Pollution

In 1979 the USEPA proposed standards for phosphate rock plants[1]. The aims of these standards was to require the best demonstrated technology for the control of particulate emission to be installed on phosphate plants. These standards limit emissions from dryers, calciners, grinders and phosphate rock handling and storage facilities. The basis of the standard was a limit on emission depending on the size of the operation. That is to say the larger the plant, the larger the allowed emission. For grinding and preparation plant the limit was a maximum of 0.02kg per tonne of material processed. Nevertheless the emissions had to pass through a filter and the standard of emission was that none could be seen, that is "no visible emission". However for phosphate storage and handling no emission rate was specified but simply no visible emissions were allowed. The basis of the control was baghouse fabric filters, or high energy scrubbers, as "experience showed that no visible emissions occur from enclosures when the process equipment is properly maintained".[1] Such standards were expected to lead to ambient air concentrations of around $88\mu g/m^3$.

As can be seen in the previous sections the phosphate handling plant at Tartous is operating well outside the expected range of performance as described above.

Phosphate has no known carcinogenic effects and no particular characteristic properties which would give cause for concern on health grounds, other than those associated with dust, and so would fall under the emission standards for dusts of non specific origin. This would require an occupational exposure standard of $10mg/m^3$ in the workplace[6] and $260\mu g/m^3$ as an ambient level. The measurements obtained during the site monitoring show that these levels have been exceeded although not all the dust measured is of phosphate origin. Nevertheless the phosphate handling is an obvious source of dust and can be operated in a more effective and efficient manner than at present. However the technology currently being used was not originally intended for this purpose and it is doubtful if the existing installation can be made to operate satisfactorily. Relocation and a new installation may be the only solution which may prove effective.

Water Pollution

Phosphorus is a naturally occurring, and in fact essential, chemical acting as a nutrient in water for living organisms together with nitrogen. It is also commonly occurring in fertilisers, detergents[4] and urban waste. Excessive nutrients in water can lead to eutrophication which is excessive stimulation of plant life in water leading to oxygen depletion. This is more common in slow moving or stationary bodies of water unlike the ocean, but if occurring in the sea can lead to "red tides" which are of great concern.[5] There is no evidence that such events are taking in place in the vicinity of Tartous at the moment as the phosphate dust is insoluble but deposition into the ocean is to be avoided if possible.

Other Concerns

In 1978 the USEPA proposed that wastes produced by the processing of ores and minerals including phosphate be subject to hazard and waste management standards. In 1980 Congress rejected this step and called for more studies.[2]

In 1985 EPA presented a report to Congress [3] on the possibilities of phosphate mining involving radioactive materials as phosphate rock naturally contains 0.05 to 0.2 kilograms of uranium per tonne of rock. In 1993 Congress required the EPA to examine the process rather than the effects and to date no Congressional action has been implemented to pass regulations on this aspect. [5]

The main area of concern is the water and sludge left after washing of the phosphate ore (referred to as "tailings") and the location of the tip where this is dumped. This will not apply to the handling of the phosphate ore at the port but could be an issue if the mining activity is to increase significantly.

Conclusion on Phosphate Dust

Phosphate dust is an undesirable environmental pollutant but does not pose any particularly special threat to human health other than those normally associated with excessive dust levels.

The phosphate handling plant at Tartous port is operating in an unsatisfactory manner and would be considered to be outside the generally accepted limits for such a plant with respect to air pollution.

Phosphate discharging into the marine environment is of concern. However in this case it is not considered to be a major issue.

Mining of phosphate rock and dumping of the waste from the mining operation can lead to accumulation of phosphate rock which the USEPA consider to be hazardous waste. If the phosphate mining activity is to be intensified this aspect should be investigated further, although it is still the subject of considerable technical debate, and no clear decision has yet been reached.

The handling of phosphate ore has several associated environmental problems which are difficult to control. Segregation of the activity from residential areas by relocating to a more remote area is considered justified. An EIA of the new location will be needed but, subject to careful selection of the site and incorporation of standard dust control measures, the new location need not necessarily prove detrimental to the amenity of the new surrounding area.

c) **Changes to Port Construction**

The fundamental changes to the existing port construction will be as follows :

- o The existing phosphate handling pier will be removed and the handling operation relocated to the new port.
- o The existing sulphur pier will be used for steel and wood.
- o An area south of the old phosphate pier will be reclaimed to give new berths for steel and wood handling.

All dredged material will be used in the reclamation.

d) **Initial Environmental Examination**

The Initial Environmental Examination(IEE) has been assessed in a tabular form in accordance with the layout recommended in the publication "Environmental Assessment for Port Development Projects", MOT, December 1993. This is shown in Table 12-8-2. The significance of impacts are shown by the entries in the tables; those in the left column representing no impact and those in the right column representing major impacts.

As can be seen the planned activities at Tartous have no major adverse impacts, although the relocation of the phosphate pier will have a major beneficial impact by improving the situation. The activities that may have an impact are dredging but this is only a small amount to restore the originally designed depth. The degree of this impact is classed as minor and a full EIA is not considered necessary. However the sediments are contaminated to a large degree with heavy metals and the intention to use the dredged material for reclamation purposes is supported. There are no extensive fishing activities in the vicinity of the port but monitoring of the seawater for heavy metals during construction and post construction is recommended. Also occasional fishing has been observed on the breakwaters and this should be prohibited during dredging activities.

The intended relocation of the phosphate handling pier will have a positive environmental impact in that an adverse impact will be removed. Of course this must be balanced against the potential adverse impact at the new location and this is examined in Section 13-9. However given the more remote location and the opportunity to upgrade the air pollution control equipment then the impact of the new installation should not be excessive.

e) **IEE Overview**

The IEE given in Table 12-8-2. is quite comprehensive and a synopsis and overview is given in Table 12-8-3. This is in accordance with JICA requirements given in the given in the Checklist for Scoping Port and Harbours, "Environmental Guidelines for Infrastructure Projects - Ports and Harbours", JICA Environmental Guidelines, September 1992.

As can be seen their are no overriding environmental impacts associated with the planned development, a full EIA is not considered necessary and no remedial measures are required.

f) Conclusions

The baseline data from the environmental survey has been reviewed. In general the water quality is acceptable and in fact could be classed as of good quality for a port where some polluting discharges are inevitable, and the beneficial uses of the water are not so demanding of high water quality. Areas of concern are the high COD and sulphides although the dissolved oxygen is acceptable. Phosphorus, phosphates and oil/grease are high but this also applies to water outside the harbour.

Heavy metals in the sediments are high, particularly mercury and arsenic although the sources seem to lie outside the harbour. Disturbance of the seabed is to be avoided, if possible, and if not possible the disposal of the dredged material must be done in a very controlled fashion. However at the moment the intention is to use the dredged material for reclamation.

There are no overriding environmental reasons why the planned activities should not proceed and a full EIA and remedial measures are not considered necessary. The intended relocation of the phosphate plant together with the other planned measures should bring about significant environmental improvements in the area around the port. Monitoring of seawater for heavy metals during dredging by the contractor is recommended with the results being reviewed by the Ministry of Environment.

References

1. USEPA. Phosphate Rock Plants Background Information for Proposed Standards September 1979, pp 1184
2. USEPA. Review of New Source Performance Standards for Phosphate Fertiliser Industry Revised November 1980, pp 3-22,23
3. USEPA. Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale, December 1985
4. United Nations. Substitute for Tripolyphosphates in Detergents, 1992
5. Palm,G., Advances in Phosphate Fertiliser Technology, AICHE Symposium Volume 89, 1993
6. Exposure Standards for Atmospheric Contaminants in the Occupational Environment, National Occupational Health and Safety Commission, Australia, 1991

TABLE 12-8-2 IEE OF EXISTING PORT: TARTOUS

After OCDI 1993

Environmental Impact Factors	Environmental Impact	Countermeasures	Size of Impact: None	Small	Large	Major	Reason	Recommendation
1. Impact from construction works								
1.1 Operation of working boats, construction machines	1.1.1 Air pollution	1.1.1 Management of construction process, selection of working hours, smoke prevention fence.	O					
	1.1.2 Generation of noise and vibration	1.1.2 Selection of construction methods/machines, selection of working hours, placement of sources of noise/vibration	O					
	1.1.3 Changes in terrestrial ecosystem	1.1.3 Selection of construction methods/machines.	O					
1.2 Dredging, stirring of bottom soil, soil dumping into water.	1.2.1 Pollution of water and bottom sediments (SS, hazardous materials)	1.2.1 Settling pond, sedimentation coagulant, selection of construction methods/machines, silt curtains.			O		Dredging of berths. Dredged material to go to reclamation	Monitoring
	1.2.2 Offensive odor	1.2.2 Selection of construction methods /machines, introduction of odor treatment methods.	O					
	1.2.3 Reduction of aquatic lives	1.2.3 Settlement pond, sedimentation coagulant, selection of construction methods/machines, silt curtains, selection of construction period, monitoring of alternative habitats.		O			No fishing grounds or shellfish beds nearby . Local fishing only.	Monitoring
	1.2.4 Pollution of marine products	1.2.4 Settlement pond, sedimentation coagulant, selection of construction methods/machines, silt curtains, selection of construction period, monitoring pollution of fishery products.	O				Dredging only inside port. No tipping outside port. No effect on fishing	None
	1.2.5 Devaluation of tourism resources	1.2.5 Settlement pond, sedimentation coagulant, selection of construction methods/machines, silt curtains,	O					
1.3 Soil removal	1.3.1 Changes in topography, underground water system	1.3.1 Prior elucidation of underground water system	O					
	1.3.2 Extinction of terrestrial ecosystem	1.3.2 Transplantation of important species, vegetation.	O					
1.4 Generation of surplus soil, wastes, dumping of dredged soil on ground	1.4.1 Pollution of water/bottom sediments	1.4.1 Treatment site planning	O				Spoil used for reclamation	None
	1.4.2 Impact on terrestrial ecosystem	1.4.2 Disposal site planning	O					
1.5 Employment of laborers	1.5.1 Inflow of alien cultures	1.5.1 Employment planning, disclosure of information	O					
	1.5.2 Change in economic activities	1.5.2 Employment planning, vocational training	O					
1.6 Congestion of work vehicles and boats	1.6.1 Economic loss (traffic jam)	1.6.1 Construction of access roads	O				Roads already exist	
	1.6.2 Devaluation of fishing ground	1.6.2 Alternative fishing ground	O					
2. Impact from port facilities and site								
2.1 Emergence of site (including landfill)	2.1.1 Pollution of water and bottom sediments	2.1.1 Change of face lines, dredging sludge, promotion of seawater exchange	O					
	2.1.2 Beach erosion and accretion	2.1.2 Change of face lines, construction of breakwaters against beach erosion, littoral nourishment	O				No major structural changes	
	2.1.3 Changes in coastal currents	2.1.3 Change of face lines, construction of breakwaters, selection of type of offshore structure	O				No major structural changes	

TABLE 12-8-2 IEE OF EXISTING PORT: TARTOUS

After OCDI 1993

	2.1.4 Decrease of habitats for aquatic lives	2.1.4 Transplant, discharge of seeds and saplings	O					
	2.1.5 Decrease of habitats for terrestrial lives	2.1.5 Change of face lines, designation of nature conservation areas, artificial tidal flats, transplant	O					
	2.1.6 Change in scenic beauty	2.1.6 Location of facilities, selection of color, plantation	O					
	2.1.7 Resettlement of local residents and culture	2.1.7 Transfer planning, information disclosure	O					
	2.1.8 Extinction of fishing grounds	2.1.8 Expansion of functions of fishing ports, marine products transportation functions	O					
2.2 Emergence of external facilities	2.2.1 Pollution of water and bottom sediments	2.2.1 Change of face lines, dredging sludge, promotion of seawater exchange	O					
	2.2.2 Beach erosion and accretion	2.2.2 Change of face lines, construction of breakwaters against beach erosion, littoral nourishment	O					
	2.2.3 Change in coastal currents	2.2.3 Change of face lines, construction of breakwaters for wave prevention , selection of type of offshore structure	O					
	2.2.4 Decrease of habitats for aquatic lives	2.2.4 Transplant, discharge of seeds and saplings	O					
	2.2.5 Change of scenic beauty	2.2.5 Changes in shape of facilities and selection of colors	O					
2.3 Emergence of sea route	2.3.1 Change in coastal currents	2.3.1 Change of face lines, construction of breakwaters for wave prevention	O					
	2.3.2 Decrease of habitats for aquatic lives	2.3.2 Transplant, discharge of seeds and saplings	O					
2.4 Emergence of anchorage	2.4.1 Change in coastal currents	2.4.1 Change of face lines, construction of breakwaters for wave prevention , selection of type of offshore structure	O					
	2.4.2 Decrease of habitats for aquatic lives	2.4.2 Transplant, discharge of seeds and saplings	O					
3. Impact from utilisation of facilities in water area and anchorage								
3.1 Impact from boats	3.1.1 Air pollution	3.1.1 Reduction of stoppage time in ports, compulsory use of high quality oil	O					
	3.1.2 Water pollution (bilge)	3.1.2 Strengthening of laws and regulations		O			More shipping anticipated	Enforcement of harbour regulations
	3.1.3 Beach erosion caused by furrow wave	3.1.3 Speed limit, beach protection structure	O					
	3.1.4 Generation of wastes (dredged material included)	3.1.4 Strengthening of laws and regulations, recycling/disposal systems		O			More waste to municipal tip	Authorities to implement correct waste disposal practices
	3.1.5 Obstruction to fisheries activities	3.1.5 Alternative fishing ground and artificial fishing sites, expansion of function of fishing ports and transportation of marines products	O					
4. Impact from cargo loading and utilisation of storage facilities								
4.1 Cargo loading and utilisation of storage facilities	4.1.1 Air pollution (dust)	4.1.1 Establishment of buffer zone, enclosure, surface treatment, selection of loading machines			O		Large improvement in air quality if phosphate handling moved.	Relocate phosphate handling
	4.1.2 Pollution of water and bottom sediments	4.1.2 Establishment of buffer zone, enclosure, surface treatment, selection of loading machines, shape of apron			O		Large improvement in water quality if phosphate handling moved.	
	4.1.3 Generation of noise	4.1.3 Zoning, sound proof fence/hood	O					
	4.1.4 Generation of offensive odor	4.1.4 Zoning, sealing of storage facilities, deodorisation facilities	O					
	4.1.5 Change in coastal ecosystem	4.1.5 Establishment of buffer zone, enclosure, surface treatment, selection of loading	O					

TABLE 12-8-2 IEE OF EXISTING PORT: TARTOUS

After OCDI 1993

		machines, shape of apron, monitoring of pollution of marine products						
	4.1.6 Generation of wastes	4.1.6 Planning for collection, treatment and disposal of wastes	O					
	4.1.7 Employment effect	4.1.7 Vocational training	O					
5. Impact from operation of facilities handling hazardous materials								
5.1 Operation of oil distribution base and facilities handling hazardous materials	5.1.1 Air pollution	5.1.1 Reduction of air pollutants (dust collection, desulphurisation, denitrification) promotion of dispersion	O					
	5.1.2 Pollution of water and bottom sediments (oil)	5.1.2 Facilities for waste oil treatment, oil fence	O					
	5.1.3 Generation of offensive odor	5.1.3 Change of zoning, containment of offensive odor, deodoriser	O					
	5.1.4 Change in coastal ecosystem	5.1.4 Facilities for waste oil treatment, oil fence, monitoring of pollution of marine products	O					
	5.1.5 Change in terrestrial ecosystem	5.1.5 Facilities for waste oil treatment, oil fence, establishment of nature conservation area	O					
	5.1.6 Decrease in amount of agricultural products, fisheries products and price	5.1.6 Facilities for waste oil treatment, oil fence, monitoring of pollution of marine products	O					
6. Impact from waste treatment and disposal								
6.1 Operation of waste treatment facility	6.1.1 Air pollution	6.1.1 Reduction of air pollutants (dust collection, desulphurisation, denitrification)	O					
	6.1.2 Pollution of water and bottom sediments	6.1.2 Reduction of discharge, drainage treatment facilities	O					
	6.1.3 Generation of offensive odor	6.1.3 Zoning, containment of offensive odor, deodoriser	O					
	6.1.4 Change in coastal ecosystem	6.1.4 Prevention of water pollution	O					
	6.1.5 Change in terrestrial ecosystem	6.1.5 Prevention of air/water pollution	O					
6.2 Impact from waste disposal facility	6.2.1 Air pollution	6.2.1 Establishment of buffer zone, surface treatment, fence	O					
	6.2.2 Pollution of water and bottom sediments	6.2.2 Sheet cover (rain prevention) settling ponds selection of bulkhead structure	O					
	6.2.3 Generation of offensive odor	6.2.3 Zoning	O					
	6.2.4 Change in coastal ecosystem	6.2.4 Prevention of water pollution	O					
	6.2.5 Change in terrestrial ecosystem	6.2.5 Prevention of air/water pollution	O					
	6.2.6 Formation of slums	6.2.6 Management plans for disposal site	O					
7. Impact from Traffic function								
7.1 Road Traffic	7.1.1 Air pollution	7.1.1 Improvement of transportation system routes, establishment of buffer zone, road pavement, green belt, cover on a bed of trucks		O			Some increase in road traffic	None
	7.1.2 Generation of noise and vibration	7.1.2 Correction of routes, establishment of buffer zone, selection of road/trackage, structure road pavement, soundproof fence		O			Some increase in road traffic	None
	7.1.3 Change in terrestrial ecosystem	7.1.3 Correction of routes, establishment of buffer zone/nature conservation area, prevention of air pollution	O					
	7.1.4 Change in local population distribution	7.1.4 Information disclosure, enlightening the local people on the concerned project	O					
	7.1.5 Traffic jams/accidents	7.1.5 Relocation of routes/overpass	O					
8. Impact from industrial production activities								
8.1 Operation of factories and plants	8.1.1 Air pollution	8.1.1 Reduction of air pollutants (dust collection, desulphurisation, denitrification) promotion of dispersal			O		Environmental improvement if phosphate relocated	Relocate
	8.1.2 Pollution of water and bottom sediments	8.1.2 Reduction of discharge, drainage treatment facilities	O					
	8.1.3 Generation of noise and vibration	8.1.3 Zoning, establishment of buffer zone,	O					

TABLE 12-8-2 IEE OF EXISTING PORT: TARTOUS

After OCDI 1993

		sound proof fence/hood						
	8.1.4 Generation of offensive odor	8.1.4 Zoning, containment of offensive	O					
		odor, deodorisation facilities						
	8.1.5 Ground subsidence	8.1.5 Regulation on the use of underground water	O					
	8.1.6 Change in coastal ecosystem	8.1.6 Prevention of water pollution, dredging	O					
		of sludge						
	8.1.7 Change in terrestrial ecosystem	8.1.7 Establishment of nature conservation area	O					
	8.1.8 Generation of wastes	8.1.8 Planning for collection treatment and	O					
		disposal of wastes						
	8.1.9 Change in local population	8.1.9 Establishment of employment planning,	O					
	distribution	information disclosure						
	8.1.10 Employment effect	8.1.10 Vocational training	O					
9. Impact from storage and distribution functions								
9.1 Storage functions (including	9.1.1 Air pollution (dust)	9.1.1 Zoning, establishment of buffer zone,	O					
outdoor storage)		containment, sprinkling, sheet cover, surface						
		treatment						
	9.1.2 Pollution of water and bottom	9.1.2 Zoning, containment, sheet cover,	O					
	sediments	establishment of drains, and settling ponds						
	9.1.3 Generation of offensive odor	9.1.3 Zoning, containment of odor, deodorser	O					
9.2 Cargo handling	9.2.1 Generation of noise	9.2.1 Zoning, establishment of buffer zone,	O					
		selection of machines, sound proof fence and						
		sound proof hoods						
	9.2.2 Employment effect	9.2.2 Vocational training	O					
10. Impact from operation of recreational facilities								
10.1 Utilisation of hotels, marinas,	10.1.1 Pollution of water and bottom	10.1.1 Water quality control through laws and	O					
artificial beaches	sediments	regulations, water quality improvement in the						
		shallow coastal area including artificial beaches						
	10.1.2 Change in coastal ecosystem	10.1.2 Prevention of pollution of water and	O					
		bottom sediments						
	10.1.3 Generation of wastes	10.1.3 Planning for collection treatment and	O					
		disposal of wastes						
	10.1.4 Inflow of alien culture	10.1.4 Selection of project location,	O					
		information disclosure, enlightening the						
		local people on the concerned project						
	10.1.5 Employment effect	10.1.5 Employment planning, vocational training	O					
	10.1.6 Obstruction to fishing activities	10.1.6 Securing of alternative fishing grounds	O					

TABLE 12-8-3 IEE OVERVIEW

After JICA 1992

CHECKLIST FOR SCOPING (PORTS AND HARBOURS)			
PORT:	TARTOUS		
	ENVIRONMENTAL ITEM	EVALUATION A/B/C/D	REASON
SOCIAL ENVIRONMENT			
1	RESETTLEMENT	D	
2	ECONOMIC ACTIVITIES	D	Impact is positive
3	TRAFFIC/PUBLIC FACILITIES	D	
4	SPLIT OF COMMUNITIES	D	
5	CULTURAL PROPERTY	D	
6	WATER RIGHTS AND RIGHTS OF COMMONS	D	
7	PUBLIC HEALTH CONDITIONS	D	
8	WASTE	D	
9	HAZARDS(RISKS)	D	
NATURAL ENVIRONMENT			
10	TOPOGRAPHY AND GEOLOGY	D	
11	SOIL EROSION	D	
12	GROUNDWATER	D	
13	HYDROLOGICAL SITUATION	D	
14	COASTAL ZONE	D	
15	FAUNA AND FLORA	D	
16	METEOROLOGY	D	
17	LANDSCAPE	D	
POLLUTION			
18	AIR POLLUTION	B	Major improvement in air quality
19	WATER POLLUTION	B	Dredging of bottom sediments to be carefully controlled and monitored.
20	SOIL CONTAMINATION	D	
21	NOISE AND VIBRATION	D	
22	LAND SUBSIDENCE	D	
23	OFFENSIVE ODOR	D	

A=Serious impact is expected
B=Some impact is expected
C=Extent of impact is unknown. Examination is needed.
D=No Impact is expected. IEE/EIA not necessary.

