CHAPTER 4 PROPOSED BANDA ACEH URBAN SYSTEM

Focus in urban system is in the function and roles/city position that will be done (cities hierarchy system). Phases to determine BAC urban system is as follows: 1) BAC spatial development model, 2) city functions and roles.

4.1 SPATIAL DEVELOPMENT MODEL FOR BAC

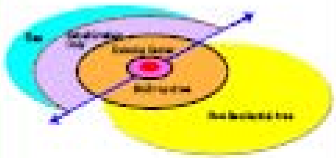
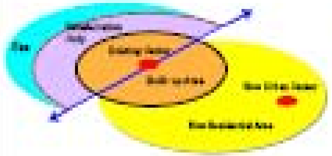
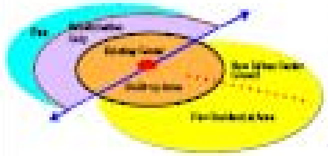
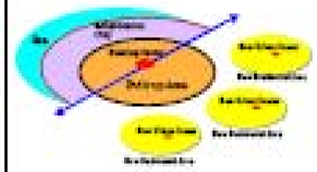
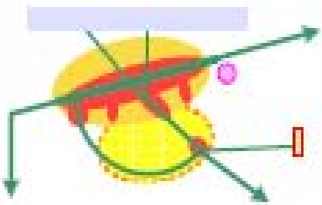
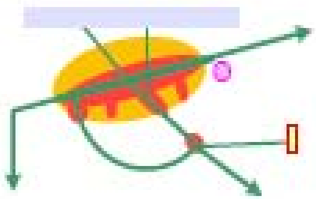
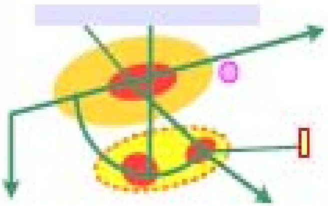
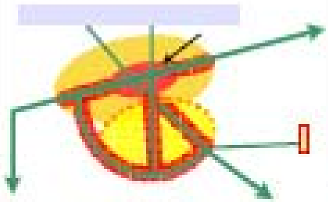
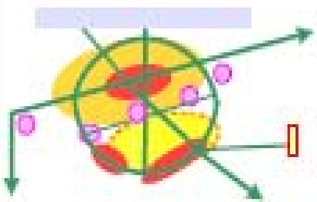
There are various types of model in city development, characterized by number of population, geographic condition, land use, transportation array, natural environment, administrative services, economic development activities, prevailing culture and tradition, etc. In addition preparedness against disaster is one of the important aspects to be considered, especially in BAC. In case of BAC, it is deemed that there would be five (5) conceivable models to be adaptable. These models are as described in Table 4.4.1 and schematically shown in Figure 4.4.1 and Table 4.4.1

Table 4.1.1 Outlines of Five Conceivable City Models

Models	Characteristics
Model A: Center Growth with Dual Residential Areas	• Residential area tends to expand to southern area since coastal area was devastated. • Administration and commercial activities remain mostly at the present location.
Model B: Center Growth with Coastal Area Development	• Coastal area will be re-developed to state of pre-disaster condition, while developing the southern area. • Administration and commercial activities remain mostly at the present location.
Model C: Dual Center with Dual Residential Area	• New urban center will be located to de-centralize administrative and commercial activities from the present urban center. • Residential area will extend between two (2) centers.
Model D: Linear Growth with Dual Residential Area	• Commercial and business center will grow along arterial road in future. • Residential area will be developed in the south.
Model E: Linked Multi Center with Multi Residential Area	• Sub-centers will be developed in form of cluster. The existing urban center and sub-centers will be linked by artery road. • Administrative centers will be relocated to disperse risk of disaster. Commercial activities would subsequently grow around new administrative centers.

Source: JICA Study Team, 2005

Figure 4.1.1 Alternatives of City Development Model BAC

	A	B	C	D	E
MODEL	*CENTER GROWTH WITH DUAL RESIDENTIAL AREA*	*CENTER GROWTH WITH COASTAL AREA DEVELOPMENT*	*DUAL CENTER WITH DUAL RESIDENTIAL AREA*	*LINEAR GROWTH WITH DUAL RESIDENTIAL AREA*	*LINKED MULTI-CENTER WITH MULTI RESIDENTIAL AREA*
DEVELOPMENT PATTERN					
SCHEMATIC CONCEPT					

Source: JICA Study Team, 2005

4.2 URBAN FUNCTIONS OF BAC

Urban hierarchy system is set up because of two major aspects, that is city services availability (city size) and cities services easiness (city oriented) these are shown by accessibility level to the existing cities. From the city conditions analysis (pre and post earthquake and tsunami) and BAC growth tendencies along with planning review that have been done previously. Generally BAC Urban function are similar to previous planning (RTRW 2005-2010 and JICA Study Team on URRP for BAC), but there is several different locations that have significant influences to its surroundings. BAC urban function consists of:

1. City Center : City center are located in Kuta Alam, Kuta Raja and Baiturahman District administrative area. Functions: *Regional scale services trade*, *Regional scale government,* Supporting functions: Commercial, Services/Banking, Public and Social Facilities, Small Industries, Religious and Cultural Center.

2. Sub City Center located in: a) Ulee Lheue, Meuraxa District, Functions: Passengers and Goods/commodities Port, Historical tourism and Beach Tourism (Tsunami Waterfront Area), Supporting function: Services Trade b) Lung Bata District, around Lampenuerut, Functions: Sport Center, Terminal area, Trade and Services (New Town), Government (New Town), Ware, c) Ulee Kareng, Ulee Kareng District, Functions: Services and Trade, Social Services/Facilities (Education and Health).

3. Development Unit : a) Around campus area, Syah Kuala District, Functions: Education Center, Services and Trade. b) Around Jl. T.Nyak Arif – Jl. Laksamana Malahayati intersection, Syah Kuala District, Functions: Services and Trade, Social Services. c) Around Lampulo, Gampong Jawa, Gampong Pande, Functions: Services and Trade, Cultural (History) d) Around Simpang Ketapang, Bandar Raya and Jaya Baru District, Functions: Services and Trade, Ware.

4. Neighborhood unit : a) Around Simpang Leung Bata, Leung Bata District b) Around Lamjabat, Surien, Bitai villages, Meuraxa District c) Around Syah Kuala Cemetery Area, Syah Kuala District d) Around Aloe Naga Village, Syah Kuala District

The abovementioned urban functions are illustrated in Figure 4.4.3, Figure 4.4.4, Figure 4.4.5 and Figure 4.4.6.

Figure 4.2.1 City Center of BAC

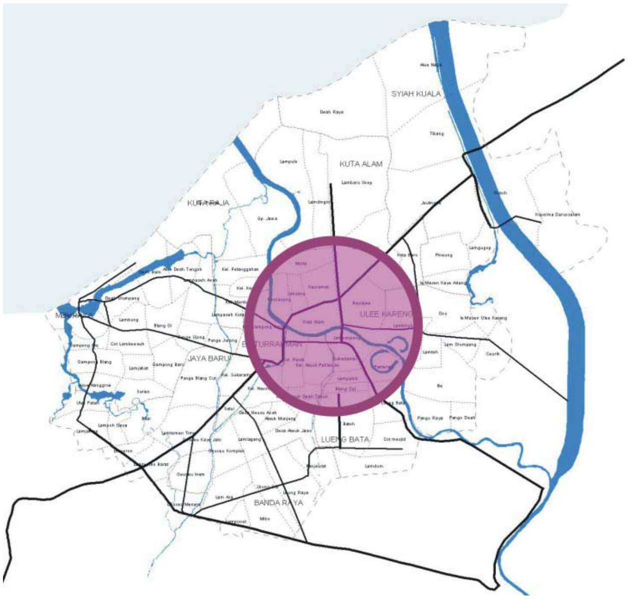


Figure 4.2.2 Sub City Center of BAC

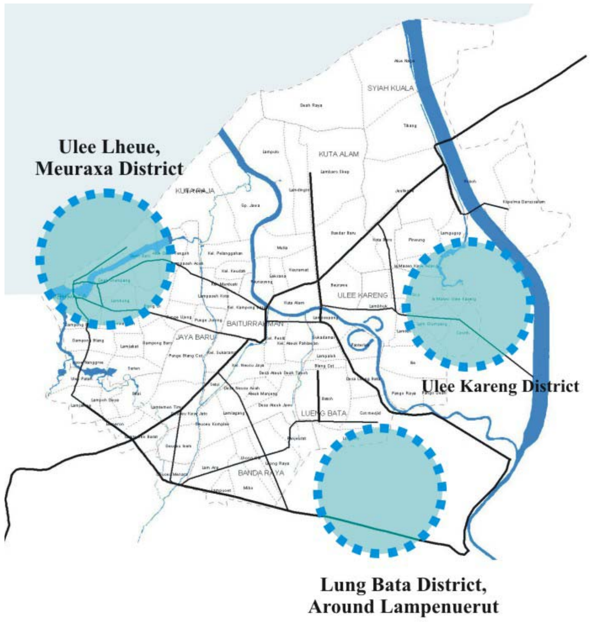


Figure 4.2.3 Development Unit of BAC

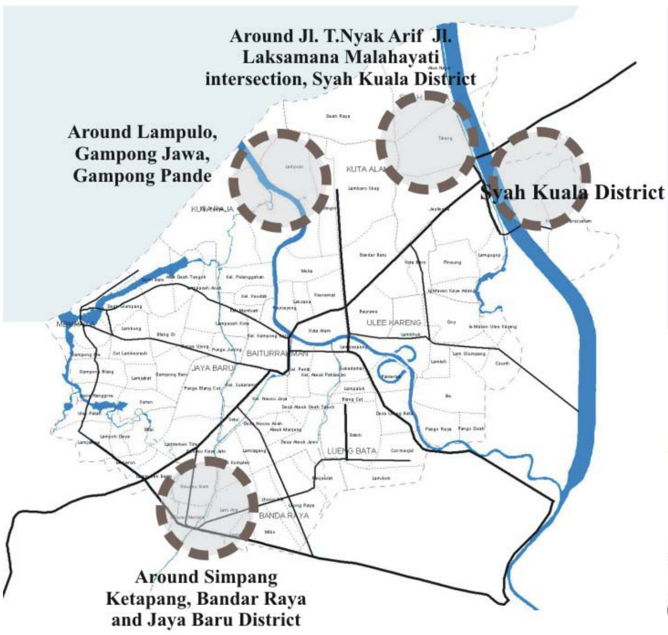
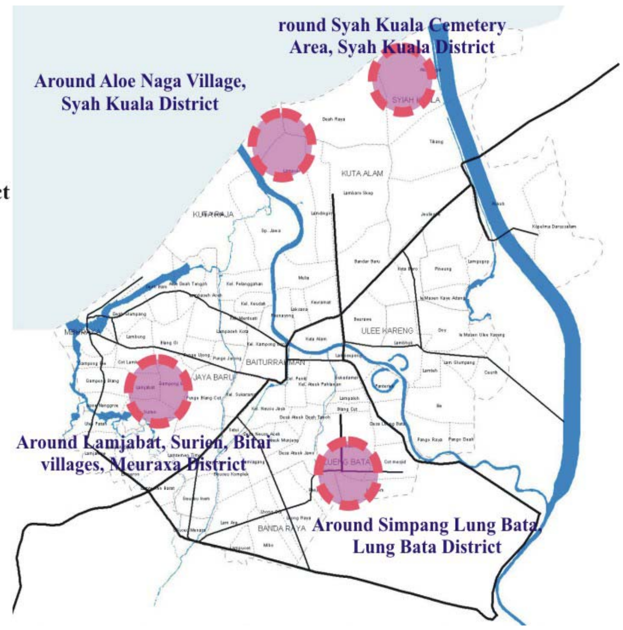


Figure 4.2.4 Neighborhood Unit of BAC



4.3 URBAN HIERARCHY OF BAC

Basically there is a hierarchy of regional center as described above. The hierarchy of an urban center can be determined based on several factors[1] as follows: 1) number of population in the urban center; 2) number of public facilities available; and 3) types of public facilities available. The more populous and more facilities and types of facilities in an urban center, the higher its hierarchy. More complex services may be acquired from centers of higher hierarchy.

Besides based on the spatial development model and BAC functions / roles that have been describe previously, cities hierarchy system in BAC are also determine by the following considerations:

- National and NAD Province Spatial Policy : Based on the national policy, NAD Province is an area that is included in Development Area A (WP-A) jointly with the North Sumatera Province, West Sumatera, and Riau. BAC included in Orde – II in those area system as "Counter Magnet" to Medan City (Order – I). In the NAD Province Spatial scope, BAC included in Hierarchy – I city. As of guideline, BAC roles are developed as: Government Center and Office, Social activities center, transit center (transportation), Religious center (Islamic Center).
- RTRW Spatial Policy (10 years year 2002-2010): Development zone (BWK) are divided into 4 BWK and 5 sub BWK that are hierarchically included in BAC cities system. As seen in figure: Urban System BAC base RTRW (10 years plan) 2002-2010

Phases that are explained above could be new BAC urban hierarchy system, which consists of:

- BWK city center (Hierarchy-1) , BWK Ulee Lheue (Hierarchy-2), BWK Ulee Kareng (Hierarchy-2) and BWK Leung Bata (Hierarchy-2).
- Sub BWK (Hierarchy-3), that is: Sub BWK inner city A, B and C, Sub BWK Lung Bata A, Sub BWK Ulee Lheue A, Sub BWK Ulee Kareng A and B.

