

iii) Surface Water

With regard to shoreline and flow variation, the same is as slope stability as explained before.

As for the Water quality, the dredging for reclamation is regarded as a cause of Suspended solids. The location of the dredging and reclamation area was explained previously.

The method of dredging and land reclamation is shown in Figure-1.4.1.19 listed below.

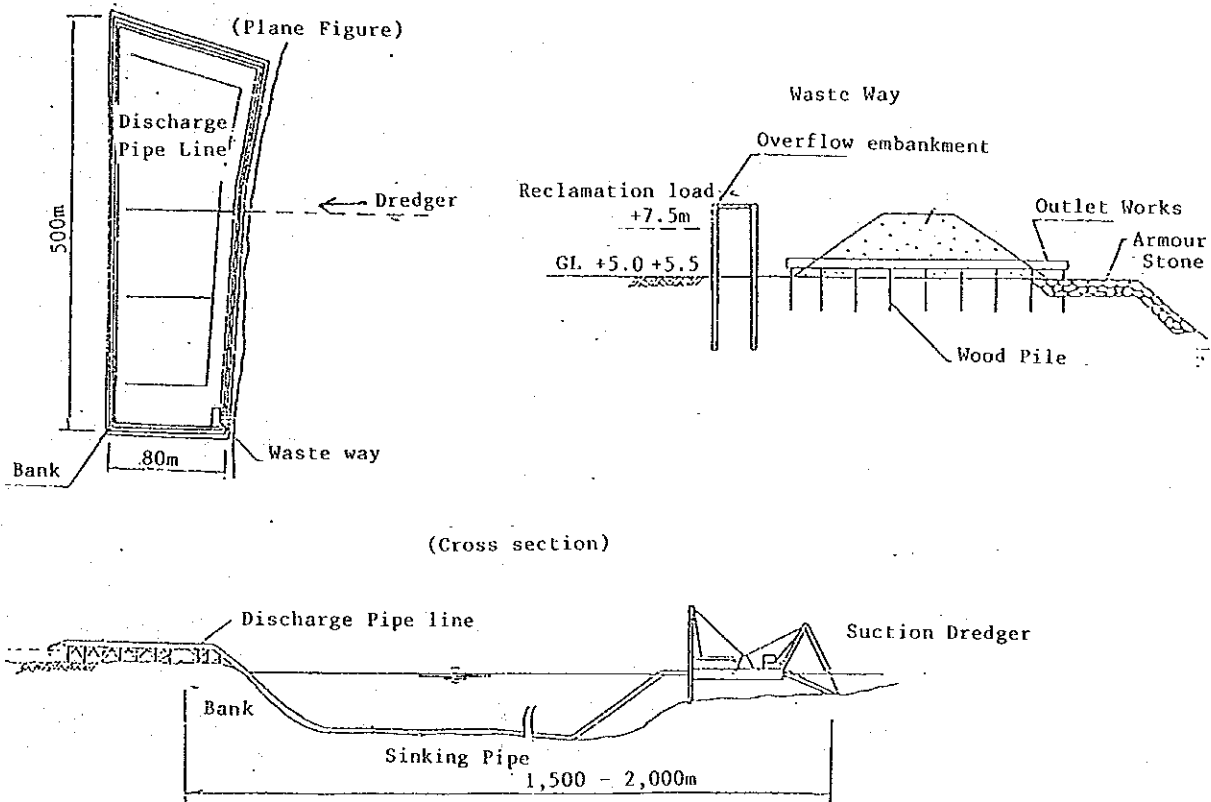


Figure-1.4.1.19 Working Diagram of Reclamation

Generally speaking, the concentration of SS from reclaimed land is below 150ppm. (The data concerning the relationship between the concentration and the progress of reclamation are listed in Appendix-IV.1.4.1.1)

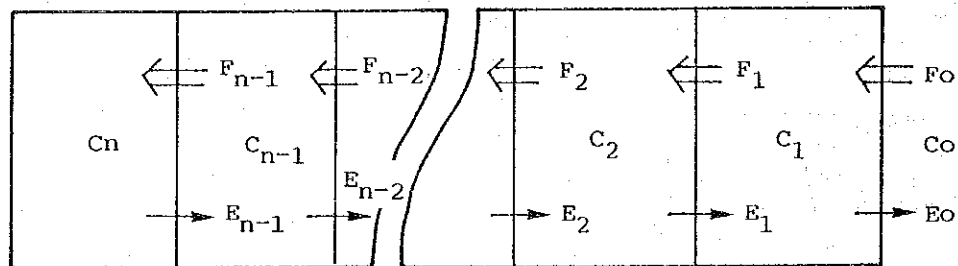
Taking into consideration the present concentration of ss, (Average concentration from Sibuh to Sarikei is between 58 and 251 ppm), the concentration from waste way can be considered not to have remarkable impact.

However, a calculation of the diffusion concentration is performed to check the extent of the diffusion using the following method.

A box mixing model was used to analyze water qualities of the river.

(1) Schematic representation of the modal

Box division of a total river



n: Number of boxes

C₀: Concentration in river mouth

C_i: Concentration in box i

F_i: Transport of water volume during flood tide between box i and box i+1

E_i: Same as F_i except during ebb. tide

Q_i: Input load into box i in one tidal cycle

(2) Mass conservation equations in an equilibrium state

For box i (i=2, ..., n-1)

$$Q_i + E_i C_{i+1} + F_{i-1} C_{i-1} = E_{i-1} C_i + F_i C_i \quad \text{----- (1)}$$

For box 1

$$Q_1 + E_1 C_2 + F_0 C_0 = E_0 C_1 + F_1 C_1 \quad \text{----- (2)}$$

For box n

$$Q_n + F_{n-1} C_{n-1} = E_{n-1} C_n \quad \text{----- (3)}$$

The above equations are algebraic linear ones and can be solved for the unknown variables, C_i.

(3) How to determine F_i , E_i

For simplicity, elevations of water surface at all boxes are assumed to change uniformly. Then, F_i is equal to the tidal range multiplied by the area of the river inner from the location at which F_i is defined.

$$F_i = H \sum_{j=i+1}^n A_j, \text{-----(12)}$$

Where, A_i : Area of box i ,
H: tidal range.

Ebb transport. E_i nearly equals F_i , but may be greater than F_i by water volume that flows into the river area inner from the location where F_i is defined, through up-atrium and so on.

$$E_i = F_i + \sum_{j=i+1}^n W_j \text{-----(13)}$$

Where, W_i : Water volume inflowing into box i during a tidal cycle.

The result of the calculation is listed in Fig-1.4.1.20. These numbers do not show the actual concentration but indicate the additional concentration. Therefore, if the concentration on a certain day is 80ppm, the actual concentration of the box existing in the waste way is 80.17ppm. Concerning the reason why those additional concentrations are very low, the width (breadth) of the river is so wide and the distance of the tidal area is so long that the discharge concentration is decreased.

Judging from this result, the impact on the water quality is very small.

Moreover, this figure is useful if the concentration of ss should change. For example, if the concentration becomes to 1,000ppm, the concentration of each box would change the value 1000/150 times. In this case also, compared with back-ground concentration of Rajang River it will not have a significant adverse impact.

