C8. PROJECT EVALUATION

C8.1 Procedures for Evaluation

In the previous chapters, priority projects selected for the intensive implementation of flood mitigation in the LBB basin were discussed and formulated mainly from technical point of view, seeking for the optimum technical solution of basin's flood and sediment issues. The priority projects is then subject to the examinations from the following aspects:

1) Economic viability
2) Financial aspects
3) Environmental impact assessment (EIA)

The economic viability of the master plan will be evaluated in the process of cost-benefit analysis. Flood damage reduction benefit accruing from the implementation of the plan will be compared with the economic cost to be invested. The discussions on the financial aspects are made mainly on the financial sources. Past trend of public financing to flood control sector will be reviewed. The study for environmental impact assessment (EIA) will include recommendations to make the project environmentally sound and sustainable and preparation of environmental management and monitoring plans.

C8.2 Economic Evaluation

C8.2.1 Basic Conditions for Economic Evaluation

(1) Conversion Factors and Elements for Real Economic Values

(a) Conversion Factors

As mentioned in the Master Plan Study, market values are usually distorted by transfer payments such as taxes and subsidies. These transfer payments are transferred to the government which acts on behalf of the society. Then, they should not be treated as cost. These have to be eliminated from market values of cost and benefit as a whole.

In the current feasibility study (F/S), construction costs of the proposed schemes were

estimated applying composite costs of civil work elements. These costs estimated at market prices are converted to economic costs applying conversion factors. For some major composite cost components, their individual conversion factors are calculated applying basic conversion factors. The economic costs of minor cost items, however, are converted applying the SCF to the market values.

Wages of skilled workers are considered to reflect an opportunity cost of labor, because of a shortage of these workers in the markets. Therefore, the shadow wage rate of skilled workers is set up as 1.0. On the other hand, unskilled workers are in excess in the regions related to the project areas, since Kabupaten Gorontalo including the project basin has excessive workers in condition of unemployment and underemployment, as discussed in Section A6.2.2. Thus, the shadow wage rate of unskilled workers is assumed at 0.6 of legislated wage rate, referring to "Limboto-Bolango-Bone Basin Water Management Master Plan, Volume I Main Report, March 1999, CIDA".

(b) Composite Conversion Factors

In cost estimation of the proposed projects in the F/S, composite unit costs are employed as mentioned in Section C5.1. In accordance with this methodology, composite conversion factors for the respective work items were calculated applying the conversion factors described in the section above. The estimates of these conversion factors are calculated in Table C8.2.1. The table below summarized these factors. Applying these factors, the project costs are converted from the estimates at market value to those in economic terms.

Civil Works	Conversion Factor
1. Excavation, Common	0.96
2. Embankment	0.96
3. Sodding	0.70
4. Wet Rubble Masonry	0.88
5. Riprap	0.89
6. Gravel Bedding	0.95
7. Gabion Mattress	0.89
8. Concrete	0.93
9. Reinforcement Bar	0.96
10. Concrete Pile ø450	0.94
11. Steel Sheet Pile	0.94
12. Bridge	0.94

(c) Land Value

As mentioned in the master plan study, land price should be evaluated on the basis of productivity of the land for productive plots such as crop cultivation, and balance of supply and demand for non-productive land such as residential plots. In this feasibility study also, crop land value is evaluated on the basis of productivity, i.e., production of paddy for project life of the proposed project. The productivity of crop land was calculated as a product of "net income of a unit of crop land" and "total areas". The net income from irrigated field was estimated at Rp.12.1 million/ha/year in economic terms under present conditions, as shown in Table B6.2.11. Meanwhile, the market value of residential land is converted to opportunity cost in the market. In this study, the economic value, i.e., opportunity cost, is estimated as a product of the market value of land and the SCF. Thus, a unit cost of residential land was estimated at Rp.18,000/m^2 in economic terms in Kota Gorontalo. In Kabupaten Gorontalo, however, a unit cost of residential land was estimated at Rp.1,800/m^2 in economic terms, since an average land value was estimated at Rp.2,000/m^2 as discussed in Section B6.2.1(3). Other areas are considered as no values from the economic point of view, because they are considered to be simply diverted to other land utilization from the original usage.

(2) Construction Schedule and Evaluation Period

1) Base Year :Beginning of 2003 (BBT case) or 2005 (Tamalate case) for detailed design and land acquisition
2) Construction Period :The years from 2003 to 2007 for BBT River Improvement Project and from 2005 to 2009 for Tamalate Floodway Project
3) Disbursement Schedule: Disbursed in accordance with construction schedule during the construction period above
4) Economic Life:50 years after the completion of the project
5) Evaluation Period:55 years including preparatory works such as detailed design and construction period, and economic life of the project scheme
6) Timing of Benefits Accruing: In proportion to the progress of the construction works for river improvement scheme
7) Social Discount Rate:12% per annum

(3) Future Damageable Assets

Socio-economic conditions in Gorontalo will be improved in accordance with the growth of regional economy. Those in the LBB Basin will also be improved in the future. Then, the damageable assets could increase along with the growth of socio-economic conditions. Thus, the flood mitigation benefit would increase, and it could be estimated on the basis of socio-economic projection.

In terms of residential units, the number of units in the respective desa or kelurahan was assumed to increase in proportion to population growth (household growth). Their damageable value was assumed to increase in proportion to GRDP per capita in the LBB Basin. Incidentally, GRDP in 2020 in the basin was estimated as 3.17 times of that in 2001 as projected in Section A6.8. Accordingly, their total assets will increase in proportion to GRDP growth (3.17 times of the present values), as a result.

In terms of industrial establishments such as manufacturing, trading and others, the increment of their assets holdings was assumed to increase in proportion to the GRDP growth. The increment is also revealed by means of an increase of the number of establishments and the growth of their production. In the basin, the increment of these phenomena was assumed to be absorbed in the same desa or kelurahan.

Paddy production in irrigated fields was assumed to increase its yield from 5.0 ton/ha to 6.0 ton/ha by the year 2020. Rainfed crop production, however, was assumed to keep the same yield even in the future. In the same manner, fishpond production was assumed to maintain the same production yield as done in the basin.

C8.2.2 Economic Benefit

(1) Benefit Components of Priority Projects

The project benefits accrue from the following three damage items, as mentioned in the master plan study: (1) direct damages, (2) infrastructure damages and (3) indirect damages. The components of the direct damages consist of residential building, manufacturing establishment, wholesale and retail trading establishment, educational facility, medical facility, crop production, and fishpond production. The damage rate of infrastructures was set as 30% of the direct damages, which was the same rate used in

the master plan study. In terms of indirect damages, the following three components were selected: (a) residence, cleaning away materials damaged after inundation; (b) business losses of private business establishments; and (c) other indirect damages. The estimation methodology was the same as done in the master plan.

(2) Distribution of Damageable Assets

The priority projects were formulated into two compound projects as Bone-Bolango-Tapodu River Improvement Project (BBT River Improvement) and Tamalate Floodway Project (Tamalate Floodway). The maximum potential flood areas of the priority projects were demarcated through the hydrologic analysis. The potential flood areas were estimated at approximately 31.5 km^2 in the BBT River Improvement area and 3.9 km^2 in the Tamalate Floodway area. In these inundated areas, damageable assets are distributed as shown in the table below. This distribution was worked out through the same procedure done in the master plan study. The distribution was tabulated for the potential flood area for 20-year and 50-year return periods.

Item	BBT River Improvement		Tamalate Floodway	
	20-year	50-year	20-year	50-year
Inundation area (km^2)	29	32	2	4
Population (1000)	20	26	10	19
Housing units	5,040	6,710	2,590	4,812
Manufacturing	330	450	205	392
Trading, hotel & restaurant	460	650	322	656
Educational facility	35	46	22	36
Medical facility	23	28	9	14
Agricultural lands (ha)	1,255	1,354	36	62
Irrigated fields	1,148	1,243	36	62
Rainfed fields	82	87	0	0
Fishpond	25	25	0	0

(3) Unit Value of Damageable Assets

Unit values of damageable assets were already estimated in the master plan study. They are also applied in the F/S. Their figures in economic terms are summarized as follows.

Damageable property	Unit	Present	2020*1
Housing unit			
Kota	Rp. million/unit	16.1	43.1
Kabupaten	Rp. million/unit	6.9	22.0
Manufacturing	Rp. million/unit	2.5	7.5
Trading	Rp. million/unit	0.9	5.1
Education facility	Rp. million/unit	396.0	1,059.3
Medical facility	Rp. million/unit	16.7	44.8
Irrigated paddy production	Rp. million/unit	6.0	7.4
Rainfed crop production	Rp. million/unit	3.2	3.2
Fishpond production	Rp. million/unit	22.5	22.5

Note: *1 The number of facilities was assumed to increase 1.19 times of the present number in 2020.

(4) Economic Benefit

The benefit consists of direct damages, infrastructure damage and indirect damage, as discussed in Section C8.2.1. The direct damages are estimated as a product of the number of facilities inundated by flood in affected areas, a damageable value of inundated property and a damage rate in accordance with inundation depth. The number of facilities inundated was counted in Section B6.2.1(2). The inundation depth in the area was identified by the hydrologic analysis. The economic values of the respective damageable facilities were also discussed in the section above.

The direct damages of the respective priority projects by return period were estimated applying the unit damageable values above and damage rates in Table B6.2.3. As mentioned in Section B6.2.1(1), the infrastructure damage was calculated as 30% of the total value of the direct damage. In addition, the indirect damages were estimated in the same way, as mentioned in Section B6.2.1(1). Finally, the entire damages of the priority projects are calculated for the respective return period of flood. The flood damages by return period were enumerated in Table C8.2.2 to C8.2.5

The average annual benefit of BBT River Improvement Project was estimated through the formula discussed in Section B6.2.1(4). The flood damages of without-project conditions under the present socio-economic conditions were shown in Table C8.2.2. The project was proposed as flood control scheme for 20-year probable rainfall. Even after the implementation of the BBT Project, however, some flood damages remains in outer areas of the proposed dikes. For more than 20-year return period flood, on the

other hand, some flood mitigation effects in the protected areas could be expected owing to the dike effects. Then, these effects were considered for the damage estimation of with-project conditions. Finally, the annual benefit was estimated at Rp.10.6 billion as follows, applying the formula discussed in Section B6.2.1(4). The procedure of annual benefit estimation is tabulated in the table below.

Return period	Flood damage (Rp. billion)			Average (Rp. billion)	Expectation	Benefit (Rp. billion)
	W/O Project	W/ Project	Reduction			
	-	-	D(Qi)	1/2(D(Qi-1)-D(Qi))	P(Qi-1)-P(Qi)	-
				4.7	0.500	2.4
2-year	15.1	5.7	9.4			
				11.7	0.300	3.5
5-year	21.6	7.7	13.9			
				19.2	0.100	1.9
10-year	33.6	9.1	24.5			
				31.4	0.050	1.6
20-year	48.8	10.6	38.2			
				41.9	0.030	1.2
50-year	75.6	30.0	45.6			
				Total Annual Benefit (B):		**10.6**

The flood damages under the future socio-economic conditions are calculated in the same manner as done in those under present conditions above. The flood damages were shown in Table C8.2.3. Through the same procedure using these estimates of flood damages, the annual benefits were calculated at Rp.31.3 billion under future conditions. The annual benefit of the proposed plan was summarized as follows.

Socio-economic condition	Annual benefit (Rp. billion)
1. Under present condition	10.6
2. Under future condition	31.3

In the same way, the average annual benefit of Tamalate Floodway Project was estimated through the same formula. The flood damages of without-project conditions were shown in Table C8.2.4 under present socio-economic conditions. The project was also formulated as a flood control scheme for 20-year probable rainfall. For more than 20-year return period flood, however, no flood mitigation effects could be expected by the project even in the protected areas because of the project characteristics. Then, the annual benefit was estimated at Rp.1.6 billion under present socio-economic conditions, as shown in the table below.

Return period	Flood damage (Rp. billion)			Average (Rp. billion)	Expectation	Benefit (Rp. billion)
	W/O Project	W/ Project	Reduction			
	-	-	D(Qi)	1/2(D(Qi-1)-D(Qi))	P(Qi-1)-P(Qi)	-
				0.2	0.500	0.1
2-year	0.6	0.1	0.5			
				1.1	0.300	0.3
5-year	2.0	0.2	1.8			
				3.5	0.100	0.3
10-year	5.5	0.3	5.2			
				11.3	0.050	0.6
20-year	17.9	0.5	17.4			
				8.7	0.030	0.3
50-year	47.6	47.6	0.0			
				Total Annual Benefit (B):		**1.6**

The flood damages under the future socio-economic conditions are calculated at Rp.5.1 billion. The annual benefit of the proposed plan was summarized as follows.

Socio-economic condition	Annual benefit (Rp. billion)
1. Under present condition	1.6
2. Under future condition	5.1

C8.2.3 Economic Cost

The construction cost consists of the following major items. The construction costs are segregated into the following cots items.

(1) Direct construction cost;
(2) Land acquisition and compensation cost;
(3) Administration cost;
(4) Engineering service cost; and
(5) Physical contingency cost.

Direct construction cost was estimated as an aggregation of composite civil works related to the project schemes. They are composed of: (1) excavation, common; (2) embankment; (3) sodding; (4) wet rubble masonry; (5) riprap; (6) gravel bedding; (7) gabion mattress; (8) concrete; (9) reinforcement bar; (10) concrete pile; (11) steel sheet pile; and (12) bridge. The project costs of the proposed schemes comprise the costs of these component civil woks. The total costs of the schemes were aggregation of the cost of these component works. For the unit costs of these civil works, furthermore, composite conversion factors were already calculated in Section C8.2.1(2). Then,

economic costs of the respective priority project schemes were estimated as a product of the costs of component works and the composite conversion factors of the respective corresponding component works.

The economic cost of the priority project schemes was calculated from the corresponding financial cost applying the composite conversion factors. The respective financial and economic costs were tabulated in Table C8.2.6. They are summarized as follows.

(Unit: Rp. billion)

Cost Item	BBT River Improvement		Tamalate Floodway	
	Financial cost	Economic cost	Financial cost	Economic cost
1. Direct construction cost	92.4	85.1	16.2	15.0
2. Land Acquisition & Compensation	2.6	0.8	0.9	0.3
3. Administration	4.8	4.3	0.9	0.8
4. Engineering services	9.2	9.2	1.6	1.6
5. Physical contingency	10.9	10.0	2.0	1.8
Total	119.9	109.4	21.6	19.5

In terms of the compensation items, the land acquisition cost is converted through the two ways i.e., agricultural land and residential land in urban areas. The procedure of valuation of these lands was mentioned in Section B6.2.2(1). Agricultural lands were evaluated as negative benefit for the evaluation period, so their cost values in the financial cost item were not included in the economic cost items.

The economic costs of the respective projects were estimated Rp.109.4 billion for the BBT River Improvement Project and Rp.19.5 billion for the Tamalate Floodway Project. Since the financial total cost is Rp.119.9 billion and Rp.21.6 billion respectively, the economic construction cost corresponds to around 90% of the financial costs. The construction cost is disbursed in compliance with the construction schedule. The disbursement schedule of economic costs is tabulated in Table C8.2.7 and C8.2.9.

In addition, the operation and maintenance (O&M) cost is annually required during the economic life of the proposed project. The O&M cost is assumed to be approximately 0.5% of the total direct construction cost of river improvement schemes. In addition, the rubber gate in the BBT Project is installed in Tapodu River, so its maintenance costs of Rp.0.14 billion for every five years must be appropriated in the O&M cost. Then,

the O&M costs were estimated at Rp.0.43 billion for the BBT Project and Rp.0.07 billion for the Tamalate Project in economic terms, after the completion of the proposed master plan project. In addition, since the rubber gate in the BBT Project is installed in Tapodu River, its maintenance costs of Rp.0.14 billion for every five years must be appropriated in the O&M cost.

C8.2.4 Economic Evaluation

In this section, the proposed projects are examined from the economic point of view. The economic benefits were expected to accrue in conformity to the schedule. For river improvement schemes, the benefits were assumed to generate in proportion to progress of the construction works, because even a part of river improvement works can give their effects to the target areas. Furthermore, once the project is completed in the sites, some flood mitigation benefits could be expected owing to the dike effects even for the flood of more than 20-year return period. The benefits under the future socio-economic conditions with the growth projection were also calculated in the same manner.

The economic evaluation indices are calculated applying the economic benefits and costs estimated in the respective sections. The annual streams of benefit and cost under with-project conditions were tabulated in Table C8.2.7 and C8.2.8 for the BBT River Improvement Project and Table C8.2.9 and C8.2.10 for the Tamalate Floodway Project.

The EIRR of the BBT Project was estimated to be 8.3%, as shown in Table C8.2.7. This rate is lower than the social discount rate of 12%. Accordingly, the proposed project is not viable at present from the economic point of view. Incidentally, the B/C is 0.71 and the NPV is estimated at Rp.-22 billion, which were discounted at 12%.

Yet, these indices are recalculated in the same manner applying the future economic benefits as the case of “under the future socio-economic conditions”. The expected benefits in the year 2020 were estimated at Rp.31.1 billion per year in Section C8.2.3(4). Once this benefit is applied for the economic evaluation, its EIRR was calculated at 17.0%. This rate is higher than the social discount rate of 12%. In this case, thus, the proposed project is viable from the economic point of view. Accordingly, the proposed project should be implemented from this time forth taking consideration of the future viability of the project. Other indices of economic evaluation are shown in the

table below.