4.4 URBAN SYSTEM OF BAC 2015

In URRP Study, JICA Study Team has created an urban system, by integrating RTRW (10 years BAC Development Plan) and Blue Print and considering disaster mitigation factors. The 2009 urban system designated urban functions for each activity center, such as commercial, religious culture, port market, education, new city urban, city center that will be linked to urban movement system (Figure 2.8 BAC Urban System, 2009). While for 2015 urban system, according to the projected population it is necessary to add new functions with smaller scale and more evenly distributed in formerly non-serviceable areas. Each function will be linked so that it will influence the 2015 network plan (Figure: 4.4.6 Urban System 2015)

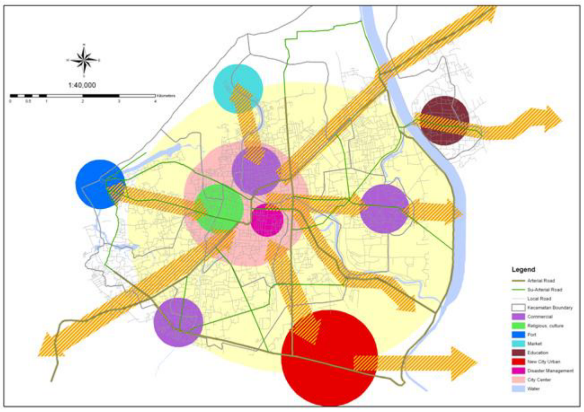


Figure 4.4.1 Urban System of BAC, 2009

[1] Budiharsono, Sugeng, The Analysis of Coastal and Ocean Development

Figure 4.4.2 Urban Function and Urban Hierarchy of BAC, 2015

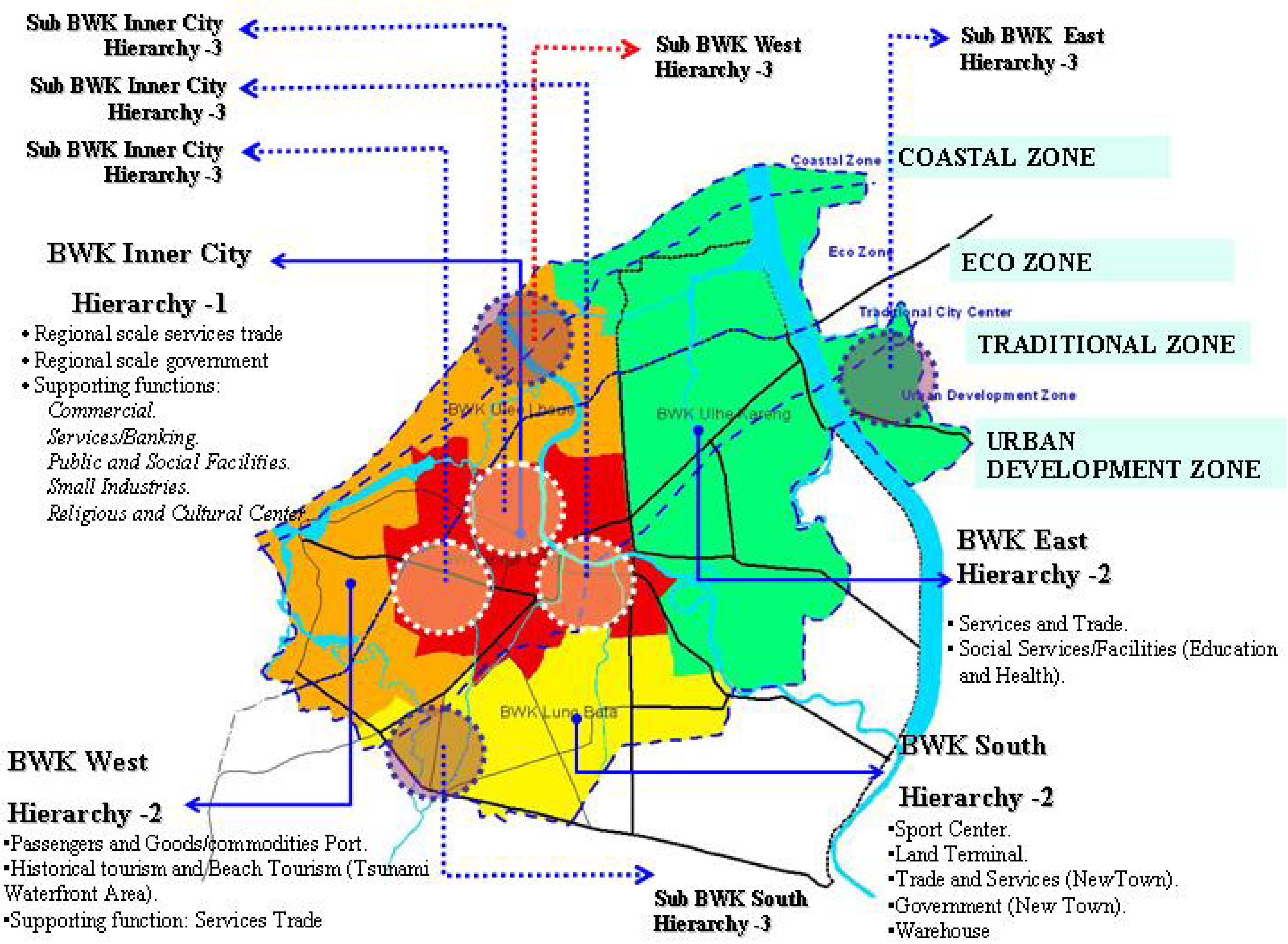
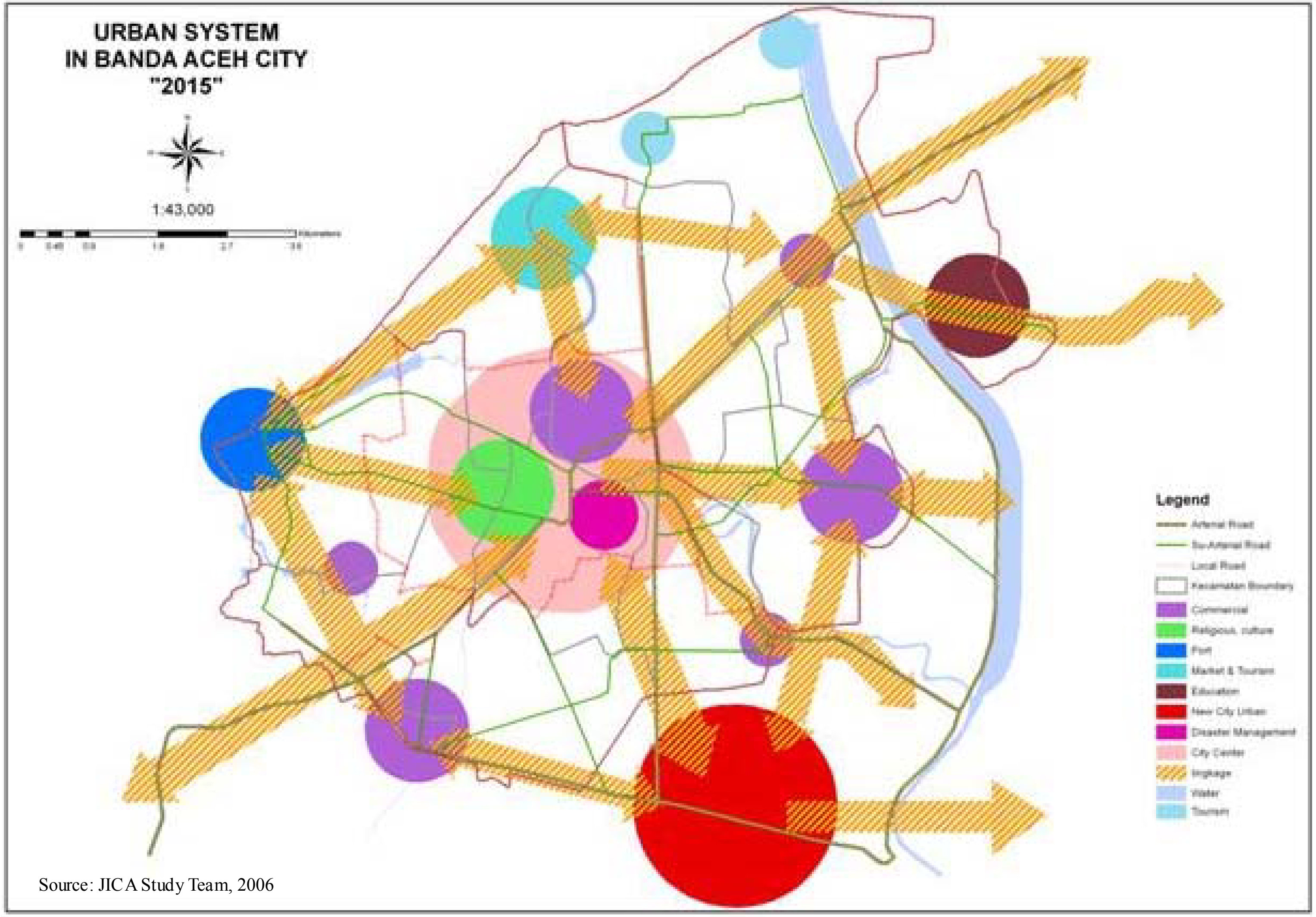


Figure 4.4.3 Urban System of BAC, 2015



Source: JICA Study Team, 2006

CHAPTER 5 PROPOSED SPATIAL STRUCTURE AND URBAN PATTERN

5.1 PROPOSED URBAN SKELETON

- **Network**

Generally, BAC urban skeleton are still fit to previous planning, but there is a few changes connected to city conditions and planning post tsunami. Several changing suggestions are: 1) Coastal road, which is city north ring road and also functioning as tourism route to beach area. 2) Baru Street from Simpang Surabaya to Sukarno Hatta Street. 3) Syah Kuala Street to coast line (Syah Kuala Cemetery)

Besides the urban structure planning suggested above, BAC urban structure that are similar with previous planning are: Jl. Sukarno Hatta, Jl. Tgk. Abd. Rahman Meunasah Meucab, Jl. Lhok Nga, Jl.Cut Nyak Dien, Jl. Tengku Umar, Jl.Sultan Alaidin Johan Syah, Jl.Sultan Malikul Saleh, Jl. Iskandar Muda, Jl.Sultan Alaidin, Jl. Tengku Cik Ditiro, Jl. Tengku Imum Lueng Bata, Jl.Rama Setia, Jl.Habib Abdurahman, Jl. Diponegoro, Jl.KH Ahmad Dahlan, Jl. Tentara Pelajar, Jl. Panglima Polim, Jl. Muhamad Daud Beureuh, Jl. Tengku Nyak Arief, Jl. Laksamana Malahayati, Jl. Syah Kuala, Jl. Tengku Hasan Dek, Jl. TH.GLP Payong, Jl. Tgk. Nyak Makam, Jl. Tengku Iskandar, Krueng Aceh River, Krueng Aceh Floodway river

- **River**

Syahkuala, Ulee Kareng, Kutaraja, Kuta Alam, Baiturahman and Lueng Bata

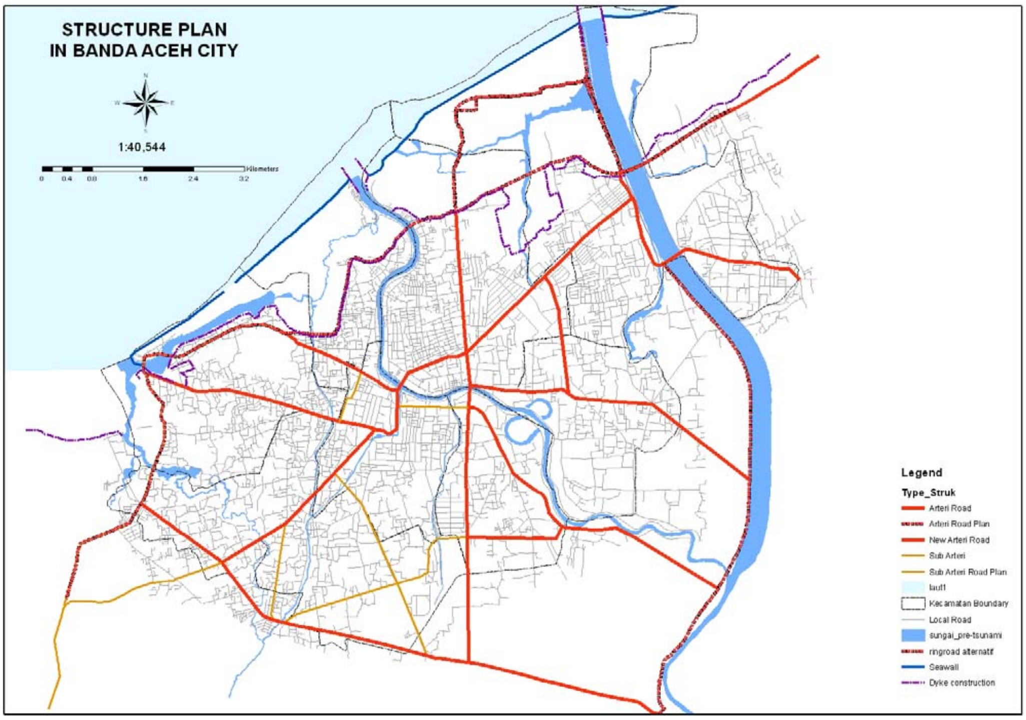
Figure 5.1.1 Urban Skeleton of BAC, 2015

Source: JICA Study Team, 2005

5.2 PROPOSED URBAN PATTERN 2015

Urban pattern shape of BAC developing area in some of city area that have been planned earlier, tend to be geometrical (grid, linier, etc), on contrary some of unplanned area (housings, commercial) are non-geometrical/amorph shape. Urban pattern of 3 Reconstruction Model Areas are as follows: 1) The shape of urban pattern in Peunayong trade area is grid geometries 2) The shape of urban pattern in New Town area (government and services/trade area) is centric/radial 3) The shape of urban pattern in Ulee Lheue area (Tsunami Waterfront Area) is formal grid and radial.

Figure 5.2.1 Urban Pattern of BAC, 2015



Source: JICA Study Team, 2005

5.3 SPECIFIC SPATIAL STRUCTURE PLAN

After phases above, BAC spatial structure plan could be arrange as planning guideline that are more detailed and region development process which is indicated in short term, medium term, long term program by noticing the priority scale.