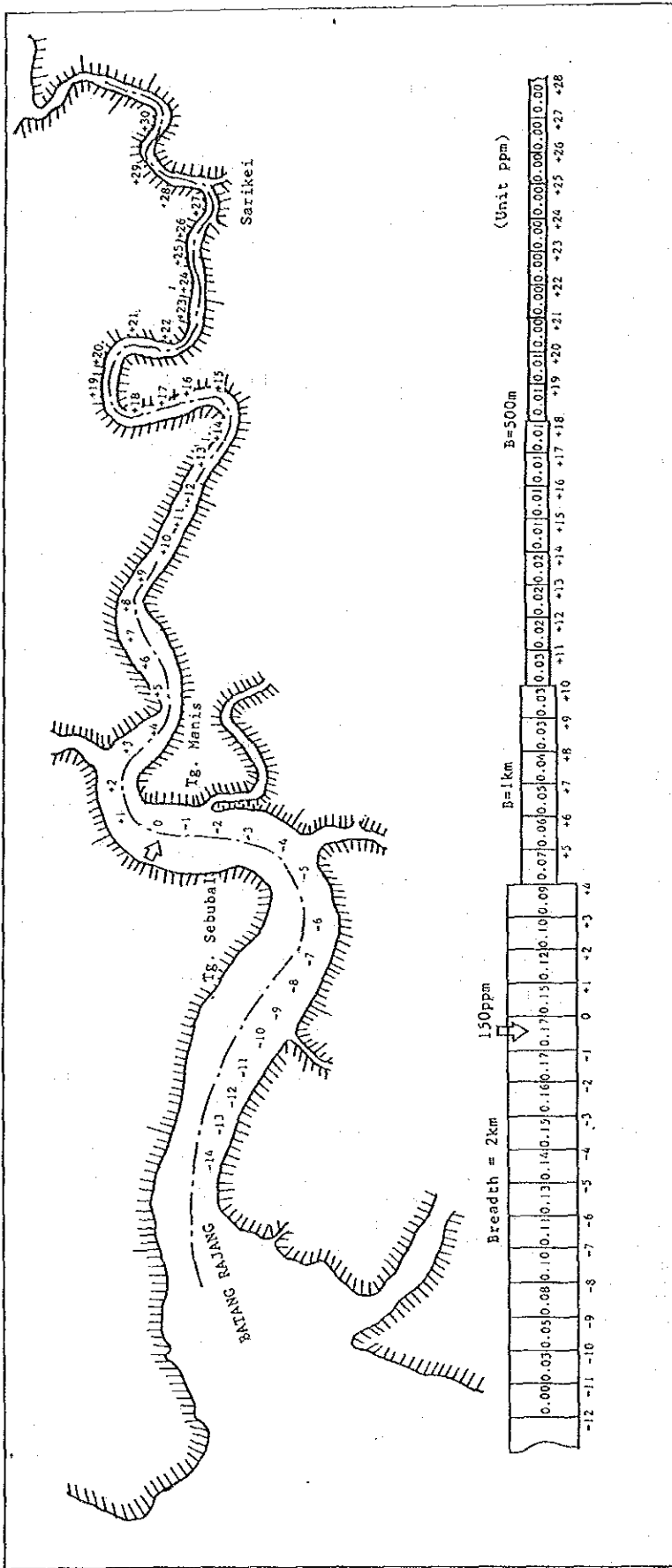


Figure-1.4.1.20 Result of Additional Concentration

iii) Atmosphere

(1) Air Quality

In the construction phase, all construction machines are regarded as causal factors affecting the air Quality. (SOx, NOx)

Additionally, some earth work will generate dust.

As for the air pollution, judging from the construction schedule, the most significant adverse impact will be caused by construction machines in 1994.

Therefore the calculation using the formula listed below was made in order to check the extent of diffusion considering the construction schedule, and consumption volume of fuel oil of each machine.

$$C(R, z) = \frac{Q_p}{(2\pi)^{3/2} \gamma} \cdot \left\{ \frac{1}{R^2 + \frac{\alpha^2}{\gamma^2} (z - H_e)^2} + \frac{1}{R^2 + \frac{\alpha^2}{\gamma^2} (z + H_e)^2} \right\}$$

$$R^2 = x^2 + y^2$$

α, γ : parameter

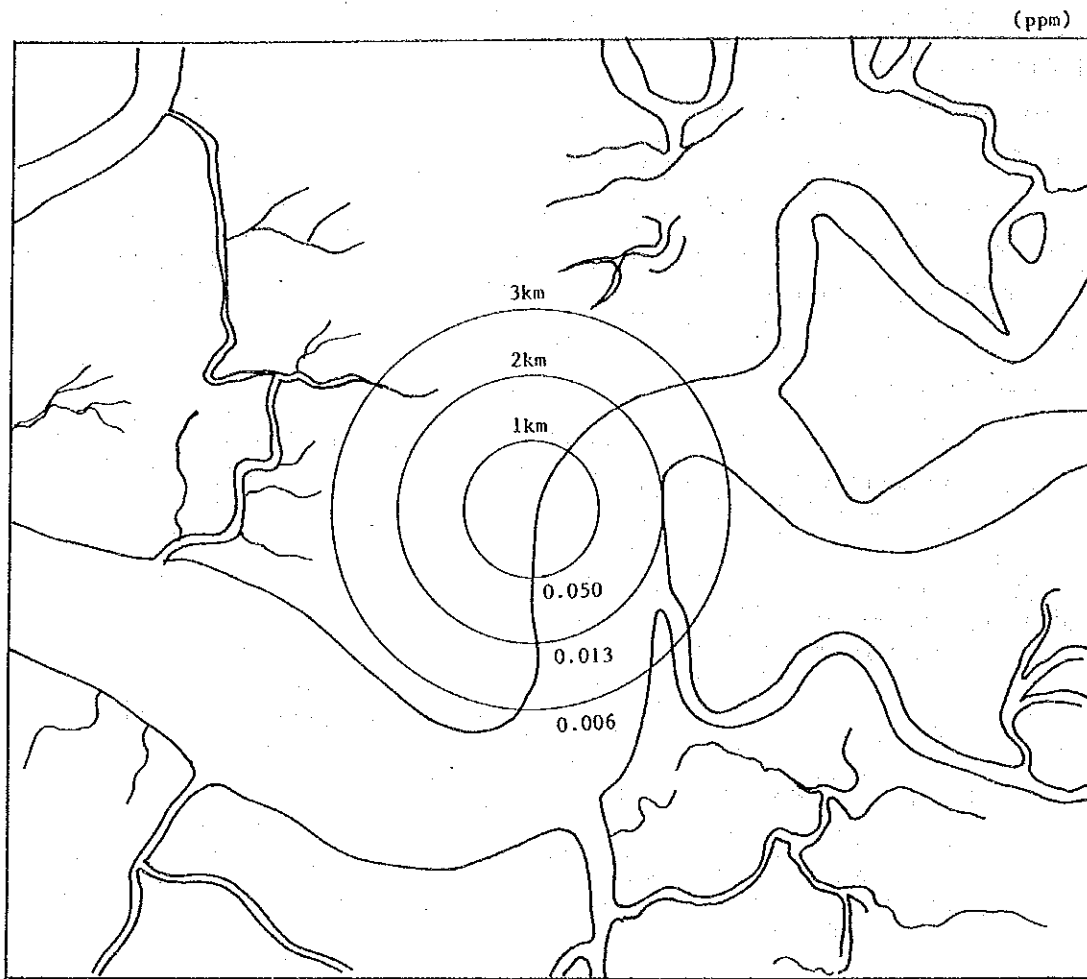
$$\sigma_x = \sigma_y = \alpha \cdot t$$

$$\sigma_z = \gamma \cdot t$$

t: time (s)

Consequently, the extent of SOx diffusion and NOx diffusion is estimated as in the following Figure.

Moreover the calculation is made using a puff-model and the emissions from all of the machines are combined as a single source. No wind condition is set as the most adverse condition.