Index	BTT River Improvement		Tamalate Floodway	
	Under present condition	Under future condition	Under present condition	Under future condition
EIRR (%)	8.3	17.0	6.3	16.2
B/C[*1]	0.71	1.54	0.55	1.44
NPV[*1] (Rp. Billion)	-21.5	39.4	-5.8	5.7

Note: *1 Discounted at 12%

In terms of the Tamalate Project, the evaluation indices are enumerated in the table above as well. Under the present socio-economic conditions, the project is not viable from the economic viewpoint as the evaluation indices point out. Once the project was implemented taking consideration of the future socio-economic conditions with growth projection, the project could be viable as the indices shown in the table above. More specifically, the EIRR was 16.2%, which exceeded the social discount rate of 12%. The B/C was 1.44 and the NPV was Rp.5.7 billion discounted at 12%.

The entire priority project including both the BBT River Improvement Project and the Tamalate Floodway Project was also evaluated as a whole. The annual streams of benefit and cost under without-project conditions were tabulated in Table C8.2.11 and C8.2.12. The evaluation indices are enumerated in the table below. Under the present socio-economic conditions, the project is not viable from the economic viewpoint. Under the future socio-economic conditions, however, the project could be viable as the indices shown in the table above. To be more specific, the EIRR was 16.9%, which exceeded the social discount rate of 12%. The B/C was 1.53 and the NPV was Rp.44 billion discounted at 12%.

Item	EIRR (%)	B/C[*1]	NPV[*1] (Rp. Billion)
Under present conditions	8.1	0.69	-26
Under future conditions	16.9	1.53	44

C8.2.5 Sensitivity Analysis

The cost and benefits are estimated with discretion by respective experts in this study. In spite of that, some uncertainty still exists in the estimation. In particular, the cases with long implementation period and/or expectation of future growth have high risks in terms of judgment on project viability. In this context, thus, the sensitivity analysis is

introduced in the following aspects, in consideration of sensitive factors for project feasibility.

(1) 5% or 10% higher than the cost estimated
(2) 5% or 10% lower than the benefit expected
(3) Combined the both aspects at the same time

The influence of the above phenomena was examined for the BBT River Improvement Project as follows. The results were presented under future socio-economic conditions. As shown in the Table C8.2.13, EIRRs of the all cases exceeded 12%. Accordingly, the BBT Project is sufficiently feasible from the economic point of view. These EIRRs were illustrated in the figure in the same table. Incidentally, in case that the benefit decreases to 65% of the original estimate, EIRR would still keep the economically feasible level, i.e., 12% of social discount rate. As for cost, even if the project cost increases around 50% more than the original estimate, EIRR could be still keep the feasible level. Thus, the BBT Project could be said to be quite viable from the economic point of view.

In terms of the Tamalate Floodway Project, its EIRRs of sensitivity test also exceeded 12%, as shown in Table C8.2.14. Although the figures of the respective cases were lower than those of the BBT Project, the project could be viable from the economic viewpoint because the worst case was still 13.8% of EIRR. The entire priority project was also said to be viable in the same reason mentioned above, as shown in Table C8.2.15. The figures of EIRRs for the respective schemes were drawn in the respective tables.

C8.3 Financial Aspect

(1) Constraints on Financial Procurement

The financial requirement of the master plan schemes was estimated at Rp.555 billion at 2001 market prices. This amount has to be invested between 2004 and 2019, as explained in the master plan study. On the other hand, the development investment expected for the same period was estimated at Rp.96 billion for the Propinsi Gorontalo. This was around 17% of the financial requirement for the projects proposed. Thus, it is obvious that the governments are short in their capital investment for the projects.

Furthermore, the national debt stocks from external financial sources aggregated to

US$150 billion as of the end of 1999. Due to these external debts, the total debt service aggregated to US$17.8 billion in 1999. Then, the DSR was 30.3% in the sane year. Thus, Indonesia already runs into the critical position to procure more external loans.

In accordance with the decentralization policy of the government, the local governments of kabupaten and kota become a leader of the local public investment instead of the central government. Through the financial transfer from the central government to the local governments, the local governments will have more financial revenues and be given more free hands for public investment than before. However, they will not always be supplied with more local funds for development than before. The local governments, particularly Propinsi Gorontalo, are in the midst of a transitory stage to the decentralization society. It will be ambiguous for the local governments concerned to appropriate a capital investment for the flood control projects at present.

(2) Motivation for Sustainable Development

The priority project was proposed as an essential scheme for the flood mitigation in the LBB Basin. The project will function as a core scheme for the river facilities for the basin. Thus, the priority project is important for the local society.

The local governments have installed a partial flood control facilities so far. However, they do not function well for effects of flood mitigation because of lack of comprehensive flood control viewpoint. Thus, once the systematic step-wise development program is proposed in the master plan, the local governments could assemble the parts of flood control facilities into a complete system in the basin. Thus, the priority project plays an important role for motivation of future development of the flood control system.

The total amount of Rp.140 billion for the priority project is not small for the public finance of the national and local governments as compared with the past trend of development funds. As mentioned above, the project is quite important as a core facility for the comprehensive flood control system. Then, the development stage would rather be divided into two periods, i.e., intensive implementation stage and sustainable implementation stage. In the intensive implementation stage, the priority project is implemented intensively as promoting the regional economic development. It takes seven years by the completion of the project. Since the decentralization of

water management is still in a transitory stage, the local governments collaborating with the central government should implement this intensive work. The governments concerned must appropriate their budgets to the priority project. For this promotion, the following financial sources should be considered:

(A) To increase capital funds for the project in the national budget intensively
(B) To procure loans having higher grant element
(C) To procure grant sources

C8.4 Environmental Impact Assessment (EIA)

C8.4.1 Legal Basis of Environmental Impact Assessment

Indonesian government is implementing the sustainable development as a part of national development by executing the policies that preserve: (a) water resource, (b) land resource, (c) forest resource, (d) water quality, (e) environment health and freshness, and (f) environmental carrying capacity. Such policies are executed to minimize any negative impacts of development activities on the environment and to promote and maximize the positive impacts. Environmental Impact Assessment is integrated to the feasibility of development plans and activities because the feasibility of a development project is not only examined on its economical and technological point of view but also on resource carrying capacity as well as environmental harmony.

Indonesian Law No. 23/1997 on Environmental Management, Section 15 states that each effort plan or activity, which might possibly cause big and important impacts on environment, is obligated to carry out Environmental Impact Assessment (EIA). Thus, the EIA study on the priority project in LBB basin is to accomplish necessary obligations required by the laws, regulations, and decrees issued by the government in order to attain the targeted sustainable development.

Other than the Indonesian Law No. 23/1997 on Environmental Management, the following Governmental Regulation and Ministry Decrees cover the technical and procedural aspects of the EIA study fro the priority project:

- Governmental Regulation No. 27/1999 on Environmental Impact Analysis;
- Presidential Decree No. 10/2000 on Environmental Impact Management Board (BAPEDAL);

- Decree of Environmental Ministry No. 17/MENLH/02/2001 on Types of Activities that Required Environmental Impact Analysis (Refer to Table C8.4.1.);
- Decree of BAPEDAL Chair No. 09/2000 on Environmental Impact Assessment Arrangement Guidelines; and
- Decree of BAPEDAL Chair No. 105/1997 on Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) Guidelines.

C8.4.2 Project Description

(1) Project Components

As a result of Master Plan Study (PART-B: FLOOD MITIGATION MASTER PLAN, SUPPORTING REPORT), the following were determined as the priority projects:

1) Lower Bone River Improvement,
2) Lower Bolango River Improvement,
3) Tapodu River Improvement with Tapodu Gate,
4) Tamalate Floodway, and
5) Sediment Trap Works in Lake Limboto (including Realignments of Alo-Pohu and Biyonga).

The detailed components of the priority projects including dimensions, area for land acquisition, etc. are listed in Table C8.4.2.

(2) Identification of Impact Activities

All the priority projects are categorized as structural measures and the impacts activities involved were identified and enumerated in Table C8.4.3.

C8.4.3 Methodology of Analyses

(1) Environmental Components to be Evaluated

Each impact activities, which are enumerated in the previous section, were examined, and accordingly the environmental components that may be affected by each impact activity were identified. With regard to the identified components, environmental

impact study is to be conducted in the next stage. The environmental components identified are the following:

a. Natural Environmental Components

- Geology (erosion and sedimentation),
- Groundwater and land subsidence,
- Water regime,
- Terrestrial flora and fauna,
- Aquatic flora and fauna,
- Air quality including noise, and
- Water quality.

b. Social Environmental Components

- Resettlement,
- Livelihood,
- Local population's opposition
- People's mobility,
- Access to water,
- Public health and sanitation, and
- Waste.

(2) Methodology of Analyses

Environmental Impacts Assessment (EIA), which is called as AMDAL in Indonesia, for the priority project was sub-contracted to the local contractor, or AMDAL Study Team consisting of researchers of Sam Ratulangi University situated in Manado. The following examinations and analyses were conducted referring to the results of the study. The methodologies, including the study results, described in this EIA study are not exactly the same as those adopted and obtained by the AMDAL Study Team.

a. Natural Environment

The methodology of impact prediction and evaluation on natural environmental components is listed in Table C8.4.4. Most of the impacts were predicted by means of analogical method based on the function, dimension and the design of the structural

interventions. The results on similar cases in other projects were referred to as well. With regards to the flora and fauna, the ecologic characteristics of the species to be affected were analyzed and taken into consideration. The impacts on water regime of rivers and Lake Limboto were predicted based on the run-off simulation results and proposed water level of the lake.

The methodology of impact evaluation was done based on the magnitude and nature of each impact, taking compensatory measures into consideration. In this respect, impact evaluations of water quality and air quality were done comparing differences between with or without conditions, based on the environmental quality criteria of Indonesia. With regards to water regime, the impact evaluation was bone based on the results of economic evaluation.

b. Social Environment

Impact is defined as the difference between a predicted social environmental condition "with" and "without" the project. Prediction of project impact on social environment used, in principle, analogical method in the present study. This was done by comparing the predicted social environmental conditions with those of another place which experienced similar project activities. As regards the residents affected directly by the projects, the impacts on their livelihood, resettlement and related matters, and possible local opposition, were predicted mainly based on primary information obtained by interview, questionnaires, socialization process of EIA study (public consultation meetings) and field observation. In addition, some quantitative estimation of affected lands and houses required for land acquisition, based on the dimension, design and location of the planned structural interventions, was also used for impact prediction.

The evaluation of predicted impacts on each social environmental component was done, in principle, based on the magnitude and characteristics of each impact. Once serious impact is predicted, then the significance of such impact is determined by employing the following evaluation criteria for environmental impacts (based on the Guidelines of Implementation of the Government Regulation No. 27/1999 and Environmental Impact Management Decree No. 056 of 1994). The methodology of impact prediction and evaluation for each of the social environmental components is summarized in Table C8.4.5.

The number of affected people: the impact is evaluated as important if the number of people who receives the impact and benefit is more than that of those who benefit from the project;
The dimension of affected area: the impact is evaluated as important if the project creates a fundamental change on an administrative area in terms of intensity or irreversibility or cumulative characteristics;
Intensity and duration of the impacts: the impact is evaluated as important if the project creates a fundamental change for one or more activity phases, in terms of impact intensity or irreversibility or cumulative characteristics; "Duration of impact" is considered as important when the project creates conflicts or controversy among concerned communities and local government;
The number of other environmental components affected: the impact is evaluated as important if the activity plan causes other secondary impacts, whose component number is similar to or more than that of the primary affected environmental component;
Impact's Cumulative Nature: the impact is evaluated as important if the activity plan causes: (a) repeating and continuous impacts, which could not be assimilated by the affected society and environment for a certain period, (b) impact accumulation in a certain space, which could not be assimilated by the affected society and environment, (c) synergetic effects of various impacts due to various activities;
Impact Reversibility: the impact is evaluated as important if the changes experienced by an environmental component could not be reclaimed, even by human intervention.

C8.4.4 Impact Assessment

(1) Natural Environment

a. Supplementary Information on Existing Environmental Condition

As physical environmental conditions, air quality, noise, water quality were measured in LBB basin. In addition, inventory of terrestrial biota, and aquatic biota were conducted for the ecological investigation.

Air Quality: Air quality measurement was carried out at 18 locations. The parameter analyzed were carbon monoxide (CO), sulfur dioxide (SO_2) and nitrogen dioxide (NO_2) as combustion products, and dust. The measurement results showed that these combustion gases were far below the air quality standard (Government Regulation No.

82/2001) while dust content exceeded the air standard limit as shown in the following table. The reason for this is estimated that due to the long period of dry season occurred in Gorontalo area in 2002, the dust particles were easy to fly into the air by wind and traffic.

(Result of Air Quality Measurement)

Parameter	CO ($\mu g/Nm^3$)	SO_2 ($\mu g/Nm^3$)	NO_2 ($\mu g/Nm^3$)	Dust ($\mu g/Nm^3$)
Minimum	<3,500	<10	<25	202
Maximum	<3,500	<10	<25	262
Average	<3,500	<10	<25	232
Quality Standard	**30,000**	**900**	**400**	**230**

Source: Field investigation in the course of this study, conducted from 4th through 7th in June, 2002.

Noise: Environmental noise was measured at the same locations as those of air quality. The result was shown in the following table, indicated that maximum levels of environmental noise at several locations were higher than the quality standard threshold value. This was caused by the motor vehicles traffic sounds, sounds from radio and audio instruments, etc.

(Result of Environmental Noise Measurement)

Parameter	Noise level (dB(A))
Minimum	44.1
Maximum	59.7
Average	52.7
Quality Standard	**55**

Source: Field investigation in the course of this study, conducted from 4th through 7th in June, 2002.

Water Quality: Water sampling was conducted at 13 locations for water quality measurement, including eight samples from major rivers, such as Alo-Pohu, Biyonga, Tapodu, Bolango, Tamalate and Bone; four samples from Lake Limboto; and one sample from the sea at Gorontalo harbor. The measurement results were summarized in Table C8.4.6, excluding the measurement result from the sea.

Most of the concentrations of the measured parameters were consistent with Class I of the water quality criteria provided by Government Regulation No. 82/2001. However, with respect to BOD and COD, which are indices of organic pollution, exceeded Class III (for COD) and even Class IV (for BOD) of the water quality criteria. This suggests that both river and lake water are substantially polluted with organic substances. This

result is in line with the water quality analysis conducted in the year earlier (Refer to PART-A EXISTING CONDITION, SUPPORTING REPORT). The values of pH and DO showed suitable condition for aquatic biota and for aquaculture, as is the same as that in the year earlier.

Among inorganic chemicals, most of heavy metals were below the respective detection limits. Regarding Selenium (Se), Lead (Pb) and Mercury (Hg), however, they were detected beyond their water quality criteria. Especially as for Mercury, the water sampling from Tamalate river showed the concentration of 0.0118 mg/l, which exceeds even Class IV of the criteria. This is quite different form the measurement results of Mercury in the year earlier, which all of last year's measurement results were blow its detection limit (0.0002 mg/l). Taking into account that not all of this year's measurement results exceeded the water quality criteria, however, it is not considered that all the river water is contaminated with those heavy metals. After all, it might as well consider that monitoring of water quality is required occasionally from now on.

Inventory of Terrestrial Biota: Inventory of terrestrial flora was conducted from 2nd through 6th for forest land, and from 7th through 8th for bush land and grass land, in June, 2002. The inventory was done in Ayumolinggo Protected Forest, Tihengo Protected Forest, upstream of Pohu, Bolango and Bone rivers for forest land. And also, the inventory was done in inlets of Biyonga, Alo-Pohu and Bolango rivers, in Tilote village and surrounding areas of Lake Limboto.

A total of 90 species of plants were identified in the forest land, and 27 species in bush land and 21 ones in grass land. Most of the species identified are common ones in LBB basin or north Sulawesi. No protected species, which is designated by the Law No. 5 of 1990 regarding "Conservation of biological resources and its ecosystem," were identified in and around the sites of the priority project.

Inventory of Aquatic Biota: Inventory of aquatic biota, including aquatic plants, phytoplankton and zooplankton, benthos and nekton was conducted from 4th through 6th, June, 2002. In this regards, benthos is the aquatic organism that exist on an aquatic bed, and nekton is the aquatic organism that can swim in a water body. The inventory was made in Lake Limboto and major rivers, such as Biyonga, Meluopo, Marisa, Alo-Pohu, Bone, Bolango and Tapodu.

A total of 20 species of aquatic plants were identified in Lake Limboto, including

emergent plants, floating plants and submerged plants. Regarding planktons, there were 38 types identified, including 21 species of phytoplankton and 17 species of zooplankton. A total of 6 species of benthos were identified including shrimps, snails and freshwater crabs. As for nekton, a total of 16 species were identified including the ones derived from a market, or a *pasar* in Indonesian language. There is no protected species identified by the inventory of aquatic biota.