(1) Zone of Preservation and Conservation

- ***Green Area (Green open Area),*** Location: Meuraxa, Kutaraja, kuta alam, Baiturahman, Syahkuala, Ulee Kareng, Lueng Bata dan Bada Raya. Utilization: open space/open park, tourism area, using river boundary, main road corridor, public area (park, sport center, residential)
- ***Mangrove Forest Meuraxa,*** Location: Kutaraja, Kuta Alam, Jaya Baru. Utilization: Preserving existing mangrove forest, Replantation the possible coast area, Mangrove replantation as green belt from fish pond
- ***River,*** Location: Syahkuala, Ulee Kareng, Kutaraja, Kuta Alam, Baiturahman dan Lueng Bata. Utilization: preserving their function as primary and secondary drainage channels, Making boundaries using limitation.
- ***Coastal ,*** Location: Kutaraja, Syahkuala, kuta alam dan Meuraxa Utilization:: fishpond area, coast conservations, area and the vegetation, economic development area (fishery), city

historical area (Urban Heritage)

Figure 5.3.1 Specific Spatial Structure Planning: Zone of Preservation and Conservation, BAC 2015

Source: JICA Study Team, 2006

(2) Zone of Development

- ***Commercial,*** Location: City Center (main road), Plan in Lueng Bata. Utilization: Optimized space for commercial area in city center fit to services hierarchy
- ***Goverment office,*** Location: City Center (main road), Plan in Lueng Bata. Utilization: Optimalized space for governance area in city center fit to services hierarchy
- ***Sport Center Area,*** Location: Banda Raya. Utilization: As recreation uses, sport and tourism
- ***Harbour***, Location: Meuraxa. Utilization: Ulee Lheue port using as passengers and cargo harbour
- ***Bus Station***, Location: Banda Raya. Utilization: Space allocation in city rural area (Leung Bata) as city station and integrated to multimoda station in Lambaro city
- ***Education,*** Location: Syiah Kuala. Utilization: Syah Kuala Education Center area, with specific functions as education area
- ***Tourism Area,*** Location: Coast area and city center Utilization: Ulee Lheue Area with specific functions as harbor area and tourism area (Tsunami Waterfront)
- ***Landfill (TPA),*** Location: Gampoong Jawa. . Utilization: Using the existing area optimally, with alternative consideration to other locations outside BAC

Figure 5.3.2 Specific Spatial Structure Planning: Zone of Development, BAC 2015

Source: JICA Study Team, 2006

5.4 Primary Land Use Plan 2015

The land use plan of BAC will be prepared in order to reconstruct the city effectively, to minimize the damage of disaster and to promote orderly urban development. The land use was planned considering the following plans: Land Use Plan of BAC (2001-2010) promulgated in 2001 (pre-tsunami), Spatial Plan of BAC in the Blue Print (2005, post tsunami), JICA Study Team on URRP for BAC, Planning Strategies and Concept, Population Allocation Plan. The primary land use plans of BAC are shown on table 4.3

Table 5.4.1 Primary Land Use Plan

No	Land Use	Detail Land Use	Location
1	Residential	City Center Residential	Kuta Raja District: Peulanggahan, Keudah. Meuraxa District: Lampaseh Kuta, Punge Jurong. Baiturahman District: Sukaramai, Neusu Jaya, Kampong Baro, Peuniti, Ateuk Pahlawan, Merduati. Kuta Alam District: Kuta Alam, Peunayong, Laksana, Kampung Mulia.
		Rural Residential	1.Coast line Meuraxa District: Ulee Lheue, Deah Glumpang, Deah Baro, Aloe Deah Tengoh, Lampaseh Aceh Kuta Raja District: Gampong Pande, Gampong Jawa. Kuta Alam District: Lam Pulo, Lam Dingin, Lambaro Skep.

No	Land Use	Detail Land Use	Location
			Syah Kuala District: Dayah Raya, Alue Naga 2.Land Syah Kuala District: Tibang , Jelingke, Rukoh, Lam Gugop, Darussalam, Ie Masen Kaye Adang. Ulee Kareng District: Ie Masen, Ceurih, Ilie Pango Deah, Pango Daya. Lueng Bata District: Cot Masjid, Lamdom. Banda Raya District: Peuyeurat, Lhong Raya, Lhong Cut, Mibo, Lampuot, Lam Ara. Jaya Baru District: Geuceu Menara, Lamteumen Barat, Emperum, Lamjene.
		Transition Area Residential	All housings among City Center Housings and Rural Housings.
2	Commercial/Services and Trade	Linear Commercial	Along Jl. Teuku Umar dan Jl. Cut Nya Dhien Along Jl. Tengku Iskandar Along Jl. Sukarno Hatta Along Jl. Syah Kuala Along jalan baru dari Simpang Surabaya Along Jl. Tgk. Nyak Makam Along Jl. Tgk.Imum Lueng Bata
		Areal Zone Surrounding Centers	Ulee Kareng New Town Setui Peunayong
3	Governance	Old Governance Office	Jl. Muh. Daud Beureuh Jl. Tengku Nyak Arief
		New Governance Office	New Town Lueng Bata
4	Industries	Limited to small industry/non polluted, small scale	Spread in several city area
5	Cultural and Educations	Cultural (Islam)	Mesjid Raya and surrounding area
		Educations	Syah Kuala and Lueng Bata
6	Park and City open Space	Tsunami Waterfront: Tsunami Living Museum, Recreation and sports, Mass Grave, City Forest, education facilities	Ulee Lheue, Lampulo, Syah Kuala
		Escape Area	Open space in northern side of Jl. Cut Nya Dien, Jl.Tengku Umar, Jl.Muh Daud Beureh, Jl.Tengku Nyak Arif
7	Coastal Area	Harbor, Port	Ulee Lheue, Lampulo
		Fish Market	Lampulo
		Landfill and Septage Treatment Plan	Gampong Jawa
		Coastal fishing settlements	Along the Coast Line

Source: JICA Study Team, 2005

Table 5.4.2 Allocation of Primary Land Use Plan 2015

Land Use	Ha	%
Park_Forest (Land)	805.77	
Fish pon Mangrove	383.56	
Sub Total Non Build up area	***1,189.32***	***18%***
Comercial	1,130.14	
Education	166.16	
Sport Center	24.90	
Tourism	327.30	
Residential Area	3,474.65	
Government Office	299.20	
TPA	10.92	
Harbour	20.72	
Sub Total Build up area	***5,453.97***	***82%***

Source: JICA Study Team, 2005

Figure 5.4.1 Primary Land Use Plan, 2015

Source: JICA Study Team, 2005

APPENDIX D

INFRASTRUCTURE DEVELOPMENT

CHAPTER 1 ROADS

1.1. Existing Roads

1.1.1. Aceh Besar Regency

The 87.72 percent of total road length that exist in Aceh Besar Regency are asphalt paved road. Of them, the 51.31 percent of roads are in good conditions, and the rest varies from damage and very damage. The 73.35 percent of roads are of type III. The complete data of roads are shown in table 1.1.1.

Table 1.1.1 Roads in Aceh Besar Regency, 2003

Detail	**Road Length (Km)**			**Total**	**Percentage**
	State Street	**Province Street**	**Regency Street**		
Surface Type:					
1. Asphalt	154.00	105.00	848.97	1,107.97	87.72%
2. limestone			64.53	64.53	5.11%
3. Land			90.55	90.55	7.17%
4. Not detailed					
Road Conditions:					
1. Good	154.00	105.00	424.975	683.98	51.31%
2. Average			486.208	486.21	36.47%
3. Damage			162.919	162.92	12.22%
4. Totally Damage					
Class of Road:					
1. Class I					
2. Class II					
3. Class III A	154.00			154.00	15.84%
4. Class III B		105.00		105.00	10.80%
5. Class III C			713.00	713.00	73.35%
6. Not detailed Class					

Source: Aceh Besar dalam Angka, 2003

1.1.2. Sabang City

The 90.70% roads in Sabang City are asphalt paved roads. Of them, the 37.34% of roads in are damaged, and the rest are good. 60.43% of total existing road are of type II. The complete data are shown in table below:

Table 1.1.2 Roads in Sabang City, 2003

Detail	Road Length (Km)		Total	Percentage
	District road	Provincial roads		
Surface Type:				
1. Asphalt	134,920	32,485	167,405	99.70%
2. Limestone	0	0	0	
3. Dirt road	500	0	500	0.30%

Source: Aceh Besar dalam Angka, 2003

1.2 NON POLLUTED MASS RAPID TRANSIT CONCEPT

1.2.1 Behind The Idea

Under the metropolitan city scenario, BAC will serve both internal and external movements. Internal movement will generate from the local people activities and flow both inside BAC and outside BAC. External movements come from external people who work, visit or live temporary in BAC. The combination of both will trigger BAC more crowded in the future.

Unfortunately, there is no record data on trips a day for BAC and its adjacent areas. However, according to other cities in Indonesia, the trips generated a day by people will usually vary from 30% to 50% of the city's total population (JMTSS, 1990). In the same case, with total population 263.668 person in 2005, BAC will expectedly generate about 120.000 trips a day. Those trips will join with ones coming from the adjacent areas, potentially reaching to 90.000 trips a day.

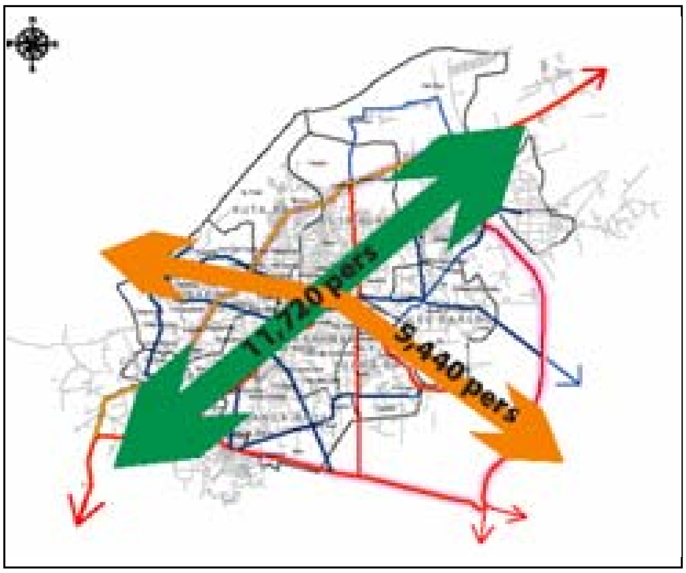
Assume that each person who makes trip will use a private car—because of the absence of public transport service. A day, approximate to 200 thousand cars trip will bomb BAC simultaneously, resulting in acute congestion along the road network inside the city. And imagine, how many pollutants will come into the air and caused the magnification of dangerous materials in it.

Therefore, the idea of implementation the mass and non-polluted transportation meet the issue of how creating a urban transportation which complies with the demand to provide a safe and efficient transportation operation. The mass transportation itself refers to the concept of how transporting people in large scale of quantity simultaneously, therefore, it is efficient. The non-polluted transportation concept will conform to the issues of environmental conservation.

In the future, the implementation of mass and non-polluted transportation will:

- Provide BAC with a system for transportation that can encourage the urban movement point to point in effective and efficient level
- Ease people paying transportation cost in affordable price, comparing to cost for the use of private car
- Alleviate traffic congestion across the BAC
- Reduce air pollution which transportation comes to one of its main contributor

Figure 1.2.1 Corridor 1 LRT line



1.2.2 BAC LRT System

a. Proposed LRT Routes

According to the road network pattern, it is recommended that routes for LRT application will be as follows:

Corridor 1

Corridor 1 will delineate along the main arterial road in the BAC town. It connects the south west to north east of BAC, serving journey by people along the road.

With the total route length reaching approximately 8 km, the corridor will be equipped at least 16 shelters, with 500 m space between shelters. Each shelter will locate at any cross line between the trunk routes and the feeder ones.

Corridor 2

Corridor 2 connects the one of vital transportation node the Ulee Lheue Harbor and the south east of BAC. Conceptually, citizens whose destination is to either the Ulee Lheue Harbor or areas along the line the corridor 2 will serve.

In future implementation, with the total length approximately 9.0 km, the corridor 2 will be equipped with at least 18 shelters, if the space between two shelters is every 500 m. Each shelter will collect prospective passengers come from the surrounding areas or from the feeder service with end route at any cross between the corridor 2 service and the feeder services.

Figure 1.2.2 Corridor 1 LRT line

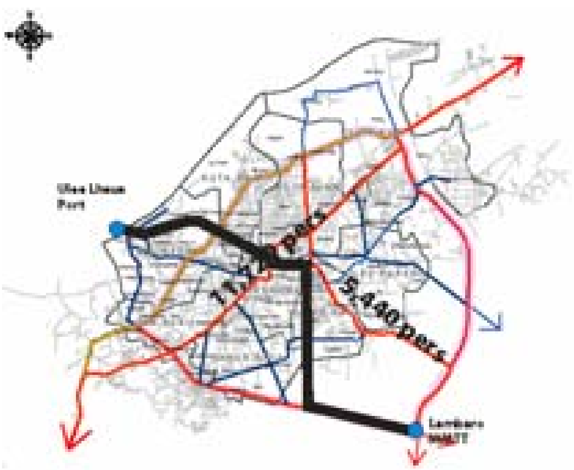
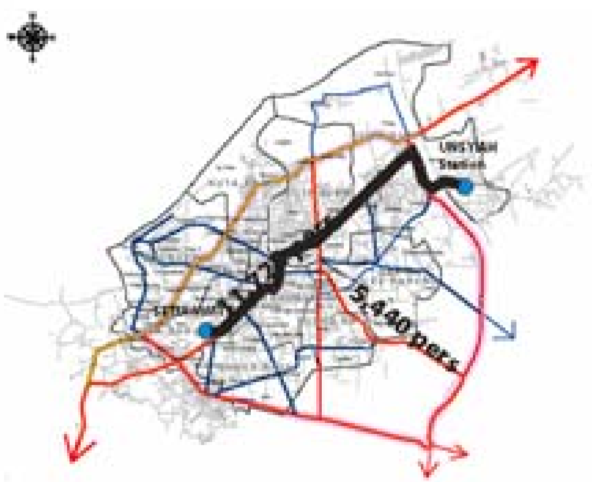


Figure 1.2.3 Corridor 2 LRT line



Source: Additional study team, 2006

b. Integration Concept with Public Transport

The LRT introduction will affect the existence of the regular public transport in two cases: route and transfer system. In case of route, it is popularly known two types of route, namely, trunk routes and feeder routes. When introducing LRT, it plays the trunk route, and the regular public transport plays the feeder route. Inter mode transfer point or terminal commonly connects those two types of route, providing passengers to access one to another.