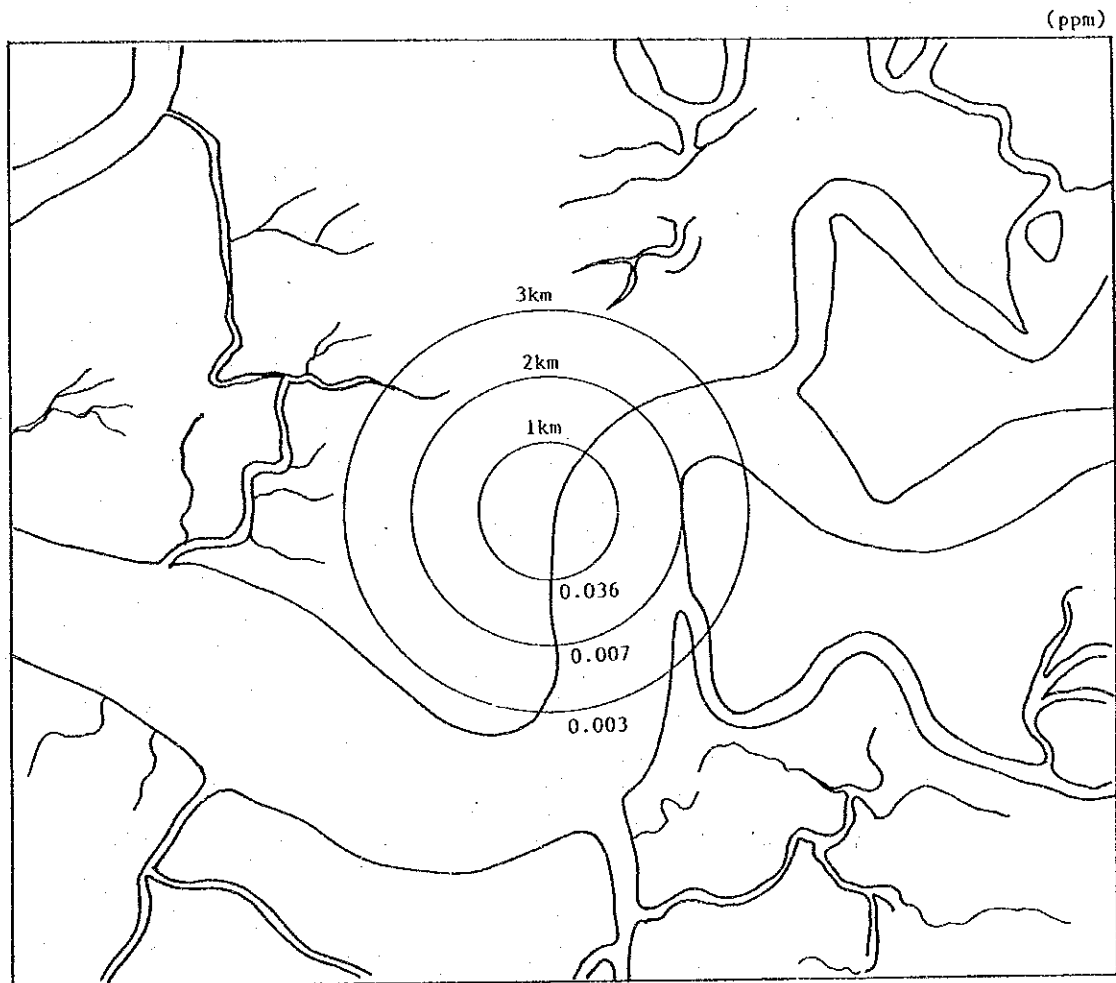


SOx

Figure-1.4.1.21 Result of SOx diffusion

According to the result of the calculation, the diffusion of SOx is considered as follows:

- i) The concentration close to the project site is rather high
 - ii) However, at 3km distance, the concentration becomes very low
- Consequently, the adverse impact caused by SOx would be small.



NOx

Figure-1.4.1.22 Result of NOx diffusion

Judging from the result of the calculation, the diffusion of NOx is considered as follows.

Though the concentration in 1km distance from the project site is a little high, from 2-3km distance the concentration would be very low compared with the Standard.

Therefore the adverse impact from Nox can be regarded as small.

iv) Noise

Construction work typically is accompanied by noise from construction machines.

The machines to be considered as sources of noise and their power levels are listed in Table.

Table-1.4.1.12 Power level of each machine

Machimes	Power Level
Road roller	68-72 dB (10m)
Back-hoe	80-85 dB
Bulldozer	83 dB
Concrete mixer	83 dB
Pile Barge	100-130 dB

Of these machines, the pile barge has highest power level. Therefore, a calculation for checking the noise impact of the pile barge was made by using the following formula.

Formula $SPL = PWL - 20 \log R - 8 - A_e - A_b$ (Note: A_e and A_b are set as zero)

Result

Table-1.4.1.13 Noise Level

Distance from Source	Noise Level
100m	82 dB
200m	75 dB
300m	72 dB
500m	68 dB
1000m	62 dB
3000m	52 dB

According to the result of the calculation, the noise level declines with distance. The noise level is reduced by forestation. Further there is no private housing around the project site.

Therefore, the impact from the noise can be regard as minor.

v) Species and population

Generally, in the construction phase, affecting factors on ecosystems are Air Quality, Water Quality and Noise.

As explained before, the impact from them can be regarded as small.

Additionally, the removal area of mangrove and the reclamation is also considered to be relatively small. (Total area of mangrove forest to be cleared is 10ha)

Moreover, when construction work begins, the working area will be made as small as possible to help preserve the ecosystem in its natural state.

vi) Habitats and Communities

As for terrestrial wildlife, rare and protected wildlife can't be found in the area.

Additionally, sand bars which are important for birds will not be affected as part of the project.

Therefore, the impact on habitats can be regarded as small.

vii) Health and Safety

In this project, the noise is considered to have the most adverse impact on human beings because the impact from other factors can be regarded as small. But in this case, there is no private housing around the project site, and the noise level will not be higher than the acceptable limit at a distance of more than several kilometers.

Therefore, the impact on health and safety can be regarded as small.

viii) Social and Economic

Some social and economic benefits can be expected from this project. In the construction phase, for example, there will be a rise in employment opportunities for local workers.

In the Short-term plan, construction of the new port will be implemented from 1994 to 1997. During this period, many labourers will be required for construction work.

The estimated number of skilled and unskilled labourers are listed in Volume II. Economic Analysis.

The effect of employment should not be overlooked from the viewpoint of counter unemployment in the region.

ix) Aesthetic and Cultural

In the vicinity of the project site, there are no important man-made objects, historic or religious places.

So, there will not be a significant adverse impact on the aesthetic and cultural features in the construction phase.

1.4.2 Operating Phase

(1) Potential Impact and Examination of Operating Phase.

i) Determination of Causal Factors

The causal factors accompanied by the utilization of the port are changes in the traffic volume of vessels, operating of cargo handling equipment, and gray water from administration buildings.

The change in the traffic volume of vessels will influence Air Quality and erosion of the shoreline. The operating of cargo handling will also influence Air Quality and make noise.

Additionally, the gray water will affect water quality especially BOD and COD.

ii) Land

Of the environmental factors related to "Land", the erosion of shoreline by vessels is regarded to have the most adverse impact.

However, the traffic volume of vessels will decline in 1997 as following table indicates, so the environmental impact on Air Quality can be regarded as small or as lower than the present situation.