12.9 Facility Design

In Tartous Port, two additional berths for general cargo are planned at the root of the main breakwater in the Master Plan.
In this section the standard cross sections of the berth and pavements are proposed.

12.9.1 Design Conditions

(1) Geological Conditions

In general, sub-soil conditions in Tartous Port are favorable of the construction of the gravity type structures judging from the structures of existing berthing facilities.

(2) Seismic Conditions

For the design of the facilities in this study, seismic coefficient 0.03 will be adopted referring the case of Latakia Port.

12.9.2 Structural Design

(1) Berths

The quay walls have been constructed by using precast concrete blocks. As the sufficient bearing capacity can be expected at the sea bed, this gravity type are recommended for the newly planned general cargo berths. The construction materials for this type of berths are available locally. The standard cross section of the berths is referred to Fig. 12.9.2-1.

(2) Open Yard, Road

Apron, open yard and road behind the planned berths should be paved by using the asphalt concrete in the view points of workability and maintenance. The design load are assumed as follows.

Truck	T-14
Tractor trailer	20 ft, 40 ft

The composition of the bituminous pavement is shown below.

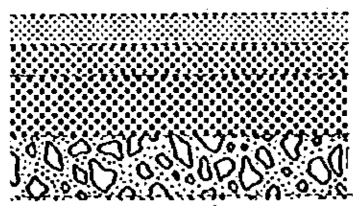
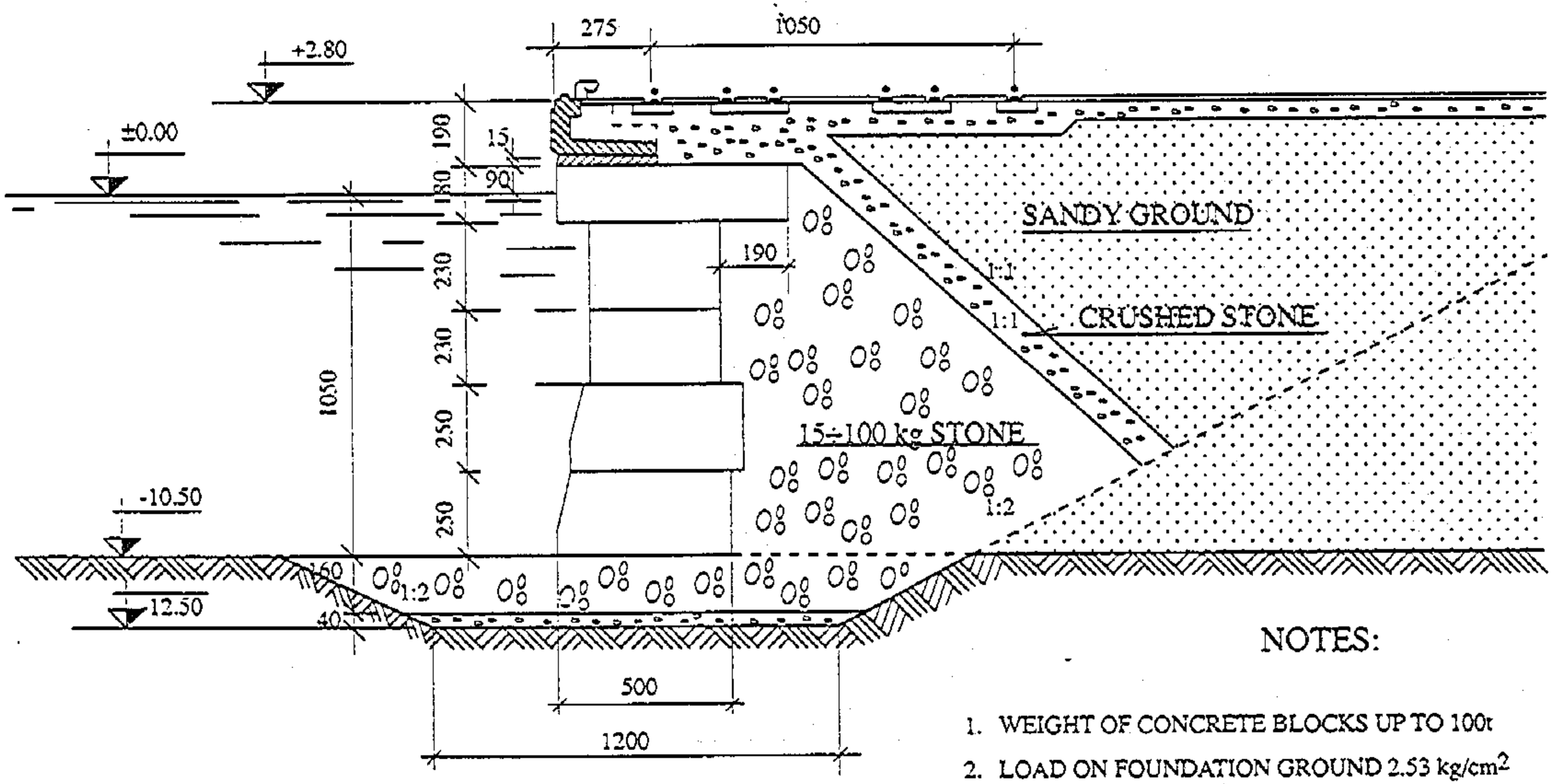


Fig. 12.9.2-2 Standard Cross Section of Yard, Apron



NOTES:

1. WEIGHT OF CONCRETE BLOCKS UP TO 100t
2. LOAD ON FOUNDATION GROUND 2.53 kg/cm^2
3. DIMENSIONS IN cm; ELEMENT IN m

Fig. 12.9.2-1 Typical Cross Section of Quay - Tartous Port

12.10 Cost Estimate

12.10.1 Conditions of Cost Estimate

General conditions of cost estimate are mentioned in Chapter 6.3, and the estimate is carried out based on the design and the quantities of each facility.

12.10.2 Total Cost

The total cost of Master Plan is shown in Table 12.10.2-1, and the breakdown of cargo handling equipment is shown in Table 12.10.2-2.

Table 12.10.2-1 Total Cost of Master Plan

TARTOUS(Master-Plan)

No.	Facilities	Unit	Q'ty	Unit Cost(Unit:S.P) F.C	Unit Cost(Unit:S.P) L.C	Unit Cost(Unit:S.P) Total	Cost(Unit: 1,000 S.P) F.C	Cost(Unit: 1,000 S.P) L.C	Cost(Unit: 1,000 S.P) Total
A	Civil Works								
1	General Berth Terminal(1)								
	Wharf(-10m)	m	385	200,000	700,000	900,000	77,000	269,500	346,500
	Ro/Ro Berth(-10m)	m	35	200,000	700,000	900,000	7,000	24,500	31,500
	Revetment(1)	m	50	0	250,000	250,000	0	12,500	12,500
	Revetment(2)	m	330	0	210,000	210,000	0	69,300	69,300
	Road/Open Space	m2	60,000	0	720	720	0	43,200	43,200
	Reclamation	m3	1,154,000	0	300	300	0	346,200	346,200
	Sub-Total						84,000	765,200	849,200
2	General Cargo Terminal(2)								
	Wharf(-10m)	m	160	200,000	700,000	900,000	32,000	112,000	144,000
	Revetment	m	70	200,000	700,000	900,000	14,000	49,000	63,000
	Road/Open Space	m2	14,400	0	720	720	0	10,368	10,368
	Reclamation	m3	187,200	0	300	300	0	56,160	56,160
	Sub-Total						46,000	227,528	273,528
	Total of Civil Works						130,000	992,728	1,122,728
B	Building								
1	Terminal Office	m2	3,000	0	12,000	12,000	0	36,000	36,000
2	Work Shop/Cleanning	m2	3,000	0	12,000	12,000	0	36,000	36,000
3	Passenger Terminal &	m2	2,300	0	9,130	9,130		21,000	21,000
	Total of Building						0	93,000	93,000
C	Utilities	LS	1				0	30,453	30,453
D	Cargo Handling Equipment								
	Total fo Handling Eq.	LS	1				1,493,040	0	1,493,040
E	Physical Conti/Engineering Fee	LS	1				66,000	31,000	97,000
F	Grand Total						1,689,040	1,147,191	2,836,231

Table 12.10.2-2 Cargo Handling Equipment
Tartous Port

Unit Cost:1,000Sp

Items	Capacity	Unit Price	Master Plan	
			Q'ty	Cost
1. Container Terminal				913,440
Container Cranes		239,400	2	478,800
Rail-mounted Transfer Cranes		91,980	3	275,940
Tire-mounted Transfer Cranes		52,900	3	158,700
2. Conventional Berths				579,600
Portal Jib Cranes	16tx32m	35,320	3	105,960
Portal Jib Cranes	3tx25m	17,220	3	51,660
Mobil Tower Cranes	6tx25m	34,000	6	204,000
Forklift Trucks	10t	3,360	17	57,120
Forklift Trucks	5t(Special)	2,520	17	42,840
Forklift Trucks	5t	2,100	25	52,500
Forklift Trucks	3t	1,680	13	21,840
Trailers		1,680	26	43,680
Total				1,493,040

12.10.3 Investment in Every Term

If total cost will be divided to two terms: Short Term and Second Half, the investment of each term is tabulated as shown in Table 12.10.3-1.

Table 12.10.3-1 Investment in Every Year

(Unit : Million S.P)

		Short-Term	Second-Term	Master-Plan
A	Civil Works	849	273	1,122
B	Buildings	24	69	93
C	Utilities	23	7	30
D	Cargo Handling Equipment	1,050	443	1,493
E	Physical Contingency and Engineering Fee	70	27	97
F	Grand Total	2,016	819	2,836

12.11 Stage Plan

Construction schedule of Tartous Port is closely related with the schedule of the new port. Until the phosphate terminal is shifted to the new port, the area behind the phosphate terminal cannot be reconstructed, that is to say, the steel and wood cannot be concentrated in the reconstructed area.

Stage I (- 2003)

- Preparation of Multi-Purpose Terminal at Pier-B
- Establishment of the new berths behind the breakwater

Stage II (2004-2007)

- Modernization of the existing container terminal
  (2 container cranes, related equipment, relocation of yards, gate, operation facilities)
- Conversion of existing phosphate terminal into grain terminal
- Reclamation of the root of the grain pier.

Stage III (2007-2010)

- Modernization of the existing container terminal
  (completion of marshaling yard, cargo-handling equipment)
- Preparation of storage facilities
  (long/heavy cargo, vehicles, containers)

12.12 Preliminary Economic Analysis

12.12.1 Methodology

The method of analysis in this case is the same as that of Latakia Port mentioned in Chapter 11.14.1.

12.12.2 Prerequisites of Analysis

(1) Base Year

1995 is set as the "Base Year" for this study.

(2) Project Life

Taking into consideration the depreciation period of the main facilities of 30 years and the construction period of 4 years, the period of calculation (project life) in the economic analysis is assumed to be 34 years from the beginning of construction.

(3) Foreign Exchange Rate

The exchange rate adopted for this analysis is US$ 1.00 = 42 S.P., the same rate as used in the cost estimation.

(4) "With"case

The "With" case scenario includes all improvements in productivity and all expansions of port facilities for the master plan.

(5) "Without"case

In order to calculate the substantial benefits of Tartus Port, only the cargoes which are planned to be handled in Tartus Port are set as objects of economic analysis. In this study, the following conditions are adopted as the "Without" case.

i) No investment is made for the port.
ii) Handling capacity of the existing grain terminal is estimated to be about 1.1 million tons. The overflowed grain is assumed to be handled at the general cargo berth.
iii) Handling capacity of the existing container terminal is estimated to be about 83,000 TEUs in the "Without" case.
iv) As for the container terminal projects, the working efficiency of cargo handling is not the same as the "With" case.

Table 12.12.2-1 Handling Cargo Volume by Categories of Berth in Tartous Port

["Without"case] (Unit: thousand ton)

Classification of Berth		1994	2003	2004	2005	2006	2007	2008	2009	2010
Phosphate Terminal		777	0	0	0	0	0	0	0	0
Container Terminal		170	528	619	720	830	950	1,083	1,226	1,387
Grain Terminal: Export		57	600	600	600	600	600	600	600	600
: Import		294	390	420	453	489	500	500	500	500
Grain	Export	0	0	0	0	0	0	0	0	200
	Import	0	0	0	0	0	27	68	112	160
General		2,228	907	941	978	1,017	1,057	1,098	1,142	1,187
Food			497	499	502	504	506	508	511	513
Animal			191	206	223	241	260	280	303	327
Steel			546	599	659	725	797	876	964	1,060
Wood			351	387	426	469	517	570	628	692
Machine			169	183	198	214	232	251	272	295
Chemical			290	312	335	360	387	415	446	479
Ro/Ro			68	77	86	97	109	123	138	155
General Berth Total		2,228	3,018	3,204	3,407	3,626	3,891	4,191	4,516	5,068
Total		3,526	4,536	4,843	5,180	5,545	5,941	6,374	6,842	7,555

Table 12.12.2-2 Working Efficiency of Cargo Handling in both Case

			"Without"	"With"
Working Efficiency (ton/hr)	Container(TEU/hr)		13	48
	General	General	33.0	
		Foodstuff	44.0	
		Animal	12.0	
		Steel	80.0	
		Wood	22.2	
		Machine	39.0	
		Chemical	32.2	
		Ro/Ro	34.4	

The results of forecast on the handling volume by categories of berth are shown in Table 12.12.2-1.
The working efficiency of cargo handling in the "With" and "Without" cases are shown in Table 12.12.2-2.

12.12.3 Costs of the Projects

The items that should be considered as costs of the projects are construction costs and maintenance costs.

(1) Construction Costs

Construction costs are divided into such categories as civil costs and mechanical costs. Main mechanical costs are purchasing of handling equipment.

(2) Maintenance Costs

The costs of maintaining the port facilities are estimated as a fixed proportion (1 % for structures, 4 % for handling equipment) of the original construction costs excluding the costs of dredging and reclamation costs.

Table 12.12.3-1 Costs of the Projects

(Unit: million S.P.)

Items		Costs
Construction Costs (Total)		2,836.2
Maintenance Costs per Year		68.1
	Structure	8.4
	Equipment	59.7

12.12.4 Benefits of the Projects

(1) Benefit Items

As benefits brought about by the master plan of study port, the following items are identified.

1) Savings in waiting costs of ships
2) Savings in water transportation cost by enlargement of ship size
3) Savings in land transportation costs
4) Investment in "Without" case
5) Savings of cost in cargo handling
6) Savings in interest of cargo costs
7) Reduction of cargo damage and accidents at the port
8) Reduction of harmful influence on surroundings due to handling phosphate rock

9) Promotion of regional economic development
10) Increase in employment opportunities and incomes

Items 1), 2), 3), 4), 5) and 6)are considered countable and in this study the monetary benefits of item 1) are calculated.

(2) Calculation of Benefits

Items and methods of calculation of benefits are as mentioned in Section 11.14.4(2).

The results of calculation of benefits are shown in Table 12.12.4-1.

Table 12.12.4-1 Benefits of the Projects

(Unit: million S.P.)

Item / project	Waiting Cost	Mooring Cost	Total
Container	0.0	357.5	357.5
General Cargo	383.1	0.0	383.1
Total	383.1	357.5	740.6

12.12.5 Evaluation of the Projects

(1) Calculation of the EIRR

The economic internal rate of return (EIRR) based on a cost-benefit analysis is used to appraise the economic feasibility of the project.

The EIRR of the master plan is calculated as 18.0 %. Result of calculation is shown in Table 12.12.5-1.

(2) Evaluation

As for this project, even though the economic calculation only takes into account the items which are easily quantified, the EIRR exceeds 10 %. Therefore, this master plan development project is feasible from the viewpoint of the national economy.

Table 12.12.5-1 Cost/Benefit Analysis of Master Plan in Tartous Port

(Unit: million S.P.)

	Year	Cost			Benefit		Net Present Value (NPV)		
		Construction	Maintenance	Total	Total	Benefit - Cost	Benefit	Cost	Benefit - Cost
1	2008	709	0	709	0	-709	0	709	-709
2	2009	709	0	709	0	-709	0	601	-601
3	2010	709	0	709	0	-709	0	509	-509
4	2011	709	0	709	0	-709	0	431	-431
5	2012	0	68	68	741	673	381	35	346
6	2013	0	68	68	741	673	323	30	293
7	2014	0	68	68	741	673	274	25	249
8	2015	0	68	68	741	673	232	21	211
9	2016	0	68	68	741	673	196	18	178
10	2017	0	68	68	741	673	166	15	151
11	2018	0	68	68	741	673	141	13	128
12	2019	0	68	68	741	673	119	11	108
13	2020	0	68	68	741	673	101	9	92
14	2021	0	68	68	741	673	86	8	78
15	2022	0	68	68	741	673	73	7	66
16	2023	0	68	68	741	673	61	6	56
17	2024	0	68	68	741	673	52	5	47
18	2025	0	68	68	741	673	44	4	40
19	2026	0	68	68	741	673	37	3	34
20	2027	0	68	68	741	673	32	3	29
21	2028	0	68	68	741	673	27	2	24
22	2029	0	68	68	741	673	23	2	21
23	2030	0	68	68	741	673	19	2	17
24	2031	0	68	68	741	673	16	1	15
25	2032	0	68	68	741	673	14	1	13
26	2033	0	68	68	741	673	12	1	11
27	2034	0	68	68	741	673	10	1	9
28	2035	0	68	68	741	673	8	1	8
29	2036	0	68	68	741	673	7	1	6
30	2037	0	68	68	741	673	6	1	5
31	2038	0	68	68	741	673	5	0	5
32	2039	0	68	68	741	673	4	0	4
33	2040	0	68	68	741	673	4	0	3
34	2041	0	68	68	741	673	3	0	3
	Total	2836	2043	4879	22218	17339	2477	2477	0

EIRR= 0.18048

Chapter 13 Master Plan of the New Port

13.1 The Basic Concept of the Port Development

The purpose of the Master Plan (target year 2010) is to serve as a target and guideline for phase plans including the Short-Term Plan (target year 2003). The Master Plan shall be an integrated plan covering the layout plans for port facilities and adequate management and operation systems. In making the Master Plan for the New Port, the following various aspects concerning the port development are recognized:

(1) Limited space for port expansion in Tartous Port and the necessity of creation of a new port

Both the northern and southern coasts of Tartous Port are not usable for the port expansion areas: the northern coast is occupied by the military zone and the southern coast is used for resort beach adjacent to densely-populated urban areas. Hence, to meet the forecast port demand, it is necessary to create a new port to receive cargoes overflowing from the existing Tartous Port. Taking account that Tartous Port is adjacent to densely-populated residential areas, bulk cargoes risking dust emissions harmful to humans which will originate from or be destined for its hinterland need to be diverted to the new port; phosphate rock, cement clinker, iron pellet, scraps sulfur, fertilizer in bulk and petroleum coke are listed as those bulk cargoes. As mentioned in Section 13.7, the site located south of Hamidieh and around 30 km south of Tartous Port is selected as the optimum site for the new port.

(2) Problem on phosphate dust emission in Tartous Port

The new port is required to resolve the current problem on phosphate dust emission in Tartous by transferring the existing phosphate-handling facilities from Tartous Port to the new port.

(3) The Necessity of the new port to back up the manufacturing and mining industries in the southern part of Syria

Spread throughout the southern part of Syria, port-related heavy industries including phosphate mines, cement-making factories, a iron and steel making factory, a fertilizer factory and a petroleum refinery are located. In addition to the present operations of the industries, several projects of the industries are on-going or on the verge of being materialized. Hence, the new port is indispensable to back up the industries through importing raw or intermediate materials or exporting their final products or by-products.

(4) Necessity of the new port to promote transit traffic of bulk cargo from/to the Arab countries neighboring Syria

In Iraq, phosphate mines are situated in Akashat near the border between Iraq and Syria. On the other hand, sulfur mines are situated in Mosul which is near the above border as well. Sulfur is also produced as by-product of petroleum refineries. There are several major petroleum refineries in Kirkuk and Baiji in north-west part of Iraq. Sulfur and phosphate rock are major exports of Iraq. Before the close of the border in 1981, Iraq intended to ship those bulk cargoes through Tartous Port and so requested to Syria. Instead of Tartous Port, the new bulk cargo port could be a gateway for those cargoes in the foreseeable future.

(5) Future demand for use of the port

According to the demand forecast mentioned in Chapter 10, the volume of cargoes to be handled at the new port in 2010 is estimated as 8.1 million tons. The volume of exports is estimated as 6.3 million tons, accounting for 77.6% of the total. In exports, the volume of phosphate rock and cement clinker accounts for 65.3% and 15.9% of the total respectively. On the other hand, the volume of imports is estimated as 1.8 million tons. In exports, the volume of iron pellet and scraps account for 88.4% and 11.6% of the total respectively.