The presence of LRT with 2 corridors must be followed by efforts to rearrange the existing public transport route by two options:

(1) Exclusive Route (option 1)

If this option is preferred, along Jl. Tengku Cut Nyak Arief, Jl. Daud Beureuh and other roads passed by LRT is only dedicated to LRT operation only. The regular public transport then will stop in each transfer points which have been provided.

The implementation of the option will have benefits and weakness and as be listed in Table. It is clear, stated in Table, that the option is not recommended as the social cost to pay is very high.

Table 1.2.1 Benefits and Weakness for the option 1

Benefits	Weakness
LRT is expected to have high load factor (LF) as passengers have no other choice instead of LRT usage	Passengers are constrained by only one choice. When the LRT headway is operated higher than normal headway (60-90 seconds), passengers will have more waiting time. This is compensated by passengers.
Complicated management can be avoided as the mode-transfer between LRT and the regular public transport is easy operable	Passenger is expected to have more times to travel from their origins to destinations they want to achieve because of the existence of mandatory mode transfer system between LRT and the regular public transport along the fixed route of LRT.
	The presence of new management that it obligates the regular public transport out of LRT route can trigger protest from the private company and may lead to an unexpected social conflict of interest.

Source: Additional study team, 2006

(2) Inclusive Route (option 2)

In spite of the exclusive option, inclusive option will remain open for the regular public transport. If this option is preferred, Jl. Tengku Cut Nyak Arief, Jl. Tengku Daud Beureuh, and other roads passed by LRT may remain open by the presence of the regular public transport. One of benefits from the option is that any possibility of social protest can be minimized. So, the option 2 is recommended to implement.

Table 1.2.2 Benefits and Weakness for the option 1

Benefits	Weakness
Passengers have much more choices. More choices mean more flexibility for passengers to use public transport services. Many choices are also valuable for passengers as they probably spend less time waiting for public transport.	LRT is expected to have less load factor (LF) as passengers have more other choices besides LRT usage
Passenger is expected to have less time to travel from their origins to destinations they want to achieve because of the absence of mandatory mode transfer system between LRT and the regular public transport along the fixed route of LRT.	Complicated management can not be avoided as the mode-transfer between LRT and the regular public transport is hardly operable
The absence of new management that it obligates the regular public transport out of LRT route can avoid protest from the private company and can eliminate an unexpected social conflict of interest.	

Source: Additional study team, 2006

Due to its benefits and causing less social cost, the option 2 is recommended to use for implementing the LRT planning in BAC.

c. Proposed LRT Types

Implementing the LRT will quietly depend on the passenger demand rate and the load capacity of the LRT itself. There are two types of the LRT in accordance with its capacity especially its line capacity, i.e. LRT Type 1 and LRT Type 2. The main difference of both types of LRT is a right of way the LRT will use. The LRT Type 1 will use a right of way that remains open by road traffic intervention, while the LRT Type 2 will use that of one without road traffic intervention.

Because of the presence the intervention by road traffic, the LRT 1 will logically have less line capacity than the LRT 2, since the line capacity is dependent on the flow rate of the LRT a day. Shortly, the intervention by road traffic will lengthen the LRT travel time along the line, subsequently causing the more headway needed by the first vehicle and its consecutive vehicle.

Even though, the LRT 1 has lower line capacity, its construction cost is presumed cheaper, since the track is shareable with road traffic, so the new structure provision can be avoided.

The LRT 1 will quietly be applicable for BAC in reason it gives space to urban development in the future that is more flexible.

d. Proposed Power Supply

LRT is commonly powered by electricity ranging from 700 to 1500 KV. The power demand could be supplied by a new power plant or can utilize the existing one if it is presumed sufficient enough in capacity as it shares with community uses.

e. Track and Road Sharing

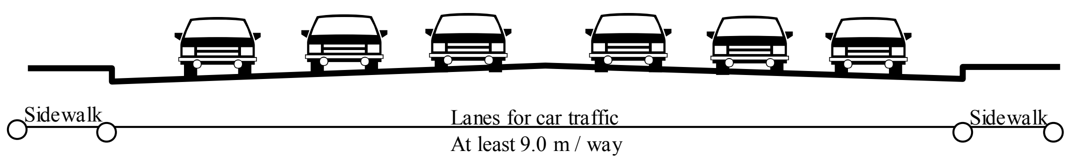
As previously has been exposed, the LRT 1 is dedicated to use track that can utilize some space of the existing road. To alleviate traffic congestion resulting in the narrowing of the road space for non train traffic, it is recommended to apply traffic demand management following the supply management that will be implemented. Out of such a problem, the space sharing between LRT track and road will remain applicable under some assumptions previously presented.

Some justifications below should follow any strategy will apply to the space sharing method. Space sharing will only apply for roads with at least 3 lanes and or 9.0 meters in width.

At which a bridge presents, the LRT track must not share width with road alignment. The track preferably uses an independence bridge. It will be unavailable if the bridge width exceeds 9.0 meters.

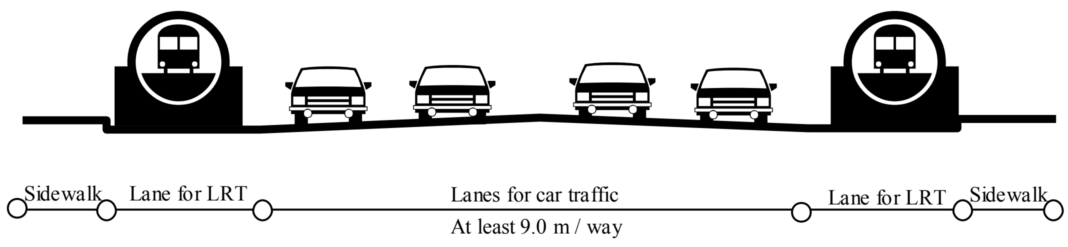
Afterward, the proposed strategy will be as depicted in Figure 4.3.7 and 4.3.8.

Figure 1.2.4 Road lanes utilization before LRT introduction



Source: Additional Study Team, 2006

Figure 1.2.5 Road and track sharing after introducing the LRT



Source: Additional Study Team, 2006

f. Headway Adjustment

Because of the normal headway will cause low load factor for MRT, it is necessary to set headway in appropriate value so the proposed MRT operation will be effective as well as efficient.

Table 4.3.7 shows the results of headway adjustment to meet the operational planning in 2015 in accordance with the prospective passenger demand. The result indicates that the lower headway seems to be economically feasible and producing some benefits. Passengers will benefit from the more choices any hour they want to access the MRT and from the minimum waiting time in station or transfer point they will spend. Operators will benefit from the total passenger they transmit a day proportional to the cost a day they have to pay for the investment value.

Table 1.2.3 Adjusted headway following the passenger demand in 2015

Description	**Vehicle Capacity (pass)**	**Adjusted Headway (minutes)**		
		Line 1	Line 2	Line 3
Light Rail Transit I	450	37,3	143,2	94,5
Light Rail Transit II	900	74,6	286,4	189,1

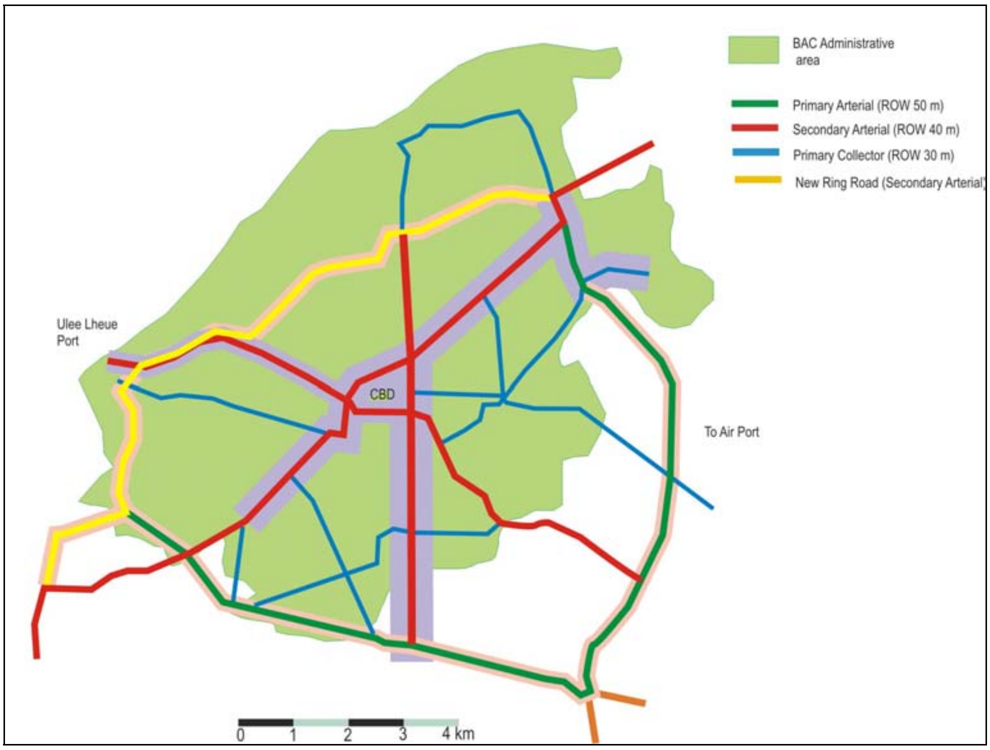
Source: Additional Study Team, 2006

1.3 ROAD DEVELOPMENT PLAN

1.3.1 BAC

a. Proposal For up to 2015

Figure 1.3.1 The new Road Hierarchy Plan Proposal (2015)



Source: Additional Study Team 2006 based on URRP study team 2004

In completion of the URRP study, another roads hierarchy plan is proposed and as presented in Figure 4.6.2. The new proposal is not largely different with the URRP result. The only differences are the coastal road alignment which is slightly adjusted following the embankment trace that is recently in construction progress; and the road hierarchy names which are adjusted to be Indonesian style.

(a) Primary system

Primary system consists of primary arterials and primary collectors networks. Links in the primary arterials connects Banda Aceh to the surrounding areas. They provide movements from Banda Aceh to the other province or regency and facilitate trough movement with bypass concept. (See green color lines in Figure).

The primary collectors link areas being the main development unit in the Banda Aceh city system. The primary collectors also provide wide range access to people from the small unit of village. (See aqua color in Figure).

(b) Secondary system

Secondary system is distinguished to be two secondary arterials and secondary collectors. Secondary arterials link medium development units. In secondary arterials, types of travel are medium speed and medium journey. They support primary system by collecting traffic from the primary collectors or from secondary collectors. (See red color line in Figure).

Secondary collectors link smaller development units. They collect trip or traffic which transport from the smaller unit of village and trip from streets.

Table 1.3.1 Roads Hierarchy and Their Characteristics

Class of road	Types of Road	Dimensions	Design speed	Width (ROW)
Class 1	Primary Arterials	6 L 2 W/D	> 70 km/hr	50 m
	Secondary Arterials	6 L 2 W/D	> 60 km/hr	40 m
Class 2	Primary Collectors	4 L 2 W/D	< 60 km/hr	30 m
	Secondary Collectors	4 L 2 W/UD	< 50 km/hr	20 m
Class 3	Primary Locals	2 L 2 W/UD	<30 km/hr	12 m

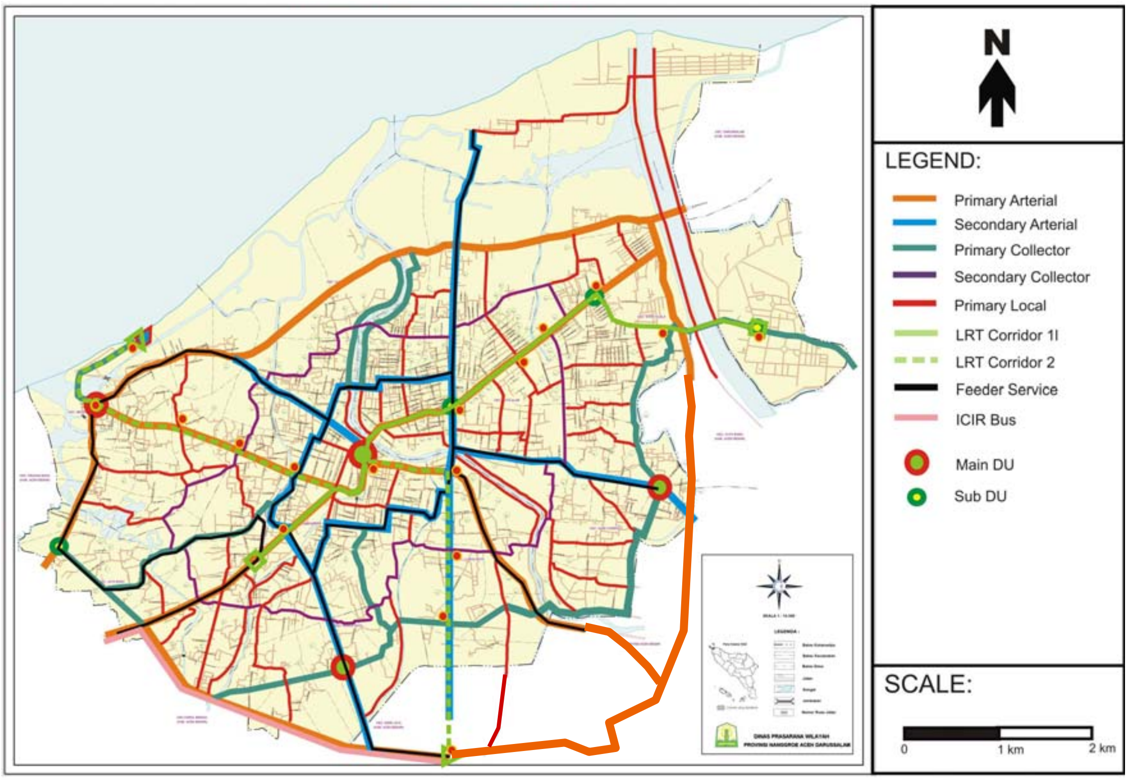
Source: Additional Study Team, 2006
Notes: L = lane, W = Way, D = Divided or Median, UD = Undivided

b. Long Term Road Network for BAC on LRT Introduction

If the proposition of LRT were realized by the government, the above road network should be aligned so it can be fit to LRT operation. Then, the complete guidelines for road network of BAC will be like in Figure. Figure tells roads in BAC are engineered in a form of concentric radial with consisting of two major rings and several nodes or centers which the main center of city is placed in the core. The core and the rings are connected with some roads forming like as a grid of spider known as the so-called grid network.