Table-1.4.2.1 GRT Distribution of Vessels in 1989

	SIBU	SARIKEI	BINTANGOR	S. MERAH	TG.MANIS	TOTAL
BELOW 1000	222	85	32	N.A.	43	382
1000 - 1999	132	55	19	N.A.	22	228
2000 - 1999	49			N.A.	139	188
3000 - 2999	46			N.A.	355	401
4000 - 4999	8			N.A.	312	320
5000 - 5999	23			N.A.	114	137
6000 - 6999	10			N.A.	57	67
7000 - 7999				N.A.	2	2
8000 - 8999				N.A.	8	8
9000 - 9999				N.A.	21	21
10000 - 14999				N.A.	27	27
15000 - 19999				N.A.	27	27
OVER 20000				N.A.	8	8
TOTAL	490	140	51	144	1135	1816
Average GRT	1739	993	843	1028	4768	-

Table-1.4.2.2 GRT Distribution of Ships (1997)

	Sibu	Sarikei	Bintang.	S. Merah	TG.Manis (timber)	T.manis (coal)
Below 1000	218	223	65	-	6	-
1000 - 1999	129	145	39	-	3	-
2000 - 1999	152			-	18	-
3000 - 2999	144			-	45	-
4000 - 4999	14			-	40	-
5000 - 5999	38			-	15	-
6000 - 6999	16			-	7	-
7000 - 7999				-	1	-
8000 - 8999				-	1	-
9000 - 9999				-	3	-
10000 - 14999				-	4	-
15000 - 19999				-	4	-
Over 20000				-	1	-
TOTAL	711	368	104	-	148	-

iii) Surface water

As for the Water Quality, effluents include gray water from related buildings and rain water from the area.

The volume of effluents from related office buildings is very small compared with other industries. Therefore, the impact of effluents on Water Quality can be considered very small as well.

Discharges of rain water from the coal yard must be treated with extreme care. These discharges typically contain acid water so they must not be allowed to flow directly into the river.

Therefore, the team has proposed building a sedimentation pond in the coal yard.

As a point of interest, there are no inlets/outlets from the river for the port operation.

iv) Air Quality

The causal factors affecting on Air Quality are SO_x and NO_x emitted by vessels staying at new berths, and that of cargo handling equipment.

However the emission volume of SO_x and NO_x are small compared with other industries to be built behind the port area.

The coal dust will have an impact on Air Quality. However, sprinkling on coal is recommended to avoid fire and heavy dust.

v) Noise Levels

The noise made by the cargo handling equipment can be considered to be small compared with the construction machines. Therefore the extent of the noise level will be smaller than that of the construction phase.

The impact on noise can be regarded as small.

1.5 Mitigating and Abatement Measures

The primary mitigating and abatement measures proposed in this report are as follows.

1.5.1 Construction Phase

Air Quality

* To reduce the dust caused by leveling and other earthworks, sprinkling is effective means especially in dry season.

Secondary effect of this means is good for terrestrial vegetation and for construction workers.

Water Quality

* To reduce the Suspended Solid from the reclaimed area, the establishment of a sedimentation pond is effective measure. Additionally, some precipitant will be useful for reduction, if necessary. Secondary effect is good for aquatic/marine life.

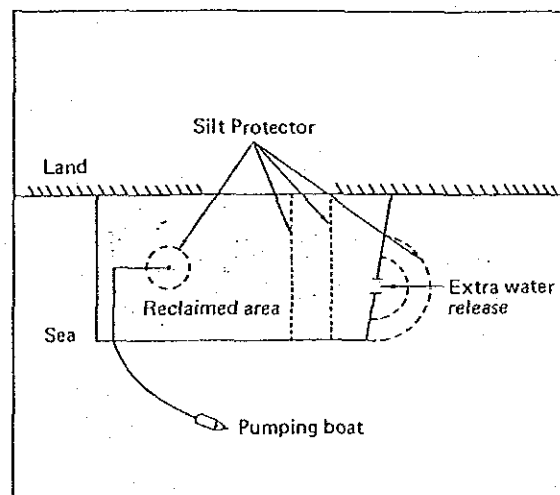
In the case of a clear water area, other countermeasures such as silt protector can be used. However, this countermeasure always costs too much. Therefore, the effect and the cost should be evaluated before taking this measure. Figure listed below shows the typical way to use a silt protector.

Method of processing extra water

- ① Natural settlement of suspended materials
- ② Aggregated settlement by coagulant
- ③ Filtration

In the case of natural settlement, it is necessary to increase the sectional area of water flow and reduce the water surface inclination in the reclaimed area. Also, in order to prevent diffusion of turbulence caused by soil charge, Silt Protector is installed.

In the case where the capacity of the reclaimed area is small or sufficient settlement time is not available at the end of the reclamation period, Silt Protector is installed near the extra water release port.



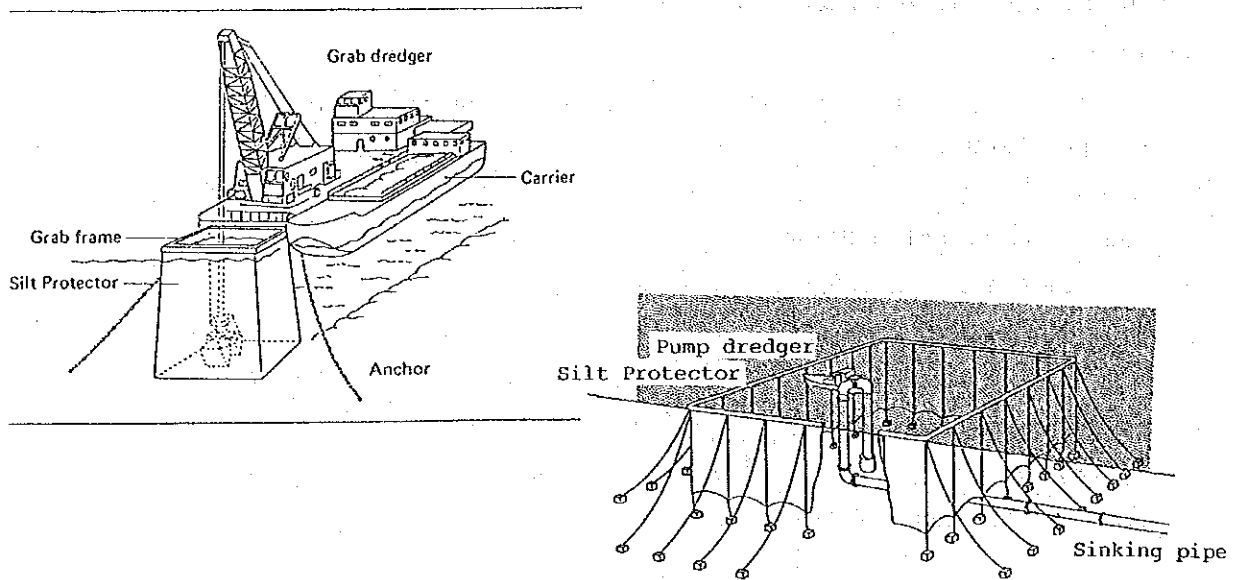


Figure-1.5.1.1 Typical way to use siltprotector

Erosion Control

It is necessary to protect the river bank and structures facing the Rajang River against erosion.

The stone gabions and sand bags type with chemical fiber sheet (as shown in the following figures) are recommended from a comprehensive viewpoint of construction, maintenance cost and protection effect.