An eel is one of nekton identified, which inhabits widely in LBB basin and which migrates between lake-river and the sea. It is categorized as catadromous fish that goes down to the sea for breeding. Eels are abundant in LBB lake-river network, suggesting the regeneration system, or their life history is functioning properly. Aside from eels, the overall fish abundance is higher in the lake than in the rivers supposedly because river water varies its discharge to the extent that fish cannot inhabit there.

b. Impact Prediction

Enumeration of Conceivable Impacts: The impacts of the implementation of the priority projects were examined and predicted in detail. First and foremost, the priority projects are not such a project that generates pollutant, toxic or hazardous substances. In this regards, the priority projects are not considered to be the origin of pollution. The priority projects are planned to locate in the lower reaches of the Bolango, Bone, Alo-Pohu and Biyonga rivers, and around Lake Limboto and on Tapodu river. The surrounding areas of them are densely populated and heavily modified already by human activity: hence, there is no protected area, such as game refuges, or national parks. Further, there considered not to be growing or inhabiting the protected species of terrestrial flora and fauna designated by the Indonesian Law No. 5 of 1990 regarding "Conservation of Biological Resources and Its Ecosystems."

In spite of the nature of the priority projects mentioned above, they will bring about impacts on natural environmental components, including both negative and positive ones. Among them, negative impacts are as follows:

- Groundwater level lowering and land subsidence along Tamalate floodway, Tapodu river and Tenda Cutoff channel.
- Vegetation clearance at the sites of Tamalate floodway and Tapodu river.
- Habitat disturbance of terrestrial fauna at the sites of Tamalate floodway and Tapodu river.

- Habitat disturbance of aquatic fauna, especially fish, caused by turbid water and alkali water discharge, and by improper channel shift during construction work.
- Disturbance of migration habit of migratory fish at Tapodu gate.
- Air pollution and noise caused by construction machinery and transportation vehicles.
- Dust from construction work site, especially caused by earth work.
- Water quality deterioration caused by turbid water and alkali water discharges.

Likewise, the positive impacts are as follows:

- Alleviation of erosion currently occurring along lower reaches of major rivers.
- Flood control for floods up to 20 year recurrence period and mitigation of flood damages for bigger ones.
- Stabilization of water level of Lake Limboto and resultant water quality improvement.
- Improvement of fish ecology brought about by stabilization of water level and water quality improvement in Lake Limboto.
- Confining of turbid water within sediment trap and reduction of turbidity and sedimentation in the rest of Lake Limboto.

Description of Impacts: The details of these conceivable impacts were described with its characteristics and possible secondary impacts in Table C8.4.7. The following are the additional descriptions for in-depth analyses:

Impact on Eels: The impact magnitude cannot be identified quantitatively due to the ecologic complication or difficulty of its calculation. Each of the negative impacts, however, does not seem to be significant, except for the impacts on eels (*Anguilla* sp.), specifically on its life history, or migration habit, because Tapodu river is modified and disconnected longitudinally at the gate. Not all the eels cannot go up to Lake Limboto, but some of them can go up to the lake through narrow drainage channels along Tapodu river which are the modification of existing Tapodu river and small stream along kelurahan Lekobato. The effectiveness of these drainage channels, however, are not clear and how many percentages of juvenile eels which congregate at Tapodu gate intending to go up for Lake Limboto can not be quantified.

Impact on Groundwater and Land Subsidence: Another negative impact that will affect the living condition of local people is the drawdown of groundwater level and

consequent consolidation phenomenon. These impacts will be caused by the excavation for Tamalate floodway, Tapodu river and Tenda Cutoff channel. Because the groundwater levels around these interventions are situated around 2 m below ground level, judging from boring data, and because the excavation depth is at approximately 4 m on these channels on average, the groundwater drawdown will be estimated some 2 m. Based on the geologic layer, showing mostly silty clay or clay, and applying the following formula, which is often used for estimation of impact area of water wells, the impact area on groundwater is estimated up to 50 m at most from these excavation areas.

$$R = 3{,}000 \times S \times \sqrt{K}$$

where, R: Area of impact (m),
S: Maximum drawdown of groundwater level (m), and
K: Permeability (m/s).

In this regard, the calculation of the impact area was done assuming the permeability of the geologic layer as an order of 10^{-5} at maximum. The result of this calculation indicates the maximum area, not effective area. Therefore, it should be noticed that not all the households located within the calculated impact area will be affected.

Impact on Aquatic Flora in Lake Limboto: Due to the stabilization of water level in Lake Limboto, the following impacts on aquatic weeds, specifically on macrophytes, is considered to be brought about. There are three types of macrophytes growing in Lake Limboto; 1) submerged macrophytes, 2) emergent macrophytes and 3) floating macrophytes. Submerged macrophytes are the aquatic plants which roots in the lake bed but does not reach their stems or leaves above the water surface while emergent macrophytes extends them above water surface. Floating macrophytes are the ones which grow and extend their habitat floating on the water surface.

Submerged macrophytes grow depending on the penetration of light: they can extend as deep as 10 m in clear lakes, while emergent macrophytes are generally limited to shallow depths of 1 m or less. Due to the high turbidity of Lake Limboto, i.e. Secchi depths indicate generally less than 0.5 m, submerged macrophytes are limited to spread into the deeper areas of the lake. According to "Lake Limboto Management Plan, Environmental Screening," 1996, the vegetated zone of such submerged macrophytes in the lake occurs on depths of up to 1.5 or 2.0 m.

Owing to the control at Tapodu gate, water level will be maintained at higher than 4.0 m,

therefore, the submerged macrophytes or emergent macrophytes cannot grow on the area with depth of more than 2 m, at least. This indicates that the area where macrophytes (submerged or emergent ones) can grow will be limited substantially. According to the relationship of water level and the area of water surface in Lake Limboto, out of 25.11 km^2 of water surface at water level of 4.0 m, these macrophytes will not be able to grow on the deeper area, i.e. the center of the lake, of 11.50 km^2, which amounts to 46% of the water surface. Thus, the water quality in Lake Limboto will improve as a result of synergy because of the decrease of decomposition of those aquatic macrophytes.

Positive Impacts: Regarding other positive impacts, their benefits cannot be quantified, either, except for water regime, specifically the alleviation of flood risks. The economic effect brought about by the flood control was quantified economically described in detail in Chapter C8.2.

c. Impact Evaluation

Overview: The impact evaluation should be undertaken comprehensively taking into account not only the feature of negative or positive but also nature of the impact, i.e. reversibility, possibility of avoidance and duration, spatial extent, and so on. In addition, the impacts should be evaluated based on the identicalness of those who get benefit and those who suffer from the project, namely, whether or not people who get benefit from the project is identical with the people who suffer from it.

First of all, it should be noticed that the priority project is not such a project that generates pollutants, toxic or hazardous substances, as stated earlier. The project is aimed to control the flood risks and therefore it is evaluated to contribute to the improvement of natural condition, especially of living condition. And also, the priority projects will not disturb any precious species of terrestrial flora and fauna, either, nor will they occupy any protected area of the basin as described in the previous section. As for the details, however, the impacts on natural environmental components were evaluated as in Table 8.4.8 and as described below:

Evaluation of Negative Impacts: There are some negative impacts which can not be evaluated clearly. They include the impacts on groundwater and land subsidence, and on aquatic fauna, especially eels. Those who suffer from these negative impacts are not necessarily identical with those who get benefit from the project, because, for example,

people who suffer from groundwater lowering along the Tamalate floodway will not get direct benefit from the floodway – the people who currently live around the planned Tamalate floodway are not suffering from flood risks. As for the impacts on eels, it is not clear if fishermen who catch eels are identical with those who are currently suffering from flood risks.

Although the magnitude of some negative impacts cannot be evaluated clearly, these are not considered to be serious provided that these negative impacts are to be compensated with money or the same materials. For example, the fishing output decrease of eels should be compensated with money in reality, and the drawdown of well water revel should be compensated with the supply of drinking water.

Evaluation of Positive Impacts: As for positive impacts, on the other hand, all of them are considered to be significant, except for the impacts of sediment trap. The effects of sediment trap cannot be evaluated quantitatively. All of the positive impacts are considered to last for years or forever if proper operation and maintenance are given.

Conclusion: In conclusion, the negative impacts are evaluated as not significant or not serious in terms of applicability of compensatory mitigation. Positive impacts are evaluated significant taking into consideration the possible secondary effects. Thus, the negative impacts are canceled by the positive impacts with a surplus of substantial benefits, and the priority projects are considered to be valid from the viewpoint of natural environment.

(2) Social Environment

a. Supplementary Information on Existing Environmental Condition

Hereunder is important supplementary information on existing social environment in the region.

Socialization: Since the beginning of the present study, two PCM were organized by EIA study team for dissemination about the priority projects in addition to 3 PCM by JICA. Some villages at the project site become more familiar with the proposed projects.

Traditional Market (Pilolodaa): There is a traditional market of desa Pilolodaa which is

located near the Tapodu Gate construction site. The market activities are most active on Monday, Wednesday and Thursday when the neighborhood area is very crowded.

Local residents' habit: It is common to see people dumping into rivers domestic house waste. People also like just to spend time on riversides and lake sides. The limitation of access to the river and lake sides could disturb such habit and may cause some problem.

Livelihood: The residents living in the planned project areas earn their income by agricultural activities (mostly rice culture), fishery and by working as public servant or for private company (service sector). The dependency on the primary sector is very high at the kabupaten level, and in kota, the residents' income comes largely from the government or private sector.

Fish culture: The utilization of *karamba* (bamboo cage) is decreasing and *Jaring apung* (Floating Net) becomes more and more popular for fish culture in the lake Limboto.

People's Perception on the project: During the subcontracted EIA study, 338 residents (Kabupaten: 146, Kota: 192) were questioned to know about their opinion on the projects. The respondents were selected to represent the project-affecting areas in Kota and Kabupaten Gorontalo. The majority (68%: Kota 72.9%, Kab. 61.6%) of the respondents agreed to the project implementation. The reasons and suggestions are also listed below together with those raised by the respondents who have not agreed (23.1%). In principle, all community components involved during socialization processes by EIA study have understood the paramount importance of the project and agreed that it should be holistically implemented by involving government and private sectors.

<AGREE (68%)>	**<NOT AGREE(23.1%)>**
Reasons 1. Can overcome flood problem 2. Employment opportunities 3. Increase income 4. No specific reason Suggestions 1. Employ the local people 2. Do not resettle the people 3. Involving people living at project sites 4. Appropriate compensation for land and building acquisition	Reasons 1. Can not solve core problem 2. Already accustomed to flood 3. May inundate settlement area 4. Resettlement (incl. Rice field) 5. Do not know Suggestions 1. Flood control measures in upper watershed 2. Dike construction at Limboto lake shore

b. Impact Prediction

Predicted impacts on each social environmental component were judged in principle as "negative" or "positive" and summarized in the Table C8.4.9. In the table, additional information useful for impact assessment, such as quantitative magnitude and possible secondary impacts, are also presented. Hereunder is the summary of both negative and positive impacts foreseen for the project implementation.

Negative Impacts: Land acquisition is prerequisite for the construction of any structural interventions. But it will have a negative impact on various social environmental components, mainly resettlement, livelihood and local population's opposition.

- Change of residence is needed for project's structural interventions, namely Tamalate Floodway, Tapodu Gate and also for dike construction for river improvement works of Bolango, Bone, Tapodu as well as realignment of Alo-Pohu rivers.
- Loss of productive lands such as rice field is predicted in the areas along Tamalate Floodway and Tapodu river improvement and gate construction site, which can lead to the decrease of household's income and may force occupation change.
- Local population's opposition is predicted at the pre-construction stage, which would be caused by insufficient information and understanding of the projects, and this impact may be aggravated by a frustration vis-a-vis improper application of land acquisition measures.
- Disturbance of local circulation of goods and persons is predicted especially around Pilolodaa market which is close to the site of Tapodu gate construction/river improvement work.
- Access to river and lake waters, strongly related to people's daily life, will be limited, at all the stages, by land occupation by the projects and construction of facilities such as dike.
- Disturbance of waste dumping habit of people living nearby the treated rivers.

Positive Impacts: Positive impacts are direct and immediate economic benefits for individual residents and long- (or mid-) term benefits for the economy of wider range.

- As the project plans to recruit workers for its implementation, local people directly affected by the project may be able to get employed and enhance their

earning during construction phase.

- Stabilizing lake water level at 4 m above the sea level after the project completion, the potential for fish culture production will be enhanced and can contribute to individual and regional economy.
- People's mobility around the project sites would be increased, as people can use a new access road along dikes (the Tamalate Floodway) and new/heightened bridges; impact at the Operation and Maintenance stage.
- Reduction of flood risks stabilizes community settlement on the riversides.
- Public health and sanitary condition will be improved, as incidence of flooding and inundation in settlement areas should become almost none, once the projects will have completed.
- Limited access to river and lake waters may lead the people living along rivers and the lake, to reconsider their habit of dumping domestic waste and utilizing for privies. It might result in less polluted river and lake waters.

The magnitude of most of the impacts on social environmental components is difficult to be quantified and only estimation of number of houses affected directly by land acquisition and the villages located at the project sites was possible. For example, in terms of dumping waste into rivers, such habit was confirmed by field observation, but any concrete investigation to determine the volume of waste dumped by nearby residents has not been conducted. There is no quantitative data available at this point. In addition, for the prediction of impact on each social environmental component, people's habit and custom, such as the utilization of river and lake waters in daily life, is considered to be unchangeable and only adjustable. It is assumed that the people maintain their actual habit and custom throughout the project implementation period.

c. Impact Evaluation

The nature of predicted impacts, both negative and positive, is examined and each impact is evaluated in a comprehensive manner, using the six criteria presented in the previous section. Quantitative magnitude is also taken into account, but such a parameter was not considered as definitive. The result of evaluation is summarized in Table C8.4.10.

Regarding the negative impacts, all of them are considered as "Not significant". However, some of these "Not significant" impacts need certain considerations: Proper and fair land acquisition process and sufficient socialization (dissemination) activities

should be secured. These two elements are very important, even crucial, since they affect more than one social environmental component and considering its practice at the earliest stage of project implementation.

As to the positive impacts, most of them are considered to be significant except for the impacts on a people's habit, precisely waste dumping practice. One of the positive impacts, job creation may improve immediately, during the construction phase, economic base for local population and even can alleviate directly the negative impact on livelihood of the affected households. In addition to this short-term income opportunity, stabilized water level of lake Limboto can offer sustainable income source for the people of surrounding areas in the long-term.

In conclusion, the negative impacts are evaluated as not significant provided that land acquisition and socialization are properly and fairly proceeded. Positive impacts are evaluated significant based on its large benefiting population and area and their long-lasting nature. Also most of the impacts are concentrated on the project sites, and so do the affected population and area. It is considered that the not significant negative impacts would be canceled by the significant positive impacts. The priority projects are considered as a whole, to be valid from the social environmental point of view.

C8.4.5 Environmental Management Plan

(1) Purpose of Environmental Management

An environmental management plan (RKL) shall be formulated to ensure to maintain and/or enhance the current environmental condition when it is in good condition, and to mitigate the possible impacts to be affected by the implementation of the project. The environmental management plan shall provide the environmental components to be managed, management elements and goals, measures and/or actions for mitigation and/or enhancement and evaluation criteria for the management. The appropriate environmental management plan should contribute to maintain and enhance the current environment and develop an awareness building and a capacity building of all the concerned people, or stakeholders, through report and dissemination process to them.

(2) Procedure of Environmental Management

JICA Study Team proposes the environmental management procedure listed on Figure

C8.4.1. The project implementer, PU/Kimpraswill, Gorontalo province, is to disseminate the environmental aspect of the project, including the Environmental Management Plan and Monitoring Plan, prior to the commencement of the construction work. During construction phase, the project implementer is to execute the necessary environmental mitigation/enhancement measures as well as environmental monitoring activities. The results of the monitoring are to be reported to the supervisory governmental agency, BAPEDAL, Gorontalo province, for discussion, inspection and necessary revision of the implementation plan of the project, if necessary. The monitoring results are also to be disseminated to the stakeholders, including local residents, NGOs, relevant government agencies and so forth. Through the dissemination, the stakeholders are to give their questions, opinions and/or requests to the project implementer. These procedures should be held several times during the construction phase timely in line with its progress. After the completion of the construction work, namely, in operation and maintenance phase, the same procedure should be undertaken among stakeholders.

(3) Environmental Management Plan on Natural Environment

The components of natural environment to be managed are the following (Ref. Table C8.4.11): Geology (erosion and sedimentation), Groundwater and land subsidence, Water regime, Terrestrial flora and fauna, Aquatic flora and fauna, Air quality and Water quality. These are the same as those to receive negative or positive impacts, described in the previous section. The management objectives are the respective elements in each environmental component. Each environmental element is to be managed to keep its acceptable condition, and the condition of the elements is to be evaluated in comparison with a certain criteria, such as environmental standard for the physical elements, i.e. air quality and water quality. As for the elements whose environmental standards are not given or set up, the evaluation is to be done based on the qualitative criteria, or the management goal set up. The environmental condition of each element shall be monitored following the Environmental Monitoring Plan (RPL) which is described in detail in the next section.

(4) Environmental Management Plan on Social Environment

The components of social environment: Resettlement, Livelihood, Local Population's opposition, People's mobility, Access to river and lake waters, Public Health and Sanitation and Waste are to be managed by the present management plan (Table

C8.4.12).