The rings concept is engineered in such a way it can work with the coming urban traffic. Suppose, when LRT is introduced in the network, and traffic need to be arranged in such a way it can support the LRT introduction. Because of the network has been prepared well, even the complex arrangement can easily be done more than ever.

Figure 1.3.2 Long Term Plan of BAC Road Network on LRT introduction



Source: Additional Study Team, 2006
Notes: Feeder service = Public transportation that support trunk service, Main DU = Main Development Unit, Sub DU = Sub Development Unit

Out of all above idealism, the network actually consists of normal road structures such as main or primary arterial highway, secondary arterials, primary collector, secondary collector, and primary local roads. In accordance with road classes, there are class I for arterials, class II for Collectors and Class III for local roads (Figure 1.1.2).

A note has been taken into account; roads which are introduced by LRT will spend one lane for LRT line.

Table 1.3.2 Road Hierarchy as presented in Figure 1.3.2

Class of road	Types of Road	Dimensions	Design speed	Width (ROW)
Class 1	Primary Arterials	6 L 2 W/D	< 70 km/hr	50 m
	Secondary Arterials	6 L 2 W/D	< 60 km/hr	40 m
Class 2	Primary Collectors	4 L 2 W/D	< 50 km/hr	30 m
	Secondary Collectors	4 L 2 W/UD	<40 km/hr	20 m
Class 3	Primary Locals	2 L 2 W/UD	<30 km/hr	12 m

Source: Additional Study Team, 2006
Notes: L= lane, W = Way, D = Divided or Median, UD = Undivided

c. Roads rehabilitation and reconstruction

It is proposed to implement the following rehabilitation and reconstruction works for road and road traffic facilities:

Table 1.3.3 Proposed Rehabilitation and Reconstruction Works for Roads and Road Traffic Facilities

No.	Works	Work Items	Features of Works
R1: Road			
R1-1	Rehabilitation of arterial road	JL. Lhoknga (including Lamjame bridge)	Road: 2.6km; Bridge: 33m
		JL. TGK. ABD Rahman Meunasah Mencab	Road: 1.6km
		JL. Iskandar Muda (including Punge I, Laguna I bridge)	Road: 3.6km; Bridge: 80m
		JL. Habib Abdurrahman (including Titi Tungkat, Laguna II bridge)	Road: 3.7km; Bridge: 56m
		JL. Syiah Kuala (including Syiah Kuala I/II bridge)	Road: 3.9km; Bridge: 43m
R1-2	Rehabilitation of sub-arterial and other roads	Roads in the city	Road: 165.1 km
R1-3	Construction of coastal road (Ring road, north part)	Road construction with bridges, road facilities and drain facilities (box culvert etc.)	Road: 14.4km, (20-25m wide, 1.5m elevation, 5-15m slope both sides), Bridge: 150m
R1-4	Extension of Jl. Syiah Kuala	Road construction	Road: 4 km
R1-5	Improvement of escape roads	Road improvement	Road: 6 km
R1-6	Completion of the ring road and construction of new arterial roads (including 3rd east-west road)	Road and bridge construction	Road: , Bridge
R2: Traffic Safety Facilities			
R2-1	Reconstruction of traffic management systems	Signals Traffic signs Road marking	9 signals 225 traffic signs 6km road marking
R2-2	Improvement of signals	Signals	28 signals
R3: Road Traffic Facilities			
R3-1	Reconstruction of bus (labi-labi) terminal	Construction of bus terminal (building, traffic management, utilities)	Area: 34,000 m^2
R3-2	Construction of vehicle inspection center, bus terminal and truck terminal		Area: 50,000 m^2
R4: Ferry Terminal			
R4-1	Reconstruction of ferry port	To be implemented by Australian Government	-

Source: URRP Study team, 2006

The preliminary cost estimate is made under the conditions and assumptions set forth below:

(1) Physical contingency and price escalation are assumed to be 10 % each of the direct construction cost.

(2) Engineering service is assumed to be 10 % of the direct construction cost for detailed study & design and construction supervision.

(3) The direct construction cost is assumed not to include the amount of VAT but import duties.

(4) Land acquisition and compensation costs are not included in the Project cost due to difficulty of estimation at this time

d. Priority for Implementation

The target years of rehabilitation and reconstruction works are set at 2006 and 2009 respectively. However there are a huge amount of works on roads, road traffic facilities and other such as ferry terminal. The works will therefore be implemented in a stage-wise way.

Table 1.3.4 Development Scenario

Priority	Stage	Proposed Works
Scenario-1 (Realistic)		
1	Rehabilitation	Rehabilitation of arterial roads and bridges
		Rehabilitation of damaged sub-arterial and other roads
2	Reconstruction	Reconstruction of road safety facilities
		Reconstruction of bus (labi-labi) terminal
3	Long term	Construction of coastal road and extension of Jl. Syiah Kuala (north-south road)
		Completion of the ring road and construction of new arterial roads
		Construction of transportation facilities
Scenario-2 (Effectiveness of Transport)		
1	Rehabilitation	Rehabilitation of arterial roads and bridges
		Rehabilitation of damaged sub-arterial and other roads
2	Reconstruction	Reconstruction of traffic management systems and transportation facilities
		Reconstruction of bus (labi-labi) terminal
		Construction of coastal road and extension of Jl. Syiah Kuala (north-south road)
3	Long term	Completion of the ring road and construction of new arterial roads

Source: URRP Study team

e. Tentative Implementation Plan

The tentative implementation plans according to the above development scenario-1 is shown in Table 1.2.5.

Table 1.3.5 Implementation Plan of Road and Transport (Development Scenario-1)

Projects/Programs		Implementation Schedule										
		Rehabilitation Stage		Reconstruction Stage			Development Stage					
		2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Road	(1) Rehabilitation of Arterial Roads and Bridges	■	■									
	(2) Rehabilitation of Sub-arterial and other roads	■	■									
	(3) Construction of coastal roads						■	■	■			
	(4) Extension of Jl. Syiah Kuala										■	■
	(5) Improvement of existing roads for Escape Roads			■								
	(6) Construction of New arterial roads									■	■	■
Traffic safety facility	(7) Reconstruction of traffic management system			■								
	(8) Improvement of signals						■					
Road traffic facility	(9) Reconstruction of bus terminal			■	■							
	(10) Construction of terminals and inspection										■	■
Ferry terminal	(11) Construction of Ulee Lheue ferry terminal			■	■	■						

Source: URRP Study team

f. Annual Fund Requirement

The annual fund requirement is estimated on the basis of the project cost estimate and implementation schedule as shown below:

Table 1.3.6 Annual Fund Requirement (Billion Rupiah)

Projects	Rehabilitation		Reconstruction			Development						Total
	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	
(1) Rehabilitation of Arterial Roads and Bridges	37.99	37.99										75.98
(2) Rehabilitation of Sub arterials and other roads	271.61	271.61										543.22
(3) Construction of (4) Coastal Road						126.27	126.27	126.27				378.8
(5) Extension of Jl. Syiah Kuala										21.935	21.935	43.87
(6) Improvement of Existing road for escape road			19.74									19.74
(7) Construction of New Arterial Roads									66.74	66.74	66.74	200.22
(8) Reconstruction of Traffic management system				4.15								4.15
(9) Improvement of signals						9.21						9.21
(10) reconstruction of Bus Terminal			31.7	31.7								63.4
(11) Constructions of Terminals and Inspection Center										46.605	46.605	93.21
(12) Construction of Ferry Terminal			22.53	22.53	22.53							67.59

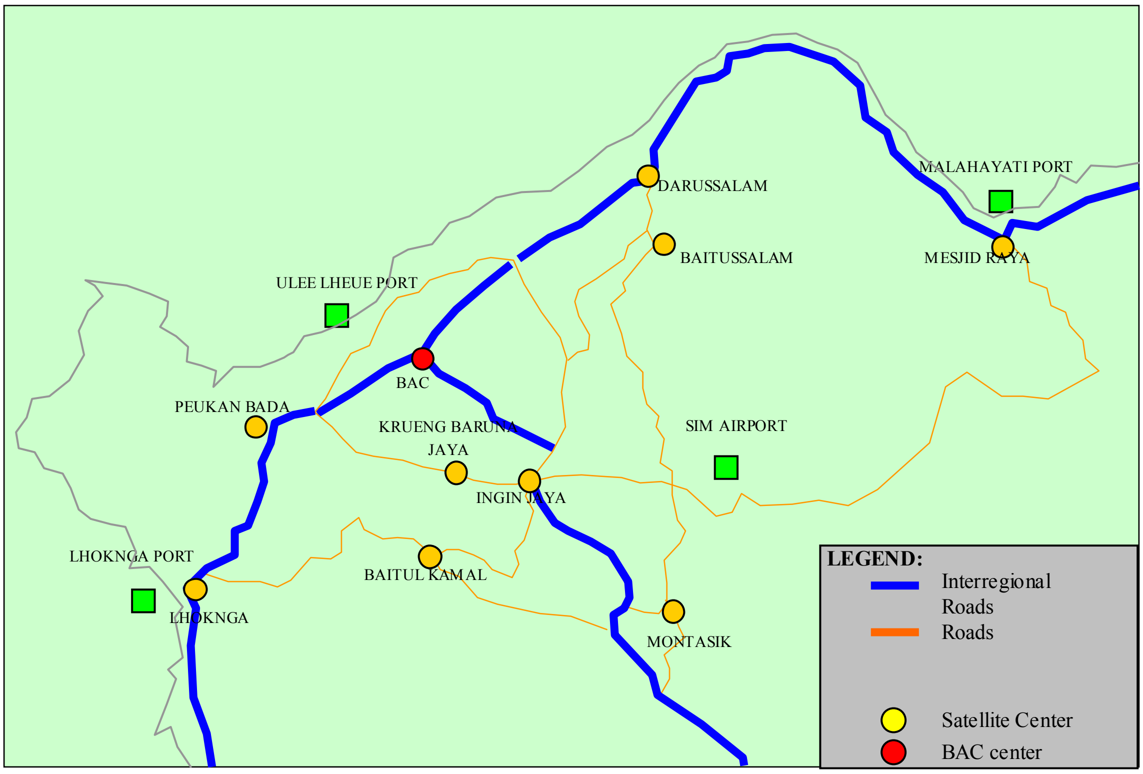
Source: URRP Study team

1.3.2 Aceh Besar

The upcoming network aims at serving all movement types both it comes from internal city generation or intercity attraction. It is obvious that the presence of interaction among cities will influence the pattern of future road network. Shortly saying that planning transportation network especially road will always considers many factors such as regional linkage, regional trip pattern, internal city generation and attraction flow, land use interaction, etc.

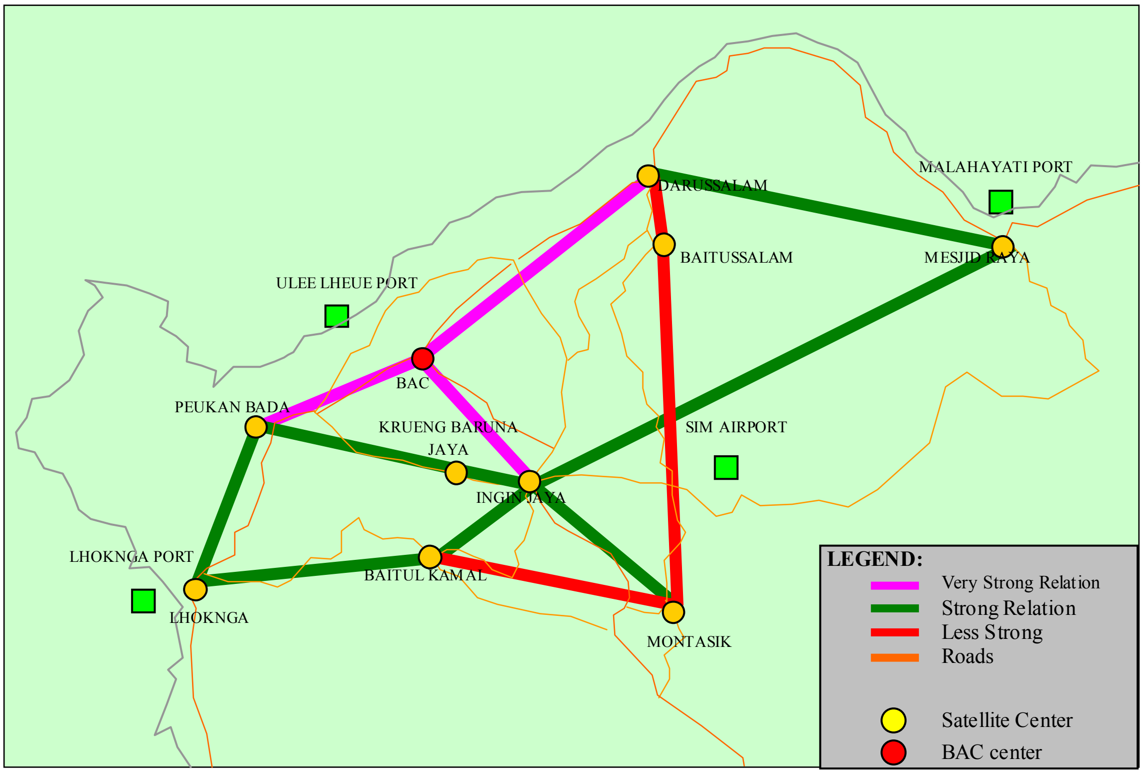
For that, it suggests at least two steps used to find out the mutual road network for coming years. The steps start from scanning regional highway connection, finding intercity linkage, overlapping both into first concept on road network, suggesting specific strategy concerning with CBD circulation pattern, and the last proposing the final road network plan.