(6) Economic transportation

In making the port investment plan, it is necessary to put emphasis on economic transportation, considering both the investment cost for port facilities and ship transportation cost from the standpoint of the national economy.

(7) Safe operations

In making the port plan, safe operations need to be considered both on waters and land. The basins need to be protected from violent waves by breakwaters, especially in the winter season, though construction cost for the breakwaters is costly. On the other hand, in order to ensure safe operations within the port area, it is necessary to prepare sufficient yard areas with required facilities adequately laid out, since narrow yards risks accidents in port operations.

(8) Environmental impact on areas around the port induced by the port development

In making the port plan, environmental impact on the area both during the periods under construction and after the start of operations must be considered.

Based on the above, the following concept of the development of the new port is proposed for the purpose of achieving safe, efficient and reliable operations.

(1) Preparation of a phosphate terminal

It is proposed to transfer phosphate handling from Tartous Port to the new port so as to resolve the current dust emission problem in Tartous and increase phosphate-handling capacity from the existing facilities in Tartous Port.

(2) Preparation of a cement clinker terminal

It is proposed to prepare a cement clinker terminal at the new port to back up export promotion for cement-making factories which are in operation or will be established in the near-term.

(3) Preparation of a pellet terminal

An iron ore handling terminal is required for the new iron/steel making factory with direct reduction furnaces to be established in Al-Zara. Iron ore is planned to be imported in pellets.

(4) Preparation of a scrap terminal

To produce iron/steel at the existing factory with electric furnaces or the new factory, it is necessary to provide scraps in the process of manufacturing. According to the production plan, some portion of required scraps must be provided from abroad. To unload scraps from vessels efficiently, magnet type cranes specially designed for scrap-handling are required with spacious back yard.

(5) Preparation of a sulfur terminal

To ship sulfur from sulfur mines in Iraq located near the border between Syria and Iraq in the future, a sulfur handling terminal is planned to be prepared.

(6) Preparation of a fertilizer terminal

As to phosphatic fertilizer, it is expected that domestic production will exceed domestic consumption in Syria in the future owing to anticipated operations of a new fertilizer plant in Palmyra. Hence, to export surplus fertilizer, a specialized terminal is planned to be prepared.

(7) preparation of public berths

In addition to the above-mentioned terminals specialized for specified bulk cargoes, it is planned to prepare public berths to receive miscellaneous cargo vessels which will not be adequately received by the above special berths. Petroleum coke could be shipped from the public berth. On the other hand, nitrogenous fertilizer needs to be imported to narrow the gap between domestic production and consumption in Syria even in the future as it is at present. Such fertilizer which is expected to be transported in bag could also be received at the public berths. In addition furnace bricks, ferro-alloy, etc for steel-making industry are also imported through the public berth.

13.2 Terminal Plans

13.2.1 Phosphate Terminal

(1) Usage Plan

Referring to the present major trade partners and considering future improvement of quality of phosphate, the following loading port and shares are adopted.

Unloading port	Share(%)	Distance(Miles)
CONSTANZA	30	1,070
MARSEILLE	50	1,600
ROTTERDAM	20	3,480

Transportation cost by vessel size is computed as follows:
"*" shows the minimum cost vessel size of each shipping route

Vessel size (DWT)	CONSTANZA	MARSEILLE	ROTTERDAM
32,200	101	102	112
40,000	100*	100*	107
45,000	102	100	105
50,000	103	101	104
65,000	107	102	100*
80,000	114	106	102

Note: Minimum cost is expressed as 100 by destination.
In order to decide the berth scale(depth), above cost and construction cost are taken into consideration. Three cases- Case 1(Berth Depth -14m, Length 280m), Case 2 (-13m, 260m), Case 3(-12m, 240m)- are compared. The total cost index during the project life(30 years) is as follows:

	Berth Depth (-14m)	Berth Depth(-13m)	Berth Depth(-12m)
Cost Index	100	102	103

Consequently, berth scale of -14m is the most economical among these cases.

Number of berths is decided using computer simulation. The following premises are adopted based on the results described above.

- Total volume of cargoes unloaded from the vessels: 4.1 million tons
- Maximum Vessel Capacity: 65,000 tons
- Number of calling vessels: 137
- Cargo handling productivity: 672 tons per hour
- Land transportation by railway
- Number of berths: 2 berths

Cargo handling productivity is calculated as follows:

(400+200ton/hr) X 2 sets X 0.8(efficiency) X 0.7(operation ratio)

Results of the simulation is as follows:

- Average ship waiting time: 6.5 hrs
- Berth occupancy ratio: Berth No.1: 51.2%
  Berth No.2: 34.0%

The number of berths for phosphate is two, because the average ship waiting time is below 12 hours. It is suitable to keep one berth for large size vessel and one berth for small size vessel according to the present distribution of the vessel size.

(2) Cargo handling facilities

At present, Phosphate Terminal for export is located in Tartous Port . The equipment of terminal includes silo (approximate 90,000t), loaders (800t/h and 500 t/h each one unit) and others .
However there are some problems at the terminal. The biggest one is air pollution and next one is shortage of capacity to cope with increasing cargo volume.
It is very difficult and uneconomical to solve these problems at the existing facilities in Tortous Port.
Then new phosphate terminal which is designed and constructed more carefully for air pollution shall be constructed in new port.

1. The considerable points for air pollution on the phosphate terminal are as follows;

1-1 Dust collection system
Decentralized dust collection system shall be introduced to ensure the dust

collection.

1-2 Conveyor system

All conveyor lines must be chain conveyor except belt conveyors for ship loaders and ship loader itself because it does not occur dust due to closed system and it is prevent over cargo flow on the conveyors by gate control.

1-3 Belt conveyor cover

The belt conveyor to be applied at the location where chain conveyor can not be used can not be covered by fixed conveyor cover. Then its shall be covered by openable cover.

1-4 The capacity of a ship loader

The smaller loading capacity compare with ship hold volume is one of effective point for dust control during ship loading

1-5 Others

a. The house for wagon station

Long and narrow rubber sheets will be hanged from upper frame at the both gateway for wagon to reduce the large opening area at the both gateway. Further more the dust in the house will be collected dust collector.

b. Dustless chute

Some type of dustless chutes are developed recently for dust control during ship loading.

Most of dust in the ship hold shall be controlled by the using dustless chute.

2. The design conditions for new phosphate terminal are as follows;

2-1 Ship size. Max 65,000 DWT
2-2 Number of berth. Two Berths
2-2 Cargo Volume to be handled in the target year. 4,100,000 t/y
2-3 Number of cargo kinds. 10 kinds
2-4 Berth occupancy. 0. 6
2-5 Working day and hour. 285 days/year and 24 hours/day
2-6 All cargo shall be shipped via silo
2-7 Specific gravity 1.5

3. Outline of equipment

3-1 Loader

Considering ship trim, loading chute capacity and breakdown of the loader, two(2) set of loader shall be installed on each berth respectively.

The required loader capacity is calculated by following formula. The capacity of the loader for small ship will be half of that of loader for large ship due to economical design for conveyor lines.

Qt =4,100/ 285 x 0.6 x 24 x 0.75 x 0.8 x 4 = 415

Say 400 t/h x 4 sets

It is recommended that the capacity of loaders shall be reduced and prevent from dust pollution in ship hold in case that the loaders are used for small ship.

3-2 Storage Facilities

The unit cost of the raw phosphate is low.

It is undesirable to cost for transportation and storage from a mine to final factory.

The raw phosphate should be transported using the most economical handling and transportation system.

On the other hand, raw phosphate is one of the most difficult cargoes in terms of dust control.

The most desirable handling system strikes a balance between cost and performance.

The most desirable handling system should be decided based on the cargo volume to be handled, the potential for air pollution and workers' health.

In this case, the cargo volume to be handled is forecast to be very large.

Therefore, air pollution and workers' health require careful consideration.

In both systems(Silo system and Transit shed system) the dust as well as outside air pollution can be adequately controlled, the cost of the dust control in the transit shed system is more expensive.

The high density of the dust in the silo is no problem for air pollution and workers' health because workers never enter the silo bin.

However, the dust in the transit shed is a big problem for workers' health and it is impossible to takeout the cargo in the transit shed without any supplementary equipment and their operator(s).

If we were to redesign the shape of the transit shed to enable the removal of cargo without any assistance, it would resemble a silo bin.

The transit shed system should considered for the following cases

1. The cargo volume is very small
2. The turnover of the cargo is very small (the dwelling days are very long). This means that the transit shed capacity is too large in comparison with the cargo volume to be handled.

As this study does not have the above conditions, there is no possibility of adopting the transit shed system.

Consequently, silo is adopted as storage facilities.

a. Silo capacity

Result of simulation (input factors; volume of the phosphate by class,Number of ships by route by class), the required silo capacity is 169,000 t.

b. Silo bin capacity and number of silo bin

Large size silo bin is more economical from the view point of construction cost.

Considering the number of cargo kind and silo operation, however, smaller size silo bin is more effective used due to reduce the dead space in the silo bin.

The decided number of such bins and their capacity are as follow.

169,000 t (3,530 t/b x bins)

3-3 Conveyor lines

a. Receiving lines and take in lines

All conveyor shall be chain conveyor to control the dust

b. Number of receiving lines and its capacity

b-1 Considering total receiving capacity, and the capacity of take out line the recommendable number of lines are 4 lines.

b-2 Capacity Qr

Qr = 4,100,000 /285 x 0.7 x 24 x 0.75 x 0.7 x 4

= 407 say 400 t/h x 4 lines

c. Take in conveyor

Chain conveyor 400 t/h x 4 lines

d. Take out lines

Chain conveyor 400 t/h x 8 lines

f. Loading conveyors from silo to beth conveyor

Chain conveyors 400t/h x 4 lines

g. Berth conveyor for ship loader

Each berth 400 t/h x 2 lines

3-4 Other equipment

a. Recycle line

b. Dust collection equipment

c. Weighing equipment

d. Wagon receiving equipment

e. Machinery tower

f. Others

Most of above equipment will be installed in the machinery tower.

13.2.2 Pellet Terminal

Referring to the present trade statistics, the following loading port and shares are adopted.

Loading port	Share(%)	Distance(Miles)
RIO DE JANEIRO	50	6,120
GOTHENBURG	50	3.980

Transportation cost by vessel size is computed as follows.
"*" shows the minimum cost vessel size of each shipping route

Vessel size (DWT)	RIO DE JANEIRO	GOTHENBURG
65,000	111	106
80,000	105	102
100,000	102	100*
120,000	100*	101

Note: Minimum cost is expressed as 100 by destination.

In order to decide the berth scale(depth), above cost and construction cost, including dredging cost are taken into consideration. Four cases- Case 1(Berth Depth: -16m, Length 320m), Case 2(-15m, 300m), Case 3(-14m, 280m), Case 4(-13m, 260m)- are compared. The total present cost index during the project life(30 years) is as follows:

	Case 1 (-16m)	Case 2 (-15m)	Case 3 (-14m)	Case 4 (-13m)
Cost Index	108	105	100	104

Consequently, berth scale of -14m is the most economical among these cases.

Number of berths are decided using the simulation method. The following premises are adopted based on the results described above.

- Total volume of cargoes unloaded from the vessels: 1.25 million tons
- Maximum Vessel capacity:65,000 tons
- Number of calling vessels: 20
- Cargo handling productivity: 520 tons per hour
- Land transportation by train
- Number of berths: 1 berth

Cargo handling productivity is calculated as follows:

500ton/hr X 2 sets X 0.65(efficiency) X 0.7(operation ratio)

Results of the simulation is as follows:

- Average ship waiting time: 36.7 hrs
- Berth occupancy ratio: 34.5%

The number of berths for phosphate is one, because the average ship waiting time is within two days.

13.2.3 Clinker Terminal

Referring to the present trade statistics, the following unloading port and shares are adopted.

Unloading port	Share(%)	Distance(Miles)
NEW YORK	30	5,200
ABIDJAN	20	5,000
ISTANBUL	20	810
BORGAS	10	940
MARSEILLE	20	1,600

Transportation cost by vessel size is computed as follows.
* shows the minimum cost vessel size of each shipping route

Vessel size (DWT)	NEW YORK	ABIDJAN	ISTANBUL	BORGAS	MARSEILLE
32,200	116	115	100*	100*	
40,000	100	109	102	101	102
50,000	106	105	106	104	100*
65,000	101	100*	112	109	101
80,000	100*	101	121	117	102

Note; Minimum cost is expressed as 100.

In order to decide the berth scale(depth), above cost and construction cost are taken into consideration. Three cases- Case 1(Berth Depth -15m, Length 300m), Case 2 (-14m, Length 280m), Case 3 (-13m, Length 260m), - are compared. The total present cost index during the project life(30 years) is as follows:

	Case 1 (-15m)	Case 2 (-14m)	Case 3 (-13m)
Cost Index	104	100	102

Consequently, berth scale of -14m is the most economical among these cases.

However, Case 1 is still a feasible alternative, partly because American large vessel, over 70,000 DWT, once had visited Tartous Port, partly because cost difference between Case 1 and Case 2 is no more than 200 million S.P. through the project life, 30 years.

Number of berths are decided using the simulation. The following premises are adopted based on the results described above.

- Total volume of cargoes unloaded from the vessels: 1.0 million tons
- Maximum Vessel capacity: 65,000 tons
- Number of calling vessels: 26

- Cargo handling productivity: 392 tons per hour
- Land transportation by train
- Number of berths: 1 berth

Cargo handling productivity is calculated as follows:

350ton/hr X 2 sets X 0.8(efficiency) X 0.7(operation ratio)

Results of the simulation is as follows:

- Average ship waiting time: 8 hrs
- Berth occupancy ratio: 35.9%

The number of berths for phosphate is one, because the average ship waiting time is within half day and total number of vessels is small.

13.2.4 Scrap Terminal

Referring to the present trade statistics, scrap is carried from the Ukraine and eastern Europe, Turkey and other Middle Eastern countries and other north European countries.

Since the cargo volume is low- 200,000 tons per year- the large vessel is not economical. Considering the present vessel size, carrying scrap and other metal materials, the vessel size is decided as 10,000 DWT.

Number of berths is decided using computer simulation. The following premises are adopted based on the results described above.

- Total volume of cargoes unloaded from the vessels: 200,000 tons
- Maximum Vessel capacity: 10,000 tons
- Number of calling vessels: 23
- Cargo handling productivity: 73 tons per hour
- Land transportation by truck
- Number of berths: 1 berth

Cargo handling productivity is calculated as follows:

50ton/hr X 3 sets X 0.7(operation ratio) X 0.7(efficiency)

Results of the simulation is as follows:

- Average ship waiting time: 30.3 hrs
- Berth occupancy ratio: 38.8%

The number of berths for phosphate is one, because the average ship waiting time is within two days and total number of vessels is small.

13.2.5 Fertilizer Terminal

Referring to the present trade statistics, the following unloading port and shares are adopted.

Unloading Port	Share(%)	Distance(Miles)
BOMBAY	40	3300
MARSEILLE	10	1600
ALGIER	20	1600
BEIRUT	10	250
PIRAEUS	20	650

Transportation cost by vessel size is computed as follows.
* shows the minimum cost vessel size of each shipping route

Vessel Size	BOMBAY	MARSEILLE	ALGIER	BEIRUT	PIRAEUS
32,200	111	102	102	108*	100*
40,000	106	100*	100*	117	103
50,000	104	101	101	130	108
65,000	100*	102	102	148	116

Minimum cost is expressed as 100.

In order to decide the berth scale(depth), above cost and construction cost are taken into consideration. Three cases- Case 1(Berth depth -11m, Length 190m), Case 2(Berth depth -12m, 240m), Case 3(Berth depth -13m, 260m) - are compared. The total present cost during the project life(30 years) is as follows:

	Case 1 (-11m)	Case 2 (-12m)	Case 3 (-13m)
Cost Index	104	100	102

Consequently, berth scale of -12m is the most economical among these cases.

Number of berths is decided using the simulation. The following premises are adopted based on the results described above.

- Total volume of cargoes loaded into the vessels:480,000 tons
- Maximum Vessel capacity: 30,000 tons
- Number of calling vessels: 21
- Cargo handling productivity: 220 tons per hour
- Land transportation by railway

- Number of berths: 1

Cargo handling productivity is calculated as follows:

150 ton × 3 units × 0.7(efficiency) × 0.7(operation)

Result of the simulation is as follows:

Average ship waiting time: 26.4 hrs
Berth occupancy ratio: 37.9 %

Average waiting time is around a day. One berth is sufficient for handling fertilizer.

13.2.6 Sulphur Terminal

Majority of the sulphur will be carried from Iraq by railway. Referring to the present trade condition, the major importers of sulphur are north African countries.

Unloading Port	Share(%)	Distance(Miles)
CASABLANCA	50	2100
TUNIS	30	1300
CONSTANZA	20	1070

Transportation cost by vessel size is computed as follows:
* shows the minimum cost vessel size of each shipping route.

Vessel Size	CASABLANCA	TUNIS	CONSTANZA
40,000	102	100*	100*
50,000	101	102	103
65,000	100*	104	106

Note:Minimum cost is expressed as 100.

In order to decide the berth scale(depth), above cost and construction cost are taken into consideration. Three cases- Case 1(Berth depth -14m, Length 280m), Case 2(Berth depth -13m, Length 260m), Case 3(Berth depth -12m, Length 240m) - are compared. The total present cost index during the project life(30 years) is as follows:

	Case1 (-14m)	Case2 (-13m)	Case3 (-12m)
Cost Index	105	103	100

Consequently, berth scale of -12m is the most economical among these cases. Number of berths are decided using the simulation. The following premises are adopted based on the results described above.

- Total volume of cargoes loaded into the vessels:500,000 tons
- Maxium Vessel capacity: 30,000 tons
- Number of calling vessels: 17
- Cargo handling productivity: 189 tons per hour
- Land transportation by train
- Number of berths: 1

Cargo handling productivity is calculated as follows:

150ton X 3 X 0.6(efficiency)X 0.7(operation)

Results of the simulation is as follows:

- Average ship waiting time: 21.8 hrs
- Berth occupancy ratio: 38.6 %

The number of berths for phosphate is one, because the average ship waiting time is around one day.

13.2.7 Public Berths

(1) Public Berth for Steel Industry

General cargoes for the new steel factory, bricks or ferro-alloys will be handled in the general cargo terminal. Since scrap terminal is fully occupied by scrap itself, new berth for miscellaneous materials for the steel factory is necessary.

Number of berths is decided using computer simulation. The following premises are adopted.

- Total volume of cargoes unloaded: 150,000 tons
- Maximum cargo handling volume: 10,000 tons
- Number of calling vessels: 17
- Cargo handling productivity: 67
- Land transportation by truck
- Number of berths: 1

Cargo handling productivity is calculated as follows:

40ton X 3gang X 0.8(efficiency)X 0.7(operation)

Result of the simulation is as follows:

Average ship waiting time: 18.5 hrs
Berth occupancy ratio: 32.1 %

One berth is sufficient for general cargo for the steel factory.

Since the cargo volume is low, large vessel is not economical. Considering the present vessel size carrying general cargo, the majority of the vessels will be under 10,000 DWT.

(2) Public Berth for Coke

Coke and other general cargo will be handled in another general cargo terminal. Since coke will impact the air quality, the berth will be located far from small vessel terminal and headquarters office.

At present, coke is exported to Turkey. Since coke is oversupplied, the condition will not change in the future. The optimum size of the vessel to Turkey is 15,000 DWT.

Number of berths is decided using computer simulation. The following premises are adopted.

- Total volume of cargoes unloaded: 200,000 tons
- Maximum cargo volume per vessel: 15,000 tons
- Number of calling vessels: 17
- Cargo handling productivity: 126 ton/hr
- Land transportation by truck
- Number of berths: 1

Cargo handling productivity is calculated as follows:

150ton X 3 X 0.6(efficiency)X 0.7(operation) X 16hr/24hr

Result of the simulation is as follows:

Average ship waiting time: 36.3 hrs
Berth occupancy ratio: 39.4 %

One berth is sufficient for coke.

(3) Public Berth for Other Bagged Cargo

Other bagged cargo is handled in the new port. Fertilizer is imported from other mediterranean countries in bagged style. Miscellaneous cargo for port maintenance and operation is also handled in the general cargo terminal.

Number of berths is decided using computer simulation. The following premises are adopted.

- Total volume of cargoes unloaded: 210,000 tons
- Maximum cargo volume per vessel: 15,000 tons
- Number of calling vessels: 18
- Cargo handling productivity: 67 ton/hr
- Land transportation by truck
- Number of berths: 2

Cargo handling productivity is calculated as follows:

2ton X 30cycles X 3gangs X 0.7(efficiency)X 0.8(operation)X16/24

Result of the simulation is as follows:

Average ship waiting time: 4.0 hrs
Berth occupancy ratio: 39.4 %

One berth is sufficient for general cargo and for other bagged cargo.

Since the cargo volume is low, large vessel is not economical. Considering the present vessel size carrying imported fertilizer, the majority of the vessels will be under 10,000 DWT.

(4) Small Vessel Terminal

The following boats are necessary for operating the new port.

- Tug Boat: 4
- Pilot Boat: 4
- Boat for Official Use: 4
- Waste Oil Collecting Boat: 1
- Boat for Quarantine and Custom: 2

To both accommodate these boats and for miscellaneous use, a small vessel berth is planned as follows:

- Length: 310 m
- Depth: -4.5 m

13.3 Cargo Handling System

Major cargo handling commodities at New Port are pellet, scrap and general cargo which is fertilizer in bags and firebricks for import and phosphate rock, cement clinker, fertilizer in bulk and oil cokes for export and sulphur for import of transit cargo. The cargo handling volume at New Port is estimated to be 8.09 million tons in 2010.
(See Table 13.3.1.)