The "management elements" are identified for each environmental component. In most of the cases, the environmental elements for social environmental components do not have any standard already set up for managerial purpose. Only an element "Land acquisition" has the regulations to be referred and its base for compensation (NJOP) is available. Therefore, it is proposed to utilize analogical method, in which evaluation is made by comparing the initial status (before-activity) with the status at the evaluation point (after-activity). For example, management element "Dissemination activity" can be evaluated by comparing the percentage of acceptance of local population after such activities, with the initial status ("Agree": 68% as in June 2002). Official data can also be utilized to grasp initial status of the elements.

The environmental condition of each element shall be monitored by following RPL (Table C8.4.14), same as for natural environmental components.

C8.4.6 Environmental Monitoring Plan

(1) Purpose of Environmental Monitoring

An environmental monitoring process is a part of the environmental management, on which the existing environmental conditions are to be maintained or enhanced. The monitoring process shall provide information about the actual environmental impacts rendered. It is essential for the evaluation to determine whether the proposed projects have achieved their stated goals or not, from the environmental point of view. The real time evaluation as the results of environmental monitoring enables the project implementer to take immediate actions in case of contingency, unexpected and/or serious situation which might happen. In order to achieve this, RPL shall be the essential to be formulated.

(2) Environmental Monitoring Plan on Natural Environment

The environmental monitoring plan is summarized in Table C8.4.13. Since the environmental monitoring process is a part of the environmental management, the environmental components and elements for the monitoring are the same as those of environmental management plan.

The monitoring sites where each monitoring activities are to be done are identical with those locations/areas where natural environmental elements are to be affected, which have been described and listed in section C8.4.4 "Impact Assessment." The time when the monitoring activities are to be carried out is the same as the time when the actual impacts are to be brought about. Specifically, the monitoring should be undertaken at the peak period of each impact. The monitoring activities should be conducted in such frequency that the impact on or change of the environmental element is to be captured. In this regard, the time period of the monitoring also shall cover the duration in which the environmental change occurs. In most of the cases, the environmental impact or change will settle or become stable within five years after an intervention, except for some special cases or secondary impacts. The methodology of the monitoring process should be carried out by means of field observation, including sampling, identification, and/or laboratory tests.

(3) Environmental Monitoring Plan on Social Environment

As regards social environmental components, impact can be monitored mainly by informal method: *i.e.* interview, questionnaire and field observation. The secondary data, such as statistics on economic performance of desa, population profile, are used as complementary information. Interviews and questionnaires can be made up of a series of points for various management elements so that monitoring activities can be done efficiently. To organize a public meeting inviting the affected residents, related government offices and others, can be an alternative for listening directly to the people's voice directly. If there is a financial constraint for the above method, it is recommended that related officials contact frequently the local populations, when visiting the project sites as a routine work of structural facilities investigation.

The monitoring sites for each monitoring activity are usually coincident with project sites, *i.e.* sites of construction works, which is summarized in below table. In addition to these location, offices of relevant agency such as BPN (Badan Pertanahan Nasional: National Land Agency) and the contractor's office can provide useful information for the monitoring.

Project	Monitoring Sites
Tapodu River Improvement with Tapodu Gate	Desa Tualango, Tabumela, Tilote, Lauwonu, Hutadaa (Kec. Telaga), Kel. Lekobalo, Dembe I, Kel. Pilolodaa, especially fishery villages
Tamalate Floodway	Desa Oluhuta and Poowo (Kec. Kabila)

Project	Monitoring Sites
River Improvement (Bolango and Siendeng)	Kel. Siendeng and Tenda (Kota Selatan), Kel. Molosipat W (Kota Barat)
River Improvement (Lower Bone)	Kel. Tenda, Talumolo (Kota Selatan)
Realignment of Alo-Pohu and Biyonga, and sediment trap	Desa around the lake Limboto (Kec. Limboto, Batudaa, Telaga, etc.), especially at the fishery village level

As for monitoring timing, it should correspond to the occurrence of impact feature. For example, "Land acquisition" can be monitored at a regular pace during land acquisition process in addition to the point when the process is concluded. Apart from regular monitoring timing, ad hoc monitoring should be programmed when necessary, for example when people complain about the situation and when local population's opposition becomes evident. Depending on a result of monitoring activities, mitigation measures may need to be enhanced or modified so that the management plan becomes appropriate and more accurate for the status of concerned environmental component at that point.

C8.4.7 Results of AMDAL Procedure

(1) Establishment of AMDAL Commission

In Gorontalo province, AMDAL Commission, namely Environmental Impact Assessment Evaluation Committee, have not been established yet because the province was newly established in 2001 and its administrative function has not been organized thoroughly. Accordingly, the temporal AMDAL commission was established specifically for this JICA priority projects.

The establishment of the AMDAL commission, including its Technical Evaluation Team, was provided by the provincial regulation (No. 231/2002), issued on June 4th, 2002. The AMDAL commission and the Technical Evaluation Team were composed of 28 and 6 members, respectively. The AMDAL commission were led by the chairman; the Vice Governor of Gorontalo province (*Wakil Gubernur Gorontalo*) and the deputy chairman; the head of Development Planning Board of Gorontalo province (*Kepala Bappeda Provinsi Gorontalo*). Other members include heads of relevant departments of Gorontalo province, university professors, NGOs and representative of community.

(2) Dissemination

In addition to three times of public consultation meeting held by JICA Study team, the dissemination at two different venues, i.e. Kecamatan Telaga meeting hall and Kecamatatn Kota Barat meeting hall, was held specifically for the AMDAL procedure on June 7th, 2002. At the dissemination, the conceivable impacts of both negative and positive ones on environment as well as the components of priority projects were informed to the local communities and the relevant organizations. The numbers of participants were 50 and 65 at Kecamatan Telaga and at Kecamatatn Kota Barat, respectively. In the consultation meetings, some questions regarding the components of the priority projects were raised, specifically, the questions on the effectiveness of Tamalate floodway, Tapodu control gate and Sediment trap in Lake Limboto.

(3) Approval of Environmental Impact Analysis

The necessary procedures were conducted following the relevant laws, regulations and decrees, and as a consequent, the Environmental Impact Analysis (ANDAL), Environmental Management Plan (RKL) and Environmental Monitoring Plan (RPL) have been approved by the AMDAL Commission effective on September 23rd, 2002. The letter of the approval is attached as Table C8.4.15, although the original letter of it is written in Indonesian language.

C8.4.8 Conclusion and Recommendations

(1) Environmental Impact Evaluation

Natural Environment: The negative impacts on natural environmental components are evaluated as not significant or not serious in terms of the nature and magnitude of impacts or the applicability of compensatory mitigation. Positive impacts are evaluated significant judging from the secondary effects, or economic benefit. Thus, the negative impacts are canceled by the positive impacts with a surplus of substantial benefits, and the priority projects are considered to be valid from the viewpoint of natural environment.

Social Environment: In terms of social environmental components, no significant negative impacts are foreseen, provided that land acquisition and dissemination activity are fully taken into consideration. On the contrary, positive impacts are considered as

significant, including the increase of the potential of fish culture production of the Lake Limboto which could be a sustainable impact for the regional economy.

(2) Recommendations

The priority projects were evaluated as environmentally valid in the previous section. However, the validity is realized if the following are provided. JICA Study team strongly recommends the following be conducted surely.

Watershed management: Watershed management, specifically forest and land use managements are to be conducted. The structural measures are effective provided that the upstream watershed management be carried out. Since no Master Plan on watershed management has been developed, its formulation is first and foremost task to be got started.

Statistical Survey on Fishery in Lake Limboto: the fishing output, and aquaculture production, has not been investigated systematically so far. The daily survey of the fishery production from Lake Limboto is essential for the management of fishery resources in it, because almost all of the local people are owing to freshwater fish in the lake for protein intake. Survey of eel's migration is included for one the necessary survey.

Monitoring and Management of water environment in Lake Limboto: Since Lake Limboto is considered to be the resource origin of all the economic activities, such as fishery, agriculture, fluvial transportation, tourism, as well as daily water use in ordinary lives, the monitoring and management are by far important aiming to keep it in good condition.

Land Acquisition: It was realized, through the investigation by the EIA study, that the key persons of local communities affected by potential projects would play an important role in the process of socialization (dissemination), land acquisition and project implementation. The key persons would be a local religious leader, kepala desa, Tokoh masyarakat (public figures), a leader of local youth group, LSM (NGO) active at the site, etc. It is crucial to first of all convince them with the necessity and importance of the project at a very early stage of preparation. Local people tend to follow an instruction of such key persons at the local level. In this regard, a combination of informal and formal steps is recommended in practice, for smoothly proceeding land acquisition procedure.

General flow of such actions is schematized in Figure C8.4.2 An informal approach to the targeted communities should be done by a third party: preferably not by the officials directly involved in the concerned project nor by the personnel of the project executor. The formal approach should fully respect the existing regulations. It is also considered as a part of socialization process.

Table C8.2.1 Composite Conversion Factors of Civil Works (1/2)

Cost Item	Financial Cost			Economic Cost			Composite
	Foreign (Yen)	Local (Rp.)	Total (Rp.)	Foreign (Yen)	Local (Rp.)	Total (Rp.)	Conversion Factor
1. Excavation, Common (Unit: per m^3)							
(1) Labor	0	403	403	0	403	403	
1) Skilled Labor	0	403	403	0	403	403	
2) Unskilled Labor	0	0	0	0	0	0	
(2) Materials	0	1,128	1,128	0	1,016	1,016	
(3) Equipment	131	5,844	16,007	10,163	5,260	15,423	
Sub-total	131	7,375	17,538	10,163	6,678	16,841	
(4) Overhead & Profit	20	1,106	2,631	1,524	1,002	2,526	
Total	151	8,481	**20,169**	11,688	7,679	**19,367**	**0.96**
2. Embankment (Unit: per m^3)							
(1) Labor	0	755	755	0	755	755	
1) Skilled Labor	0	755	755	0	755	755	
2) Unskilled Labor	0	0	0	0	0	0	
(2) Materials	0	1,582	1,582	0	1,423	1,423	
(3) Equipment	173	7,652	21,054	13,402	6,887	20,289	
Sub-total	173	9,989	23,391	13,402	9,066	22,468	
(4) Overhead & Profit	5	1,498	3,509	2,010	1,360	3,370	
Total	178	11,488	**26,900**	15,412	10,426	**25,838**	**0.96**
3. Sodding (Unit: per m^2)							
(1) Labor	0	9,754	9,754	0	6,115	6,115	
1) Skilled Labor	0	656	656	0	656	656	
2) Unskilled Labor	0	9,098	9,098	0	5,459	5,459	
(2) Materials	0	393	393	0	354	354	
(3) Equipment	18	845	2,216	1,372	760	2,132	
Sub-total	18	10,992	12,363	1,372	7,229	8,600	
(4) Overhead & Profit	3	1,649	1,855	206	1,084	1,290	
Total	20	12,640	**14,218**	1,578	8,313	**9,890**	**0.70**
4. Wet Rubble Masonry (Unit: per m^3)							
(1) Labor	0	61,489	61,489	0	48,470	48,470	
1) Skilled Labor	0	28,942	28,942	0	28,942	28,942	
2) Unskilled Labor	0	32,547	32,547	0	19,528	19,528	
(2) Materials	268	176,901	197,620	20,719	159,211	179,930	
(3) Equipment	0	0	0	0	0	0	
Sub-total	268	238,390	259,109	20,719	207,681	228,400	
(4) Overhead & Profit	40	35,758	38,866	3,108	31,152	34,260	
Total	308	274,148	**297,975**	23,827	238,833	**262,660**	**0.88**
5. Riprap (Unit: per m^3)							
(1) Labor	0	28,536	28,536	0	24,205	24,205	
1) Skilled Labor	0	17,709	17,709	0	17,709	17,709	
2) Unskilled Labor	0	10,827	10,827	0	6,496	6,496	
(2) Materials	67	56,827	61,976	5,149	51,144	56,293	
(3) Equipment	0	0	0	0	0	0	
Sub-total	67	85,362	90,511	5,149	75,349	80,498	
(4) Overhead & Profit	10	12,804	13,577	772	11,302	12,075	
Total	77	98,166	**104,088**	5,922	86,651	**92,573**	**0.89**
6. Gravel Bedding (Unit: per m^3)							
(1) Labor	0	1,074	1,074	0	843	843	
1) Skilled Labor	0	496	496	0	496	496	
2) Unskilled Labor	0	578	578	0	347	347	
(2) Materials	404	28,125	59,432	31,307	25,312	56,619	
(3) Equipment	59	2,541	7,094	4,553	2,287	6,840	
Sub-total	463	31,740	67,600	35,860	28,442	64,302	
(4) Overhead & Profit	69	4,761	10,140	5,379	4,266	9,645	
Total	533	36,501	**77,740**	41,239	32,709	**73,947**	**0.95**

Table C8.2.1 Composite Conversion Factors of Civil Works (2/2)

Cost Item	Financial Cost			Economic Cost			Composite
	Foreign (Yen)	Local (Rp.)	Total (Rp.)	Foreign (Yen)	Local (Rp.)	Total (Rp.)	Conversion Factor
7. Gabion Mattress (Unit: per m^3)							
(1) Labor	0	28,271	28,271	0	22,955	22,955	
1) Skilled Labor	0	14,979	14,979	0	14,979	14,979	
2) Unskilled Labor	0	13,292	13,292	0	7,975	7,975	
(2) Materials	106	194,596	202,832	8,236	175,137	183,372	
(3) Equipment	0	0	0	0	0	0	
Sub-total	106	222,868	231,103	8,236	198,091	206,327	
(4) Overhead & Profit	16	33,430	34,666	1,235	29,714	30,949	
Total	122	256,298	**265,769**	9,471	227,805	**237,276**	**0.89**
8. Concrete (Unit: per m^3)							
(1) Labor	0	32,037	32,037	0	24,996	24,996	
1) Skilled Labor	0	14,434	14,434	0	14,434	14,434	
2) Unskilled Labor	0	17,604	17,604	0	10,562	10,562	
(2) Materials	1,111	202,774	288,776	86,002	182,496	268,498	
(3) Equipment	851	33,949	99,813	65,864	30,554	96,418	
Sub-total	1,962	268,760	420,626	151,866	238,046	389,912	
(4) Overhead & Profit	294	40,314	63,094	22,780	35,707	58,487	
Total	2,256	309,074	**483,720**	174,646	273,753	**448,399**	**0.93**
9. Reinforcement Bar (Unit: per kg)							
(1) Labor	0	1,494	1,494	0	1,196	1,196	
1) Skilled Labor	0	749	749	0	749	749	
2) Unskilled Labor	0	745	745	0	447	447	
(2) Materials	78	230	6,234	6,003	207	6,211	
(3) Equipment	0	8	19	11	7	18	
Sub-total	78	1,733	7,747	6,014	1,411	7,425	
(4) Overhead & Profit	12	260	1,162	902	212	1,114	
Total	89	1,993	**8,909**	6,916	1,623	**8,538**	**0.96**
10. Concrete Pile ø450 (Unit: per m)							
(1) Labor	0	23,809	23,809	0	18,917	18,917	
1) Skilled Labor	0	11,581	11,581	0	11,581	11,581	
2) Unskilled Labor	0	12,228	12,228	0	7,337	7,337	
(2) Materials	2,342	166,284	347,580	181,296	149,655	330,951	
(3) Equipment	58	3,398	7,917	4,519	3,058	7,577	
Sub-total	2,401	193,490	379,305	185,815	171,631	357,446	
(4) Overhead & Profit	360	29,023	56,896	27,872	25,745	53,617	
Total	2,761	222,513	**436,201**	213,688	197,375	**411,063**	**0.94**
11. Steel Sheet Pile (Unit: per m)							
(1) Labor	0	70,914	70,914	0	56,345	56,345	
1) Skilled Labor	0	34,493	34,493	0	34,493	34,493	
2) Unskilled Labor	0	36,421	36,421	0	21,853	21,853	
(2) Materials	6,977	495,274	1,035,263	539,989	445,746	985,735	
(3) Equipment	174	10,120	23,580	13,460	9,108	22,568	
Sub-total	7,151	576,308	1,129,757	553,449	511,200	1,064,649	
(4) Overhead & Profit	1,073	86,446	169,463	83,017	76,680	159,697	
Total	8,223	662,754	**1,299,220**	636,466	587,880	**1,224,346**	**0.94**
12. Bridge (Unit: per m)							
(1) Labor	0	818,589	818,589	0	640,436	640,436	
1) Skilled Labor	0	373,207	373,207	0	373,207	373,207	
2) Unskilled Labor	0	445,383	445,383	0	267,230	267,230	
(2) Materials	95,486	6,750,413	14,141,000	7,390,587	6,075,372	13,465,959	
(3) Equipment	3,541	206,247	480,357	274,110	185,623	459,732	
Sub-total	99,027	7,775,250	15,439,947	7,664,697	6,901,431	14,566,128	
(4) Overhead & Profit	14,854	1,166,288	2,315,992	1,149,704	1,035,215	2,184,919	
Total	113,881	8,941,538	**17,755,939**	8,814,401	7,936,646	**16,751,047**	**0.94**