Figure 1.3.3 Regional arterial concepts



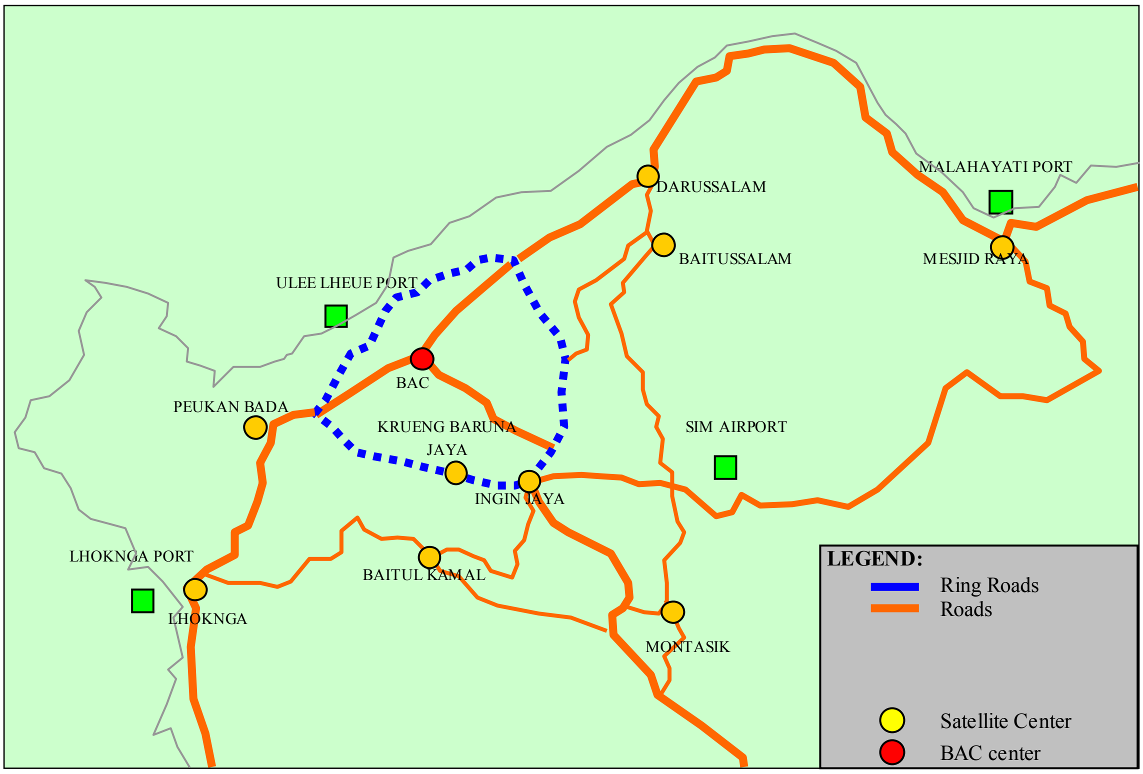
Source: Additional study team, 2006

Figure 1.3.5 Intercity Spatial Interaction Concepts



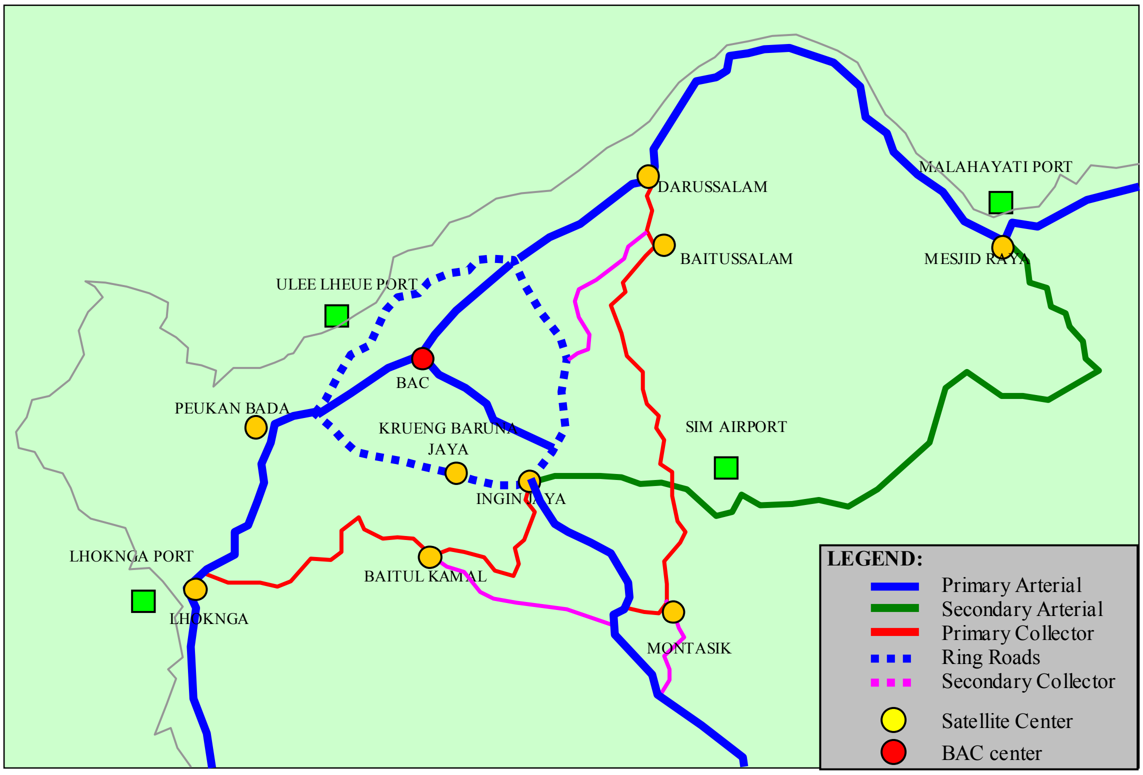
Source: Additional study team, 2006

Figure 1.3.6 Ring Roads Concepts



Source: Additional study team, 2006

Figure 1.3.7 Banda Aceh City Roads Network



Source: Additional study team, 2006

Table 1.3.10 Road classification for the proposed road network

No.	Roads	No. of Lanes	Width (m)	Frontage road	Class of Roads
1.	Primary arterial	4L2WD	50	1L/W	I
2.	Secondary arterial	4L2WD	30	1L/W	I
3.	Primary collector	4L2WUD	30	-	II
4.	Secondary collector	4L2WUD	20	-	II

Source: Additional Study Team, 2006

CHAPTER 2 DRAINAGE AND FLOOD CONTROL

2.1 REHABILITATION AND RECONSTRUCTION PLANNING FOR URBAN DRAINAGE SYSTEM FROM "URRP FOR BAC"

2.1.1 Missions, Strategies and Goals

As noted in existing drainage, substantial portion of existing drainage facilities were damaged completely. In addition, dykes and floodwalls along main rivers/floodway were broken out and/or washed away at many locations and in length. It is very serious matter how quickly such damaged/washed out/destroyed facilities could be restored in order to save people and properties against coming rainy season and high tide. In addition urban drainage system will be required to be re-organized in conformity with a new rod network and urban development plan.

Table 2.1.1 Mission, Strategy and Goals for URRP of Urban Drainage

Mission	• To ensure safety of human lives and properties • To contribute to enhancement of economic development activities without any interruption even during high tide and rainy season • To complete systematic urban drainage network over the entire city area
Strategies	• To minimize habitual inundation areas with reinforcement of drainage facilities • To layout drainage network in conjunction with urban road development plan • To remove sediment, debris and garbage deposits in conduits • To reinforce O & M capability of DPU
Goals	• To reinstall systematic drainage in devastated area by 2009 • To reinstall and reinforce drainage pump stations by 2009 • To rehabilitate broken and destroyed dyke and floodwall urgently

Source: JICA Study Team

2.1.2 Rehabilitation and Reconstruction Planning for Urban Drainage System

One of the most urgent issues is to implement urgent rehabilitation works on drainage system and dykes and floodwalls of major rivers in the city, since the city would be attacked by high tide and storm water in the later part of 2005. Although the preliminary planning of rehabilitation and reconstruction of drainage system is attempted in this report, it is important to conduct more detailed study before actual implementation of the works in framework of long-term drainage system improvement.

(1) Planning Criteria

a) General criteria

Target year	:	Rehabilitation; 2006, Reconstruction; 2009
Target area	:	Banda Aceh City with administrative area of 61 km2
Population in 2009	:	254,000 as projected under this study
Population distribution	:	As a part of urban development plan of this study
Urban development	:	As per spatial and urban development plans of this study

b) Criteria for drainage system design

Design storm rainfall	:	165 mm with a return period of 5 years
Run off calculation	:	Rat Rational formula
Run off coefficient	:	Variable, characterized by drainage area
Drainage conduit	:	Rectangular shape

(2) Approach to Planning

The rehabilitation and reconstruction plan basically follows drainage pattern and system before the disaster. However, it is necessary to slightly modify in conformity to the proposed city development plan.

Also in order to cope with the immediate problems such as marching of high tide and rainy season, it is absolutely necessary to execute countermeasures as soon as possible. The rehabilitation and reconstruction works are therefore proposed to be carried out in the priority order mentioned below.

- Priority 1 : Urgent recovery of drainage pump stations Nos.1,8,4,6 and primary drains for a length of 766 m (Drain IDs 1.3, 11.1)
- Priority 2 : Normalization of primary drains of approximately 4,620 m (Drain IDs 2.1, 4.1-2, 6.2, 7.1, 9.1-3, 9.5-6, 11.2, 12.1-3)
- Priority 3 : Rehabilitation of pumping stations Nos. 2, 3.5 and 7 and rehabilitation of primary drains for a length of 1,896 m (Drain IDs 1.1-2, 13.5-6)
- Priority 4 : Rehabilitation of primary drains for a length of 3,691 m (Drain IDs 4.1.1,4.3-,6.1,6.34,8.1)
- Priority 5 : Reconstruction of primary drain for a length of 622 m (Drain IDs 17.1-4, 19) and new drains for a length of 8,108 m (Drain IDs 1.1, 1.5, 3.5-3.7, 12.5, 14.13, 15.14, 16.1-2, 17.1-4, 19)

As reported in the preceding section of this report, there are a number of habitual inundation areas and some parts of the city area are lower than high water level of the Ache River. It is considered to be rational that drainage system is designed with a combination of drainage channels, retardation areas and pumping stations to efficiently and safely drain storm water from the land area of the city.

(3) Drainage Zones

Drainage zones remain the almost same as those before disaster. The entire drainage area is divided into three (3) zones. However the new sub-drainage areas are created, characterized by the city development plan under the current study. Those new sub-drainage areas are S14-2, S15-2, S16-2 and S17-2.

(4) Run-off

The run-off from each sub-drainage area is computed on a basis of the Rational formula and design storm rainfall as given in Table 2.1.2.

Table 2.1.2 Run-off Calculation from Each Drainage Areas

Zone	Sub Drainage	Primary Drain	Pump Station	Run-Off			
				Drain Area	Distance	Coef. of Discharge	Run-off
				(ha)	(m)	-	(m^3/s)
Zone I	1	1.1	P.3	58.00	150	0.5170	1.254
Zone I	1	1.2	P.2	53.00	200	0.5175	0.268
Zone I	1	1.3	P.1	65.50	200	0.5585	1.205
Zone I	1	1.4		29.50	150	0.5755	0.481
Zone I	2	2.1		130.00	400	0.5095	1.571
Zone I	3	3.1		41.00	1,300	0.5085	0.576
Zone I	3	3.2		75.50	600	0.5335	2.613
Zone I	3	3.3.		223.00	650	0.5190	6.484
Zone I	3	3.4		58.00	280	0.5410	1.406
Zone I	3	3.5	P.8		0.00		
Zone I	4	4.1		47.00	325	0.5075	1.832
Zone I	4	4.1.1		35.00	275	0.4930	
Zone I	4	4.2		39.50	250	0.4745	1.291
Zone I	4	4.3		29.00	250	0.4850	0.787
Zone I	4	4.4		44.00	275	0.4890	1.410
Zone I	5	5.1		77.50	200	0.4335	2.110
Zone I	5	5.2		30.00	275	0.5059	1.000
Zone I	5	5.3		56.00	400	0.4990	0.500
Zone I	5	5.4		50.50	350	0.5150	0.240
Zone I	5	5.5		110.00	150	0.5365	2.130
Zone I	6	6.1		40.50	200	0.5100	4.680
Zone I	6	6.2		125.50	550	0.5070	1.621
Zone I	6	6.3		57.00	370	0.4895	0.940
Zone I	6	6.4		75.00	350	0.4850	1.490
Zone II	7	7.1		65.00	275	0.4475	0.945
Zone II	8	8.1		90.00	200	0.4700	1.340
Zone II	9	9.1		127.00	2	0.4610	1.223
Zone II	9	9.2		45.00	500	0.4745	1.128
Zone II	9	9.3		60.00	200	0.4685	0.854
Zone II	9	9.4		53.00	200	0.4700	0.920
Zone II	9	9.5		19.00	250	0.4700	0.552
Zone II	9	9.6		50.00	420	0.4640	1.015
Zone II	10	10.1		41.00	2	0.5035	1.138
Zone II	11	11.0		54.00	300	0.5155	0.840
Zone II	11	11.1	P.4	34.00	300	0.5100	1.480

Zone	Sub Drainage	Primary Drain	Pump Station	Run-Off Drain Area (ha)	Distance (m)	Coef. of Discharge -	Run-off (m^3/s)
Zone II	11	11.2		335.00	700	0.4850	6.116
Zone II	11	11.3		19.00	220	0.4025	0.551
Zone III	12	12.0		58.00	450	0.5120	2.351
Zone III	12	12.1		150.00	50	0.5125	0.593
Zone III	12	12.2		24.00	100	0.5060	1.578
Zone III	12	12.3		38.50	175	0.4930	1.880
Zone III	12	12.4		33.00	250	0.5035	1.581
Zone III	13	13.1	P.6	45.00	100	0.5540	2.628
Zone III	13	13.2		16.00	100	0.5660	1.118
Zone III	13	13.3		26.50	400	0.3835	0.129
Zone III	13	13.4		28.50	350	0.5165	0.684
Zone III	13	13.5	P.5	43.00	500	0.5215	0.539
Zone III	13	13.6	P.7	50.00	150	0.5245	2.552
Zone III	14	14.1		45.50	300	0.5105	3.200
Zone III	15	15.1		45.00	100	0.4934	1.780
Zone III	15	15.2		27.00	150	0.5070	0.841
Zone III	15	15.3		85.00	425	0.4975	1.880
Zone III	16	16.1		180.00	200	0.3810	3.251
Zone III	17	17.1		41.50	200	0.4250	0.710
Zone III	17	17.2		20.50	100	0.5170	1.058
Total	-	-		3,499.00	-	-	82.34

Source: Additional study team, 2006

5) Preliminary Design

Primary Drains and Pumping Stations

The discharge capacity of existing primary drains and pumping stations was firstly assessed whether they are capable of draining the discharge of their drainage area. Table 2.1.3 summarizes the comparison of the computed discharge and drainage capacities of pumps and drains.