Table 13.3.1 Cargo Handling Volume at New Port in 2010

Unit:thousand ton

Commodity	Import	Export	Total
Phosphate		4100	4100
Cement Clinker		1000	1000
Pellet	1250		1250
Scrap	200		200
Oil Coke		200	200
Sulphur		500	500
Fertilizer	210	480	690
General Cargo(Fire brick & Others)	150		150
Total	1810	6280	8090

At New Port, all handling cargoes should be stored in the port area for the following reasons:

1.Reducing the number of trucks and wagons of train for delivery.
2.Stabilizing cargo handling productivity
3.Reducing the inland transportation cost

Current cargo handling time in Syrian ports is 16 hours per day in general. However, cargo handling time at New Port should be 24 hours for effective port operation. If the cargo handling productivity of New Port is not sufficiently high, this will not be economically feasible.

13.3.1 Cargo Handling System for Each Commodity in the Master Plan

(1) Phosphate

Transportation of phosphate from phosphate plant to silo facility in the port is done by wagons of train. The style of the wagon is the same as the present style, for example bottom door type wagons.

After arriving at phosphate terminal in the port, export phosphate is dumped to underground hopper at receiving facility with dust collector.
The receiving facility is enclosed by reinforced wall with roof. At the entrance for wagon, a curtain, which is composed of long narrow strips of skin, is installed to

prevent air-pollution. The phosphate is transported to elevators at the machinery tower by chain conveyors which are laid underground.

After transportation from receiving facility to elevators, the phosphate is elevated to chain conveyors for dumping to silo bins. Then, the phosphate is stored in silo bins.

When the phosphate ship arrives at phosphate pier, the phosphate is brought out from the bottom of silo bins(the exit). Then, the phosphate is sent to elevators at machinery tower by belt conveyors.

After arriving at elevators, the phosphate is elevated to belt conveyors on loading bridge. Then, the phosphate is moved to ship-loaders by sealed belt conveyors. Then the phosphate is loaded by the ship-loaders.

Dust collectors are installed at receiving facility and loading bridge.

Figure 13.3.1 shows the phosphate flow at phosphate terminal in New Port.

(2) Cement Clinker

Cement clinker is sent from the cement factory which is located about 15 km north from Tartous to New Port by train. The style of wagon of train is the same as the wagon for phosphate, namely, bottom door type wagon.

Cement clinkers are dumped from wagon to underground hopper at receiving facility. The receiving facility is enclosed by reinforced wall with roof. System of the receiving facility is the same as the receiving facility for phosphate, that is, there is a curtain which is composed of long narrow strips of skin at the entrance of wagon of train. Belt conveyors are installed underground from receiving facility to elevators for elevation to over head belt conveyor for delivery to storage shed. Then, the clinkers are stored in the shed.

When the clinkers are loaded onto ship, the clinkers are dropped onto belt conveyor under the floor, then moved to elevators for elevation to belt conveyors at loading bridge. Then, the clinkers are transported to ship-loader.

Dust collectors should be installed at receiving facility, storage shed and loading bridge.

Figure 13.3.2 shows the cargo flow for cement clinker at the terminal in New Port.

(3) Pellet

Imported pellet is unloaded from ship to belt conveyor by grab bucket unloader. After unloading pellet, the pellet is moved from unloader to stacker by belt conveyor. After moving the pellet to stacker, the pellet is dropped to storage yard.

For delivery to consignee, pelletis loaded to belt conveyor at storage yard by reclaimer. Then, the pellet is loaded to wagon of train.

Figure 13.3.3 shows the cargo flow for iron pellet at the terminal in New Port.

(4) Scrap

Iron scrap is directly unloaded from ship onto trailers by quay cranes with special attachment for iron scrap, such as lifting magnet. Then, this cargo is moved to open storage area which is located just behind the berth. All of imported iron scrap should be stored at open storage yard.

At open storage yard, iron scrap is handled for loading/unloading to/from trailers and marshalling by mobile crane.

Figure 13.3.4 shows the cargo flow for scrap at the terminal in New Port.

(5) Oil Coke

Oil Coke is sent from the oil refineries which are located in Homs and Banias by train. The style of wagon of train is the same as the wagon for phosphate, namely, bottom door type wagon.

After dumping from wagon to underground hopper at receiving facility, the sloping belt conveyor transports the oil coke to hopper which is installed at a suitable height for loading to trcuk.

After loading to truck, the oil coke is transported to stacker at storage yard. Then, the stacker dumps the oil coke to open storage area.

When vessel arrives for oil coke at New Port, the coke is transported to apron of quay by trucks. Cargo handling from the shed to trucks is done by shovel loader. After arriving at the quay, the oil coke is loaded to the ship by portable loaders.

Figure 13.3.5 shows the cargo flow for oil coke in New Port.

(6) Sulphur

Transportation of flake sulphur flom Iraq to sulphur terminal in New Port is done by bottom door type wagons of train.

After arriving at sulphur terminal in the port, export sulphur is dumped from wagons of train to underground, hopper where sulphur is sprinkled with mist water at receiving facility. Then, the sulphur is transported to elevators at sheds.

After transportation to elevator, the sulphur is elevated to overhead chain conveyors for sending to shed. The sulphur then is dumped for storing in the shed.

When sulphur vessel arrives at New Port, the sulphur is transported to apron of quay by trucks. Cargo handling at the shed for loading to trucks is done by shovel loader. After arriving at the quay, mist water is sprinkled on the sulphur, then the sulphur is loaded to the ship by portable loaders.

Figure 13.3.6 shows the cargo flow for flake sulphur at the terminal in New Port.

(7) Fertilizer (Export)

Export fertilizer is sent from the fertilizer factories which are located at Homs, Palmira and Ruqqa to New Port by train. The style of wagon of train is the same as the wagon for sulphur and oil coke, namely bottom door type wagon.

The fertilizer is dumped from the wagons of train to underground hopper. Then, fertilizer is transported onto elevators at sheds. After transportation to elevator, the fertilizer is elevated to overhead chain conveyors for sending to shed. Then, the fertilizer is dumped for storing in the shed.

When fertilizer vessel arrives at New Port, the export fertilizer is transported to apron of quay by trucks. Cargo handling from the shed to trucks is done by shovel loader. After arriving at the quay, the fertilizer is loaded to the ship by portable loaders.

Figure 13.3.7 shows the cargo flow for export fertilizer at the terminal in New Port.

(8) General Cargo (Fire Brick and Others)

Fire bricks and related products for steel industry (here after these products are called fire bricks and others) are import cargoes which are transported by general cargo ships.

Fire bricks and others are unloaded from general cargo ship to apron on the quay by ship's crane. After unloading these cargoes, the cargoes are transported to shed by fork-lift trucks. Then, these cargoes are stored at the shed.

When the fire bricks and others are delivered to consignee, these cargoes are loaded to trailer by fork-lift trucks. Then, the fire bricks and others are transported to loading area for railway by trailers.

The fire bricks and others are transported to consignee by open goods wagon of train after loading these cargoes from trailers to the open goods wagon.

(9) General Cargo (Bagged Fertilizer)

Bagged fertilizer is an import cargo which is transported by general cargo ships.

Bagged fertilizer is unloaded from general cargo ship to apron on the quay by ship's crane. After unloading this cargo, the cargo is transported to shed by fork-lift trucks. Then, this cargo is stored at the shed.

When the bagged fertilizer is delivered to consignee, the cargo is loaded to trucks by fork-lift trucks. Then, the bagged fertilizer is transported to consignee.

Figure 13.3.9 shows the cargo flow for import bagged fertilizer at New Port.

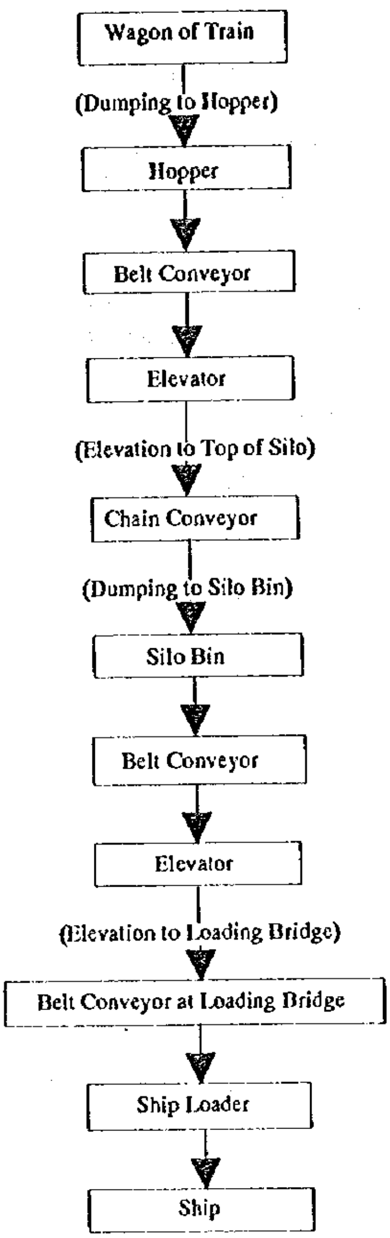


Figure 13.3.1 Cargo flow for Phosphate at New Port

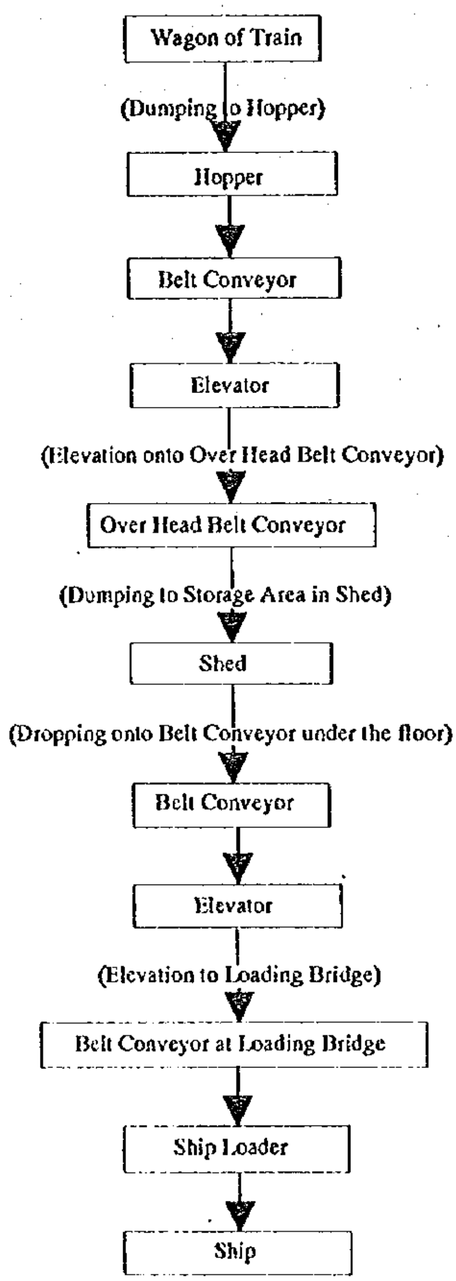


Figure 13.3.2 Cargo Flow for Cement Clinker at New Port

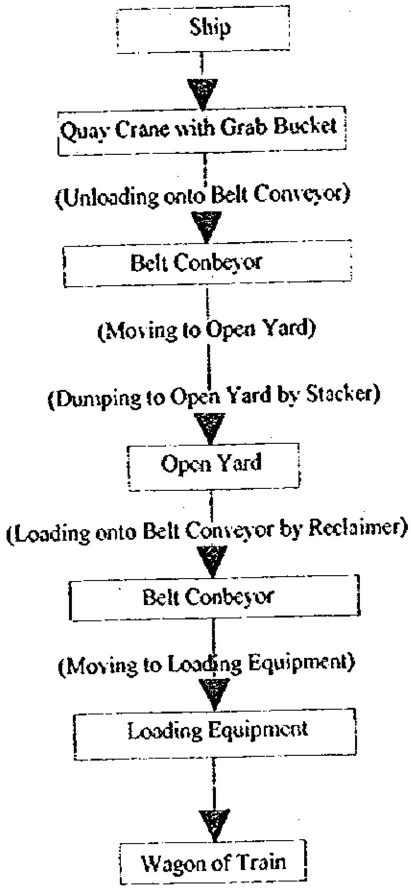


Figure 13.3.3 Cargo Flow for Iron Pellet at New Port

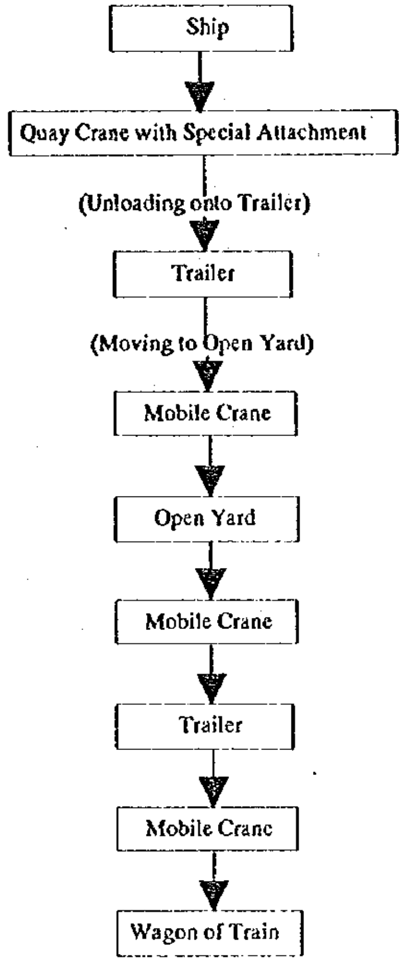


Figure 13.3.4 Cargo Flow for Scrap at New Port

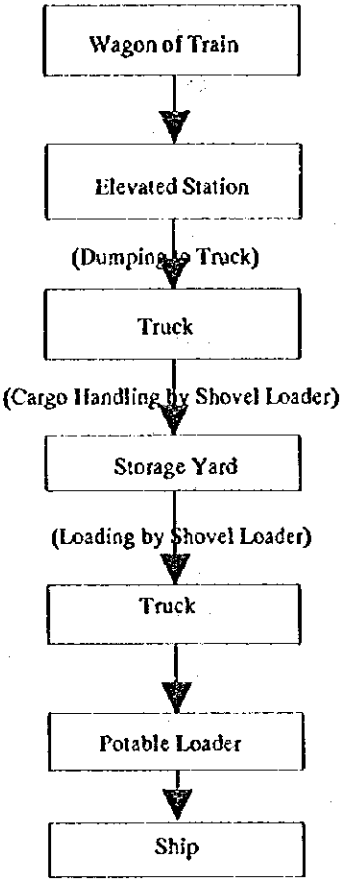


Figure 13.3.5 Cargo Flow for Oil Coke at New Port

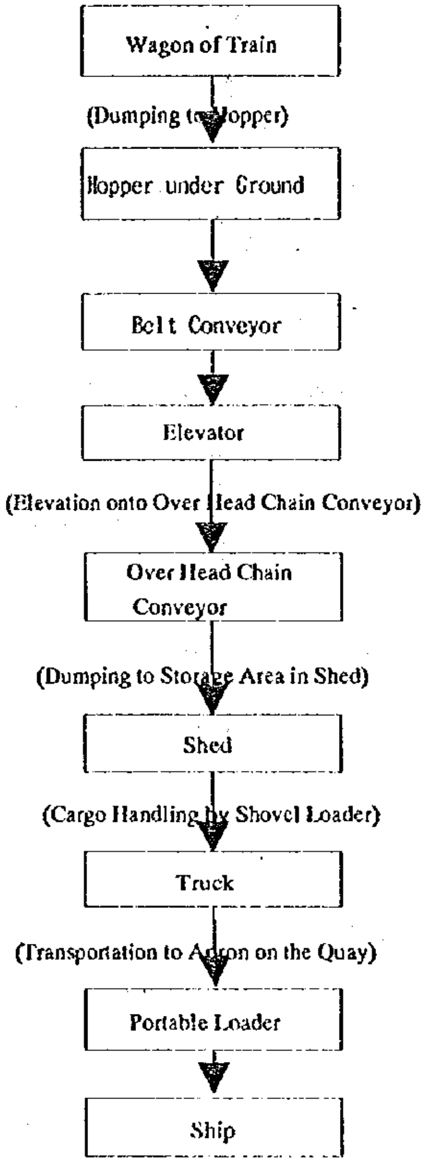


Figure 13.3.6 cargo Flow for sulphur at New Port

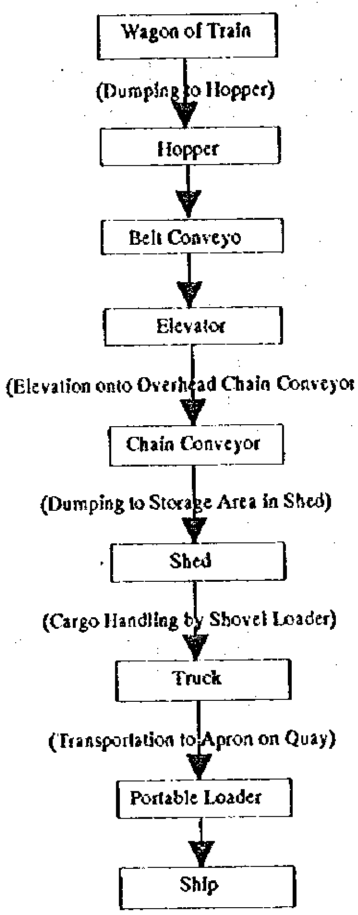


Figure 13.3.7 Cargo Flow for Export Fertilizer at New Port

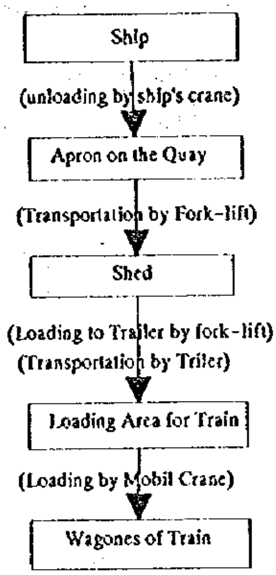


Figure 13.3.8 Cargo Flow for General Cargo at New Port (Fire Brick and Others)

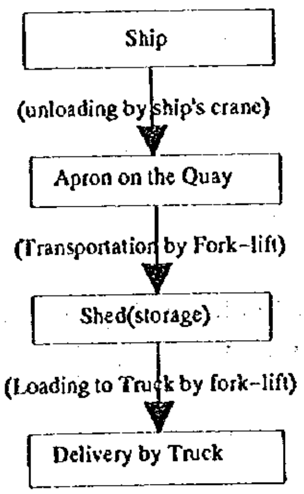


Figure 13.3.9 Cargo Flow for General Cargo at New Port (Import Bagged Fertilizer)

13.3.2 Scale of Storage Facilities for Each Commodity

The estimation procedure of the scale of storage facilities for each commodity is shown in Figure 13.3.10 for export and Figure 13,3,11 for import.