Table C8.2.2 DAMAGEABLE PROPERTY AND FLOOD DAMAGE IN BENEFICIAL AREAS OF BBT RIVER IMPROVEMENT PROJECT UNDER PRESENT SOCIO-ECONOMIC CONDITIONS

Item	Return Period (Year)				
	2	5	10	20	50
I. Affected Population and Area					
1 Affected Population (1000)	7	11	17	20	26
2 Area Inundated (km^2)	24	26	28	29	32
II. Inundated Property					
1 Buildings (Nos)	2,076	3,317	5,213	5,891	7,890
a. Housing Units	1,823	2,882	4,470	5,040	6,713
b. Manufacturing	121	197	302	334	453
c. Trading	105	200	390	460	651
d. Educational	12	17	28	35	46
e. Medical	16	21	23	23	28
2 Agricultural Land (ha)	1,012	1,070	1,183	1,255	1,354
a. Irrigated Field	936	981	1,078	1,148	1,243
b. Rainfed Field	51	64	80	82	87
c. Fishpond	25	25	25	25	25
III. Estimated Value of Damaged Property (Rp. Million in Economic Terms)					
1. Direct Damage	13,626	19,432	30,239	43,863	68,003
(1) Facilities	6,414	10,402	18,487	28,740	46,971
a. Housing Units	3,468	5,402	10,914	18,368	30,115
b. Manufacturing	975	1,629	2,526	3,321	5,286
c. Trading	245	454	870	1,306	2,332
f. Education	1,091	1,875	2,656	3,732	6,078
g. Health	143	208	259	284	351
h. Other Facilities	491	833	1,262	1,729	2,809
(2) Agricultural Production	4,067	4,546	4,774	5,002	5,339
a. Irrigated Field	3,389	3,855	4,069	4,272	4,583
b. Rainfed Field	111	125	138	163	190
c. Fishpond	567	567	567	567	567
(3) Infrastructure	3,144	4,484	6,978	10,122	15,693
2. Indirect Damage	1,499	2,158	3,402	4,926	7,658
(1) Household	66	95	176	282	453
(2) Business Losses	71	120	202	258	404
(3) Other Damages	1,363	1,943	3,024	4,386	6,800
3. Total	15,125	21,591	33,640	48,789	75,660
IV. Annualized Damage Value under Present Conditions (Rp. Million in Economic Terms)					
				14,843	

Table C8.2.3 DAMAGEABLE PROPERTY AND FLOOD DAMAGE IN BENEFICIAL AREAS OF BBT RIVER IMPROVEMENT PROJECT UNDER FUTURE SOCIO-ECONOMIC CONDITIONS

Item	Return Period (Year)				
	2	5	10	20	50
I. Affected Population and Area					
1 Affected Population (1000)	8	13	21	23	31
2 Area Inundated (km^2)	24	26	28	29	32
II. Inundated Property					
1 Buildings (Nos)	2,463	3,936	6,187	6,992	9,364
a. Housing Units	2,163	3,420	5,305	5,982	7,966
b. Manufacturing	143	233	359	396	538
c. Trading	124	237	463	546	772
d. Educational	14	20	33	41	55
e. Medical	19	25	27	27	33
2 Agricultural Land (ha)	1,012	1,070	1,183	1,255	1,354
a. Irrigated Field	936	981	1,078	1,148	1,243
b. Rainfed Field	51	64	80	82	87
c. Fishpond	25	25	25	25	25
III. Estimated Value of Damaged Property (Rp. Million in Economic Terms)					
1. Direct Damage	32,788	50,009	83,737	126,411	202,187
(1) Facilities	20,364	33,022	58,690	91,241	149,120
a. Housing Units	11,011	17,151	34,650	58,314	95,606
b. Manufacturing	3,096	5,171	8,018	10,542	16,783
c. Trading	779	1,442	2,762	4,147	7,403
f. Education	3,465	5,952	8,432	11,848	19,295
g. Health	454	661	821	902	1,114
h. Other Facilities	1,559	2,645	4,007	5,488	8,919
(2) Agricultural Production	4,858	5,446	5,723	5,998	6,408
a. Irrigated Field	4,180	4,754	5,019	5,268	5,652
b. Rainfed Field	111	125	138	163	190
c. Fishpond	567	567	567	567	567
(3) Infrastructure	7,567	11,540	19,324	29,172	46,659
2. Indirect Damage	3,713	5,684	9,573	14,355	22,942
(1) Household	208	301	559	895	1,441
(2) Business Losses	225	382	641	819	1,282
(3) Other Damages	3,279	5,001	8,374	12,641	20,219
3. Total	36,501	55,693	93,310	140,765	225,129
IV. Annualized Damage Value under Future Conditions (Rp. Million in Economic Terms)					38,368

Table C8.2.4 DAMAGEABLE PROPERTY AND FLOOD DAMAGE IN BENEFICIAL AREAS OF TAMALATE FLOODWAY PROJECT UNDER PRESENT SOCIO-ECONOMIC CONDITIONS

Item	Return Period (Year)				
	2	5	10	20	50
I. Affected Population and Area					
1 Affected Population (1000)	1	2	5	10	19
2 Area Inundated (km^2)	1	1	1	2	4
II. Inundated Property					
1 Buildings (Nos)	232	546	1,505	3,148	5,909
a. Housing Units	190	444	1,260	2,590	4,812
b. Manufacturing	22	39	98	205	392
c. Trading	20	59	130	322	656
d. Educational	1	5	13	22	36
e. Medical	0	0	5	9	14
2 Agricultural Land (ha)	17	17	24	36	62
a. Irrigated Field	17	17	24	36	62
b. Rainfed Field	0	0	0	0	0
c. Fishpond	0	0	0	0	0
III. Estimated Value of Damaged Property (Rp. Million in Economic Terms)					
1. Direct Damage	513	1,830	4,907	16,030	42,731
(1) Facilities	347	1,348	3,692	12,205	32,676
a. Housing Units	100	775	2,106	6,946	20,350
b. Manufacturing	103	189	444	1,494	3,666
c. Trading	30	70	192	772	2,040
f. Education	73	219	667	2,065	4,437
g. Health	0	0	20	51	130
h. Other Facilities	41	96	264	876	2,054
(2) Agricultural Production	48	59	82	126	194
a. Irrigated Field	48	59	82	126	194
b. Rainfed Field	0	0	0	0	0
c. Fishpond	0	0	0	0	0
(3) Infrastructure	118	422	1,132	3,699	9,861
2. Indirect Damage	62	212	563	1,837	4,884
(1) Household	2	11	28	94	279
(2) Business Losses	10	18	44	139	332
(3) Other Damages	51	183	491	1,603	4,273
3. Total	576	2,042	5,470	17,867	47,615
IV. Annualized Damage Value under Present Conditions (Rp. Million in Economic Terms)					
				1,622	

Table C8.2.5 DAMAGEABLE PROPERTY AND FLOOD DAMAGE IN BENEFICIAL AREAS OF TAMALATE FLOODWAY PROJECT UNDER FUTURE SOCIO-ECONOMIC CONDITIONS

Item	Return Period (Year)				
	2	5	10	20	50
I. Affected Population and Area					
1 Affected Population (1000)	1	2	6	12	22
2 Area Inundated (km^2)	1	1	1	2	4
II. Inundated Property					
1 Buildings (Nos)	276	648	1,787	3,736	7,013
a. Housing Units	225	527	1,496	3,074	5,710
b. Manufacturing	26	46	116	244	466
c. Trading	23	70	154	382	778
d. Educational	1	5	15	26	42
e. Medical	0	0	5	11	16
2 Agricultural Land (ha)	17	17	24	36	62
a. Irrigated Field	17	17	24	36	62
b. Rainfed Field	0	0	0	0	0
c. Fishpond	0	0	0	0	0
III. Estimated Value of Damaged Property (Rp. Million in Economic Terms)					
1. Direct Damage	1,508	5,660	15,371	50,573	135,171
(1) Facilities	1,101	4,281	11,722	38,746	103,739
a. Housing Units	318	2,460	6,685	22,051	64,604
b. Manufacturing	326	601	1,408	4,742	11,639
c. Trading	94	222	610	2,452	6,475
f. Education	231	694	2,116	6,556	14,086
g. Health	0	0	63	162	412
h. Other Facilities	130	303	839	2,783	6,522
(2) Agricultural Production	59	73	101	156	239
a. Irrigated Field	59	73	101	156	239
b. Rainfed Field	0	0	0	0	0
c. Fishpond	0	0	0	0	0
(3) Infrastructure	348	1,306	3,547	11,671	31,193
2. Indirect Damage	186	657	1,768	5,800	15,459
(1) Household	5	33	90	300	888
(2) Business Losses	30	58	141	443	1,054
(3) Other Damages	151	566	1,537	5,057	13,517
3. Total	1,694	6,317	17,139	56,373	150,630
IV Annualized Damage Value under Future Conditions (Rp. Million in Economic Terms)					
				5,066	

Table C8.2.6 FINANCIAL COST AND ECONOMIC COST

(Unit: Rp. Billion)

Work Item	Financial Cost		Economic Cost	
	BBT River Improvement	Tamalate Floodway	BBT River Improvement	Tamalate Floodway
I. Direct Cost	**92.43**	**16.25**	**85.09**	**15.01**
1. Preparatory Works	8.40	1.48	7.56	1.33
2. Channel Works	38.97	9.01	35.87	8.35
(1) Earth Works	18.44	5.14	17.35	4.91
(2) Stone Works	10.04	3.09	8.95	2.74
(3) Concrete Works	7.82	0.00	7.17	0.00
(4) Sluice, Drainage Sluice Works	1.54	0.68	1.39	0.61
(5) Miscellaneous	1.14	0.10	1.02	0.09
3. Weir Works	29.99	0.83	27.63	0.75
(1) Earth Works	1.19	0.19	1.14	0.18
(2) Stone Works	0.47	0.54	0.42	0.47
(3) Concrete Works	8.68	0.08	8.20	0.08
(4) Pile Works	4.50	0.00	4.24	0.00
(5) Rubber Gate	13.73	0.00	12.35	0.00
(6) Miscellaneous	1.43	0.02	1.29	0.02
4. Appurtenant Works	11.07	4.23	10.42	3.95
(1) Bridge Works	10.54	3.26	9.95	3.08
(2) Waterway	0.00	0.85	0.00	0.76
(3) Miscellaneous	0.53	0.12	0.47	0.11
5. Miscellaneous Works	4.00	0.70	3.60	0.63
II. Land Acquisition and Compensation	**2.54**	**0.91**	**0.82**	**0.29**
1. Compensation (Houses)	0.79	0.27	0.71	0.24
2. Land Acquisition				
Residential Land	0.13	0.05	0.11	0.05
Agricultural Land	1.62	0.59	- *1	- *1
III. Administration Cost	**4.75**	**0.86**	**4.30**	**0.77**
IV. Engineering Service Cost	**9.24**	**1.63**	**9.24**	**1.63**
V. Physical Contingency	**10.90**	**1.96**	**9.94**	**1.77**
Total	**119.85**	**21.61**	**109.39**	**19.46**

Note: *1 Counted as negative benefit.

Table C8.2.7 ECONOMIC COSTS AND BENEFITS STREAM OF BBT RIVER IMPROVEMENT PROJECT UNDER PRESENT SOCIO-ECONOMIC CONDITIONS

(Unit: Rp. Billion)

	Year	Cost				Benefit			Balance
		Const-ruction	O&M		Total	Flood Control Benefit	Negative Benefit	Total	
			River Facilities	Rubber Gate					
1	2003	2.98			2.98		0.00	0.00	-2.98
2	2004	3.25			3.25		0.20	-0.20	-3.45
3	2005	31.37			31.37		0.43	-0.43	-31.80
4	2006	36.05	0.13		36.18	3.18	0.66	2.53	-33.65
5	2007	35.74	0.28		36.01	6.90	0.66	6.24	-29.77
6	2008		0.43		0.43	10.61	0.66	9.95	9.53
7	2009		0.43		0.43	10.61	0.66	9.95	9.53
8	2010		0.43		0.43	10.61	0.66	9.95	9.53
9	2011		0.43		0.43	10.61	0.66	9.95	9.53
10	2012		0.43	0.14	0.57	10.61	0.66	9.95	9.39
11	2013		0.43		0.43	10.61	0.66	9.95	9.53
12	2014		0.43		0.43	10.61	0.66	9.95	9.53
13	2015		0.43		0.43	10.61	0.66	9.95	9.53
14	2016		0.43		0.43	10.61	0.66	9.95	9.53
15	2017		0.43	0.14	0.57	10.61	0.66	9.95	9.39
16	2018		0.43		0.43	10.61	0.66	9.95	9.53
17	2019		0.43		0.43	10.61	0.66	9.95	9.53
18	2020		0.43		0.43	10.61	0.66	9.95	9.53
19	2021		0.43		0.43	10.61	0.66	9.95	9.53
20	2022		0.43	0.14	0.57	10.61	0.66	9.95	9.39
21	2023		0.43		0.43	10.61	0.66	9.95	9.53
22	2024		0.43		0.43	10.61	0.66	9.95	9.53
23	2025		0.43		0.43	10.61	0.66	9.95	9.53
24	2026		0.43		0.43	10.61	0.66	9.95	9.53
25	2027		0.43	0.14	0.57	10.61	0.66	9.95	9.39
26	2028		0.43		0.43	10.61	0.66	9.95	9.53
27	2029		0.43		0.43	10.61	0.66	9.95	9.53
28	2030		0.43		0.43	10.61	0.66	9.95	9.53
29	2031		0.43		0.43	10.61	0.66	9.95	9.53
30	2032		0.43	0.14	0.57	10.61	0.66	9.95	9.39
31	2033		0.43		0.43	10.61	0.66	9.95	9.53
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42	2044		0.43		0.43	10.61	0.66	9.95	9.53
43	2045		0.43		0.43	10.61	0.66	9.95	9.53
44	2046		0.43		0.43	10.61	0.66	9.95	9.53
45	2047		0.43	0.14	0.57	10.61	0.66	9.95	9.39
46	2048		0.43		0.43	10.61	0.66	9.95	9.53
47	2049		0.43		0.43	10.61	0.66	9.95	9.53
48	2050		0.43		0.43	10.61	0.66	9.95	9.53
49	2051		0.43		0.43	10.61	0.66	9.95	9.53
50	2052		0.43	0.14	0.57	10.61	0.66	9.95	9.39
51	2053		0.43		0.43	10.61	0.66	9.95	9.53
52	2054		0.43		0.43	10.61	0.66	9.95	9.53
53	2055		0.43		0.43	10.61	0.66	9.95	9.53
54	2056		0.43		0.43	10.61	0.66	9.95	9.53
55	2057		0.43	0.14	0.57	10.61	0.66	9.95	9.39
	B/C:	0.71		NPV:	-21.5	Rp. Billion		EIRR:	8.3%

Table C8.2.8 ECONOMIC COSTS AND BENEFITS STREAM OF BBT RIVER IMPROVEMENT PROJECT UNDER FUTURE SOCIO-ECONOMIC CONDITIONS

(Unit: Rp. Billion)

	Year	Cost				Benefit			Balance
		Const-ruction	O&M		Total	Flood Control Benefit	Negative Benefit	Total	
			River Facilities	Rubber Gate					
1	2003	2.98			2.98			0.00	-2.98
2	2004	3.25			3.25		0.21	-0.21	-3.45
3	2005	31.37			31.37		0.45	-0.45	-31.82
4	2006	36.05	0.13		36.18	4.23	0.70	3.53	-32.65
5	2007	35.74	0.28		36.01	9.71	0.71	9.00	-27.02
6	2008		0.43		0.43	15.82	0.72	15.09	14.67
7	2009		0.43		0.43	16.74	0.73	16.01	15.58
8	2010		0.43		0.43	17.73	0.74	16.98	16.56
9	2011		0.43		0.43	18.77	0.75	18.01	17.59
10	2012		0.43	0.14	0.57	19.87	0.76	19.10	18.54
11	2013		0.43		0.43	21.03	0.77	20.26	19.83
12	2014		0.43		0.43	22.27	0.79	21.48	21.05
13	2015		0.43		0.43	23.57	0.80	22.78	22.35
14	2016		0.43		0.43	24.95	0.81	24.15	23.72
15	2017		0.43	0.14	0.57	26.42	0.82	25.60	25.03
16	2018		0.43		0.43	27.97	0.83	27.14	26.71
17	2019		0.43		0.43	29.61	0.84	28.77	28.34
18	2020		0.43		0.43	31.35	0.85	30.49	30.07
19	2021		0.43		0.43	31.35	0.85	30.49	30.07
20	2022		0.43	0.14	0.57	31.35	0.85	30.49	29.93
21	2023		0.43		0.43	31.35	0.85	30.49	30.07
22	2024		0.43		0.43	31.35	0.85	30.49	30.07
23	2025		0.43		0.43	31.35	0.85	30.49	30.07
24	2026		0.43		0.43	31.35	0.85	30.49	30.07
25	2027		0.43	0.14	0.57	31.35	0.85	30.49	29.93
26	2028		0.43		0.43	31.35	0.85	30.49	30.07
27	2029		0.43		0.43	31.35	0.85	30.49	30.07
28	2030		0.43		0.43	31.35	0.85	30.49	30.07
29	2031		0.43		0.43	31.35	0.85	30.49	30.07
30	2032		0.43	0.14	0.57	31.35	0.85	30.49	29.93
31	2033		0.43		0.43	31.35	0.85	30.49	30.07
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42	2044		0.43		0.43	31.35	0.85	30.49	30.07
43	2045		0.43		0.43	31.35	0.85	30.49	30.07
44	2046		0.43		0.43	31.35	0.85	30.49	30.07
45	2047		0.43	0.14	0.57	31.35	0.85	30.49	29.93
46	2048		0.43		0.43	31.35	0.85	30.49	30.07
47	2049		0.43		0.43	31.35	0.85	30.49	30.07
48	2050		0.43		0.43	31.35	0.85	30.49	30.07
49	2051		0.43		0.43	31.35	0.85	30.49	30.07
50	2052		0.43	0.14	0.57	31.35	0.85	30.49	29.93
51	2053		0.43		0.43	31.35	0.85	30.49	30.07
52	2054		0.43		0.43	31.35	0.85	30.49	30.07
53	2055		0.43		0.43	31.35	0.85	30.49	30.07
54	2056		0.43		0.43	31.35	0.85	30.49	30.07
55	2057		0.43	0.14	0.57	31.35	0.85	30.49	29.93
	B/C:	1.54		NPV:	39.4	Rp. Billion		EIRR:	17.0%