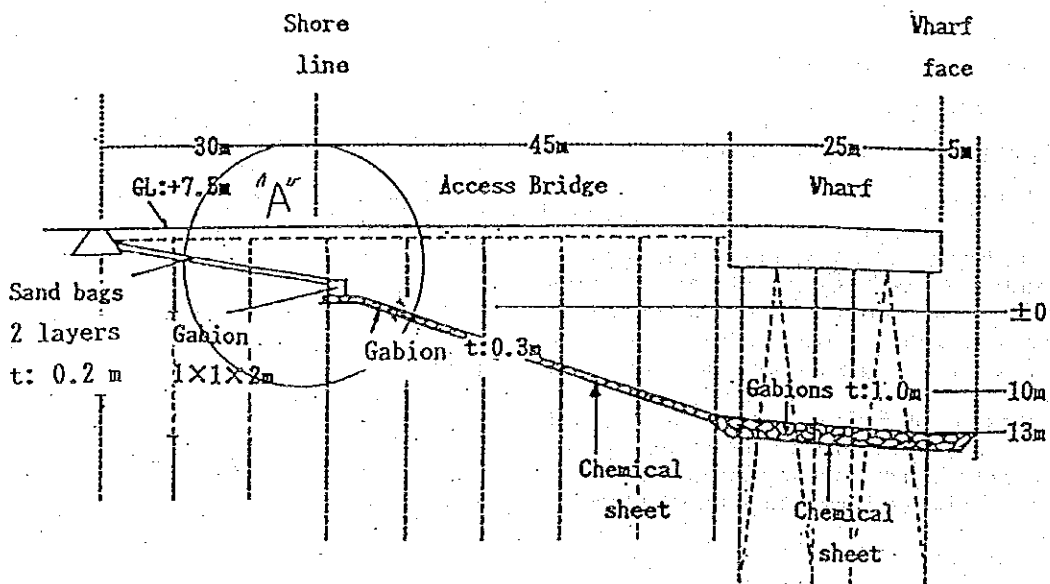


Figure-1.5.1.2 Slope Protection at Timber Products Wharf

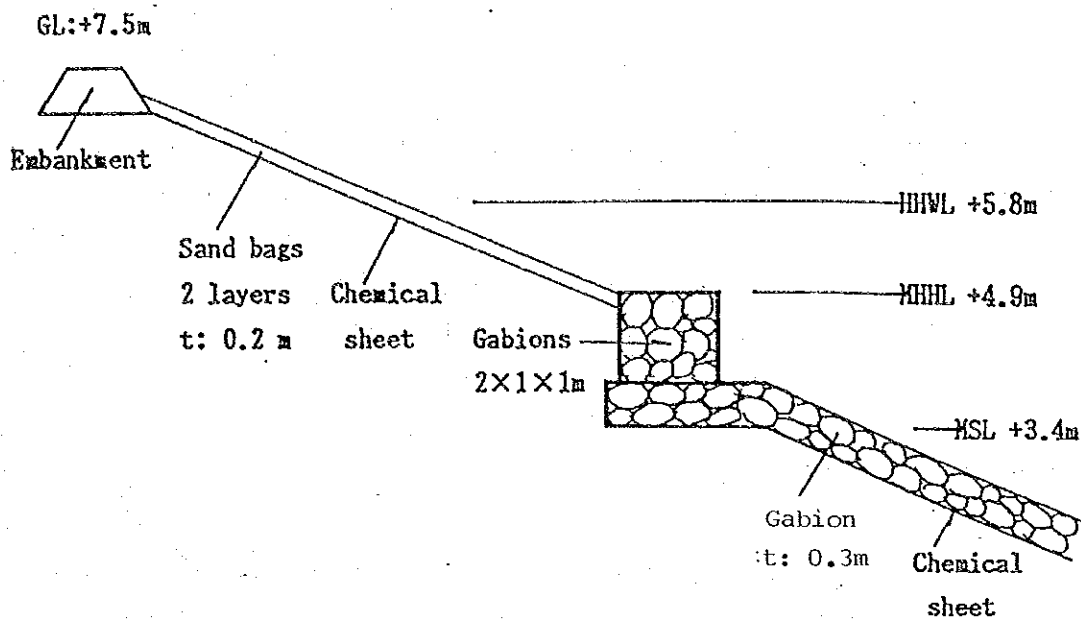


Figure-1.5.1.3 Detail of "A"

Terrestrial Vegetation Terrestrial Wildlife
--

To keep and protect the terrestrial vegetation and wildlife, it is necessary to preserve the natural forest in the area as much as possible. Therefore, a strict determination of working area is required in the construction phase.

1.5.2 Operation Phase

Air Quality

To reduce the coal dust and to prevent the risk of fire, sprinkling should be required in the coal yard especially in the dry season.

As for the coal yard, the dust will be diffused in the process of cargo handling as follows.

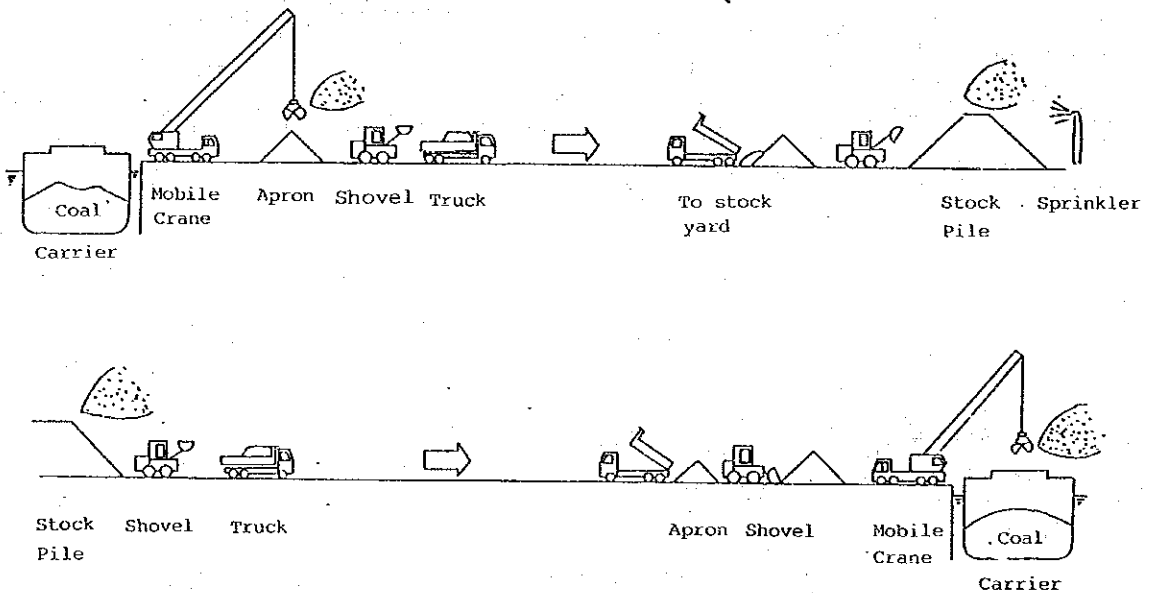


Figure-1.5.2.1 Loading and Unloading System of Coal and the Sources of Coal Dust

It is advisable that the sprinklers should be installed so as to cover the entire pile area as shown in following figure.