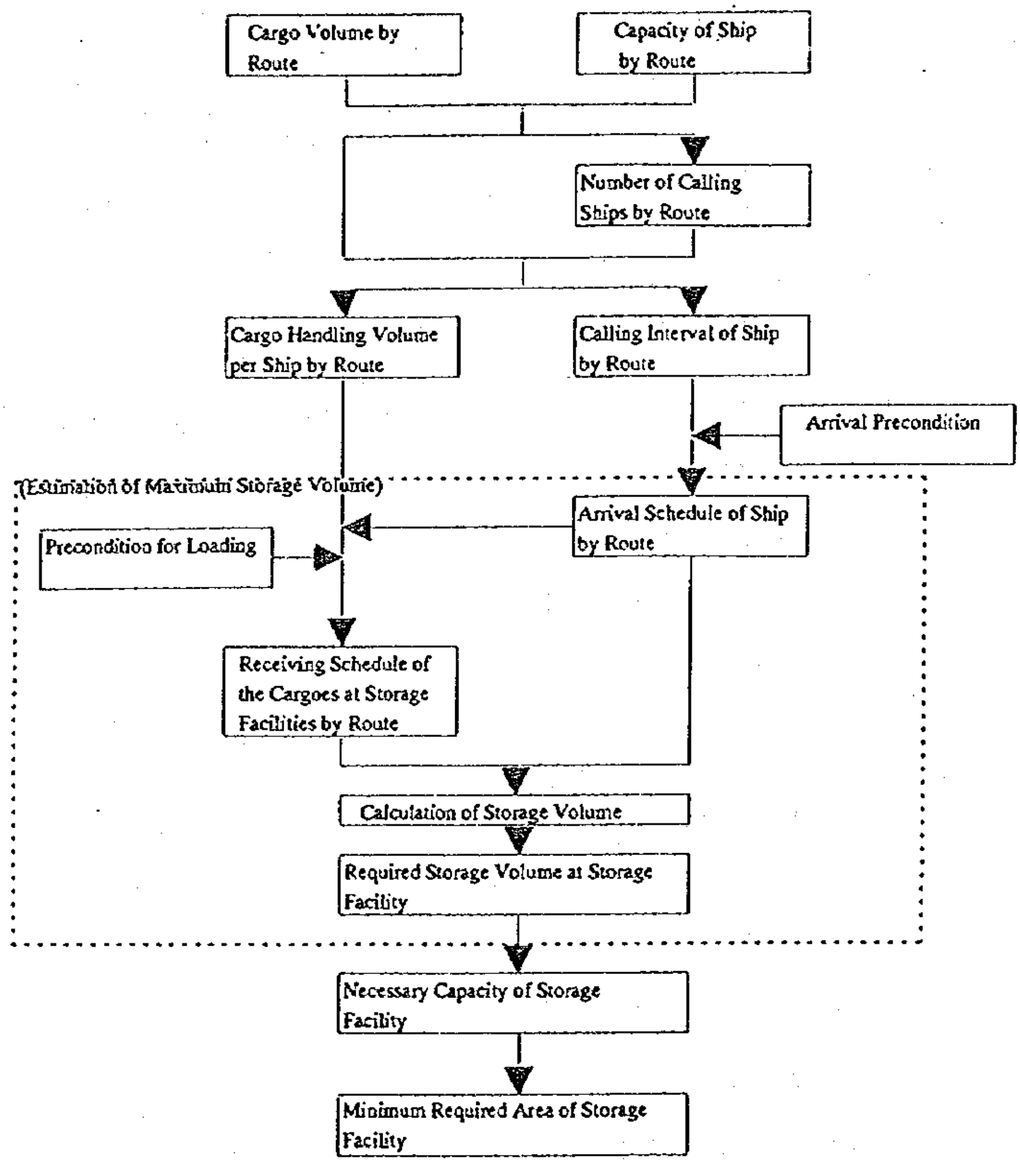


Figure 13.3.10 Flow Chart for Estimation of Minimum Required area of Storage Facilities for Export Cargo

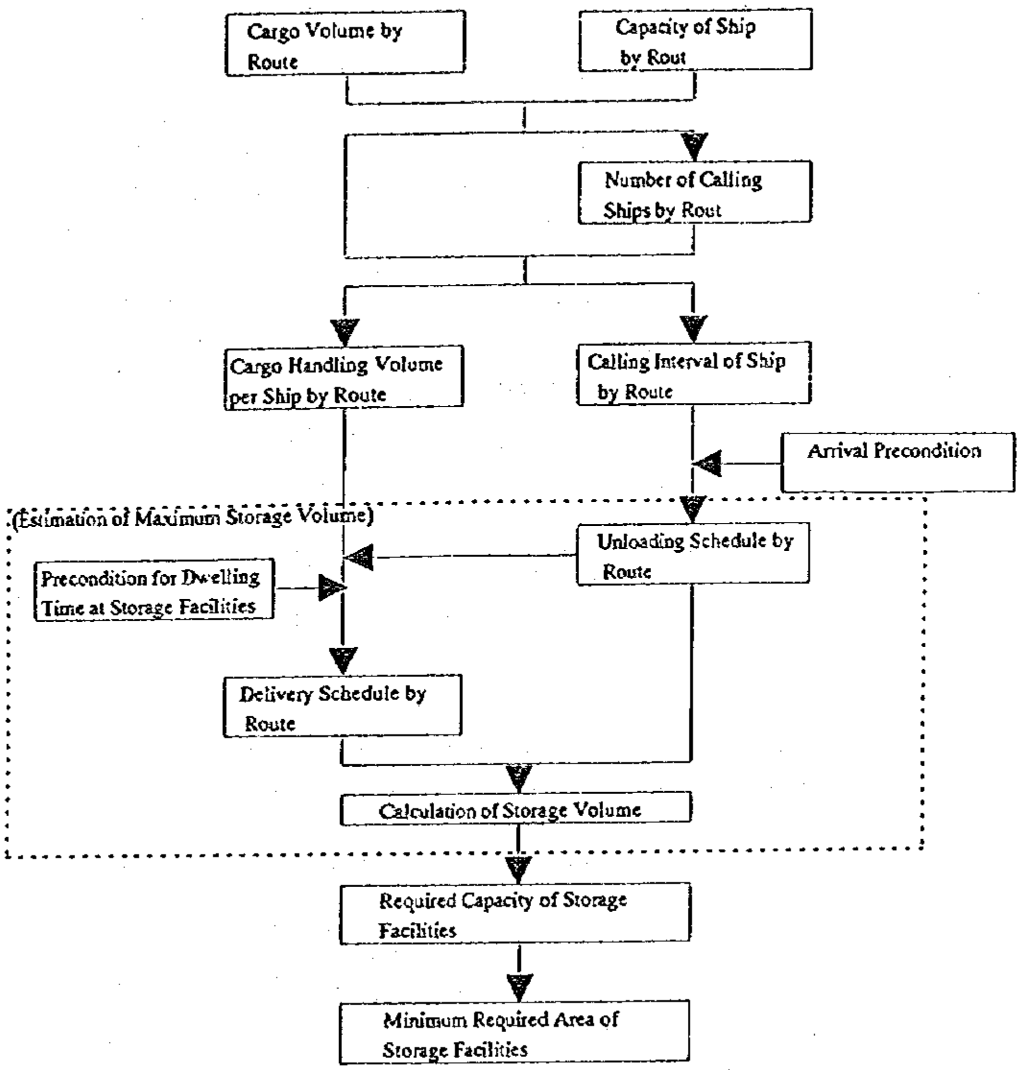


Figure 13.3.11 Flow Chart of Estimation for Area of Storage Facilities for Import Cargo

(1) Phosphate

1) Precondition

The precondition of scale estimation of phosphate terminal is as follows:

1. Export phosphate is classified into 6 grades. Percentage of export volume for each grade with volume is shown in Table 13.3.2.

Table 13.3.2 Percentage and Volume of each grade Phosphate in 2010

Class	Percentage (%)	Volume (tons/year)
A	23.3	956,667
B	23.3	956,667
C	23.3	956,667
D	10.0	410,000
E	10.0	410,000
F	10.0	410,000
Total	100.0	4,100,000

2. The ports of trade partners with percentage of trade volume of phosphate to New Port by grade are shown in Table 13.3.3.

Table 13.3.3 Percentage and Volume for Each Grade of Phosphate by Trading Partner

Class	Volume by class	Constanza			Marseille			Rotterdam		
		Percentage by route	Cargo Volume by route	Number of ships by class	Percentage by route	Cargo Volume by route	Number of ships by class	Percentage by route	Cargo Volume by route	Number of ships by class
	(tons)	(%)	(tons)	(Ships)	(%)	(tons)	(Ships)	(%)	(tons)	(Ships)
A	956,667				33	683,333	19.0	33	273,333	4.7
B	956,667				33	683,333	19.0	33	273,333	4.7
C	956,667				33	683,333	19.0	33	273,333	4.7
D	410,000	33	410,000	11.4						
E	410,000	33	410,000	11.4						
F	410,000	33	410,000	11.4						
Total	4,100,000	100	1,230,000	35	100	2,050,000	57	100	820,000	14

3. Maximum capacities of ships for phosphate by route are as follows:

Route	Average Capacity
Constanza	36,000 tons
Marseille	36,000 tons
Rotterdam	58,500 tons

4. Same route ships don't arrive at the same time at New Port
5. The interval of calling ships for same route is kept constant in general.
6. Loading to target ship should be started only after a sufficient loading volume is stored in silo.

2) Number of Ships and Average Cargo-handling Volume per Ship

Number of ships by route is calculated by the cargo handling volume of phosphate by route by grade and the average capacity of ships by route by grade.

The result of the calculation is as follows:

Route	Constanza	Marseille	Rotterdam	Total
Number of ships (ships/year)	35	57	14	104

Average cargo-handling volume per ship by route is calculated by the cargo handling volume of phosphate by route by grade and number of ships by route by grade.
The result of the calculation is as follows:

(Route)	(Constanza)	(Marseille)	(Rotterdam)
Average cargo-handling volume (tons/ship)	36,200	35,700	58,600

Details of both calculations are shown in Appendix-7.

3) Interval of Calling Ships for Same Route
The interval of calling ships for same route is calculated by number of annual days(365 days) and number of ships by route.
Result of the calculation is as below:

Constanza : 11 days
Marseille : 46 days
Rotterdam : 7 days

Details of the calculation are shown in Appendix-7.

4) Maximum Storage volume
Maximum storage volume of Phosphate is calculated based on average cargo handling volume per ship by route, cargo handling productivity from wagons of train to the receiving facility and from apron on the quay to ship and interval of calling ships by shipping route.

The procedure of calculation of maximum storage volume for phosphate is as follows:

1. Determine cargo handling time per ship between wagons and hopper of receiving facility by shipping route.
2. Determine cargo handling time per ship between apron on the quay and the vessel by shipping route.
3. Estimate combination of shipping routes of which ships have possibility to arrive at same time in a year at the new port using the least common multiple of the interval of calling ships by each route.
4. Calculate maximum storage volume based on the result of above.

(A) Calculation of Cargo Handling Time

a) From wagons of train to the apron of open yard

The cargo handling time per ship between wagons and receiving facility is calculated by the cargo-handling productivity from wagons to hopper at receiving facility, number of wagons per train, cargo volume per wagon and cargo-handling volume per ship.

Result of the calculation is shown below:

(Route)	(Constanza)	(Marseille)	(Rotterdam)
Cargo-handling time per ship from wagons to hopper(days)	4	5	7

Details of the calculation are shown in Appendix-7.

b) From apron on the quay to the ship

Cargo handling time per ship between apron on the quay and ship is calculated by cargo volume per ship, capacity of loader, number of loader, working hours per day and cargo handling efficiency.

Result of the calculation is as follows:

(Route)	(Constanza)	(Marseille)	(Rotterdam)
Cargo-handling time per ship from apron to ship(days)	3.1	3.1	2.7
Berthing time per ship(days)	4.0	4.0	3.0

Details of the calculation are shown in Appendix-7.

(B) Estimation of combination of shipping routes

The possibility of arrival at same time in a year is estimated by the least common multiple of approximate numerical values of the intervals of calling ships whose respective routes are different. If the least common multiple among around numerical values of the intervals of calling ships for some combination of routes is more than 365 days, the combination of these routes is not included in the calculation of the maximum storage cargo volume at storage facilities in the port.

According to the result of the estimation for the possibility of arrival at same time in a year, constituent routes included in the calculation of the maximum storage volume for storage facilities are as follows:

Constanza	-	The New Port
Marseille	-	The New Port
Rotterdam	-	The New Port

(C) Calculation of maximum storage volume

The maximum storage volume is calculated using the calculation table, namely

Table 13.3.4, which is made considering the most severe condition for shipping schedule based on the estimation of shipping routes combination and the preconditions of scale estimation of phosphate terminal.

According to Table 13.3.4,the required storage volume of the phosphate terminal is as follows:

98,385 tons (from Table 13.3,4) x 1.7 (spare ratio) = 167,000 tons

(2) Cement Clinker

1) Precondition

The precondition of scale estimation of cement clinkers terminal is as follows:

1. he ports of trade partners with percentage of volume to total is shown in Table 13.3.5.

Table 13.3.5 Percentage and Volume of Cement Clinker by Trade Partner

Trading Partner	Cargo handling Volume (1,000 tons)	Parcentage of Cargo Volume (%)
New York	300	30
Abidjan	200	20
Istanbul	200	20
Borgas	100	10
Marsaille	200	20
Total	1,000	100

2. Maximum capacities of ships for cement clinkers by route are as follows:

(Route)	(Average Capacity)
New York	58,800 tons
Abidjan	58,500 tons
Istanbul	28,980 tons
Borgas	28,980 tons
Marsaill	36,000 tons

3. Same route ships don't arrive at the same time at New Port
4. The interval of calling ships for same route is kept constant in general.
5. Loading to target ship should be started only after a sufficient loading volume is stored in sheds.

2) Number of Ships

Number of ships in a year by route and average cargo handling volume per ships by route are calculated by cargo handling volume by route, average capacity of ships by route.

Table 13.3.4 Calculation Table for Storage Volume of Phosphate

	Marseille			Rotterdam			Constanza			Total		Total storage volume
	Receiving volume	Loading volume	Storage volume	Reciving volume	Loading volume	Storage volume	Reciving volume	Loading volume	Storage volume	Storage volume A-C	Storage volume D-F	
1	8960		35840				8960		8960	35840	8960	44800
2	125		35965	8960		8960	8960		17920	44925	17920	62845
3		8991	26974	8960		17920	8960		26880	44894	26880	71774
4	8960	8991	26943	8960		26880	8263		35143	53823	35143	88966
5	8960	8991	26912	8960		35840		8786	26357	62752	26357	89109
6	8960	8992	26880	8960		44800		8786	17571	71680	17571	89251
7	8960		35840	8960		53760		8786	8785	89600	8785	98385
8	125		35965	4811		58571		8785	0	94536	0	94536
9		8991	26974		19.524	39.047			0	66021	0	66021
10	8960	8991	26943		19.524	19.523			0	46466	0	46466
11	8960	8991	26912		19.523	0	8960		8960	26912	8960	35872
12	8960	8992	26880			0	8960		17920	26880	17920	44800
13	8960		35840			0	8960		26880	35840	26880	62720
14	125		35965			0	8263		35143	35965	35143	71108
15		8991	26974			0		8786	26357	26974	26357	53331
16	8960	8991	26943			0		8786	17571	26943	17571	44514
17	8960	8991	26912			0		8786	8785	26912	8785	35697
18	8960	8992	26880			0		8785	0	26880	0	26880
19	8960		35840			0			0	35840	0	35840
20	125		35965			0			0	35965	0	35965
21		8991	26974			0	8960		8960	26974	8960	35934
22	8960	8991	26943			0	8960		17920	26943	17920	44863
23	8960	8991	26912			0	8960		26880	26912	26880	53792
24	8960	8992	26880			0	8263		35143	26880	35143	62023
25	8960		35840			0		8786	26357	35840	26357	62197
26	125		35965			0		8786	17571	35965	17571	53536
27		8991	26974			0		8786	8785	26974	8785	35759
28	8960	8991	26943	8960		8.960		8785	0	35903	0	35903
29	8960	8991	26912	8960		17.920			0	44832	0	44832
30	8960	8992	26880	8960		26.880			0	53760	0	53760

Result of the calculation is shown below:

(Route)	(Number of ships)	(Average cargo-handling volume)
New York	6 ships/year	50,000 tons/ship
Abidjan	4 ships/year	50,000 tons/ship
Istanbul	7 ships/year	28,571 tons/ship
Borgas	4 ships/year	25,000 tons/ship
Marsaill	6 ships/year	33,333 tons/ship

Details of the calculation are shown in Appendix-8.

3) Interval of Calling Ships for Same Route
The interval of calling ships for same route is calculated by number of annual days(365 days) and number of ships by route.

Result of the calculation is as follows:

New York	: 61 days
Abidjan	: 91 days
Istanbul	: 52 days
Borgas	: 91 days
Marseille	: 61 days

Detailws of the calculation are shown in Appendix-8.

4) Maximum Storage volume
Maximum storage volume of cement clinker is calculated based on average cargo handling volume per ship by route, cargo handling productivity from wagons of train to the receiving facility and from apron on the quay to ship and interval of calling ships by shipping route.

The procedure of calculation of maximum storage volume for cement clinker is as follows:

1. Determine cargo handling time per ship between wagons and receiving facility by shipping route.
2. Determine cargo handling time per ship between apron on the quay and the vessel by shipping route.
3. Estimate combination of shipping routes of which ships have possibility to arrive at same time in a year at the new port using the least common multiple of the interval of calling ships by each route.
4. Calculate maximum storage volume based on results of above.

(A) Calculation of Cargo Handling Time
a) From wagons of train to the apron of open yard
The cargo handling time per ship between wagons and receiving facility is

calculated by the cargo-handling productivity from wagons to hopper at receiving facility, number of wagons per train, cargo volume per wagon and cargo-handling volume per ship.

Result of the calculation is as follows:

(Route)	(Cargo-handling time from wagons to hopper)
New York	7 days/ship
Abidjan	7 days/ship
Istanbul	4 days/ship
Borgas	4 days/ship
Marseille	4 days/ship

Details of the calculation are shown in Appendix-8.

b) From apron on the quay to the ship
Cargo handling time per ship between apron on the quay and ship is calculated by cargo volume per ship, capacity of loader, number of loader, working hours per day and cargo handling efficiency.

Result of the calculation is as follows:

Route	New York	Abidjan	Istanbul	Borgas	Marseille
Cargo-handling time per ship from apron to ship(days)	3.9	3.9	2.2	1.9	2.6

Details of the calculation are shown in Appendix-8.

(B) Estimation of combination of shipping routes
The possibility of arrival at same time in a year is estimated by the least common multiple of approximate numerical values of the intervals of calling ships whose respective routes are different. If the least common multiple among numerical values of the intervals of calling ships for some combination of routes is more than 365 days, the combination of these routes is not included in the calculation of the maximum storage cargo volume at storage facilities in the port.

According to the result of the estimation for the possibility of arrival at same time in a year, constituent routes included in the calculation of the maximum storage volume for storage facilities are as follows:

New York - The New Port
Abidjan - The New Port
Borgas - The New Port
Marseille - The New Port

Table 13.3.6 Calculation Table for Storage Volume of Cement Clinker

Day	New York			Abidjan			Borgas			Marsaille			Total Storage Volume
	loading volume (tons)	reciving volume (tons)	Storage Volume (tons)	loading volume (tons)	reciving volume (tons)	Storage Volume (tons)	loading volume (tons)	reciving volume (tons)	Storage Volume (tons)	loading volume (tons)	reciving volume (tons)	Storage Volume (tons)	(tons)
1											7.500	7.500	7.500
2		7.500	7.500								7.500	15.000	22.500
3		7.500	15.000								7.500	22.500	37.500
4		7.500	22.500								7.500	30.000	52.500
5		7.500	30.000								3.333	33.333	63.333
6		7.500	37.500		7.500	7.500				12.800		20.533	65.533
7		7.500	45.000		7.500	15.000				12.800		7.733	67.733
8		5000	50.000		7.500	22.500				7.733		0	72.500
9	12.800		37200		7.500	30.000							67.200
10	12.800		24400		7.500	37.500							61.900
11	12.800		11600		7.500	45.000							56.600
12	11.600		0		5000	50.000							50.000
13				12800		37.200		7.500	7.500				44.700
14				12800		24.400		7.500	15.000				39.400
15				12800		11.600		7.500	22.500				34.100
16				11600		0		2.500	25.000				25.000
17							12.800		12.200				12.200
18							12.200		0				0
19													0
20													0

(C) Calculation of storage volume

The storage volume is calculated using the calculation table, namely Table 13.3.6, which is made considering the most severe condition for shipping schedule based on estimation of shipping routes combination and the preconditions of scale estimation of cement clinker terminal.

According to Table 13.3.6,the required storage volume of the cement clinker terminal is as follows:

72,500 tons(from Table 13.3.6) x 1.2(spare ratio) ≒ 87,000 tons

5) Required Storage Area for Cement clinker

The required storage area for cement clinker is calculated by the required storage volume, volume of cargo per unit space and utilization ratio.

The resultant required storage area is approximately 28,600 m^2.

Details of the calculation are shown in Appendix-8.

(3) Iron Pellet

1) Precondition

The precondition of scale estimation of iron pellet terminal is as follows:

1. The ports of trade partners with percentage of volume to total import iron pellet is shown in Table 13.3.7.

Table 13.3.7 Percentage and Volume of Iron Pellet by Trade Partner

Port of Trade Partner	Cargo Volume (1,000tons)	Percentage of Cargo Volume (%)
S. America	625	50
Sweden	625	50
Total	1250	100

2. The Maximum capacities of ships for iron pellet by route are as follows:

Route	Maximum Capacity
South America	72,000 tons
Sweden	58,500 tons

3. Same route ships don't arrive at same time at New Port
4. The interval of calling ships for same route is kept at constant intervalin general.

2) Number of Ships

Number of ships by route and average cargo handling volume per ships by route are calculated by cargo handling volume by route, average capacity of ships by route.

Result of the calculation are as follows:

South America	9 ships/year	69,500 ton/ship
Sweden	11 ships/year	56,800 ton/ship

Details of the calculation are shown in Appendix-9.

3) Interval of Calling Ships for Same Route
The interval of calling ships for same route can be calculated by number of annual days(365 days) and number of ships by route.

Result of calculation for the intervals is as follows:

South America	: 41 days
Sweden	: 33 days

Details of the calculation are shown in Appendix-9.

4) Maximum Storage volume
Maximum storage volume of iron pellet is calculated based on average cargo handling volume per ship by route, cargo handling productivity from ship to apron on the quay, from loading facility for train to wagons of train and interval of calling ships by shipping route.

The procedure of calculation of maximum storage volume for iron pellet s shown below:

1. Determine cargo handling time per ship between ship and apron on the quay by shipping route.
2. Determine cargo handling time per ship between loader and wagons of train by shipping route.
3. Calculate maximum storage volume.

(A) Calculation of Cargo Handling Time
a) From ship to the apron on the quay
The cargo handling time per ship between ship and apron on the quay is calculated by the cargo-handling volume per ship, capacity of unloader, number of un loader, working time per day and working ratio.

Result of calculation is as follows:

(Route)	(Cargo handling time from ship to apron)
South America	6 days/ship
Sweden	5 days/ship

Details of the calculation are shown in Appendix-9

b) From Loader at Loading Facility to Wagons of Train
The cargo handling time per ship between loader for loading to train and wagons of train is calculated by the cargo volume per ship, working time per day, operating efficiency, number of wagons per train, capacity of wagon, capacity of loader and cargo-handling efficiency.

Result of calculation is as follows:

(Route)	(Cargo handling time from loader to train)
South America	7 days/ship
Sweden	6 days/ship

Details of the calculation are shown in Appendix-9

(B) Calculation of maximum storage volume
The maximum storage volume is calculated using the calculation table, namely Table 13.3.8, which is made considering the most severe condition for shipping schedule based on preconditions of scale estimation of iron pellet terminal.