Table C8.2.9 ECONOMIC COSTS AND BENEFITS STREAM OF TAMALATE FLOODWAY PROJECT UNDER PRESENT SOCIO-ECONOMIC CONDITIONS

(Unit: Rp. Billion)

		Cost			Benefit			Balance
	Year	Construction	O&M	Total	Flood Control Benefit	Negative Benefit	Total	
1	2005	0.49		0.49		0.00	0.00	-0.49
2	2006	0.59		0.59		0.07	-0.07	-0.66
3	2007	5.50		5.50		0.16	-0.16	-5.66
4	2008	6.32	0.02	6.34	0.49	0.24	0.25	-6.09
5	2009	6.21	0.05	6.26	1.05	0.24	0.82	-5.44
6	2010		0.07	0.07	1.62	0.24	1.38	1.31
7	2011		0.07	0.07	1.62	0.24	1.38	1.31
8	2012		0.07	0.07	1.62	0.24	1.38	1.31
9	2013		0.07	0.07	1.62	0.24	1.38	1.31
10	2014		0.07	0.07	1.62	0.24	1.38	1.31
11	2015		0.07	0.07	1.62	0.24	1.38	1.31
12	2016		0.07	0.07	1.62	0.24	1.38	1.31
13	2017		0.07	0.07	1.62	0.24	1.38	1.31
14	2018		0.07	0.07	1.62	0.24	1.38	1.31
15	2019		0.07	0.07	1.62	0.24	1.38	1.31
16	2020		0.07	0.07	1.62	0.24	1.38	1.31
17	2021		0.07	0.07	1.62	0.24	1.38	1.31
18	2022		0.07	0.07	1.62	0.24	1.38	1.31
19	2023		0.07	0.07	1.62	0.24	1.38	1.31
20	2024		0.07	0.07	1.62	0.24	1.38	1.31
21	2025		0.07	0.07	1.62	0.24	1.38	1.31
22	2026		0.07	0.07	1.62	0.24	1.38	1.31
23	2027		0.07	0.07	1.62	0.24	1.38	1.31
24	2028		0.07	0.07	1.62	0.24	1.38	1.31
25	2029		0.07	0.07	1.62	0.24	1.38	1.31
26	2030		0.07	0.07	1.62	0.24	1.38	1.31
27	2031		0.07	0.07	1.62	0.24	1.38	1.31
28	2032		0.07	0.07	1.62	0.24	1.38	1.31
29	2033		0.07	0.07	1.62	0.24	1.38	1.31
30	2034		0.07	0.07	1.62	0.24	1.38	1.31
31	2035		0.07	0.07	1.62	0.24	1.38	1.31
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42	2046		0.07	0.07	1.62	0.24	1.38	1.31
43	2047		0.07	0.07	1.62	0.24	1.38	1.31
44	2048		0.07	0.07	1.62	0.24	1.38	1.31
45	2049		0.07	0.07	1.62	0.24	1.38	1.31
46	2050		0.07	0.07	1.62	0.24	1.38	1.31
47	2051		0.07	0.07	1.62	0.24	1.38	1.31
48	2052		0.07	0.07	1.62	0.24	1.38	1.31
49	2053		0.07	0.07	1.62	0.24	1.38	1.31
50	2054		0.07	0.07	1.62	0.24	1.38	1.31
51	2055		0.07	0.07	1.62	0.24	1.38	1.31
52	2056		0.07	0.07	1.62	0.24	1.38	1.31
53	2057		0.07	0.07	1.62	0.24	1.38	1.31
54	2058		0.07	0.07	1.62	0.24	1.38	1.31
55	2059		0.07	0.07	1.62	0.24	1.38	1.31
	B/C:	0.55	NPV:	-5.8	Rp. Billion		EIRR:	6.3%

Table C8.2.10 ECONOMIC COSTS AND BENEFITS STREAM OF TAMALATE FLOODWAY PROJECT UNDER FUTURE SOCIO-ECONOMIC CONDITIONS

(Unit: Rp. Billion)

		Cost			Benefit			Balance
	Year	Construction	O&M	Total	Flood Control Benefit	Negative Benefit	Total	
1	2005	0.49		0.49		0.00	0.00	-0.49
2	2006	0.59	0.00	0.59	0.00	0.08	-0.08	-0.66
3	2007	5.50	0.00	5.50	0.00	0.17	-0.17	-5.67
4	2008	6.32	0.02	6.34	0.74	0.26	0.48	-5.86
5	2009	6.21	0.05	6.26	1.70	0.27	1.44	-4.82
6	2010		0.07	0.07	2.78	0.27	2.51	2.44
7	2011		0.07	0.07	2.95	0.27	2.68	2.61
8	2012		0.07	0.07	3.14	0.28	2.86	2.78
9	2013		0.07	0.07	3.33	0.28	3.05	2.97
10	2014		0.07	0.07	3.54	0.29	3.25	3.18
11	2015		0.07	0.07	3.75	0.29	3.46	3.39
12	2016		0.07	0.07	3.99	0.29	3.69	3.62
13	2017		0.07	0.07	4.23	0.30	3.93	3.86
14	2018		0.07	0.07	4.49	0.30	4.19	4.12
15	2019		0.07	0.07	4.77	0.31	4.47	4.39
16	2020		0.07	0.07	5.07	0.31	4.76	4.68
17	2021		0.07	0.07	5.07	0.31	4.76	4.68
18	2022		0.07	0.07	5.07	0.31	4.76	4.68
19	2023		0.07	0.07	5.07	0.31	4.76	4.68
20	2024		0.07	0.07	5.07	0.31	4.76	4.68
21	2025		0.07	0.07	5.07	0.31	4.76	4.68
22	2026		0.07	0.07	5.07	0.31	4.76	4.68
23	2027		0.07	0.07	5.07	0.31	4.76	4.68
24	2028		0.07	0.07	5.07	0.31	4.76	4.68
25	2029		0.07	0.07	5.07	0.31	4.76	4.68
26	2030		0.07	0.07	5.07	0.31	4.76	4.68
27	2031		0.07	0.07	5.07	0.31	4.76	4.68
28	2032		0.07	0.07	5.07	0.31	4.76	4.68
29	2033		0.07	0.07	5.07	0.31	4.76	4.68
30	2034		0.07	0.07	5.07	0.31	4.76	4.68
31	2035		0.07	0.07	5.07	0.31	4.76	4.68
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42	2046		0.07	0.07	5.07	0.31	4.76	4.68
43	2047		0.07	0.07	5.07	0.31	4.76	4.68
44	2048		0.07	0.07	5.07	0.31	4.76	4.68
45	2049		0.07	0.07	5.07	0.31	4.76	4.68
46	2050		0.07	0.07	5.07	0.31	4.76	4.68
47	2051		0.07	0.07	5.07	0.31	4.76	4.68
48	2052		0.07	0.07	5.07	0.31	4.76	4.68
49	2053		0.07	0.07	5.07	0.31	4.76	4.68
50	2054		0.07	0.07	5.07	0.31	4.76	4.68
51	2055		0.07	0.07	5.07	0.31	4.76	4.68
52	2056		0.07	0.07	5.07	0.31	4.76	4.68
53	2057		0.07	0.07	5.07	0.31	4.76	4.68
54	2058		0.07	0.07	5.07	0.31	4.76	4.68
55	2059		0.07	0.07	5.07	0.31	4.76	4.68
	B/C:	1.44	NPV:	5.7	Rp. Billion		EIRR:	16.2%

Table C8.2.11 ECONOMIC COSTS AND BENEFITS STREAM OF ENTIRE PRIORITY PROJECTS UNDER PRESENT SOCIO-ECONOMIC CONDITIONS

(Unit: Rp. Billion)

	Year	Cost				Benefit			Balance
		Const-ruction	O&M		Total	Flood Control Benefit	Negative Benefit	Total	
			River Facilities	Rubber Gate					
1	2003	2.98			2.98			0.00	-2.98
2	2004	3.25			3.25		0.20	-0.20	-3.45
3	2005	31.86			31.86		0.43	-0.43	-32.29
4	2006	36.64	0.13		36.77	3.18	0.73	2.45	-34.31
5	2007	41.24	0.28		41.52	6.90	0.81	6.08	-35.43
6	2008	6.32	0.45		6.77	11.10	0.90	10.20	3.43
7	2009	6.21	0.47		6.68	11.67	0.90	10.77	4.09
8	2010		0.50		0.50	12.23	0.90	11.34	10.84
9	2011		0.50		0.50	12.23	0.90	11.34	10.84
10	2012		0.50	0.14	0.64	12.23	0.90	11.34	10.70
11	2013		0.50		0.50	12.23	0.90	11.34	10.84
12	2014		0.50		0.50	12.23	0.90	11.34	10.84
13	2015		0.50		0.50	12.23	0.90	11.34	10.84
14	2016		0.50		0.50	12.23	0.90	11.34	10.84
15	2017		0.50	0.14	0.64	12.23	0.90	11.34	10.70
16	2018		0.50		0.50	12.23	0.90	11.34	10.84
17	2019		0.50		0.50	12.23	0.90	11.34	10.84
18	2020		0.50		0.50	12.23	0.90	11.34	10.84
19	2021		0.50		0.50	12.23	0.90	11.34	10.84
20	2022		0.50	0.14	0.64	12.23	0.90	11.34	10.70
21	2023		0.50		0.50	12.23	0.90	11.34	10.84
22	2024		0.50		0.50	12.23	0.90	11.34	10.84
23	2025		0.50		0.50	12.23	0.90	11.34	10.84
24	2026		0.50		0.50	12.23	0.90	11.34	10.84
25	2027		0.50	0.14	0.64	12.23	0.90	11.34	10.70
26	2028		0.50		0.50	12.23	0.90	11.34	10.84
27	2029		0.50		0.50	12.23	0.90	11.34	10.84
28	2030		0.50		0.50	12.23	0.90	11.34	10.84
29	2031		0.50		0.50	12.23	0.90	11.34	10.84
30	2032		0.50	0.14	0.64	12.23	0.90	11.34	10.70
31	2033		0.50		0.50	12.23	0.90	11.34	10.84
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42	2045		0.50		0.50	12.23	0.90	11.34	10.84
43	2046		0.50		0.50	12.23	0.90	11.34	10.84
44	2047		0.50	0.14	0.50	12.23	0.90	11.34	10.84
45	2048		0.50		0.50	12.23	0.90	11.34	10.84
46	2049		0.50		0.50	12.23	0.90	11.34	10.84
47	2050		0.50		0.50	12.23	0.90	11.34	10.84
48	2051		0.50		0.50	12.23	0.90	11.34	10.84
49	2052		0.50	0.14	0.64	12.23	0.90	11.34	10.70
50	2053		0.50		0.50	12.23	0.90	11.34	10.84
51	2054		0.50		0.50	12.23	0.90	11.34	10.84
52	2055		0.50		0.50	12.23	0.90	11.34	10.84
53	2056		0.50		0.50	12.23	0.90	11.34	10.84
54	2057		0.50	0.14	0.64	12.23	0.90	11.34	10.70
55	2058		0.50		0.50	12.23	0.90	11.34	10.84
56	2059		0.50		0.50	12.23	0.90	11.34	10.84

B/C: 0.69 NPV: -26.1 Rp. Billion EIRR: 8.1%

Table C8.2.12 ECONOMIC COSTS AND BENEFITS STREAM OF ENTIRE PRIORITY PROJECTS UNDER FUTURE SOCIO-ECONOMIC CONDITIONS

(Unit: Rp. Billion)

	Year	Cost				Benefit			
		Const-ruction	O&M		Total	Flood Control Benefit	Negative Benefit	Total	Balance
			River Facilities	Rubber Gate					
1	2003	2.98			2.98			0.00	-2.98
2	2004	3.25			3.25		0.21	-0.21	-3.45
3	2005	31.86			31.86		0.45	-0.45	-32.31
4	2006	36.64	0.13		36.77	4.23	0.78	3.45	-33.31
5	2007	41.24	0.28		41.52	9.71	0.88	8.83	-32.69
6	2008	6.32	0.45		6.77	16.56	0.99	15.57	8.80
7	2009	6.21	0.47		6.68	18.45	1.00	17.45	10.77
8	2010		0.50		0.50	20.51	1.01	19.49	18.99
9	2011		0.50		0.50	21.72	1.03	20.69	20.19
10	2012		0.50	0.14	0.64	23.00	1.04	21.96	21.32
11	2013		0.50		0.50	24.36	1.06	23.31	22.81
12	2014		0.50		0.50	25.80	1.07	24.73	24.23
13	2015		0.50		0.50	27.33	1.09	26.24	25.74
14	2016		0.50		0.50	28.94	1.10	27.84	27.34
15	2017		0.50	0.14	0.64	30.65	1.12	29.54	28.89
16	2018		0.50		0.50	32.46	1.13	31.33	30.83
17	2019		0.50		0.50	34.38	1.15	33.23	32.73
18	2020		0.50		0.50	36.41	1.16	35.25	34.75
19	2021		0.50		0.50	36.41	1.16	35.25	34.75
20	2022		0.50	0.14	0.64	36.41	1.16	35.25	34.61
21	2023		0.50		0.50	36.41	1.16	35.25	34.75
22	2024		0.50		0.50	36.41	1.16	35.25	34.75
23	2025		0.50		0.50	36.41	1.16	35.25	34.75
24	2026		0.50		0.50	36.41	1.16	35.25	34.75
25	2027		0.50	0.14	0.64	36.41	1.16	35.25	34.61
26	2028		0.50		0.50	36.41	1.16	35.25	34.75
27	2029		0.50		0.50	36.41	1.16	35.25	34.75
28	2030		0.50		0.50	36.41	1.16	35.25	34.75
29	2031		0.50		0.50	36.41	1.16	35.25	34.75
30	2032		0.50	0.14	0.64	36.41	1.16	35.25	34.61
31	2033		0.50		0.50	36.41	1.16	35.25	34.75
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42	2045		0.50		0.50	36.41	1.16	35.25	34.75
43	2046		0.50		0.50	36.41	1.16	35.25	34.75
44	2047		0.50	0.14	0.64	36.41	1.16	35.25	34.61
45	2048		0.50		0.50	36.41	1.16	35.25	34.75
46	2049		0.50		0.50	36.41	1.16	35.25	34.75
47	2050		0.50		0.50	36.41	1.16	35.25	34.75
48	2051		0.50		0.50	36.41	1.16	35.25	34.75
49	2052		0.50	0.14	0.64	36.41	1.16	35.25	34.61
50	2053		0.50		0.50	36.41	1.16	35.25	34.75
51	2054		0.50		0.50	36.41	1.16	35.25	34.75
52	2055		0.50		0.50	36.41	1.16	35.25	34.75
53	2056		0.50		0.50	36.41	1.16	35.25	34.75
54	2057		0.50	0.14	0.64	36.41	1.16	35.25	34.61
55	2058		0.50		0.50	36.41	1.16	35.25	34.75
56	2059		0.50		0.50	36.41	1.16	35.25	34.75

B/C: 1.53 NPV: 44.0 Rp. Billion EIRR: 16.9%

Table C8.2.13 SENSITIVITY TEST OF BBT RIVER IMPROVEMENT PROJECT

		Benefit		
		0%	-5%	-10%
EIRR (%)				
Cost	0%	17.0%	16.3%	15.6%
	5%	16.4%	15.7%	15.0%
	10%	15.8%	15.1%	14.5%
B/C				
Cost	0%	1.54	1.46	1.39
	5%	1.47	1.39	1.32
	10%	1.40	1.33	1.26
NPV (Rp. Billion)				
Cost	0%	39.4	33.8	28.2
	5%	35.8	30.2	26.5
	10%	32.1	26.5	20.9