Table 2.1.3 Capacities of Existing Drainage Facilities vs Run-off

Sub-drainage areas	Name	Drain to:	Run-off (m^3/s)	Discharge Capacity of Drain (m^3/s)	Pumping Capacity (m^3/s)
1.3	P.1	Aceh River	1.205	1.082	0.245
1.2	P.2	Aceh River	0.268	0.470	0.200
1.1	P.3	Aceh River	1.254	0.357	0.270
11.1	P.4	Daroy River	1.480	1.099	0.745
13.5	P.5	Doy River	0.539	0.51	0.824
13.1	P.6	Doy River	2.628	0.512	0.225
13.6	P.7	Doy River	2.552	4.022	0.200
3	P.8	Titi Panjang	11.080	0.686	0.225

Source: JICA Study Team

Of the existing 8 pumping stations, 7 stations have less capacity than the required drainage quantity. Also it is assessed that existing drains are not capable of conveying storm run-off so that excess water should be absorbed in retardation basins. Table 2.1.4 summarizes drainage facilities proposed for rehabilitation and reconstruction plan.

Table 2.1.4 Summary of Rehabilitation and Reconstruction Plan for Urban Drainage

Term	Rehabilitation Stage	Zone	Sub Drainage	Primary Channel	Pump No.	Run-Off		Pumping Facilities	Primary Channel				Water Gates			Retarding Ponds	
						Drainage Area	Run-Off		Total Length	Damaged Length	Damaged Ratio	New Channels	Total Gates	Damaged Gates	Damaged Ratio	Dimension	Volume
						(ha)	(m3/s)	(m3/s)	(m)	(%)	(%)	(m)	-	-	(%)	(m)	(m3)
Urgent Recovery	1	Zone I	1	1.3	P.1	65.50	1.205	1.205	950	500	53	0	4	4	100	-	0
		Zone I	3	3.5	P.8	0.00	0.000	11.079	250	0	0	0	0	0		240X120X3.5	540,000
		Zone II	11	11.1	P.4	34.00	1.480	1.480	700	266	38	0	2	0	0	-	0
		Zone III	13	13.1	P.6	45.00	2.628	2.628	225	0	0	0	1	0	0	-	0
	2	Zone I	2	2.1	-	130.00	1.571	-	1,225	490	40	0	2	2	100	-	0
		Zone I	3	3.1-4	-	397.50	11.079	-	5,025	0	0	0	3	2	67	-	0
		Zone I	4	4.1-2	-	86.50	3.123	-	1,475	265	37	0	2	0	0	-	0
		Zone I	6	6.2	-	125.50	1.621	-	1,725	1,670	97	0	2	0	0	-	0
		Zone II	7	7.1	-	65.00	0.945	-	1,363	1,363	100	0	6	0	0	-	0
		Zone II	9	9.1-3,5-6	-	301.00	4.772	-	3,575	293	24	0	12	2	17	-	0
		Zone II	10	10.1	-	41.00	1.138	-	1,500	0	0	0	1	0	0	-	0
		Zone II	11	11.2	-	335.00	6.116	-	1,750	280	16	0	2	4	200	-	0
		Zone III	12	12.1-3	-	212.50	4.051	-	2,075	259	35	0	3	0	0	500X50X3	75,000
		Zone III	13	13.2-4	-	71.00	1.931	-	1,887	0	0	0	5	0	0	-	0
Rehabili -tation	3	Zone I	1	1.1-2	P.2,3	111.00	1.522	1.522	950	850	177	0	4	4	100	-	0
		Zone III	13	13.5-6	P.5,7	93.00	3.091	3.091	1,348	1,046	142	0	9	0	0	-	0
	4	Zone I	1	1.4	-	29.50	0.481	-	575	0	0	0	5	3	60	-	0
		Zone I	4	4.1,1.3-4	-	108.00	2.197	-	1,285	454	70	0	0	0		-	0
		Zone I	5	5.1-5	-	324.00	5.980	-	5,270	0	0	0	0	0		-	0
		Zone I	6	6.1,3-4	-	172.50	7.110	-	4,005	1,948	171	0	3	0	0	-	0
		Zone II	8	8.1	-	90.00	1.340	-	1,289	1,289	100	0	0	0		-	0
		Zone II	9	9.4	-	53.00	0.920	-	1,000	0	0	0	1	1	100	-	0
		Zone II	11	11.0,3	-	73.00	1.391	-	1,760	0	0	0	6	0	0	-	0
		Zone III	12	12.0,4	-	91.00	3.930	-	2,365	0	0	0	0	0		-	0
Recons -truction	5	Zone I	1	1.1,1.5	-	0.00	0.000	-	0	0	0	440	0	0		-	0
		Zone I	3	3.5-7	-	0.00	0.000	-	0	0	0	1,920	0	0		-	0
		Zone III	12	12.5	-	0.00	0.000	-	0	0	0	500	0	0		-	0
		Zone III	14	14.1-3	-	45.50	3.200	-	840	0	0	1,020	12	4	33	-	0
		Zone III	15	15.1-4	-	157.00	0.000	-	4,150	0	0	820	5	0	0	-	0
		Zone III	16	16.1-2	-	180.00	3.251	-	975	0	0	680	4	4	100	-	0
		Zone III	17	17.1-4,4.19	-	62.00	1.768	-	1,825	0	0	2,728	4	0	0	-	0
Total	-	-	-	-	-	3,499.00	77.843	21.005	51,362	11,595	23	8,108	98	30	31	-	615,000

Source : JICA Study Team, 2005

Retardation Areas

It is proposed to create the retardation ponds at two (2) locations: one is at Pump Station No.8 with a storage capacity of 540,000m3 and the other is in Sub-drainage 12 with a storage capacity of 75,000m^3.

(6) Preliminary Cost Estimate

The rehabilitation and reconstruction cost is roughly estimated as shown in Table 2.1.5 on the basis of experiences of the similar works.

Table 2.1.5 Preliminary Cost Estimate

Proposed Project/Program	Works	Total (Billion Rupiahs)
A. Projects	(1) Urgent Recover (Priority 1 and 2)	130.28
	(2) Rehabilitation Works (Priority 3 and 4)	49.40
	(3) Reconstruction Works (Priority 4)	177.97
	(4) Rehabilitation and reconstruction of dykes and floodwall along major rivers	95.00
	Total	452.65

Source: JICA Study Team, 2005

The cost estimated is also based on the following conditions and assumptions:

- Land acquisition and compensation cost is not included.
- The direct construction cost is assumed to include the amount of VAT but not to include import duties.
- The physical and price contingencies are assumed to be 10 % of the direct construction cost, respectively.
- The engineering service for design and construction supervision is assumed also to be 10 % of the direct construction.

2.2 DRAINAGE PLAN OF “RIVER AND COASTAL MANAGEMENT PROJECT (RCMP)”

2.2.1 Problem Solving Concept

To handle the flood and/or inundation problems in Banda Aceh City, there must be an integrated, effective, and efficient problem solving concept. The concepts are :

- Floodway in southern BAC, which divert flood volume and protect BAC from the flood overflow from the higher ground area, directed into Kr. Raba
- The city drainage system must be functioned as the collector drain and long storage, that they will be able to intercept and retain the water volume/flood in the water tide.

- To optimize/normalize the river according to the city river system and drainage plan.
- The building of retarding basin and retarding pond supported with water pump system.
- To secure the river bank area and to reduce the flood water volume (surface overflow) by managing the water overflow volume to be absorbed into the ground.

2.2.2 City Flood Control and Drainage Management

a. Flood Control Plan

Based on the flood/inundation problem solving concept, the flood management shall involve efforts as follow:

(1) Building the flood canal in the south side of the Banda Aceh City (Floodway) to direct the flood water out of the inner city rivers that usually cause flood/inundation.

The floodway are:

Table 2.2.1 Flood Canal Plan in the Southern BAC

No	River	Width (m)	Right & Left Riverbanks (m)	Length (km)	Q_5 (m^3/sec)	Q_{10} (m^3/sec)
1	Kr. Titi Paya – Kr. Kon Keumeh	20	5	3,895	117,5	148,64
2	Kr. Kon Keumeh – Kr. Lhueng Paga	20	5	3,270	123,4	175,44
3	Kr. Lhueng Paga – Kr. Daroy	33	5	2,444	187,82	269,05
4	Kr. Daroy – Tunnel width 50 m	50	5	1,116	278,31	411,74
5	Tiga Tunnel	10	-	800	-	-
6	Outlet Tunnel – Width 58 m	10 - 58	5	3,498	337,807	485,31

Source: Proyek Pengendalian Sungai dan Pengendalian Pantai, Provinsi NAD

(2) Inner city river normalization for the river that usually cause inundation.

River normalization includes:

Table 2.2.2 River Normalization Plan

No	River	Length (km)	Width (m)	Dyke Gradient	River Gradient	Discharge Capacity (m^3/sec)	Flood Volume for Each Recurring Interval
1	Kr. Daroy	3.05	20	0.5	0.00025	from 10 becomes 102	25 years
2	Kr. Neng	0.98 1.6 11	5 7 11	0.5	0.00055	from 2 becomes 47.33	5 years
3	Kr. Lhueng Paga (upstream)	3.62	10	0.5	0.001	from 12 becomes 111.43	25 years

Source: River and Coastal Flood Control Study, 2003

b. City Main Drainage Management Plan

The city drainage management plan includes:

(1) The drainage system of Banda Aceh city divide in 7 Zone main drainage management. Zone boundary:

- Zone 1, bordered by Kr. Neng and Kr Doy
- Zone 2, bordered by Kr. Aceh and Kr. Doy
- Zone 3, bordered by Kr. Kr Aceh
- Zone 4, bordered by Kr. Daroy and Kr. Lhueng Paga
- Zone 5, bordered by Kr. Titi Panjang and Kr. Cut
- Zone 6, bordered by Kr. Lhueng Paga and Kr. Tanjung
- Zone 7, bordered by Kr. Aceh and Kr. Cut

(2) Building saline water dyke barrier in the coastal area to prevent the sea water tide to permeate to the upland (construction by BRR).

(3) Building the water gate, retarding pond, and water pump on the tunnel outlet to be use as the main drainage tunnel.

The water gate and water pump arrangement shown in the table bellow:

Table 2.2.3 The water gate, retarding pond and water pump arrangement plan

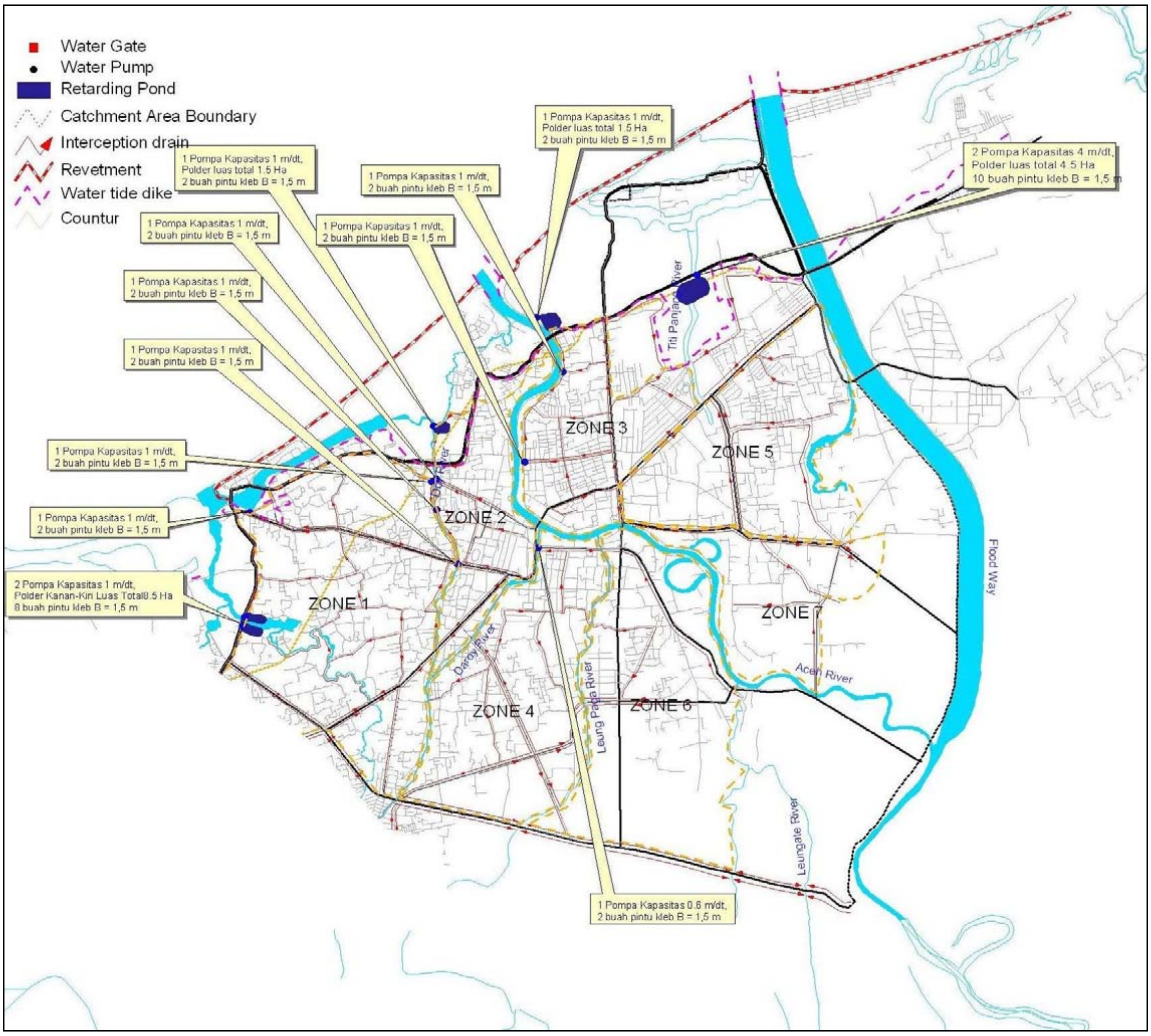
No	Location	Retarding Pond (Ha)	Watergate		Pump	
			Unit	Width (m)	Unit	Capacity (m^3/sec)
1	**Outlet Zone 1**					
	Ujung Kr. Neng	8.5	8	1.5	2	4
	Outfall in Ulee Lheu area	-	2	1.5	1	1
	Outlet in Kr. Doy	-	2	1.5	1	1
2	**Outlet Zone 2** (4 outlets, interconnected long storage)					
	Outlet 1	-	2	1.5	1	1
	Outlet 2	-	2	1.5	1	1
	Outlet 3	-	2	1.5	1	1
	Outlet 4 (Lampaseh area)	1.5	2	1.5	1	1
3	**Outlet Zone 3** (4 outlets, interconnected long storage)					
	Outlet 1	-	2	1.5	1	1
	Outlet 2	-	2	1.5	1	1
	Outlet 3 (Lampulo area)	1.5	2	1.5	1	1
4	**Outlet Zone 4**					