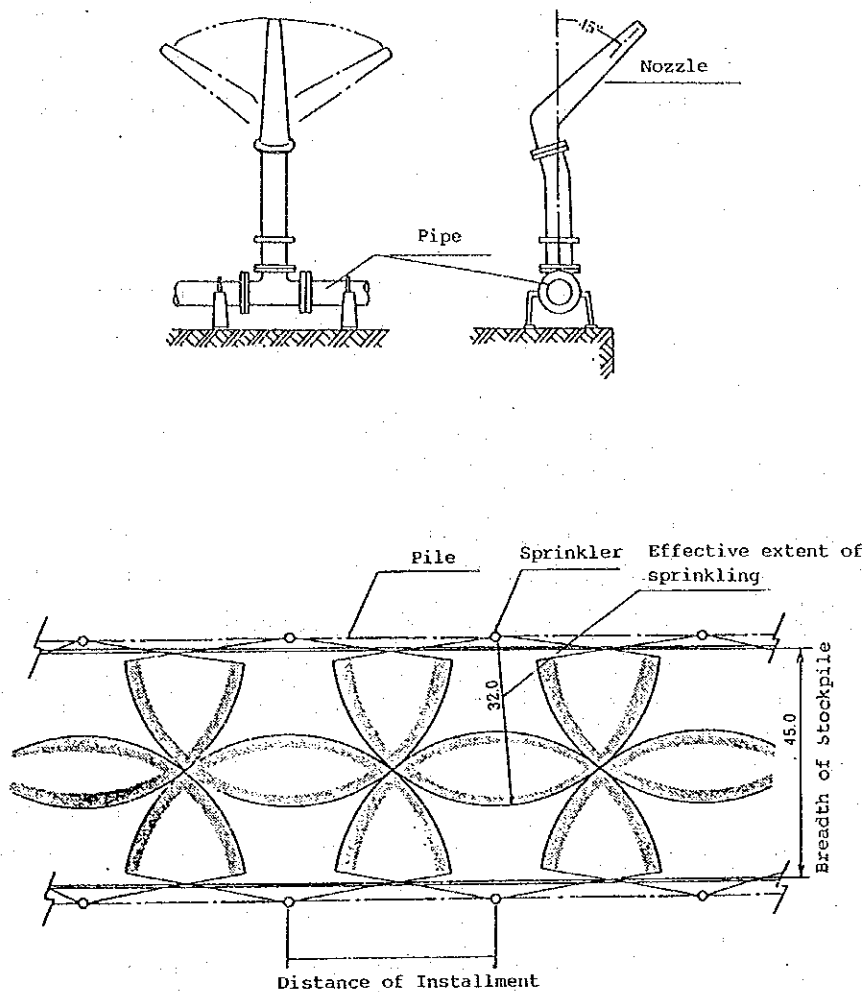


Figure-1.5.2.2 Sprinkler

The establishment of sprinkler is the best way to reduce the dust diffusion. However, when the volume of coal handling is not great, sprinkling cars will suffice for reducing the dust diffusion. In the final analysis, however, a sprinkler is required to meet the expected volume of coal handling.

Additionally to reduce the extent of dust diffusion, preservation of trees around the coal yard as a buffer zone can be considered as an other effective way.

Secondary effects of these measures are good for housing area, terrestrial vegetation and terrestrial wildlife.

Water Quality

Because the discharges of rain water from the coal yard typically contain acid water, they must not be allowed to flow directly into the river.

Therefore, the team has proposed building a sedimentation pond in the coal yard.

Figure below shows the location of water processing pond.

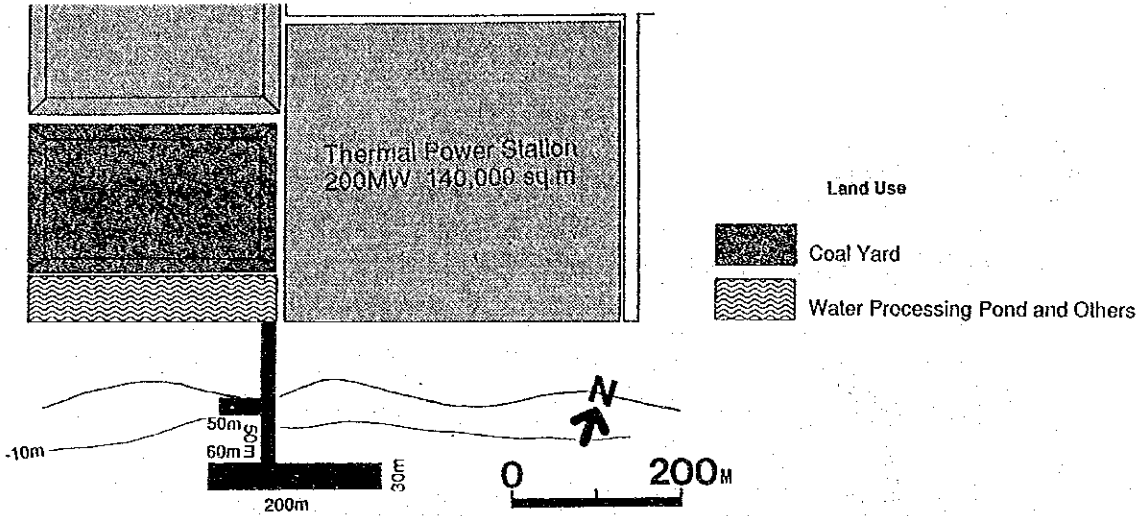


Figure-1.5.2.3 Location of water processing pond

Moreover, to neutralize the acid water, a precipitant/counteragent can be used if necessary.

Secondary effect of these measures are good for aquatic/marine life, especially fish.

1.6 Residual Impact

1.6.1 Environmental Impact Related to the Construction Work

1 Site Clearing

(1) Impact on Land Use

To clear the site, all trees, including those left along the shoreline, need to be removed.

Therefore, the mode of land use will change by this activity from forest to port area. The impact affected by site clearing can be regarded as small because the removal area is relatively small.

No countermeasures required.

N

(2) Impact on Buffer Zone

Trees left as a buffer zone by STIDC need to be removed for construction work. However, the breadth and the length of the zone is relatively very small. The impact caused by this activity can be considered small.

N

(3) Impact on Terrestrial Vegetation

The impact on terrestrial vegetation caused by the removal of Mangrove trees amounts to the loss of the Mangrove trees themselves, the removal of plants and trees around the Mangrove trees, and a change in conditions such as sun levels and the water content of the soils around the removal area.

However, because the width of the removal area is small, the impact on those conditions and others can be regarded as small.

No countermeasure required.

N

(4) Impact on Terrestrial Wild Life

Rare and protected animals can't be found in or around the project site. However, it is dangerous to assume that there are no animals in the area. Indeed, it would be prudent to believe that the site clearing will have some impact, such as the loss of territory.

Still, the impact itself can be regarded as small because the affected area near the site does not form the primary habitats for the animals.

No countermeasures required.

N

(5) Impact on Other Terrestrial Fauna

Regarding small animals such as rats, squirrels snakes and lizards, there is some impact on them because of the loss of a life zone. But, the impact can be considered small because the removal area is small.

No countermeasures required.

N

(6) Impact on Terrestrial Habitats

Although the survey regarding the Terrestrial Habitats has not been carried out, we can assume that habitats do exist around the site and that there will be some impact as a result.

However, the impact on Terrestrial habitats by the site clearing can be regarded as small because the removal area of the trees is small.

No countermeasures required.

N

(7) Impact on Terrestrial Communities

There is a small impact on terrestrial communities because the Mangrove trees themselves exists in a group.

Additionally, concerning small animals, there is some possibility that communities of small animals inhabit in the forest, so, it seems there will be a small impact on these animals.

Because the impact will be small, it will not be necessary to take countermeasures.

N

(8) Impact on Landscape

The landscape will be changed by removing the trees. But the impact can be regarded as small because the width of the removal area is also small.

No countermeasures required.

N

2. Burning

As for burning related to the construction work, waste materials, removed roots and others should be burned or treated by other methods. But the volume of these materials can be regarded as small enough to have no impact on related environmental factors.

N

3. Demolition

In this project, it is not necessary to demolish existing structures, because the area has been covered exclusively with natural forest until now.

4. Excavation

Excavation will take place during road construction, the leveling of uneven areas and building construction.

Further, if there is some soft ground in areas designated for the road or cargo handling yard, it should be moved out by excavation.

As for the volume of excavation, it is considered small enough to have no real impact because the area is virtually flat.

5. Backfill

The impact of backfill can be discounted because of the reason explained above.

6. Leveling (including a small volume of excavation and backfill)

(1) Impact on Air Quality

The diffusion of SO_x and NO_x from construction machines can be viewed as an impact on Air Quality as can the dust from leveling. In both cases, the impact on Air Quality can be regarded as small.

Sprinkling is recommended if there is heavy dust during leveling.