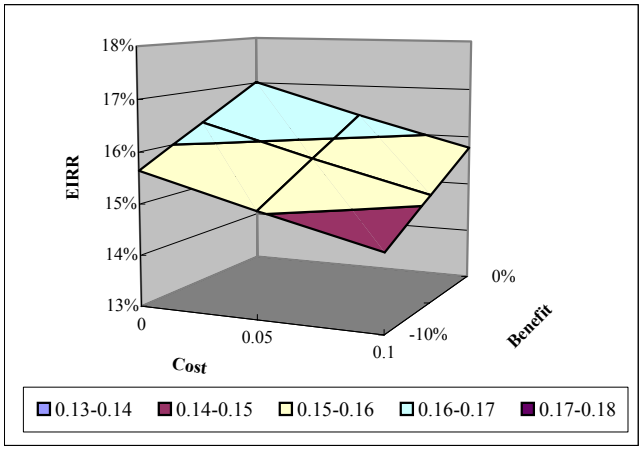

Table C8.2.14 SENSITIVITY TEST OF TAMALATE FLOODWAY PROJECT

		Benefit		
		0%	-5%	-10%
EIRR (%)				
Cost	0%	16.2%	15.5%	14.9%
	5%	15.6%	14.9%	14.3%
	10%	15.0%	14.4%	13.8%
B/C				
Cost	0%	1.44	1.37	1.30
	5%	1.37	1.31	1.24
	10%	1.31	1.25	1.18
NPV (Rp. Billion)				
Cost	0%	5.7	4.7	3.8
	5%	5.0	4.1	3.2
	10%	4.4	3.5	2.5

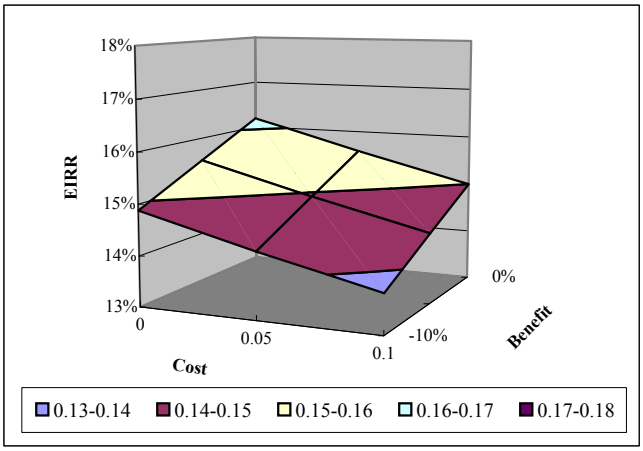

Table C8.2.15 SENSITIVITY TEST OF ENTIRE PRIORITY PROJECT

		Benefit		
		0%	-5%	-10%
EIRR (%)				
Cost	0%	16.9%	16.3%	15.6%
	5%	16.3%	15.6%	15.0%
	10%	15.7%	15.1%	14.4%
B/C				
Cost	0%	1.53	1.45	1.38
	5%	1.46	1.38	1.31
	10%	1.39	1.32	1.25
NPV (Rp. Billion)				
Cost	0%	44.0	37.7	31.3
	5%	39.9	33.5	27.1
	10%	35.7	29.4	23.0

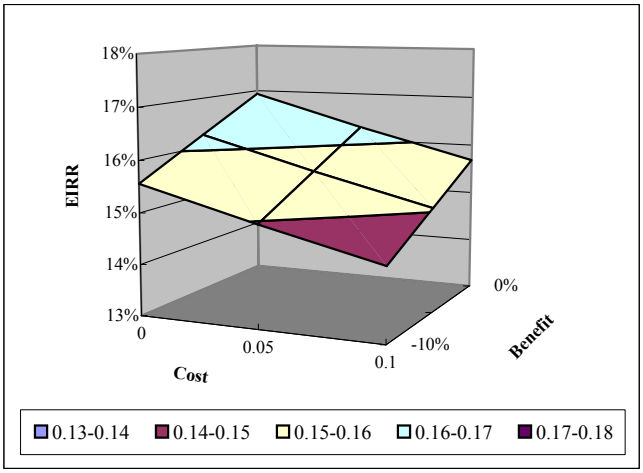

Table C8.4.1 ACTIVITIES NEEDED TO CONDUCT ENVIRONMENTAL IMPACT STUDY (1/3)

(Provided by Ministry Decree No.17/MENLH/02/2000)

No.	ACTIVITIES	SCALE / AREA
I. MINING AND ENERGY SECTOR		
A.	**General Mining**	
1	License Area	>= 5000 ha and/or
	Open Mining Area	>= 100 ha (cumulative/year)* and/or
2	Production and Exploitation Phases	
	a. Coal	>=1.200,000 ton/year (ROM)**
	b. Primary Ores	>=1.000,000 ton/year (ROM)
	c. Secondary Ores	>=1.200,000 ton/year (ROM)
	d. Non-metallic minerals (C Group mined Products)	>=300,000 m/year (ROM)
	e. Radioactive materials including mining processing and purification	All
	f. Lead materials including mining processing and purification	All
3	Sea (Offshore) Mining	All
4	Submarine Tailing Disposal	All
5	Ore`s Processing Through "Cyanide Process"	All
	* To prevent too wide land clearing	
	** Raw of Material	
B.	**Electricity**	
1	Transmission	>=150 KV
2	PLTD/PITG/PLTU/PLTGU	>=100 MW
3	Electric Hydro Power with Dam Height/	>=15 m or
	Electric Electric Hydro Power with Puddle Area	>=200 ha
4	Geothermal electricity generating stations	>=55 MW
5	Nuclear Power electricity generating stations	All
6	Other types of electricity generating stations	>=55 MW
C.	**Oil and Natural Gas**	
1	Oil and Natural Gas Exploitation and Land Production Improvement	Oil Field >= 5000 BPOD Gas Field >= 30 MMSCFD
2	Oil and Natural Exploitation and Sea Production Improvement	Oil Field >= 15000 BPOD Gas Field >= 90 MMSCFD
3	Oil and Natural Gas Transmission (Excluding Pipes Installation)	Land and Sea >= 100 km Pipe's diameter >= 20 inches
4	Oil and Natural Gas Refinery (Including Visitor Facilities)	Capacity of >= 50 MMSCFD
5	Used Lubricant Oil Refinery (Including Visitor Facilities)	Capacity of >= 10.000 ton/year
D.	**Environmental System Geology**	
1	Ground Water Exploitation (either Shallow or Deep Soil Well)	>=50 lt./day (from 1 well/ or from 5 wells in < 10 ha area for commercial purposes)
II. COMMERCE AND INDUSTRIAL SECTOR		
1	Cement Industry	All
2	Pulp Industry	All
3	Upstream Petrochemical Industry	All
4	Steel and Iron Smelting	All
5	Lead (Pb) Smelting	All (Including recycling industry)
6	Copper (Cu) Industry	All (Raw Material from Copper Concentration)
7	Aluminum manufacture	All (Raw Material from Alumina)
8	Industrial Estate	All (Including integrated industrial Estate)
9	Dock Industry using a Graving System	>= 4000 DWT
10	Aircraft Industry	All
11	Weapon, Munitions, and Explosive Material Industry	All
12	Dry Cell (battery) Industry	All
13	Wet Battery Industry (Electrical Accumulator)	All
14	Trade and shopping center/	Area > = 5 ha or Building area > = 20,000 m^2
15	Other Industry Activities	Arial Use : Urban : Metropolitan >= 10 ha Big Cities >= 20 ha Small Cities >= 30 ha Rural >= 50 ha

Table C8.4.1 ACTIVITIES NEEDED TO CONDUCT ENVIRONMENTAL IMPACT STUDY (2/3)

(Provided by Ministry Decree No.17/MENLH/02/2000)

No.	ACTIVITIES	SCALE / AREA
III.	**TRANSMIGRATION SECTOR**	
1	Transmigration Settlement Development Plan	>= 4500 ha
IV.	**TOURISM AND ARTS SECTOR**	
1	Recreation Park	Area > = 100 ha
2	Tourism Area	All
V.	**COMMUNICATION SECTOR**	
1	Railway Network Construction	Length > = 25 Km
2	Station Construction	Big Class Station and/Class I Station
3	Subway	All
4	River Dredging	Volume > = 500,000 m^3
5	Subway	
	a. Port	Length > 200 m; or Area > 6,000 m^2 with Massive construction
	b. Break Water/*Talud*	Length > = 200 m or Area > = 5 ha
	c. Port's supporting infrastructure facilities including terminal, warehouse, container, etc)	>= 200 m
	d. Single Mooring Buoy	For Ship >= 10.000 DWT
6	Dredging	
	a. Capital Dredging	Volume > = 250,000 m^3
	b. Maintenance Dredging	Volume > = 500,000 m^3
7	Reclamation	Area > = 25 ha or Volume > = 5.000,000 m^3
8	Dumping Activities	Volume > = 250,000 m^3
9	Development of New Airport with its Facilities	All dimension (Class I up to IV)
10	Development of Airport with its Facilities	Class I, II, III based on its Development Plan
11	Airport Expansion with/or its Facilities	Community Resettlement > = 500 family or Area E > = 100 ha Land Exemption Area >= 100 ha Shore reclamation Area > = 25 ha, or volume > = 10,000 m^3 Hill and Airport Land Dredging : volume 500.000 m^3
12	Fishery Port Dredging and/or Shipping Line in Fishery Port with criteria	
	a. Dredging volume	>= 500.000 m^3; or
	b. Dredging Depth	>= 4 m LWS
13	Shore Dredging/Reclamation in the Fishery Port	Area >= 25 ha
VI.	**DEFENSE and SECURITY SECTOR**	
1	Development of Central and Regional Munitions Storehouses	All
2	Development of Navy Base	A and B Classes
3	Development of Air Forced Base	A and B Classes
4	Development of Combat Training Center	Area > = 10,000 ha
5	Development of Army, Navy, Air Force and Police Shooting Fields	Area > = 10,000 ha
VII.	**NUCLEAR DEVELOPMENT SECTOR**	
1	Development and Operation of Nuclear Reactor	
	a. Power Reactor	All installation
	b. Research Reactor	> = 100 KW
2	Development and Operation of Non-Reactor Nuclear Installation	
	a. Nuclear Fuel Manufacture	Production > 50 ton elements/year
	b. Uranium Processing and Refining	Production > = 100 ton yellow cake/year
	c. Radioactive waster Processing	All installation
	d. Irradiator (Category II up to IV)	Activity Source >= 37.000 TBq (100.000 Ci)
	e. Radioisotope Production	All installation
VIII.	**AGRICULTURE SECTOR**	
1	Establishment of Wet Rice Field in the Forested Area	Area > = 1,500 ha
2	Annual Food and Horticultural Crop Cultivation with or without Processing Units	Area > = 4,500 ha
3	Perennial Food and Horticultural Crop Cultivation with or without Processing Units	Area > = 10,000 ha
4	Fish/Shrimp Pond Farm with or without Processing Units	Area > = 50 ha
5	Fishery Facility Development Plan (i.e., Public Fishery Port) with criteria :	
	Length of Port	>= 300 m; or
	Having a Fishery Industrial Area	Area >= 10 ha; or
	Depth of Port	>= 4 m LWS

Table C8.4.1 ACTIVITIES NEEDED TO CONDUCT ENVIRONMENTAL IMPACT STUDY (3/3)

(Provided by Ministry Decree No.17/MENLH/02/2000)

No.	ACTIVITIES	SCALE / AREA
IX. FORESTRY AND PLANTATION SECTOR		
1	Forest Concession (HPH)	All
2	Sago Forest Concession	All
3	Bamboo Forest Concession	All
4	Industrial Forest Concession	>= 10,000 ha or with Areas of <=10,000 ha
		located just next to the protected area
5	Annual Food and Horticultural Crop Cultivation with or without Processing Units	Area > = 4,500 ha
6	Perennial Food and Horticultural Crop Cultivation with or without Processing Units	Area > = 10,000 ha
X. PUBLIC WORK		
1	Dam construction	Height > = 15 m, or
		Reservoir area > = 200 ha
2	Irrigation	
	a. New Development	Area > = 2,000 ha
	b. Expansion	Area > = 1,000 ha
	d. Wet Rice Field Establishment	Area > = 500 ha
3	Swamp Expansion	
	Swamp reclamation	Area > = 2,000 ha
4	Beach Pacification and River Outlet Improvement	Length > = 500 m
5	River Normalization and Canalization	
	a. Big/Metropolitan City *	Length > = 10 km or Area > = 5 ha
	b. Medium City *	Length > = 15 km
	c. Village *	Length > = 20 km
	d. River Dredging Volume and Dumping Activities	>= 500.000 m^3
6	Highway Development	All
	Fly-over and Subway Development	2 Km
7	Road Upgrading and Widening and Construction	
	a. Big/Metropolitan City	
	Length	> = 10 km
	or Area	> = 10 ha
	b. Medium City	
	Length	> = 30 km
	or Area	> = 15 ha
	c. Rural, Length	> = 50 km
8	Garbage	
	a. Controlled Landfill or Sanitary Landfill Systen	Area >= 40 ha
	b. Landfill Site in the Estuary Area	Area >= 25 ha
	c. Transfer System Development	Capacity of >= 1000
9	Housing	
	a. Medium and small city	Area > = 200 ha
	b. Big City	Area > = 100 ha
	c. Metropolitan City	Area > = 50 ha
10	a. IPLT and /or IPAL	Area > = 3 ha
	b. Wastewater Pipeline System Construction	Service Area > = 500 Ha
11	Settlement Sewage System	
	a. Big/Metropolitan city	Size > = 5 m or Length > = 3 km
	Wide	> = 5 km
	Length	> = 10 km
	b. Medium city	
	Wide	> = 10 km
	Length	> = 15 km
12	Clean water in the big city	
	a. Distribution Network Development	Service Area > = 1,500 ha
	b. Transmission Network Development	> = 25 km
13	Water Intake from Lake, River, Water Spring or Other Water Sources	Flow rate > = 500 l/second
XII. TOXIC AND HAZARDOUS MATERIAL MANAGEMENT SECTOR		
1	Toxic and Hazardous Material Waste Collection, Use, Process and/or Dumping as a main activity	All activities characterized as public service, commercial, permanent that process all kind of the waste (excluding used lubricant collection, used oil and slop oil, lead use, and flux solder).

* Big/Metropolitan City is defined based on its area: >= 5,000 ha.
Medium City is defined based on its area: >= 1,000 ha, but < 5,000 ha.
Village is defined based on its area: < 1,000 ha.

Table C8.4.2 DESCRIPTIONS OF MAJOR COMPONENTS OF THE PRIORITY PROJECTS

Project	Major components	Structure and texture	Dimension				Area of land	Other characteristics
			length *	width (m)	depth (m)	height (m)		
1) Tapodu River Improvement with Tapodu Gate	Tapodu river channel	With bank protection and dike	11.6 km	118 - 132	4.5 - 4.9	-	32.27 ha	Existing stream are remained as drainage channels.
	Control gate	Rubber dam	15 m	78	-	2.0		
	River dike	Earth dike	3.8 km	4	-	1.3 - 2.5		
	Bank protection	Concrete	30 m	-	4.1	-		
	Drainage channels	Open channel made of concrete	1.0 km (left) 0.4 km (right)	4	1.8	-		Installed along and drained into Tapodu river.
	Dike along Lake Limboto	Earth dike	3.8 km	4	-	2.4 (max.)	3.68 ha	
2) Tamalate Floodway	Tamalate floodway	Partly bank protected	1.8 km	29	3.8	-	22.37 ha	
	Tamalate weir	Concrete on river bed	15 m	12 - 14	-	0.5		With sluice gate.
	River dike	Earth dike (partly)	1.4 km	3	-	1.9 (max.)		
	Bank protection	Concrete (partly)	1.4 km	-	3.2	-		
3) River improvement (Bolango and Siendeng)	Widening	-	2.3 km	10 (max.)	3.8 or 4.0	-	3.78 ha	
	River dike	Earth dike / Concrete dike	2.3 km	3	-	2.4 (max.)		
	Bank protection	Concrete / Gabion	2.5 km	-	3.2	-		
	Tenda Cutoff channel	Bank protected with gabion or earth dike	0.15 km	24	4.2	-		
4) River improvement (Lower Bone)	Widening	-	-	-	-	-	None	
	River dike	Earth dike	-	-	-	-		
	Bank protection	Gabion	0.6 km	-	3.0	-		
5) Realignment of Alo-Pohu and Biyonga, and sediment trap	Realignment (Alo-Pohu)	Without bank protection	1.6 km	20 (river bed)	0 - 1.9	-	7.02 ha	
	Realignment (Biyonga)	Without bank protection	1.0 km	10 (river bed)	0 - 0.5	-		
	Sediment trap	Bamboo net	2.5 km	-	-	1.0 - 2.0		

* : Total length of left and right banks.