Table 13.3.8 Calculation Table for Storage Volume of Iron Pellet

Day	South America unloading volume (tons)	South America delivery volume (tons)	South America Storage Volume (tons)	Sweden unloading volume (tons)	Sweden delivery volume (tons)	Sweden Storage Volume (tons)	Total Storage Volume (tons)
1	13440		13440				13440
2	13440		26880				26880
3	13440		40320				40320
4	13440		53760				53760
5	13440		67200				67200
6	2300		69500				69500
7			69500	13440		13440	82940
8			69500	13440		26880	96380
9			69500	13440		40320	109820
10			69500	13440		53760	123260
11			69500	3040		56800	126300
12		10500	59000			56800	115800
13		10500	48500			56800	105300
14		10500	38000			56800	94800
15		10500	27500			56800	84300
16		10500	17000			56800	73800
17		10500	6500		10500	46300	52800
18		6500	0		10500	35800	35800
19			0		10500	25300	25300
20			0		10500	14800	14800
21			0		10500	4300	4300
22			0		4300	0	0
23			0			0	0
24			0			0	0
25			0			0	0
26			0			0	0
27			0			0	0
28			0			0	0
29			0			0	0
30			0			0	0
31			0			0	0
32			0			0	0
33			0			0	0
34			0			0	0
35			0			0	0
36			0			0	0
37			0			0	0
38			0			0	0
39			0			0	0
40			0	13440		13440	13440
41			0	13440		26880	26880
42			0	13440		40320	40320
43			0	13440		53760	53760
44			0	3040		56800	56800
45	13440		13440			56800	70240
46	13440		26880			56800	83680
47	13440		40320			56800	97120
48	13440		53760			56800	110560
49	13440		67200			56800	124000
50	2300		69500		10500	46300	115800
51	0		69500		10500	35800	105300
52			69500		10500	25300	94800
53			69500		10500	14800	84300
54			69500		10500	4300	73800
55		10500	59000		4300	0	59000
56		10500	48500			0	48500
57		10500	38000			0	38000
58		10500	27500			0	27500
59		10500	17000			0	17000
60		10500	6500			0	6500
61		6500	0			0	0
62						0	0

According to Table 13.3.8,the required storage volume of the iron pellet terminal is as follows:

126,300 tons(from Table 13.3.8) x 1.2(spare ratio) ≒ 152,000 tons

5) Required Storage Area for Iron Pellet
The required storage area for iron pellet is calculated by the required storage volume, volume of cargo per unit space at storage yard and utilization ratio at storage yard.

The resultant required storage area is approximately 28,500 m^2.

Detailws of the calculation are shown in Appendix-9

(4) Scrap

1) Precondition
The precondition of scale estimation of scrap terminal is as follows:

1. The ports of trade partners with percentage of volume to total import scrap are shown in Table 13.3.9.

Table 13.3.9 Percentage and Volume of Scrap by Trade Partner

Port of Trade Partner	Cargo Volume (ton)	Percentage of Cargo Volume (%)
Novorosisk	140,000	70
Istanbul	20,000	10
Rotterdam	40,000	20
Total	200,000	100

2. Maximum capacities of ships for scrap by route are as follows:
RouteMaximum Capacity
Novorosisk9,000 tons
Istanbul9,000 tons
Rotterdam9,000 tons

3. Same route ships don't arrive at same time at New Port
4. The interval of calling ships for same route is kept at constant intervalin general.
5. Average dwelling time of cargo at open yard in the port area is 5 days.

2) Number of Ships
Number of ships by route and average cargo handling volume per ships by route are calculated by the cargo handling volume by route, average capacity of ships by route, average cargo handling volume per ship by route.

The results of the calculation are as follows:

(Route)	(Number of Calling ships)	(Avrage cargo-handling volume)
Novorosisk	16 ships/year	8,750 tons/ship
Istanbul	3 ships/year	6,667 tons/ship
Rotterdam	5 ships/year	8,000 tons/ship

Details of the calculation are shown in Appendix-10

3) Interval of Calling Ships for Same Route
The interval of calling ships for same route can be calculated by number of annual days(365 days) and number of ships by route.

Result of calculation for the intervals is as follows:

Novorosisk : 23 days
Istanbul : 122 days
Rotterdam : 73 days

Details of the calculation are shown in Appendix-10.

4) Maximum Storage volume
Maximum storage volume of scrap is calculated based on average cargo handling volume per ship by route, cargo handling productivity from ship to apron on the quay, from loading facility for train to wagons of train and interval of calling ships by shipping route.

The procedure of calculation of maximum storage volume for scrap is shown below:

1. Determine cargo handling time per ship between ship and apron on the quay by shipping route.
2. Determine cargo handling time per ship between apron at open yard and wagons of train by shipping route.
3. Estimate combination of shipping routes of which ships have possibility to arrive at same time in a year at the New Port using the least common multiple of the interval of calling ships by each route.
4. Calculate maximum storage volume based on results of above.

(A) Calculation of Cargo Handling Time
a) From ship to the apron on the quay
The cargo handling time per ship between ship and apron on the quay is calculated by the cargo-handling volume per ship, capacity of crane, number of cranes, working time per day and working ratio.

The results of the calculation are as follows:

Cargo handling volume per day from ship to apron : 1,176 tons/day
Cargo handling time per ship from ship to apron by shipping route :

Novorosisk : 8 days
Istabul : 6 days
Rotterdam : 7 days

Details of the calculation are shown in Appendix-10.

b) From cranes at loading facility to wagons of train
The cargo handling time per ship between cranes for loading to train and wagons of train is calculated by the cargo volume per ship, working time per day, operating efficiency, number of wagons per train, capacity of wagon, capacity of cranes and cargo-handling efficiency.

Result of the calculation is as follows:

Novorosisk : 8 days
Istabul : 6 days
Rotterdam : 8 days

Details of the calculation are shown in Appendix-10.

(B) Estimation of combination of shipping routes
The possibility of arrival at same time in a year is estimated by the least common multiple of approximate numerical values of the intervals of calling ships whose respective routes are different. If the least common multiple among numerical values of the intervals of calling ships for some combination of routes is more than 365 days, the combination of these routes is not included in the calculation of the maximum storage cargo volume at storage facilities in the port.

According to the result of the estimation for the possibility of arrival at same time in a year, constituent routes included in the calculation of the maximum storage volume for storage facilities are as follows:

Novorosisk - The New Port
Rotterdam - The New Port

(C) Calculation of storage volume
The storage volume is calculated using the calculation table, namely Table 13.3.10, which is made considering the most severe condition for shipping schedule based on preconditions of scale estimation of storage area for scrap.

According to Table 13.3.10, the required storage volume of storage facility for scrap is as follows:

14,686 tons(from Table 13.3.10) x 1.2(spare ratio) = 17,600 tons

5) Required Storage Area for Scrap

The minimum required storage area for scrap is calculated by the required storage volume, volume of cargo per unit space at the storage facility and utilization ratio at the storage facility.

The resultant required storage area is about 21,500 m^2.

Details of the calculation are shown in Appendix-10.

Table 13.3.10 Calculation Table for Storage Volume of Scrap

Day	Novorossisk Total unloading volume (tons)	Novorossisk Total delivery volume (tons)	Novorossisk Storage Volume (tons)	Rotterdam Total unloading volume (tons)	Rotterdam Total delivery volume (tons)	Rotterdam Storage Volume (tons)	Total Storage Volume (tons)
1	1176		1176				1176
2	1176		2352				2352
3	1176		3528				3528
4	1176		4704				4704
5	1176		5880				5880
6	1176		7056				7056
7	1176		8232				8232
8	518		8750				8750
9			8750	1176		1176	9926
10			8750	1176		2352	11102
11			8750	1176		3528	12278
12			8750	1176		4704	13454
13			8750	1176		5880	14630
14		1120	7630	1176		7056	14686
15		1120	6510	944		8000	14510
16		1120	5390			8000	13390
17		1120	4270			8000	12270
18		1120	3150			8000	11150
19		1120	2030			8000	10030
20		1120	910			8000	8910
21		910	0		1120	6880	6880
22			0		1120	5760	5760
23			0		1120	4640	4640
24	1176		1176		1120	3520	4696
25	1176		2352		1120	2400	4752
26	1176		3528		1120	1280	4808
27	1176		4704		1120	160	4864
28	1176		5880		160	0	5880
29	1176		7056			0	7056
30	1176		8232			0	8232
31	518		8750			0	8750
32			8750			0	8750
33			8750			0	8750
34			8750			0	8750
35			8750			0	8750
36			8750			0	8750
37		1120	7630			0	7630
38		1120	6510			0	6510
39		1120	5390			0	5390
40		1120	4270			0	4270
41		1120	3150			0	3150
42		1120	2030			0	2030
43		1120	910			0	910
44		910	0			0	0
45			0			0	0
46			0			0	0
47	1176		1176			0	1176
48	1176		2352			0	2352
49	1176		3528			0	3528
50	1176		4704			0	4704
51	1176		5880			0	5880
52	1176		7056			0	7056
53	1176		8232			0	8232
54	518		8750			0	8750
55			8750			0	8750
56			8750			0	8750
57			8750			0	8750
58			8750			0	8750
59			8750			0	8750
60		1120	7630			0	7630
61		1120	6510			0	6510
62		1120	5390			0	5390
63		1120	4270			0	4270
64		1120	3150			0	3150
65		1120	2030			0	2030
66		1120	910			0	910
67		910	0			0	0

(5) Oil Coke

1) Precondition

The precondition of scale estimation of storage area of oil coke is as follows:

1. The ports of trade partners with percentage of volume to total export oil coke are shown in Table 13.3.11.

Table 13.3.11 Volume and Percentage of Oil Coke by Trade Partner

Trading Partner	Cargo handling Volume (1,000 tons)	Parcentage of Cargo Volume (%)
Constanza	100	50
Istanbul	100	50
Total	200	100

2. Maximum capacity of ships for oil coke by route are as follows:

Route	Maximum Capacity
Constanza	13,500 tons
Istanbul	13,500 tons

3. Ships of the same route do not arrive simultaneously at New Port.
4. The interval of calling ships for same route is kept at constant interval in general.
5. Loading to target ship should be started only after a sufficient loading volume is stored in storage facility.

2) Number of Ships

Number of ships by route and average cargo handling volume per ships by route are calculated by the cargo-handling volume by route and average capacity of ships by route.

The results of the calculation are as follows:

(Route)	(Number of ship by route)	(Cargo-handling volume per ship)
Constanza	8 ships/year	12,500 tons/ship
Istanbul	8 ships/year	12,500 tons/ship

Details of the calculation are shown in Appendix-11.

3) Interval of Calling Ships for Same Route

The interval of calling ships for same route is calculated by number of annual days(365 days) and number of ships by route.

Results of the calculation are as below:

Constanza : 46 days
Istanbul : 46 days

Details of the calculation are shown in Appendix-11.

4) Maximum Storage volume
The maximum storage volume of oil coke is calculated based on average cargo handling volume per ship by route, cargo handling productivity from wagons of train to the yard and from apron on the quay to ship and interval of calling ships by shipping route.

The procedure of calculation of maximum storage volume for oil coke is as follows:

1. Determine cargo handling time per ship between wagons and apron of open yard by shipping route.
2. Determine cargo handling time per ship between apron on the quay and the vessel by shipping route.
3. Estimate combination of shipping routes of which ships have possibility to arrive at same time in a year at the new port using the least common multiple of the interval of calling ships by each route.
4. Calculate of maximum storage volume based on results of above.

(A) Calculation of Cargo Handling Time

a) From wagons of train to the apron of open yard
Cargo handling time per ship between wagons and receiving facility is calculated by the cargo-handling volume per ship, productivity of cargo-handling from wagon to hopper, number of wagons per train, cargo-handling volume per wagon.

The result of the calculation is as follows.

Constanza : 7.0 days/ship
Istanbul : 7.0 days/ship

Details of the calculation are shown in Appendix-11.

b) From apron on the quay to the ship
Cargo handling time per ship between apron on the quay and ship is calculated by the cargo-handling volume per ship, capacity of loader, number of loaders, working time per day and cargo-handling efficiency(including working ratio).

The result of the calculation is as follows:

Constanza : 5.0 days/ship
Istanbul : 5.0 days/ship

Details of the calculation are shown in Appendix-11.

(B) Estimation of combination of shipping routes

The possibility of arrival at same time in a year is estimated by the least common multiple of approximate numerical values of the intervals of calling ships whose respective routes are different. If the least common multiple among approximate numerical values of the intervals of calling ships for some combination of routes is more than 365 days, the combination of these routes will not be included in the calculation of the maximum storage cargo volume at storage facilities in the port.

According to the result of the estimation for the possibility of arrival at same time in a year, constituent routes included in the calculation of the maximum storage volume for storage facilities are as follows:

Constanza - The New Port
Istanbul - The New Port

(C) Calculation of storage volume

The storage volume is calculated using the calculation sheet, namely, Table 13.3.12, which is made considering the most severe condition for shipping schedule in the result of the estimation of shipping routes combination.

Table 13.3.12 Calculation Sheet for Storage Volume of Oil Coke

According to Table 13.3.12, the required storage volume of oil coke is as follows:

16,100 tons (from Table 13.3.12) x 1.2(spare ratio) 19,500 tons

Table 13.3.12 Calculation Sheet for Storage Volume of Oil Coke

Day	Constanza			Istanbul			Total Storage Volume (tons)
	reciving volume (tons)	loading volume (tons)	Storage Volume (tons)	reciving volume (tons)	loading volume (tons)	Storage Volume (tons)	
1				1,800		1,800	1,800
2				1,800		3,600	3,600
3				1,800		5,400	5,400
4				1,800		7,200	7,200
5				1,800		9,000	9,000
6	1,800		1,800	1,800		10,800	12,600
7	1,800		3,600	1,700		12,500	16,100
8	1,800		5,400		3072	9,428	14,828
9	1,800		7,200		3072	6,356	13,556
10	1,800		9,000		3072	3,284	12,284
11	1,800		10,800		3072	212	11,012
12	1,700		12,500		212	0	12,500
13		3,072	9,428				9,428
14		3,072	6,356				6,356
15		3,072	3,284				3,284
16		3,072	212				212
17		212	0				0
18							
19							
20							

5) Required Storage Area for Oil Coke

The minimum required storage area for oil coke is calculated by the required storage volume, volume of cargo per unit space at storage facility and utilization ratio at the storage facility.

The resulting minimum required storage area is about 15,000 m^2.

Details of the calculation are shown in Appendix-11.

(6) Sulphur

1) Precondition

The precondition of scale estimation of flake sulphur terminal is as follows:

1. The ports of trade partners with percentage of volume to total loading flake sulphur are shown in Table 13.3.13.

Table 13.3.13 Volume and Percentage of Sulphur by Trade Partner

Trading Partner	Cargo handling Volume (ton)	Parcentage of Cargo Volume (%)
Casablanca	250,000	50
Tunis	150,000	30
Marsaille	100,000	20
Total	500,000	100

2. Maximum capacity of ships for sulphur by route are as follows:

Route	Maximum Capacity
Casablanca	58,500 tons
Tunis	36,000 tons
Marseille	36,000 tons

3. Ships of the same route do not arrive simultaneously at New Port.
4. The interval of calling ships for same route is kept at constant interval in general.
5. Loading to target ship should be started only after a sufficient loading volume is stored in storage facility.

2) Number of Ships

Number of ships by route and average cargo handling volume per ships by route are calculated by the cargo handling volume by route, average capacity of ships by route.

The result of the calculation are as follows.

Route	Number of ships	Average Cargo-handling Volume
Casablanca	7 ships/year	35,714 tons/ship
Tunis	5 ships/year	30,000 tons/ship
Marseille	3 ships/year	33,333 tons/ship

Details of the calculation are shown in Appendix-12.

3) Interval of Calling Ships for Same Route

The interval of calling ships for same route is calculated by number of annual days(365 days) and number of ships by route.

Result of the calculation is as below:

Casablanca : 52 days
Tunis : 73 days
Marseille : 122 days

Details of the calculation are shown in Appendix-12.

4) Maximum Storage volume

Maximum storage volume of sulphur is calculated based on average cargo handling volume per ship by route, cargo handling productivity from wagons of train to the yard and from apron on the quay to ship and interval of calling ships by shipping route.

The procedure of calculation of maximum storage volume for sulphur is as follows:

1. Determine cargo handling time per ship between wagons and receiving facility at open yard by shipping route.
2. Determine cargo handling time per ship between apron on the quay and the vessel by shipping route.
3. Estimate combination of shipping routes of which ships have possibility to arrive at same time in a year at the new port using the least common multiple of the interval of calling ships by each route.
4. Calculate maximum storage volume based on results of above.

(A) Calculation of Cargo Handling Time

a) From wagons of train to the apron of open yard

Cargo-handling time per ship between wagons and receiving facility is calculated by the cargo-handling volume per ship, productivity of cargo-handling from wagons to hopper at receiving facility, number of wagons per train and cargo volume per wagon.

The result of the calculation is as follows:

Casablanca : 5 days/ship
Tunis : 4 days/ship

Marsaille : 5 days/ship

Details of the calculation are shown in Appendix-12.

b) From apron on the quay to the ship
Cargo handling time per ship between apron on the quay and ship is calculated by cargo-handling volume per ship, capacity of loader, number of loader at receiving facility, working time per day at receiving facility, cargo-handling efficiency(including working ratio) at receiving facility.

The result of the calculation is as follows:

Casablanca : 5 days/ship
Tunis : 4 days/ship
Marsaille : 5 days/ship

Details of the calculation are shown in Appendix-12.

(B) Estimation of combination for shipping routes
The possibility of arrival at same time in a year is estimated by the least common multiple of approximate numerical values of the intervals of calling ships whose respective routes are different. If the least common multiple among approximate numerical values of the intervals of calling ships for some combination of routes is more than 365 days, the combination of these routes will not be included in the calculation of the maximum storage cargo volume at storage facilities in the port.

According to the result of the estimation for the possibility of arrival at same time in a year, constituent routes included in the calculation of the maximum storage volume for storage facilities are as follows:

Casablanca - The New Port
Tunis - The New Port

(C) Calculation of storage volume
The storage volume is calculated using the calculation sheet, namely, Table 13.3.14, which is made considering the most severe condition for shipping schedule based on the estimation of shipping routes combination and the scale estimation of sulphur terminal.

Table 13.3.14 Calculation Sheet for Storage Volume of Sulphur

Day	Casablanca			Tunis			Total Storage Volume
	Total loading volume (tons)	Total reciving volume (tons)	Storage Volume (tons)	Total loading volume (tons)	Total reciving volume (tons)	Storage Volume (tons)	(tons)
1					7,500	7500	7,500
2					7,500	15000	15,000
3					7,500	22500	22,500
4		7,500	7,500		7,500	30000	37,500
5		7,500	15,000	8,192		21808	36,808
6		7,500	22,500	8,192		13616	36,116
7		7,500	30,000	8,192		5424	35,424
8		5,714	35,714	5,424		0	35,714
9	8,192		27,522				27,522
10	8,192		19,330				19,330
11	8,192		11,138				11,138
12	8,192		2,946				2,946
13	2,946		0				0
14							0
15							0

(7) Fertilizer(Export)

1) Precondition

The precondition of scale estimation of storage facility for export fertilizer is as follows:

1. Cargo style of all of fertilizer for export is in bulk.
2. The ports of trade partners with percentage of volume to total loading fertilizer are shown in Table 13.3.15.

Table 13.3.15 Volume and Percentage of Fertilizer by Trade Partner

Trading Partner	Cargo handling Volume (1,000 tons)	Parcentage of Cargo Volume (%)
Bombay	204	40
Marsaille	51	10
Algier	102	20
Beirut	51	10
Piraeus	102	20
Total	510	100

3. Maximum capacity of ships for the export fertilizer by route are as follows:

Route	Maximum Capacity
Bombay	36,000 tons
Marseille	36,000 tons
Algiers	36,000 tons
Beirut	9,000 tons
Piraeus	28,980 tons

4. Ships of the same route do not arrive simultaneously at New Port.

5. The interval of calling ships for same route is kept at constant interval in general.
6. Loading to target ship should be started only after a sufficient loading volume is stored in storage facility.

2) Number of Ships
Number of calling ships by route and average cargo handling volume per ships by route are calculated by the cargo handling volume of export fertilizer by route and average capacity of ships by route.

The result of the calculation are as follows:

Route	Number of Ships
Bombay	6 Ships/year
Marseille	2 Ships/year
Algiers	3 Ships/year
Beirut	6 Ships/year
Piraeus	4 Ships/year

Details of the calculation are shown in Appendix-13.

3) Interval of Calling Ships for Same Route
The interval of calling ships for same route is calculated by the number of annual days (365 days) and number of ships by route.

Result of the calculation is as below:

Bombay	:	61 days
Marseille	:	183 days
Algiers	:	122 days
Beirut	:	61 days
Piraeus	:	91 days

Details of the calculation are shown in Appendix-13.

4) Maximum Storage volume
Maximum storage volume of export fertilizer is calculated based on average cargo handling volume per ship by route, cargo handling productivity from wagons of train to the receiving facility and from apron on the quay to ship and interval of calling ships by shipping route.

The procedure of calculation of maximum storage volume for export fertilizer is as follows:

1. Determine cargo handling time per ship between wagons and receiving facility at export fertilizer terminal by shipping route.
2. Determine cargo handling time per ship between apron on the quay and

the vessel by shipping route.

3. Estimate combination of shipping routes of which ships have possibility to arrive at same time in a year at the new port using the least common multiple of the interval of calling ships by each route.
4. Calculate maximum storage volume based on the result of above.