N

7. Piling

(1) Impact on flow variation

Because the line of the wharves is designed to minimize the effect on the flow variation, the impact on the flow variation can be regarded as small.

Additionally, it is recommended that periodical observation should be made to monitor further erosion and accumulation.

C

(2) Impact on Air Quality

There is some impact on the Air Quality made by piling machines. However, the impact on Air Quality can be regarded as small because the emission volume of SO_x and NO_x is also small.

N

(3) Impact on Noise Levels

At close range, piling generates noise at 130dB(A), but the noise level declines with distance. Moreover, the noise also is reduced by forestation.

Additionally, there is no private housing around the project site.

Therefore, the impact on noise levels by piling can be considered small. N

(4) Impact on Terrestrial Wildlife

The impact on Terrestrial Wildlife can be regarded as small because the noise level declines with distance.

(5) Impact on Other Terrestrial Fauna

Same as above.

8. Pavement

It is generally said that large scale pavement accompanied with urbanization causes temperatures to rise and climatic changes.

Because the pavement areas in this project are small, the impact on related environmental factors can be small enough to ignore.

As for the loss of swamps, it will be related in the "Reclamation".

9. Revegetation

There are no activities regarding revegetation in this project.

10. Waste Disposal

If the Timber Wharf and Coal Wharf will be built with vertical piles, the soil materials existing at the construction point should be dredged and be disposed as waste material. Because, according to the results of borings, the soil is not suitable for construction.

Therefore, in this study, it is recommended that these wharves be built with diagonal piles because it is not necessary to dredge and dispose the soft soil.

11. Erosion Control

(1) Impact on Shoreline

To protect the shoreline from erosion following the removal of trees or due to natural causes, it would be prudent to build a revetment or install armour stones. E

12. Drainage Alternation

(1) Impact on Drainage Pattern

Some small channels and drainage lines existing in the site area should be reclaimed or improved for the project. However, rain water will be drained through a gutter in the yard or a culvert. Therefore, the impact regarding the drainage pattern can be regarded as small. C

13. Dredging

(1) Impact on Shoreline

Although the middle of the river will be dredged for reclamation, the volume of dredging is small. Therefore, the impact on the shoreline can be regarded as small. N

(2) Impact on Bottom Interface

Although a part of bottom interface will be changed by dredging, the volume of dredging will be small. Therefore, the impact on the bottom interface can be considered small. N

(3) Impact on Flow variation

Although the depth of the river will be changed by dredging at the dredging point, the volume of dredging is small. Therefore the impact on the flow variation can be regarded as small. N

(4) Impact on Water Quality

The diffusion of Suspended Solids from a suction dredger will have an impact on Water Quality. However, the volume of soil to be dredged is small, so the impact on water quality can be regarded as small. N

(5) Impact on Air Quality

The emission of SOx and NOx will have an impact on Air Quality. But the emission volume of SOx and NOx is small, and the period of this activity is limited (short). Therefore, the impact on air quality can be regarded as small. N

(6) Impact on Noise Level

The sand discharge pipe will have an impact on noise level. However, the impact on noise level can be considered small because the required length of the pipe is not so long. N

(7) Impact on Existing Use

In the construction work, the sand discharge pipe will be established from the dredging point in the river to the reclaimed area. Therefore, some traffic of vessels will be restricted in the river.

The related authorities and organizations should be notified of the construction period and zone prior to the start of work.

(8) Impact on Aquatic/Marine Flora

The impact on Aquatic/Marine flora can be considered small because the impact on the water quality is small. N

(9) Impact on Fish

The impact on Fish can be regarded as small for the same reason as above. N

(10) Impact on Other Aquatic/Marine Flora

Same as (8). N

(11) Impact on Aquatic Habitats and Communities

Same as above. N

14. Reclamation

(1) Impact on Landforms

The land level behind the wharves should be elevated by the

reclamation. However, the impact on the landforms can be regarded as small because the target reclamation level is very low. N

(2) Impact on Soil Composition

The soil composition will be changed by reclamation. But the volume of dredging and the width of the reclaimed area will be small. Therefore, the impact soil composition can be regarded as very small. N

(3) Impact on Subsidence and Compaction

The reclaimed land will cause a small subsidence by increasing the surcharge. However, the areas to be reclaimed are small, so the impact can be considered small as well. N

(4) Impact on Flood Plains/Swamps

To a certain extent, swamp land will be reclaimed for the yard. However, the width of the area is small, so the impact on swamps can be considered small. N

(5) Impact on Drainage Pattern

Same as 12. (1). N

(6) Impact on Flooding

Same as above. N

15. Employment

(1) Impact on Employment

Please refer to the Economic Analysis. E

1.6.2 Environmental Impact related to the Utilization of the Port

1. Coastal and Harbour Traffic

(1) Impact on Shoreline

The change in the traffic volume of the vessels will increase the progress of the erosion. However, the difference of traffic volume between present and the target year is small. Additionally, the bank in front of the wharves will be protected with armour stones or revetment.

(2) Impact on Air Quality

As explained above, the difference of traffic volume between the present and the target year is small. Therefore the impact on Air Quality can be regarded as small.

(3) Impact on Physical Safety

An increase in traffic volume will have an impact on the rate of accidents. However, the impact on accidents can be regarded as small because the increasing traffic volume of vessels is small. Moreover, navigation aids are proposed in the plan to maintain safety.

2. Anchorage

(1) Impact on Air Quality

The impact on Air Quality will be less detrimental because the number of vessels using anchorage will decrease as a result of the new port.

(2) Impact on Physical Safety

Those vessels staying anchorage along the shoreline can be regarded as obstacles for other navigating ships. However, the impact on physical safety will be improved because of the reason stated above.

3. Timber Handling and Storage Cargoes

(1) Impact on Air Quality

The causal factors affecting Air Quality are SO_x and NO_x emitted by vessels staying at new berths, and that of cargo handling equipment.

However, the emission volume of SO_x and NO_x is small compared with that expected from other industries to be built behind the port area.

(2) Impact on Noise Levels

The noise made by the cargo handling equipment can be considered to be small compared with the construction machines. Therefore, the extent of the noise level will be lower than that of the construction phase.

The impact on noise levels can be regarded as small.

N

(3) Impact on Terrestrial Wildlife

The impact on terrestrial wildlife can be considered small because of the same reason above.

N

(4) Impact on Other Terrestrial Fauna

Same as above.

N

(5) Impact on Tranquility

Although there is no private housing around the site, the noise from cargo handling equipment will have an small impact on tranquility.

N

4. Coal Handling and Storage Cargoes

(1) Impact on Water Quality

The rain water on the coal yard contains acid water. If the water is discharged to the river with no treatment, there will be an impact on the water quality of the river. However, in this project, a sedimentation pond is proposed in the coal yard. Therefore, the impact on water quality can be regarded as small. Additionally, some precipitant may be useful for the reduction of the acid rate, if necessary.

C

(2) Impact on Air Quality

The dust from coal piles will have an impact on the air quality.

However, sprinkling is recommended to avoid fires and heavy dust. Therefore, the impact on air quality can be regarded as small.

C

(3) Impact on Noise

Same as 3.(2)

N

(4) Impact on Terrestrial Vegetation

The coal dust will have an impact on terrestrial vegetation. However, sprinkling on coal is recommended to prevent fires and heavy dust.

C

5. Effluent

(1) Impact on Water Quality

The gray water from administration buildings will have an impact on water quality. However, the volume of gray water discharges will be very small and the effluent should be treated together with that of other industries in the near future. Therefore, the impact on water quality can be regarded as small.

C

(2) Impact on Aquatic/Marine Flora

Same as above.

N

(3) Impact on Fish

Same as above.