Table C8.4.3 IMPACT ACTIVITIES INVOLVED IN THE PRIORITY PROJECTS

Project component	*Phase**	*Main impact activities involved*
Tapodu river improvement with Tapodu gate.	PC	• Land acquisition for project site. • Land acquisition for relocation site. • Relocation site development. • Residential transfer and change of living environment and possibility of vocational change.
	C	• Vegetation clearance. • Excavation, widening and dredging for river channel. • Embankment for dike construction. • Construction of control gate, equipped with rubber dam. • Bank protection with gabion and concrete. • Bridge construction. • Mobilization of machinery and materials, etc. • Employment of local people as construction workers.
	O/M	• Water level control at Tapodu gate, including sluice gates of drainage channels. • Existence of constructed structures.
Tamalate floodway.	PC	• Same as the case of Tapodu river improvement.
	C	• Construction of Tamalate weir, equipped with sluice gate. • The rest is the same as Tapodu river improvement.
	O/M	• Run-off control at Tamalate weir. • Existence of constructed structures.
River improvement on Bolango and Bone rivers.	PC	• Same as the case of Tapodu river improvement, but in smaller magnitude.
	C	• Same as Tapodu river improvement except for the construction of the control gate.
	O/M	• Existence of constructed structures.
Realignment of Alo-Pohu and Biyonga.	PC	• Same as the case of Tapodu river improvement, but in smaller magnitude.
	C	• Vegetation clearance. • Excavation, widening and dredging for river channel. • Embankment for dike construction. • Mobilization of machinery and materials, etc. • Employment of local people as construction workers.
	O/M	• Existence of realignment channels.
Sediment trap.	C	• Construction of sediment trap. • Mobilization of machinery and materials, etc. • Employment of local people as construction workers.
	O/M	• Existence of sediment trap. • Utilization of sediment load within the sediment trap.

* PC: Pre-Construction phase, C: Construction phase, O/M: Operation and Maintenance phase.

Table C8.4.4 METHODOLOGY OF IMPACT ASSESSMENT ON NATURAL ENVIRONMENTAL COMPONENT

Environmental component	*Impact Prediction*	*Impact Evaluation/Criteria*
1. Geology (erosion and sedimentation)	• Analogical method based on function, dimension and design of structural interventions.	• Method based on the magnitude and nature of the impact.
2. Groundwater and land subsidence	• Analogical method based on the boring data and calculation of impact area using simple estimation formula.	• Method based on the magnitude and nature of the impact on due consideration of compensatory measure.
3. Water regime	• Quantitative analysis based on the run-off simulation of rivers. • Analogical method based on the proposed water level in Lake Limboto.	• Interpretation of economic evaluation brought about by the flood control.
4. Terrestrial flora and fauna	• Analogical method based on the existing species of plants and animals and their ecological characteristics.	• Method comparing the differences between with or without conditions.
5. Aquatic flora and fauna	• Analogical method based on the existing macrophytes and fish and their ecological characteristics.	• Method based on magnitude and nature of the impact, taking possible secondary impacts into consideration.
6. Air quality including noise	• Analogical method based on the dimension and volume of construction works.	• Method comparing differences between with or without conditions.
7. Water quality	• Analogical method based on the dimension and volume of construction works. • Analogical method based on the proposed water level in Lake Limboto.	• Method comparing differences between with or without conditions.

Table C8.4.5 METHODOLOGY OF IMPACT ASSESSMENT ON SOCIAL ENVIRONMENTAL COMPONENTS

Environmental component	*Impact Prediction*	*Impact Evaluation/Criteria*
1. Resettlement	• Analogical method based on results of interview/questionnaire and socialization processes. • Quantitative analysis based on dimension and location of the projects.	• Evaluation based on its magnitude and characteristics of the impact and significance impact evaluation method was utilized according to the criteria listed above.
2. Livelihood	• Analogical method based on results of interview/questionnaire of possibly affected persons and secondary data of project locations.	• Evaluation based on its magnitude and characteristics of the impact. Potential of new income sources is also taken into consideration.
3. Local Population's Opposition	• Analogical method based on the results of interview/questionnaire and socialization processes of possibly affected persons.	• Evaluation based on its magnitude and characteristics of the impact. Significance impact evaluation method was utilized.
4. People's mobility	• Analogical method based on field observation and interview, and project construction components.	• Evaluation based on its magnitude and characteristics of the impact.
5. Access to waters	• Analogical method based on field observation, the results of interview/questionnaires and the design of structural interventions.	• Evaluation based on its magnitude and characteristics of the impact. Multiple aspect of the environmental component is also taken into consideration.
6. Public Health and sanitation	• Analogical method based on interview/questionnaire and existing statistics.	• Evaluation based on its magnitude and characteristics of the impact.
7. Waste	• Analogical method based on observation, interviews and planned operation of constructed facilities.	• Evaluation based on its magnitude and characteristics of the impact.

Table C8.4.6 SUMMARY OF WATER QUALITY MEASUREMENT CONDUCTED IN JUNE, 2002

No.	Parameters	Unit	Rivers *		Lake Limboto		Water Quality Criteria **			
			Min.	Max.	Min.	Max.	Class I	Class II	Class III	Class IV
A	**Physical**									
1	Temperature	^{o}C	26.8	27.8	26.9	27.6	1) ***	1)	1)	2)
2	TDS (Total Dissolved Solids)	mg/l	148	345	179	358	1000	1000	1000	2000
3	TSS (Total Suspended Solids)	mg/l	3	15	4	19	50	50	400	400
4	Turbidity	NTU	2.7	19.6	8.3	29.4	-	-	-	-
B	**Inorganic chemicals**									
5	pH	-	6.6	7.3	6.8	7.0	6 - 9	6 - 9	6 - 9	5 - 9
6	BOD_5	mg/l	18.09	36.09	17.09	32.06	2	3	6	12
7	COD	mg/l	21	51	20	44	10	25	50	100
8	DO	mg/l	5.7	6.2	6.0	6.3	>6	>4	>3	>0
9	Phosphate (P)	mg/l	0.0065	0.0212	0.0082	0.0163	0.2	0.2	1	5
10	Nitrate Nitrogen (NO_3-N)	mg/l	1.08	1.53	1.35	1.48	10	10	20	20
11	Nitrite Nitrogen (NO_2-N)	mg/l	<0.01	<0.01	<0.01	0.05	0.06	0.06	0.06	(-)
12	Arsenic (As)	mg/l	<0.002	0.040	<0.002	0.018	0.05	1	1	1
13	Cobalt (Co)	mg/l	<0.03	<0.03	<0.03	<0.03	0.2	0.2	0.2	0.2
14	Boron (B)	mg/l	0.00	0.00	0.00	0.00	1	1	1	1
15	Selenium (Se)	mg/l	0.006	0.011	<0.005	0.01	0.01	0.05	0.05	0.05
16	Cadmium (Cd)	mg/l	<0.005	<0.005	<0.005	<0.005	0.01	0.01	0.01	0.01
17	Hexavalent Chromium (Cr^{6+})	mg/l	<0.02	<0.02	<0.02	<0.02	0.05	0.05	0.05	0.01
18	Copper (Cu)	mg/l	<0.01	<0.01	<0.01	<0.01	0.02	0.02	0.02	0.2
19	Lead (Pb)	mg/l	<0.05	0.20	0.08	0.20	0.03	0.03	0.03	1
20	Mercury (Hg)	mg/l	<0.0002	0.0118	<0.0002	0.0009	0.001	0.002	0.002	0.005
21	Zinc (Zn)	mg/l	<0.005	<0.005	<0.005	<0.005	0.05	0.05	0.05	2

* Alo-Pohu, Biyonga, Bolango, Topadu, Bone and Tamalate rivers.

** Government Regulation No.82/2001, Class I water is utilized for drinking water, Class II water is utilized for recreational activity, freshwater fish culture, animal husbandry, irrigation, Class III water is utilized for freshwater fish culture, animal husbandry, irrigation, and Class IV water is utilized for irrigation.

*** 1) Air Temperature ±3℃. 2) Air Temperature ±5℃.

Table C8.4.7 DESCRIPTION OF IMPACTS ON NATURAL ENVIRONMENTAL COMPONENT (1/3)

Environmental components	*Phase**	*Description of direct impact*	*Negative/ Positive*	*Spatial extent/ Area to be affected*	*Conditions of impacts to occur*	*Quantitative magnitude*	*Secondary impacts/effects*
1. Geology (erosion and sedimentation)	C	None	-	-	-	-	-
	M/O	Erosion presently occurring along rivers during floods will be reduced owing to river improvement works such as bank protection. Consequently, the entailing sedimentation phenomenon in the downstream of rivers will be alleviated.	Positive	Downstream of each work site on Bolango, Tapodu, Bone rivers and Tamalate rivers.	Original and much bigger source of sedimentation is supplied from upstream area of LBB basin. In this sense, the effectiveness is canceled unless proper watershed management is undertaken.	Basically, erosion will not occur on bank protected reaches.	Improvement of land safety living condition along river banks.
2. Groundwater and land subsidence	C	Excavation work for Tamalate floodway, Tapodu rivers and Tenda Cutoff channel will lower groundwater level along these channels because the excavation are planned to be deeper than the current groundwater level. This may cause groundwater level lowering or depletion of well water along the channels. The drawdown of groundwater level may cause consolidation phenomenon, judging from the geologic profile, showing there is clayey silt or clayey layer, which are vulnerable to consolidation phenomenon.	Negative	Area along the excavated channels. Impact area will be up to some 50 m at most from the channels.	Practically not avoidable. The impact of consolidation last for certain period of time, usually for years after the completion of excavation depending on geologic characteristics.	Down to same level as riverbed of floodway in the vicinity of channels. Magnitude of land subsidence is not clear.	Inconvenience of water use from wells due to draw down of well water level. Land subsidence might cause uneven settlement of houses located close to channels.
	O/M	The above impacts will last in O/M phase.	Ditto	Ditto	Ditto	Ditto	Ditto
3. Water regime	C	None.	-	-	-	-	-
	O/M	Flood control for the floods of up to 20 year recurrence period and mitigation of flood damages for longer recurrence period.	Positive	Area along lower Bolango, Bone, Tamalate, and around Lake Limboto.	Effectiveness will be weekend unless proper watershed management, specifically land use and forest management, is undertaken.	Floods up to 20 year recurrence period are controlled.	Improvement of living environment and economic effect with an EIRR of 16.9 %.
	O/M	Stabilization of Lake Limboto water level at rather high.	Positive	In Lake Limboto.	Appropriate gate control at Tapodu gate is requisite.	Higher than water level of 4.0 m.	Improvement of water quality and fishery product.

* C: Construction phase, O/M: Operation and Maintenance phase.

Table C8.4.7 DESCRIPTION OF IMPACTS ON NATURAL ENVIRONMENTAL COMPONENT (2/3)

Environmental components	*Phase**	*Description of direct impacts.*	*Negative/ Positive*	*Spatial extent/ Area to be affected*	*Conditions of impacts to occur*	*Quantitative magnitude*	*Possible secondary impacts*
4. Terrestrial flora and fauna	C	Due to the excavation for Tamalate floodway and Tapodu river, some natural vegetation including agricultural one will be cleared. Tree species to be affected in the natural vegetation are Acacia, Banyan, Linggua and Nantu. Excavation works for Tapodu river and Tamalate floodway will disturb habitat of wild birds such as egrets and wild ducks. Other river improvement works will not affect significantly because these sites are already modified to such extent that there is no habitat of wild animals.	Negative	In and around the excavation sites.	Not avoidable.	Negligible or minor judging from the areal ratio of the affected and the whole area of LBB basin.	No significant impact.
	O/M	Impacts mentioned above will last in O/M phase.	Negative	Ditto	Ditto	Ditto	Ditto
5. Aquatic flora and fauna	C	Impacts of construction works on fish are the habitat disturbance due to turbidity increase and alkalinity increase caused by dredging and/or concrete works in rivers and Lake Limboto. Disturbance is also caused by means of obstruction of their migration due to temporal channel shift or possibility of improper bypath construction.	Negative	In the vicinity of construction site and downstream.	Practically, not avoidable.	Not clear.	Impacts on fishery or aquaculture. But seemed not to be significant.
	O/M	Stabilization of water level of Lake Limboto will control the growth of aquatic weeds (macrophytes), specifically submerged plants. This will decrease the decomposition of weeds, which in turn less deteriorate water quality in terms of DO and BOD. Since aquatic weeds function as shelter or supply foods, decrease of weeds may result in affecting fish.	Both	In Lake Limboto.	Proper management of Tapodu gate is requisite.	Submerged and emergent plants cannot grow at depth more than 2 m.	Not clear.
	O/M	Tapodu gate will affect fish's longitudinal migrating habit within Tapodu-Bolango-Bone river system or between the sea and Lake Limboto. The migratory fish which have been identified so far is eel (*Anguilla sp.*). Coverage of river bank with concrete wall or gabion will modify the fish habitat and may affect fish population.	Negative.	Over the LBB river network.	Practically not avoidable.	Not clear.	Impacts on fishing output of eels, and accordingly on the fishermen depending on it.
	O/M	Stabilization of Lake Limboto water level owing to Tapodu gate higher than 4.0 m. This will bring about good condition on fish ecology in terms of water quality improvement and water volume.	Positive	In Lake Limboto.	Proper management of Tapodu gate is requisite.	Not clear.	Increase of fishing output and aquaculture production.

* C: Construction phase, O/M: Operation and Maintenance phase.

Table C8.4.7 DESCRIPTION OF IMPACTS ON NATURAL ENVIRONMENTAL COMPONENT (3/3)

Environmental components	*Phase**	*Description of direct impacts.*	*Negative/ Positive*	*Spatial extent/ Area to be affected*	*Conditions of impacts to occur*	*Quantitative magnitude*	*Possible secondary impacts*
6. Air quality including noise	C	Air pollution (by emission gas) and dust will be generated. While air pollution is generated from construction machinery and transportation vehicles at all the construction works, dust is caused by earth work, such as excavation for floodway and river channel widening. Dust is also generated from trucks loaded with earth, i.e. soil and sand. Noise will be also generated during these construction works, caused by construction machinery and transportation vehicles.	Negative	Near construction site. Along the transportation route (not decided yet) of machinery, materials and laborers.	Not avoidable.	Not clear.	Impacts on living environment, especially on school, hospital, clinic which require rather quiet environment.
	O/M	None.	-	-	-	-	-
7. Water quality	C	Turbidity increase will occur during construction phase. The possible source activities are all the construction works on rivers, dredging/widening of rivers and a sediment trap. Alkali water discharge can be caused by concrete work, especially during construction of floodway, dike and bank protection.	Negative	Downstream of each work or in Lake Limboto.	Not avoidable.	Not clear.	Impacts on fishing output and aquaculture. Impacts on water use such as bathing and laundry.
	O/M	High turbid water from Alo-Pohu and Biyonga rivers will be confined within sediment trap and accordingly this alleviates the pollution with high suspended solids and sedimentation in Lake Limboto.	Positive	In Lake Limboto.	Proper management of sediment trap including dredging of sediment deposits is requisite.	Not clear.	Possibility of usage of the sediment load deposited within sediment trap for construction materials.
	O/M	Turbid water flowing into the lake from the Bolango River will be improved due to the improvement of the Tapodu River.	Negative	In Lake Limboto.	Not avoidable	Not clean	Impacts on fishing output and aquaculture.

* C: Construction phase, O/M: Operation and Maintenance phase.

Table C8.4.8 RESULT OF IMPACT EVALUATION ON NATURAL ENVIRONMENTAL COMPONENTS

Conceivable impacts	*Nature of impacts*	*Evaluation result*
(1) Negative impacts		
Groundwater level lowering and land subsidence.	1) Practically not avoidable. 2) Irreversible. 3) Confined along Tamalate floodway, Tapodu river and Tenda Cutoff channel. Impacts are limited to the households located within some 50 m from these channels. 4) Not identical with those who get benefit. *	Compensatory mitigation is applicable.
Vegetation clearance.	1) Not avoidable. 2) Irreversible. 3) Confined in and along Tamalate floodway and Tapodu river. 4) Not necessarily identical. *	Impacts are minimal judging from its spatial extent vs. the whole ecosystem.
Habitat disturbance of terrestrial fauna.	1) Not avoidable. 2) Irreversible. 3) Confined in and around Tamalate floodway and Tapodu river. 4) Not necessarily identical. *	Impacts are minimal judging from its spatial extent.
Habitat disturbance of aquatic fauna, especially fish.	1) Practically not avoidable. 2) Reversible./ Impacts are confined within construction phase. 3) Rivers and in Lake Limboto. 4) Not necessarily identical. *	Impact magnitude is not clear, but seemed not significant.
Disturbance of migration habit of migratory fish, especially eels.	1) Practically not avoidable. 2) Irreversible. 3) In the whole Lake Limboto. 4) Not necessarily identical with those who benefit. *	Impact magnitude is not clear. Compensatory mitigation is applicable for fishermen of eels.
Air pollution (emission gas) and dust.	1) Not avoidable. 2) Reversible. / Impacts are confined within construction phase. 3) Near all the construction sites and transportation routes. 4) Identical with those who benefit. *	Not significant.
Turbid water and alkali water discharge.	Ditto	Not significant.
(2) Positive impacts		
Alleviation of erosion of rivers.	1) Benefit will last for years. 2) Lower reaches of river bank of Bolango, Bone, Tamalate, etc.	Significant.
Reduction of flood risks.	1) Benefit will last for years. 2) Benefit area is low area of LBB basin.	Significant.
Stabilization of water level water quality improvement in Lake Limboto	1) Benefit will last practically forever. 2) As a secondary impact, a stable and high fishing output and aquaculture production will be expected.	Significant.
Confining of turbid water within sediment trap.	1) Benefit lasts for years. 2) As a secondary impact, a high fishing output and aquaculture production will be expected.	Not clear.

*: Whether or not people who get benefit from the project is identical with the people who suffer from it.