(A) Calculation of Cargo Handling Time

a) From wagons of train to the receiving facility

Cargo handling time per ship between wagons and receiving facility is calculated by the cargo volume pér ship, productivity of cargo handling from wagons to hoppers, number of wagons per train, cargo volume per wagon.

The result of the calculation is as follows:

Route	Cargo-handling time from Wagons to Receiving Facility
Bombay	6 days/ship
Marseille	5 days/ship
Algiers	6 days/ship
Beirut	2 days/ship
Piraeus	5 days/ship

Details of the calculation are shown in Appendix-13.

b) From apron on the quay to the ship

Cargo handling time per ship between apron on the quay and ship is calculated by the cargo volume per ship, capacity of loader, number of Loaders, working hours per day, cargo handling efficiency including working ratio.

Result of the calculation is as follows.

Route	Cargo-handling time from Apron to Ship
Bombay	6 days/ship
Marseille	5 days/ship
Algiers	6 days/ship
Beirut	2 days/ship
Piraeus	5 days/ship

Details of the calculation are shown in Appendix-13.

(B) Estimation of combination of shipping routes

The possibility of arrival at same time in a year is estimated by the least common multiple of approximate numerical values of the intervals of calling ships whose respective routes are different. If the least common multiple among approximate numerical values of the intervals of calling ships for some combination of routes is more than 365 days, the combination of these routes will not be included in the calculation of the maximum storage cargo volume at storage facilities in the port.

According to the result of the estimation for the possibility of arrival at same time in a year, constituent routes for the calculation of the maximum storage volume of storage facilities are as follows:

Bombay - The New Port
Algiers - The New Port
Marseille - The New Port
Beirut - The New Port

(C) Calculation of storage volume
The storage volume is calculated using the calculation sheet, namely, Table 13.3.16, which is made considering the most severe condition for shipping schedule based on the estimation of shipping routes combination.

According to Table 13.3.16, the required storage capacity of the storage facility for export fertilizer is as follows:

46,000 tons(from Table 13.3.16) x 1.2(spare ratio) = 55,200 tons
about 55,000 tons

5) Required Storage Area for Export Fertilizer
The minimum required storage area for export fertilizer is calculated by the Required storage volume, volume of cargo per unit space and utilization ration.

The resulting required storage area is about 21,000 m^2.

Details of the calculation are shown in Appendix-13.

(8) General Cargo (Fire brick and Others)

1) Precondition
The precondition of scale estimation of storage facility for the cargo of related products of iron industry(hereafter, these cargoes are called fire bricks and others) is as follows:

1. The ports of trade partners with percentage of volume to total import fire bricks and others is shown in Table 13.3.17.

Table 13.3.16 Calculation Sheet for Storage Volume of Export Fertilizer

Day	Bombay			Algier			Marsaille			Beirut			Total Storage Volume
	Total loading volume (tons)	Total reciving volume (tons)	Storage Volume (tons)	Total loading volume (tons)	Total reciving volume (tons)	Storage Volume (tons)	Total loading volume (tons)	Total reciving volume (tons)	Storage Volume (tons)	Total loading volume (tons)	Total reciving volume (tons)	Storage Volume (tons)	(tons)
1		6,000	6,000										6,000
2		6,000	12,000										12,000
3		6,000	18,000								6000	6000	24,000
4		6,000	24,000								2500	8500	32,500
5		6,000	30,000		6,000	6000				4320		4180	40,180
6		4,000	34,000		6,000	12000				4180		0	46,000
7	8,640	0	25,360		6,000	18000						0	43,360
8	8,640		16,720		6,000	24000							40,720
9	8,640		8,080		6,000	30000							38,080
10	8,080		0		4,000	34000		6000	6000				40,000
11			0	8,640	0	25360		6000	12000				37,360
12				8,640		16720		6000	18000				34,720
13				8,640		8080		6000	24000				32,080
14				8,080		0		1500	25500				25,500
15						0	6480		19020				19,020
16						0	6480		12540				12,540
17							6480		6060				6,060
18							6060		0				0
19													0
20													0

Table 13.3.17 Percentage and Volume of General Cargo (Fire Bricks and Others)

Trading partner	Cargo handling volume (ton)	Parcentage of cargo volume (%)
Constanza	75,000	50
Marseille	75,000	50
Total	150,000	100

2. The maximum capacities of ships for fire bricks and others by route are as follows:

Route	Maximum Capacity
Constanza	9,000 tons
Marseille	9,000 tons

3. All calling ships for fire bricks and others are regular calling ships.
4. Same route ships don't arrive at same time at New Port.
5. The interval of calling ships for same route is kept at constant interval in general.
6. Dwelling time of fire bricks and others at storage facility in the port is about five days after completion of unloading for all cargoes.

2) Number of Ships

Number of ships by route and average cargo handling volume per ships by route are calculated by the cargo handling volume by rote, average capacity of ships by route, average cargo handling volume per ship by route.

The result of the calculation are as follows:

Route	Number of Ships	Average Cargo-handling Volume
Constanza	9 Ships/year	8,334 tons/ship
Marseille	9 Ships/year	8,334 tons/ship

Details of the calculation are shown in Appendix-14.

3) Interval of Calling Ships for Same Route

The interval of calling ships for same route can be calculated by number of annual days(365 days) and number of ships by route.

Result of calculation for the intervals are as follows:

Constanza : 41 days
Marseille : 41 days

Details of the calculation are shown in Appendix-14.

4) Storage volume

The maximum storage volume of fire bricks and others is calculated based on average cargo handling volume per ship by route, cargo handling productivity from ship to apron on the quay, from loading yard for train to wagons of train and interval of calling ships by shipping route.

The calculation procedure of maximum storage volume for fire bricks and others is shown below:

1. Determine cargo handling time per ship between ship and apron on the quay by shipping route.
2. Calculate cargo handling time per ship between loading yard and wagons of train by shipping route.
3. Calculate maximum storage volume based on results above.

(A) Calculation of Cargo Handling Time

a) From ship to the apron on the quay

The cargo handling time per ship between ship and apron on the quay is calculated by the cargo volume per ship, cargo handling volume per hour per crane from ship to apron, number of cranes, working time per day(24 hours), working ratio.

Result of the calculation is as follows:

Route	Cargo-handling Time from Ship to Apron
Constanza	3 days/ship
Marseille	3 days/ship

Details of the calculation are shown in Appendix-14.

b) From Loading Yard to Wagons of Train

The cargo handling time per ship between loader for loading to train and wagons of train is calculated by the working time per day, operating efficiency, number of wagons per train, number of wagons per train, number of cranes, capacity of wagon, cargo handling volume of crane per hour.

The result of the calculation is as follows:

Route	Cargo-handling Time from Loading Yard to Wagons
Constanza	4 days/ship
Marseille	4 days/ship

Details of the calculation are shown in Appendix-14.

(B) Calculation of storage volume

Storage volume is calculated using the calculation table, namely Table 13.3.81, which

Table 13.3.18 Calculation Table for Storage Volume of Fire Bricks and Others

Day	Constanza unloading volume (tons)	Constanza delivery volume (tons)	Constanza Storage Volume (tons)	Marseille unloading volume (tons)	Marseille delivery volume (tons)	Marseille Storage Volume (tons)	Total Storage Volume (tons)
1	3,240		3,240				3,240
2	3,240		6,480				6,480
3	1,854		8,334				8,334
4			8,334	3,240		3,240	11,574
5			8,334	3,240		6,480	14,814
6			8,334	1,854		8,334	16,668
7			8,334			8,334	16,668
8			8,334			8,334	16,668
9		2,419	5,915			8,334	14,249
10		2,419	3,496			8,334	11,830
11		2,419	1,076			8,334	9,410
12		1,076	0		2,419	5,915	5,915
13			0		2,419	3,496	3,496
14			0		2,419	1,076	1,076
15			0		1,076	0	0
16			0			0	0
17			0			0	0
18			0			0	0
19			0			0	0
20			0			0	0
21			0			0	0
22			0			0	0
23			0			0	0
24			0			0	0
25			0			0	0
26			0			0	0
27			0			0	0
28			0			0	0
29			0			0	0
30			0			0	0
31			0			0	0
32			0			0	0
33			0			0	0
34			0			0	0
35			0			0	0
36			0			0	0
37			0			0	0
38			0			0	0
39			0			0	0
40			0			0	0
41			0			0	0
42	3,240		3,240			0	3,240
43	3,240		6,480			0	6,480
44	1,854		8,334			0	8,334
45			8,334	3,240		3,240	11,574
46			8,334	3,240		6,480	14,814
47			8,334	1,854		8,334	16,668
48			8,334			8,334	16,668
49			8,334			8,334	16,668
50		2,419	5,915			8,334	14,249
51		2,419	3,496			8,334	11,830
52		2,419	1,076			8,334	9,410
53		1,076	0		2,419	5,915	5,915
54			0		2,419	3,496	3,496
55			0		2,419	1,076	1,076
56			0		1,076	0	0
57			0			0	0
58			0			0	0
59			0			0	0
60			0			0	0

is made considering the most severe condition for shipping schedule based on preconditions of scale estimation of storage area for fire bricks and others.

According to Table 13.3.18, the required storage volume of storage area for fire bricks and others is as follows:

16,668 tons(from Table 13.3.18) x 1.2(spare ratio) = 20,000 tons

5) Required Storage Area for Fire Bricks and Others
The required storage area for fire bricks and others is calculated by the required storage volume, volume of cargo per unit space at the storage facility, utilization ration at the storage facility.

The resultant required storage area is approximately 6,500 m^2.

Details of the calculation are shown in Appendix-14.

(9) General Cargo (Bagged Fertilizer)

1) Precondition
The precondition of scale estimation of storage facility for import bagged fertilizer is as follows:

1. The ports of trade partners with percentage of volume to total import fertilize in bag is shown in Table 13.3.19.

Table 13.3.19 Volume and Percentage of import bagged fertilizer by Trade Partner

Trading partner	Cargo handling volume (ton)	Parcentage of cargo volume (%)
Constanza	105,000	50
Marseille	105,000	50
Total	210,000	100

2. The maximum capacities of ships for import fertilizer in bag by route are as follows:

Route	Maximum Capacity
Constanza	12,000 tons
Marseille	12,000 tons

3. All calling ships for import fertilizer in bag are regular calling ships.
4. Same route ships don't arrive at same time at New Port.
5. The interval of calling ships for same route is kept at constant interval in general.

6. Dwelling time of import bagged fertilizer at storage facility in the port is about 5 days after completion of unloading for all cargoes.

2) Number of Ships

Number of ships by route and average cargo handling volume per ships by route are calculated by the cargo handling volume by route, average capacity of ships by route, average cargo handling volume per ship by route.

The result of the calculation are as follows:

Route	Number of Ships	Average Cargo-handling Volume
Constanza	9 ships/year	11,667 tons/ship
Marseille	9 ships/year	11,667 tons/ship

Details of the calculation are shown in Appendix-15.

3) Interval of Calling Ships for Same Route

The interval of calling ships for same route can be calculated by number of annual days and number of ships by route.

Result of calculation for the intervals is as follows:

Constanza : 41 days
Marseille : 41 days

Details of the calculation are shown in Appendix-15.

4) Storage volume

The maximum storage volume of import bagged fertilizer is calculated based on average cargo handling volume per ship by route, cargo handling productivity from ship to apron on the quay and from shed to truck and interval of calling ships by shipping route.

The calculation procedure of maximum storage volume for import fertilizer in bag is shown below:

1. Determine cargo handling time per ship between ship and apron on the quay by shipping route.
2. Determine cargo handling time per ship between shed and truck by shipping route.
3. Calculate maximum storage volume based on the results of above.

(A) Calculation of Cargo Handling Time

a) From ship to the apron on the quay

The cargo handling time per ship between ship and apron on the quay is calculated by the cargo volume per ship, cargo handling volume per hour per crane from ship to apron, number of cranes, working time per day, working ratio.

The result of the calculation is as follows:

Route	Cargo-handling Time from Ship to Apron
Constanza	5 days/ship
Marseille	5 days/ship

Details of the calculation are shown in Appendix-15.

b) From shed to trucks
The cargo handling time per ship between shed and trucks is calculated by the cargo volume per ship, number of cargo handling point at shed, capacity of truck, working time per day, working ratio, cycle time of fork-lift truck between shed and truck for loading, cargo handling volume per cycle of fork-lift truck, operating ratio.

The result of the calculation is as follows:

Route	Cargo-handling Time from Shed to Trucks
Constanza	11 days/ship
Marseille	11 days/ship

Details of the calculation are shown in Appendix-15.

(B) Calculation of storage volume
Storage volume is calculated using the calculation table, namely Table 13.3.20, which is made considering the most severe condition for shipping schedule based on preconditions of scale estimation of storage area for import bagged fertilizer.

According to Table 13.3.20, the required storage volume of storage area for import fertilizer in bag is as follows:

23,334 tons(from Table 13.3.20) x 1.2(spare ratio) = 28,000 tons

5) Required Storage Area for Import Bagged Fertilizer
The required storage area for import bagged fertilizer is calculated by the required storage volume, volume of cargo per unit space at the storage facility, utilization ration at the storage facility.

The resultant minimum required storage area of is about 10,000 m^2.

Details of the calculation are shown in Appendix-15.

Table 13.3.20 Calculation Table for Storage Volume of Import Bagged Fertilizer

Day	Constanza unloading volume (tons)	Constanza delivery volume (tons)	Constanza Storage Volume (tons)	Marseille unloading volume (tons)	Marseille delivery volume (tons)	Marseille Storage Volume (tons)	Total Storage Volume (tons)
1	2700		2700			0	2700
2	2700		5400			0	5400
3	2700		8100			0	8100
4	2700		10800			0	10800
5	867		11667			0	11667
6			11667	2700		2700	14367
7			11667	2700		5400	17067
8			11667	2700		8100	19767
9			11667	2700		10800	22467
10			11667	867		11667	23334
11		1152	10515			11667	22182
12		1152	9363			11667	21030
13		1152	8211			11667	19878
14		1152	7059			11667	18726
15		1152	5907			11667	17574
16		1152	4755		1152	10515	15270
17		1152	3603		1152	9363	12966
18		1152	2451		1152	8211	10662
19		1152	1299		1152	7059	8358
20		1152	147		1152	5907	6054
21		147	0		1152	4755	4755
22			0		1152	3603	3603
23			0		1152	2451	2451
24			0		1152	1299	1299
25			0		1152	147	147
26			0		147	0	0
27			0			0	0
28			0			0	0
29			0			0	0
30			0			0	0
31			0			0	0
32			0			0	0
33			0			0	0
34			0			0	0
35			0			0	0
36			0			0	0
37			0			0	0
38			0			0	0
39			0			0	0
40			0			0	0
41			0			0	0
42	2700		2700			0	2700
43	2700		5400			0	5400
44	2700		8100			0	8100
45	2700		10800			0	10800
46	867		11667			0	11667
47			11667	2700		2700	14367
48			11667	2700		5400	17067
49			11667	2700		8100	19767
50			11667	2700		10800	22467
51			11667	867		11667	23334
52		1152	10515			11667	22182
53		1152	9363			11667	21030
54		1152	8211			11667	19878
55		1152	7059			11667	18726
56		1152	5907			11667	17574
57		1152	4755		1152	10515	15270
58		1152	3603		1152	9363	12966
59		1152	2451		1152	8211	10662
60		1152	1299		1152	7059	8358
61		1152	147		1152	5907	6054
62		147	0		1152	4755	4755

13.4 Access Channel and Basins

The largest vessel that moors at the New Port is pellet carrier phosphate carrier and clinker carrier. The dimensions of the vessel are as follows:

- Capacity: 65,000 DWT
- Draft: 12.3 m
- LOA (Length Over All): 235 m
- Breadth: 33.3 m

The width of the channel is determined as 250m, (over 1 LOA of a vessel). In order to reduce the distance to the port, the channel access runs perpendicular to the coast line then curves around 30 degrees before the entrance of the port. The depth of the access channel is -15 m.

Turning basin has a diameter of 470m(double the LOA) and a water depth of -14m.

Total volume of dredging in Alternative(4) is 2 million m^3, that is less than the half of the reclamation volume.

13.5 Breakwaters

Table 13.5-1 shows the distribution of calmness at point A, B and C which are situated at phosphate berth, pellet berth and turning basin respectively.
The following 3 cases of plan were examined.

Plan-1 Without breakwater
Plan-2 2,200m main breakwater and 700m sub-breakwater
Plan-3 1,950m main breakwater and 700m sub-breakwater

Table 13.5.1 Calmness in the Basin

Plan-1

Wave Height	Point A	Point B	Point C
0~0.3m	51.99%	51.99%	51.99%
0.3~0.6m	13.97%	13.97%	13.97%
0.6~1.0m	18.72%	18.72%	18.72%
1.0~2.0m	10.98%	10.98%	10.98%
2.0m~	4.31%	4.31%	4.31%

Plan-2

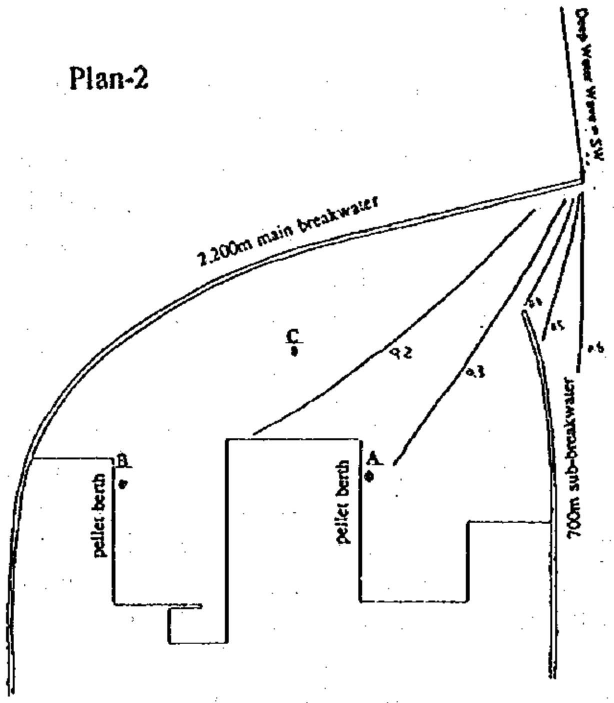
Wave Height	Point A	Point B	Point C
0~0.3m	86.08%	96.95%	94.53%
0.3~0.6m	9.21%	2.48%	4.11%
0.6~1.0m	3.35%	0.43%	1.10%
1.0~2.0m	1.21%	0.12%	0.24%
2.0m~	0.12%		

Plan-3

Wave Height	Point A	Point B	Point C
0~0.3m	84.30%	94.52%	93.34%
0.3~0.6m	11.52%	4.14%	4.76%
0.6~1.0m	3.22%	1.07%	1.41%
1.0~2.0m	0.88%	0.24%	0.46%
2.0m~	0.06%		

Calmness in case of Plan-2 is better than case Plan-3.
However, taking into account the construction cost, Plan-3 is recommendable.
Fig. 13.5-1 shows the example of wave diffraction from the SW deep water wave.

Plan-2



Plan-3

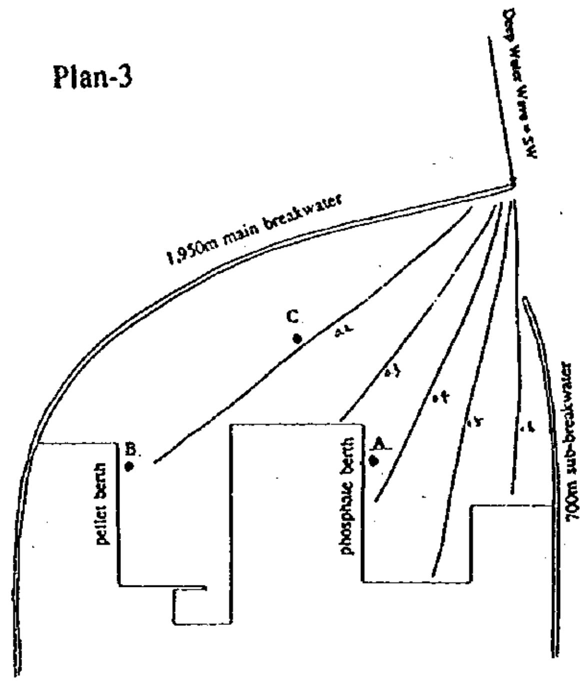


Figure 13.5.1 Wave Diffraction from the SW Deep Water Wave

13.6 Access Roads and Railways

The traffic volume of vehicles originating from or destined to the port in the year 2010 during peak time is estimated to be 385 vehicles per day and the hourly traffic corresponding to that daily traffic is estimated to be 49 vehicles. Even if the port related vehicles for operation, maintenance are included, two lane road is sufficient for the road transport. The access road overpasses the siding railway in front of the new port. Since the width of the access road is 5 ~ 7 m, the width should be expanded to 7 - 10 meters. During the construction work, the temporary road should be built in order to separate construction vehicles from city traffic.

Six items, phosphate, pellet, cement clinker, oil coke, sulphur and exported fertilizer, are mainly carried by railway. Total volume carried by railway is 7 million tons per year. Cargo to/from the new port is carried through branch line that connect to the main line between Akkali and Samlian Station. Most of the cargo is carried through the mainline between Tartous and Homs. Maximum traction weight of a traction engine is 1,400 ton for cargo to Fartous, 750 ton for cargo to Homs due to the inclination. And track capacity of the line is 3 million tons per year. In order to accommodate cargoes to/from the new port, the line between Tartous and Homs should be doubled. Since every cargo is carried on its own schedule, marshaling yard is planned before ramifying. Loading/unloading yard is located on each terminal. Each branch is double track.