N

(4) Impact on Other Aquatic/Marine Fauna

Same as above.

N

6. Employment

(1) Impact on Employment

Please refer to Economic Analysis

E

(2) Impact on Housing

If the employees working for the port operation are to live in Tg. Manis, housing for these people will be needed in the future.

N

(3) Education

Schools to be established on the STIDC site should have an adequate capacity to handle the employees' children.

N

5. Waste Disposal and Recovery

Taking into consideration the consequent urbanization, the disposal of general rubbish and the treatment of sewage will become primary issues.

Therefore, a facility for waste disposal including the waste disposal from other projects will be required.

1.6.3 Summary of Conclusion

The relationship between all activities and the impact caused by them are summarized in EIA matrix.

1.7 Recommendation

1.7.1 General

When the implementation of the project commences, the project initiator should consider the basic matters listed below. These recommendations are offered from an environmental point of view.

(1) Port Project

i) Construction Phase

Sprinkling is an effective means of reducing the dust caused by leveling and other earthworks, especially in the dry season.

The establishment of a sedimentation pond is an effective means of reducing the Suspended Solid from the reclaimed area. Additionally, some precipitant will be useful for reducing the concentration, if necessary.

It is necessary to protect the river bank and structures facing the Rajang River against erosion. Therefore, the stone gabions and sand bags type with chemical fiber sheet (as shown in Chapter 1.5.1) are recommended from the comprehensive viewpoint of construction, maintenance cost and protection effect.

To preserve the natural forest and to protect the terrestrial vegetation and wildlife, the working area (including a storage area for machines and material) should be made as small as possible.

During the construction period, many working craft will be navigating the existing waterway. Construction is likely to interrupt traffic; dredgers, above all, have the possibility of disturbing vessel progress. To prevent such an occurrence, the project proponent should notify the authorities concerned of the duration of the working period and identify the working area before execution.

ii) operating Phase

a) Timber Port

Although the team has taken the impact of the wharves on the water

current into account and has designed the wharves to prevent water disturbance as much as possible, it is necessary to monitor further erosion and accumulation of the river bank. periodical observation of the shore line is recommended.

b) Coal Port

It is necessary to sprinkle water to prevent natural ignition and dispersion of coal dust from the piling area.

It is necessary to set up a sufficiently large buffer zone to reduce the dispersion of coal dust.

It is necessary to install covers over the conveyers to prevent the dispersion of coal dust in coal handling.

It is necessary to set up a sedimentation pond for the treatment of water from the coal piling yard. This facility has been taken into account in this report.

(2) Other Project (Coal Thermal Power Plant Project)

i) Construction Phase

With regard to the construction of the power plant, it is necessary to carry out an environmental impact Assessment study before execution, The protection of the ecological system of the Rajang River and an investigation of the atmosphere, water and river bed sediment is necessary.

When provisional roads or towers for transmission lines are constructed, special consideration should be given to their location and layout with a view to preserving the existing natural forest.

ii) Operating Phase

Because warm water will be discharged from the power plant, it is possible that the temperature of the river water will rise and that the density of dissolved oxygen will fall. As a result, the ecological system of the river will probably be influenced. Special consideration should be given to the structure of the facilities for intaking river water or discharging warm water.

It will be necessary to set up a dust collector for the treatment of dustladen gas. The volume of contaminated substances discharged into the atmosphere should be reduced as much as possible by introducing SOx and NOx treatment instruments.

Disposed substances from the power will comprise coal ashes, disposed oils, disposed acids, disposed alkalis etc. In particular, it is probable that coal ashes will contain unhealthy heavy metals. Therefore, to treat ashes, we should set up a pond with a retaining wall, and an anti-permeation mat should be installed inside the pond.

Since there are many matters to be considered in the power plant project, a thorough environmental impact assessment should be undertaken.

(3) Consequent Projects

As urbanization advances in the Timber Product Zone, the disposal of general rubbish and the treatment of sewage will become primary issues. We should examine whether a facility for disposing general rubbish and a plant for sewage treatment will be required.

It is generally said that the water discharged from related timber factories contains a high density of COD. Therefore, a proper plant for discharging water treatment will be needed.

Since a wide variety of industries are present in the project area, it is desirable that periodical monitoring for quality of atmosphere and water at fixed points is carried out in the early stages of the project.

1.7.2 Further Study to be required

In this study, the description of the existing environment was made, as much as possible, according to the collected data; as for the prediction of some environmental factors, a quantitative analysis was carried out. However, sufficient data for certain environmental factors were not available. Therefore, further study will be required to grasp the present environmental condition and to make the predictions more precise.

Further study concerning the following factors should be made by the

project initiator or related authorities at an appropriate time.

(1) Water Quality

To measure the impact caused by the construction work on water quality, periodical observation of Suspended Solid will be required. However because the concentration of the river under natural conditions is comparatively high, it may be difficult to distinguish the degree of impact. Therefore, measurements should be taken at specific points such as near the mouth of the extrawater release, upstream and downstream. In this manner, the relative difference of the concentration can be measured during the construction period (when dredging and reclamation will be executed).

As for other items such as BOD, COD and PH, they should be measured around the project site, after the opening of TPZ and the Coal Terminal. In this case, the measuring point should be set near the mouse of the waste way, that will be build in each area and have a volume in a massive quantity, and upstream and downstream of the site.

The project initiator (RPA) will be responsible for measuring water quality before construction and during construction. This measurement should be carried out by a third party designated by RPA or the constructor.

Additionally, after the opening of TPZ or the Coal Terminal, although it is standard procedure for each project initiator (STIDC, SESCO) to share the measurement of water quality, it is recommended that the Department of Environment conducts the water quality survey in the down stream of the river, taking into consideration the scale of the development including other developments at Tg. Sebulal and the possibility of future urbanization. Periodical observation will be useful in studying the environmental impact of urbanization.

(2) Terrestrial Vegetation, Terrestrial Wildlife and Aquatic/marine Life

Although Figure-1.3.5.3 clearly shows the distribution of terrestrial vegetation, and a supplement survey was conducted by the team, the populations of rare and protected vegetation in the removal area should be surveyed before the final removal area of forest is determined.

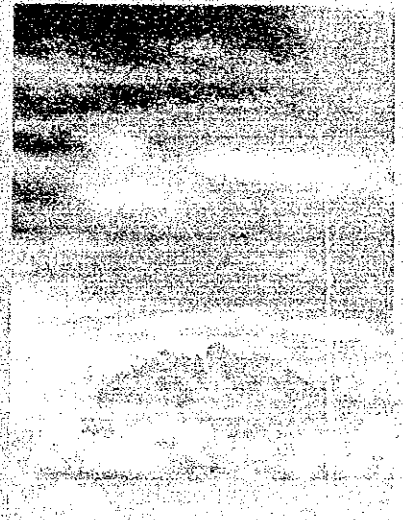
As for the terrestrial wildlife, although rare species and protected wildlife in Sarawak are shown in Chapter 1.3.5, a study on their current

distribution hasn't been carried out yet. Therefore, a study to determine the distribution of terrestrial wildlife should be carried out before construction work begins.

With respect to the birds that habitate the sandbars, because a study has recently been carried out by an other organization, it is not necessary to make an additional survey at the sandbars.

Concerning Aquatic/Marine life, a study has not been conducted yet. Therefore a study concerning the species and population of fish, shellfish, benthos, plankton and other aquatic/marine life (including flora) should be required before construction. Moreover, in the event that some rare and protected species are found as a result of the study, periodical observation is recommended during the construction phase and after the opening of the terminals.

Although the team conducted the Preliminary Environmental Impact Assessment instead of the project initiator, the necessary EIA should be carried out in line with the procedure related in the Environmental Quality Act by the project initiator.



JICA