13.7 Site Selection

13.7.1 Site Selection Criteria

(1) Navigational Accessibility

A port should be open to the calling vessels. Calmness and accessibility are contradictory concepts. The more a port is protected by breakwaters or island and peninsula, the less accessible it is for vessels. A port should not be situated near a fishery area or recreational area. These activities will disturb vessel's navigation.

(2) Maneuverability of Vessels in the Possible Basins

Basins for anchoring, turning or mooring should be reserved in the port. For example, in case of single anchoring, the basin should be an area with a radius of L+6D (L:Length of Vessel, D:Depth of Water).

(3) Accessibility by Land Transport

Since a port is a junction between land and maritime transportation, accessibility from land is also important. In order to avoid traffic congestion, access road to the port should by-passes the densely populated districts.

(4) Economical Transport from/to the Possible Hinterland of the New Port

Reduction of transportation cost is the major purpose of a new port. From this point of view, the suitable port location is the point that minimizes the total length between major origin/destination of cargoes and the port.

(5) Possibility of Economical Construction

Economical construction is also an important factor in site selection. Construction cost mainly consists of the cost of breakwater, dredging, land reclamation and leveling, and land acquisition. In this view, waters too shallow or too deep which would require high dredging costs or high reclamation costs should be avoided. Expensive land acquisition also needs to be avoided.

(6) Certainty of Land Acquisition

A project site which could be easily acquired is desirable to avoid lengthy land acquisition proceduresof a long time, which delay the start of works. In this view, a land owned by the executing agency of the project is favorable. It is advisable to avoid the land which is owned by many owners as a lot of time might be required to reach an agreement among all owners.

(7) Possibility of Acquiring the Future Expansion Space

A port should reserve space for the future expansion.

(8) Environmental Impact Caused by the New Port Project

The adverse environmental impacts associated with a new port will fall into two broad categories. These are the impacts due to the construction of the facility, and those due to the operation of the port. The former may be quite severe, for instance if dredging and heavy construction works are required. However they may be of limited duration, that is to say the life of the construction period and then the time following that for the ecosystem to recover. Operational impacts may be less evident immediately but lead to long term effects. In addition, considering the possibly port activities of a new port, a project site should be located not close to the planned residential or recreational area. (See Table 13.7.1-1)

13.7.2 Outline of the Syrian Coast in View of the Site Selection

Syrian coast line extends 183 km from Turkish border to Lebanese border. Since the proposed new port is required to accommodate bulk cargo (phosphate, iron ore, cement clinker, and other bulk), the new port is favorable to be located close to the mine or factories. In the first step of the site selection, according to the field survey on the whole Syrian coast, eight alternatives between Latakia and Lebanese border were chosen to assess their respective advantage and disadvantage and compared with each other to select the suitable site. North of Latakia is not considered, because these area is already developed or under planning of tourism facilities. The followings are results of the assessment of each site from the eight factors mentioned in the Section 13.7.1.
(See Fig.13.7.1-1 for location, and Table 13.7.1-1)

(1) South of Hamidieh

The site is located 5km south from the Hamidieh village 2km from the Lebanese border. There is no recreational or fishery area near the site. The seabed slope is not steep, and the soil is gravel sand mixture. Water depth over 15 m is more than 1,000 m offshore, the condition is similar along the coast between Tartous and the Lebanese border.

The national road (4 lanes) that connects Tartous and Beirut, passes through the east edge of the site. The railway passes 7km from the site. Two major cargoes, phosphate rock and pellet of iron ore are assumed to be carried by the train. The railway distance from the site to both Al-Zara steel-making factory and the phosphate mines is the shortest among the alternatives.

The land is flat and the soil mainly consists of sand and gravel. Part of the land, approximately 50 ha (300m * 1700m), is already acquired by the nation and

Table 13.7.1-1 Environmental Impacts of New Port Project

(I) Construction Impacts

Social Environment

Resettlement: Land acquisition for workers camps and construction sites.
Economic Activities: Interference with local economic activities such as fishing, farming and animal grazing.
Traffic and Public Facilities: Construction traffic and effects on local facilities such as schools, residences.
Split of Communities: Obstructing access ways and animal movement paths.
Cultural Property: Damage to historical and religious buildings from construction.
Water Rights/ Rights of Commons: Disruption of access to common resources such as drinking water, or grazing on common land.
Public Health Condition: Dumping of waste or contamination of drinking water causing insanitary conditions and possible illness.
Waste: Solid waste and construction garbage
Hazards (Risk): Storage of hazardous substances.

Natural Environment

Topography and Soil Condition: Change of natural conditions in a temporary way due to site clearing, removal of vegetative cover, and increased runoff.
Soil Erosion: Alteration of drainage pattern and loss of fertile soils leading to possible flooding.
Groundwater: Contamination of wells due to spillage of hazardous materials.
Hydrological Situation: Disturbance of surface water flows due to temporary works.
Coastal Zone: Coastal erosion and change of natural habitats due to dredging and construction.
Fauna and Flora: Disturbance of naturally occurring rare species due to construction activities such as migratory birds.
Meteorology: Microclimate changes due to removal of soil cover and enhanced risk due to exposure to extreme environmental conditions, such as storms, floods.
Landscape: Visual impact due to site clearing and construction works including lighting. Need for site rehabilitation after finishing of project and clearing of site.

Pollution

Air Pollution: dust emissions from concrete batching plants, stockpiles of raw materials, and uncovered surfaces.
Water Pollution: Runoff of rainwater and possible contamination with spilled oils, or lubricating fluids. Sewage from workers camps.

Soil Contamination: Spillages of oils polluting aquifers.
Noise and Vibration: Construction equipment and rock breaking.

Table 13.7.1-1(cont) Environmental Impacts of New Port Project

Disturbance of fishing due to construction noise and vibration.
Ground Subsistence: Dewatering of site due to excavation can lead to nearby subsistence.
Offensive Odor: Exhaust fumes from poorly maintained vehicles, generators, and compressors.

(ii) Operational Impacts

Social Environment
Resettlement: Resettlement of villagers.
Economic Activities: Change of local economy from agriculture to activities supporting port and infrastructure.
Traffic and Public Facilities: Increased traffic load on rail, road, and air traffic.
Split of Communities: New roads, railway links and access routes may separate neighbours or prevent expansion of villages.
Cultural Property: Land take may encroach on as yet undisturbed historical sites.
Water Rights/ Rights of Commons: Land take may reduce amount of commons eg grazing land, beach access for recreation or sport.
Public Health Condition: Dust emissions from bulk cargo handling, accumulation in port waters of bacterial contamination.
Waste: Additional solid waste to be disposed of at local sites which are already overloaded.
Hazards (Risk): Storage of dangerous cargoes, potentially hazardous materials such as LNG, LPG.

Natural Environment
Topography and Soil Condition: Permanent loss of arable land for port needs.
Soil Erosion: Unpaved or unvegetated areas in port may lead to soil erosion and block drainage systems as well as cause increased sediment loads to sea.
Groundwater: Possible effects on groundwater due to risk of saline intrusion.
Hydrological Situation: Alteration of natural drainage pattern of streams and rivers.
Coastal Zone: Construction of new breakwaters may block normal silt transport in longshore current and upset equilibrium of coastal erosion / deposition.
Fauna and Flora: Permanent alteration of ecological system due to destruction of habitats.
Landscape: Permanent visual impact due to buildings and lighting in sensitive areas such as residential areas or tourist areas.

Pollution
Air Pollution: Dust from bulk cargo handling.
Water Pollution: Discharges from ships and sewerage lines in harbour. Potential for oil spills. Increased turbidity, if dredging necessary, with effects on fishing.
Soil Contamination: Long term leakage from tank farms into soil and so into groundwater.

Table 13.7.1-1(cont) Environmental Impacts of New Port Project

Noise and Vibration: Night time operation of cranes, silos, road traffic from port, ships sirens.
Ground Subsistence: Dewatering of excavated site leading to nearby subsidence. Need to excavate elsewhere to obtain breakwater rock materials.
Offensive Odor: Fumes from vehicles.

The above constitutes a listing of some of the possible effects of the construction and operation of a new port. This list is not necessarily exhaustive and other factors may be added as the study proceeds.

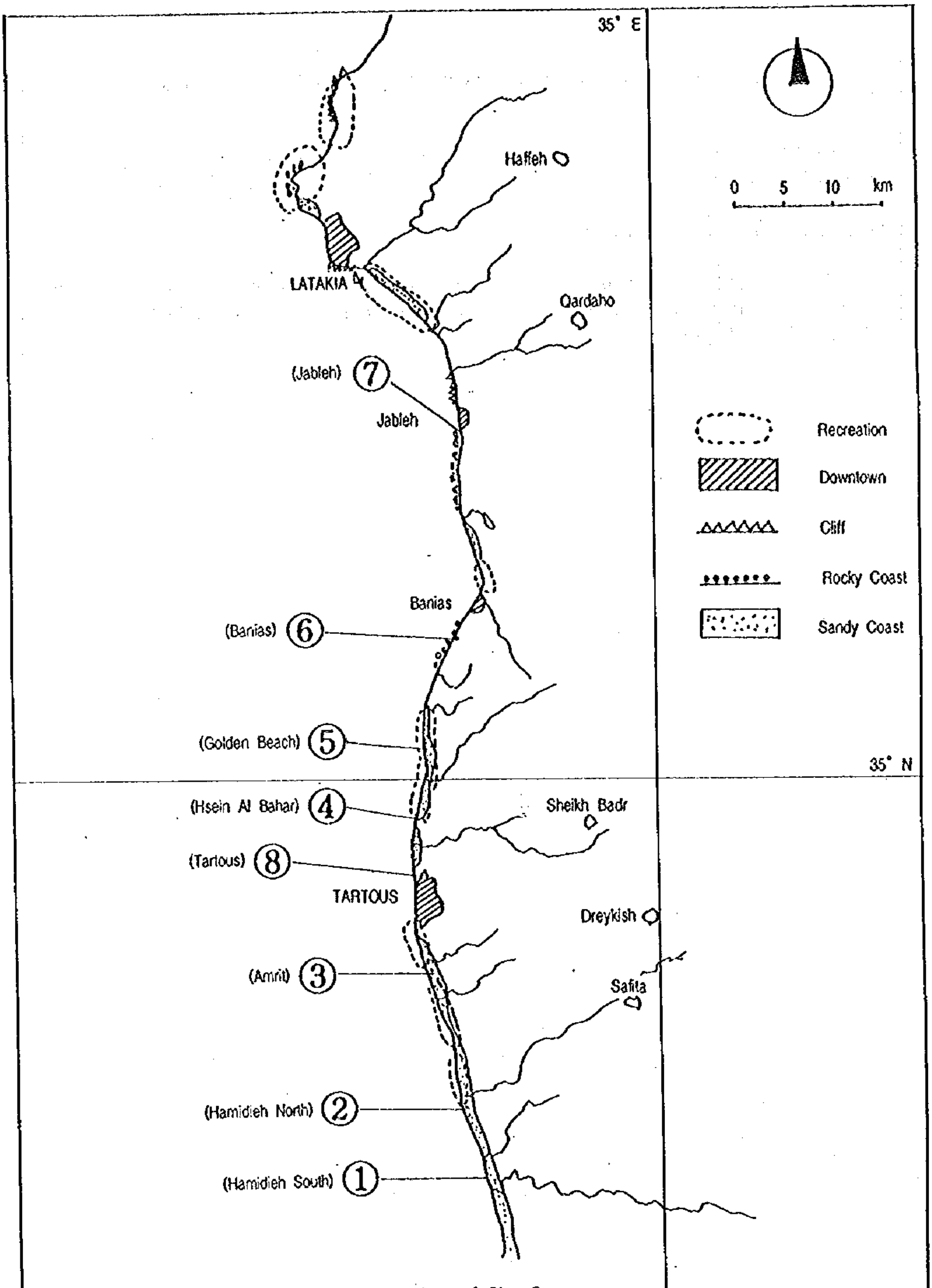


Figure 13.7.1-1 Location of Site Survey

enclosed by the concrete fence. The coast of the similar condition extends north up to ARABSH'ATE'E and to the south, Lebanese border. The small villages, AL KHARABEI and SHEKH JABER are located south of the site. Other areas around the site are mostly wasteland or small agriculture fields.

(2) North of Hamidieh - AL MONTAR -

The site is located 3km north of Hamidieh. Coastline is separated by inlets. AL MONTAR is located behind an inlet, and consists of small beach and low hill where the houses are located. The rock shoal extends approximately 2 km from the shore. Dredging is indispensable in order to maintain the basin for the large bulk vessels.

The site is located 800 m from the national road and 4km from the railway. Small villages and agriculture land, mainly citrus fields, are spread between the road and the site. New houses are under construction in these villages.

Land around AL MONTAR is owned by individuals. Since these areas are developed as residential areas, it seems to be very difficult to acquire land for the port and to reserve land for the future expansion.

(3) South of Tartous - AMRIT -

AMRIT is located 8km south of Tartous City and adjacent to the historical archaeological site. Water area around the site is surrounded by recreational area and preserved area. The only way to access the site is the route from the south. The area is also disturbed by ARWAD island and another small reef.

The distance from the national road is over 1 km, while the railway approaches to the coast. The pavement condition of connecting road is not good.

The site consists of narrow (10-20m) beach, low(under 1m) hill and simple rest houses. Seabed in front is also shallow and made of rocks. Behind the site, population density is small. However, most of the houses are for upper class. Agriculture field also high ranked and enclosed by fences or barbed wires.

Land around the site is owned mainly by the nation and individuals. The nation owns and preserves land for the purpose of tourism. Individuals, mostly belong to upper class, owns land for residential or agriculture purposes. These lands seems to be difficult to acquire.

(4) North of Tartous - HSEIN AL BAHR -

This site was surveyed and analyzed by the Syrian government. Part of the site is used as port for small vessels of the oil terminal. Water area in front is also used for anchoring and mooring basins for petroleum tankers. Access channel for the new port is restricted by the existing basin. Location of the port facilities is also limited, because the breakwaters to be constructed for a new port possibly interfere with petroleum tanker's anchoring due to possible reflecting waves from the breakwaters.

Though the distance from the national road and the railway is less than 1 km, present access route from inland is limited. The access road to the cement factory, located 1 km inland, might be extended to the site.

Since in front of the site, the shallow rocks are extended up to 1,500 m to the offshore and it is surrounded by a high (over 10m) cliff, construction costs for dredging, excavation and levelling are more costly than that in the flat area.

Land behind the site is used for oil terminal facilities, rest houses and residential area for the workers of the cement factory. In case of port construction, these facilities and houses need to be resettled.

(5) Golden Beach and the South of Banyas

Coastal area between ASSODA and ARRAWDA are being developed as tourism sites. In these areas, coast consists of flat sandy beach and smooth slope of the hill.

Cottages of various types are extended along the coast line. Each cottage is connected by pedestrian road and service road.

According to interviews with the Ministry of Tourism, these areas have been developed and will be developed as the tourism area.

Coastal area between the Golden Beach and Banyas is separated by high (10-20m) caves and poor access roads. Though soil condition and land condition is not suitable for residential and agricultural use, port construction also costs more than other alternatives.

(6) BANYAS

Banyas petroleum terminal is located on the coast of small bay adjacent to Banyas City. Coastal area is already used basins for petroleum tankers, power plant/refinery and urban areas of Banyas City. The suitable place for the new port is limited. Only the coast between the power plant and Banyas port is seems to be affordable.

Since the water area is occupied by mooring basin for the tankers, a safe navigational access waterway for the port seems difficult to acquire. The seabed in front of the site is shallow rocks. Since the roads concentrate on Banyas City, the accessibility by roads and railways is better than other alternatives. However, the railway distance from the phosphate mine and the AL-Zara steel-making factory becomes longer.

(7) North of Banyas - JABLEH -

The coastal area between Banyas and Jableh consists of high caves and agricultural land. The national road passes far from the seashore and access road to the sea is in very poor condition.

The coastal area between Jableh and Latakia is protected from development activities. Northern half of the coast is sand dunes and southern half of the coast is high (over 10m) caves. The Ministry of Tourism designated these areas as future tourism complex. A residential area is being developed in the remaining area.

The more the site shifts to the north, the more distant from the phosphate mines and the new steel-making factory it becomes.

(8) Expansion of Tartous Port

Expansion of the existing port is generally the easiest way to accommodate new or increased cargo for the future. In Tartous Port, however, expansion of the existing port seems to be difficult. The coast south of the existing port is already urbanized and densely populated. On the other hand, in the north of the existing port the Navy base is located and hence the port cannot be extended in that direction.

Although beyond the Navy base, the coastal areas are still not well used, the municipality has a plan to develop the areas for tourism use. Moreover, Tartous City seems to be expanding in the north direction, because south of the city center is already developed and presently many residential buildings are under construction in north of the city center.

Table 13.7.2-1(1) Summary of Site Conditions

	① Hamidieh-S	② Hamidieh-N	③ Amrit	④ Hsein Al Bahar
1)	Open to the sea No fishery, recreation area	Small inlets Fishery area	Access limited Recreation/protected area Arwad, small rock disturbe	Anchoring basin for tankers Access channel limited
2)	Shallow water Sand/stone mixture	Shallow water Reeves offshore	Shallow water Rock bed	Shallow rock seabed
3)	Adjacent to national road 7km from the railway Easy access	800 m from the national road 4km from the railway	More than 1km from the national road 4km from the railway	Access road to the cement factory available 1km from the railway
4)	Closest from the phosphate mine & the new steel factory	Close from the phosphate mine & the steel factory	Close from the phosphate mine & the steel factory	Longer railway distance from phosphate/steel factory Best to the cement factory
5)	Mainly sand/flat land Medium dredging cost, law reclamation cost	High dredging cost Medium land excavation	High dredging cost Medium land excavation	Medium dredging cost High land excavation cost
6)	50 ha acquired by the nation	Small villages spread behind Land owned privately	Land owned by upper class residents or rich farmers	Fixed land owning condition (oil terminal, cement factory)
7)	Similar beach extend north south direction Poor agriculure field behind	Difficult inland expansion	Recreation area in the north Archaeological ruins south	Surrounded by the oil terminal, residential area and factory
8)	Scattered population No rare species	Need to resettle villages	Impact on tourism area and historical area is estimated	Resettlement of worker's houses oil terminal Concentration merit of pollutants Reflection wave of port on tankers

Table 13.7.2-1(2) Summary of Site Conditions

	⑤ Golden Beach	⑥ Banyas	⑦ Jableh	⑧ Tartous Expansion
1)	Open to the sea Recreation area in front	Existing channel available Traffic congestion	Open to the sea Shallow rock seabed	Share existing channel Direction is limited
2)	Shallow water Sand seabed	Water area used for tankers Reeves offshore	Shallow water Rock bed	Shallow rock seabed
3)	1.5km from the trunk road 2km from the railway Good access condition	Close from the national road Close from the railway	7-800m from the national road 1.5km from the railway	Share access road and railway of the existing port Isolation by military facilities
4)	Longer distance to the phosphate/steel industry	Longer railway distance from Phosphate mine & steel factory	Longest railway distance from Phosphate mine & steel factory	Same distance from the phosphate mine. close to the new factory
5)	Mainly sand/flat land Low dredging cost Low reclamation coat	Low dredging cost High land excavation	High dredging cost Medium land excavation	Low dredging cost Low land reclamition cost
6)	Privately owned for cottage residential use	Land owned by oil company and city residents	Land is mainly owned by the nation as protected area from development	Land is owned by public sector (government. nunicipality)
7)	Similar beach extend north south direction	Usable land is limited Mostly land use fixed	Recreation area in the north Densely populated area south	Expansion direction and space is limited
8)	Developed and developing as tourism area	Concentration merit of pollutants Impact on air quality of large city	Impact on tourism area is estimated	Resettlement public facilities Air pollution to the city

13.7.3 Proposed Suitable Sites for the New Port

Table 13.7.3-1 describes conditions of each site by eight factors to be considered for port construction. This assessment is only from the viewpoint of port construction. For example, Amrit is given "D" in environmental factor, because historical ruins are located adjacent to the site. Generally the coastal area north of Banyas is not suitable for a new port, partly because most of this area is developed or being developed as tourism and recreational zones, and partly because the railway distance from phosphate mine and the new steel factory increases. The coast between Tartous and Einz'zarqa(south of Tartous) is also not suitable for a new port, because these areas have already been developed as residential areas.
The coastal areas in and around Banyas and Tartous seems to be not suitable to locate a new port, as residential or recreational area is also expanding.

South of Hamidieh (location longitude 34° 39'425N latitude 35° 57'974E) seems to be suitable for a new port, because the land around the sites is hardly utilized for agriculture and residential areas. Tansportation condition is good both from inland and from the sea.

Table 13.7.3-1 Estimation of Each Site

	①Hamidieh-S	②Hamidieh-N	③ Amrit	④ Al-Bahar	⑤ G-Beach	⑥ Banyas	⑦ Jableh	⑧ Tartous
(1)	A	B	C	B	A	A	B	A
(2)	A	B	B	B	A	B	B	A
(3)	A	A	B	A	A	A	B	A
(4)	A	A	A	A	B	B	C	A
(5)	A	A	B	B	A	C	C	A
(6)	A	B	B	B	C	C	C	C
(7)	A	B	C	C	C	C	B	A
(8)	A	B	D	B	D	C	C	B
total	A	B	C	B	B	C	C	B

A: Excellent Condition
B: Good Condition
C: Fair Condition
D: Unacceptably Bad Condition