No	Location	Retarding Pond (Ha)	Watergate		Pump	
			Unit	Width (m)	Unit	Capacity (m^3/sec)
	Outlet (long storage)	-	2	1.5	1	0.6
5	**Outlet Zone 5**					
	Outlet Kr. Titi Panjang	4.5	10	1.5	2	4
6	**Outlet Zone 6**	-	-	-	-	-
7	**Outlet Zone 7**	-	-	-	-	-

Source: River and Coastal Flood Control Study, 2003

The Banda Aceh City drainage management from The River Management and Coastal Management Project is shown in Figure 2.2.1.

Figure 2.2.1 Banda Aceh City Drainage Management Plan



Source: PT Wahana, PT Global

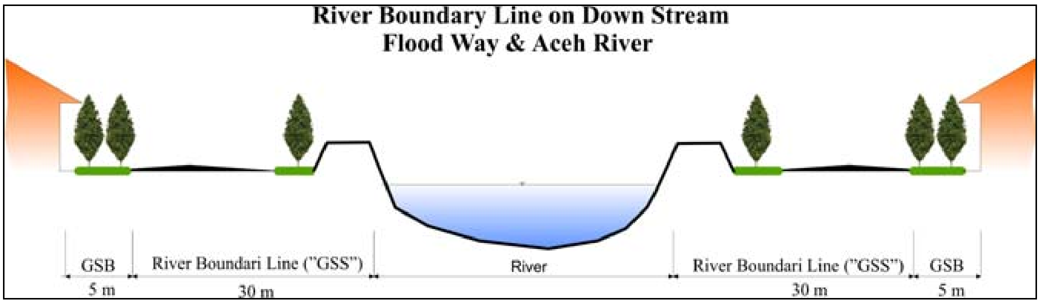
2.2.3. Conservation

Besides the drainage network and system plan, it is also necessary to reduce run-off volume (surface overflow), ground water conservation and river bank protection. The management can be done in several ways:

(1) River Boundary Line ("GSS") and Coastal Boundary Line

The designated river boundary line for Floodway and Aceh River (as Flood Management River) is 30 m to the right and left. The cross-section is illustrated in Figure 2.2.2

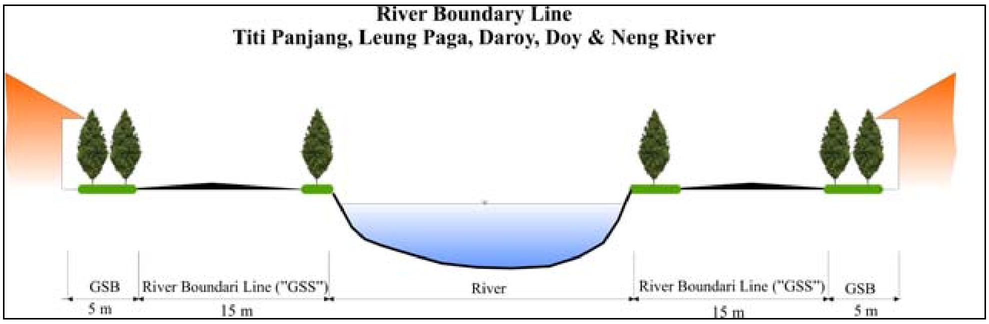
Figure 2.2.2 River Boundary Line of Floodway & Aceh River



Source: Additional study team, 2006

The designated river boundary line for Titi Panjang, Leung Paga, Daroy, Doy and Neng Rivers (as city main drainage) is 15 at minimum to the right and left, as illustrated in Figure 2.2.3.

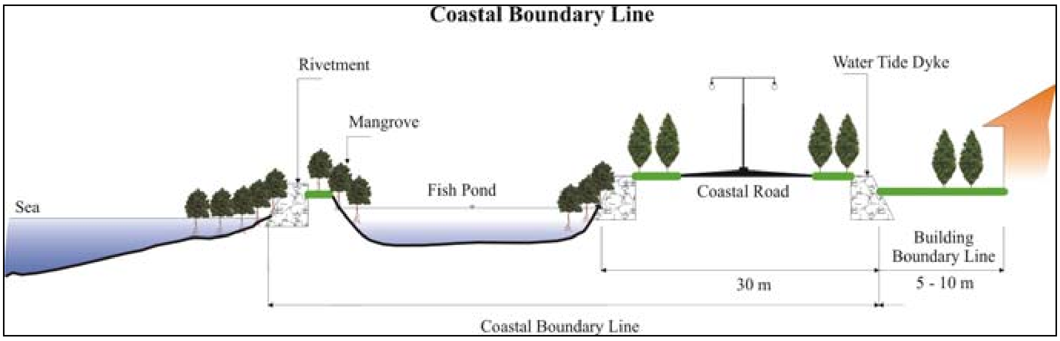
Figure 2.2.3 River Boundary Lines of Titi Panjang, Leung Paga, Daroy, Doy & Neng Rivers



Source: Additional study team, 2006

Coastal Boundary Line is planned proportional to coast shape and conditions (from outer shoreline to tidal dyke or coastal road)

Figure 2.2.4 Coastal Boundary Line



Source: Additional study team, 2006

(2) Absorb well.

It is used to reduce flood debit and increase ground water conservation by absorbing rainwater into the ground.

(3) Urban forest

It is also utilized to increase ground water conservation. Urban forest is planned in accordance with land use plan in this study.

(4) Check dam

It is mainly used to reduce the sedimentation in the river downstream area.

(5) Land conservation in upstream area through existing forest preservation as water absorbent location.

(6) Preserving swamp/fishpond interception and retention area.

2.3 PRELIMINARY COST AND TENTATIVE IMPLEMENTATION

2.3.1 Based on URRP

a. Preliminary Cost Estimate

The rehabilitation and reconstruction cost is roughly estimated as shown in Table 4.6.6, on the basis of experiences of the similar works.

Table 2.3.1 Preliminary Cost Estimate

Proposed Project/Program	Works	Amount (billion rupiahs)
A. Projects	(1) Urgent Recover (Priority 1 and 2)	130.28
	(2) Rehabilitation Works (Priority 3 and 4)	49.40
	(3) Reconstruction Works (Priority 4)	177.97
	(4) Rehabilitation and reconstruction of dykes and floodwall along major rivers	95.00
	Total	452.65

Source: JICA Study Team, 2005

The cost estimated is also based on the following conditions and assumptions:

- Land acquisition and compensation cost is not included.
- The direct construction cost is assumed to include the amount of VAT but not to include import duties.
- The physical and price contingencies are assumed to be 10 % of the direct construction cost, respectively.
- The engineering service for design and construction supervision is assumed also to be 10 % of the direct construction.

b. Implementation Schedule

It is proposed the proposed plan will be implemented along with the following schedule:

Table 2.3.2 Tentative Implementation Schedule

	Implementation Schedule				
	Rehabilitation Stage		Reconstruction Stage		
	2005	2006	2007	2008	2009
(1) Urgent Recover (Priority 1 and 2)					
(2) Rehabilitation Works (Priority 3 and 4)					
(3) Reconstruction Works (Priority 4)					
(4) Rehabilitation and reconstruction of dykes and floodwall along major rivers					

Source: JICA Study Team

c. Annual Fund Requirement

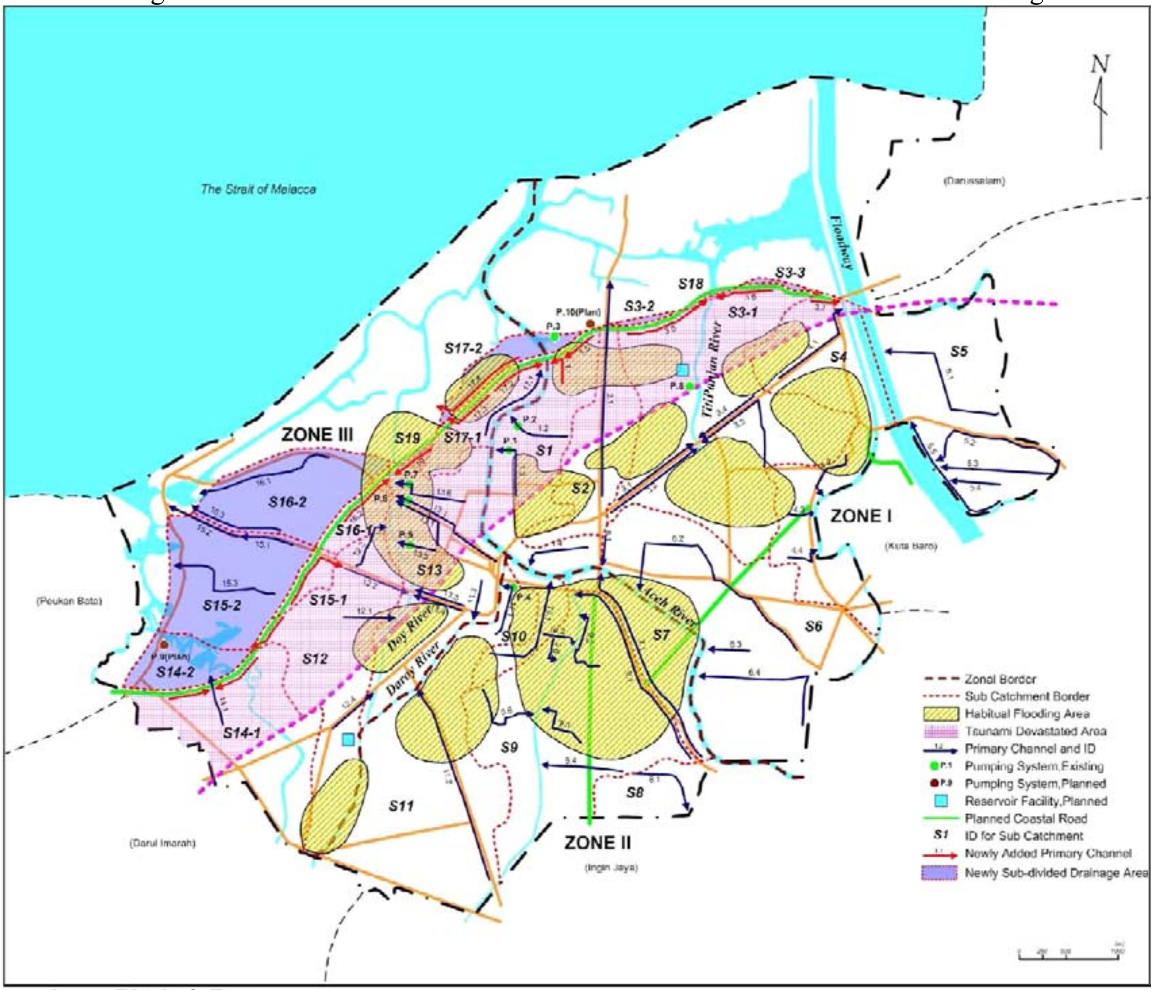
In accordance with the preliminary project cost estimate and tentative implementation schedule as presented above, annual fund requirement for Drainage System is set as follows:

Table 2.3.3 Annual Fund Requirement for Drainage System (Rp. billion)

Projects/Program	Rehabilitation		Reconstruction			Long-term	Total
Project	2005	2006	2007	2008	2009	2010/15	
Urgent Recovery (Priority 1 and 2)	32,569	65,138	32,569				130.28
Rehabilitation Works (Priority 3 and 4)		14,820	34,580				49.40
Reconstruction (Priority 5)			35,594	71,188	71,188		177.97
Rehabilitation and reconstruction of dykes and floodwall along major rivers/floodway	28,500	66,500					95.00
Total	61,069	146,458	102,743	71,188	71,188		452.65

Source: JICA Study Team

Figure 2.3.1 Outline of Rehabilitation and Reconstruction Plan for Urban Drainage



Source: JICA Study Team

2.3.2 Based on RCFC

a. Preliminary project cost estimate

The rehabilitation and reconstruction cost was estimated based on data and information made available from DPU. Preliminary project cost for the urgent rehabilitation and reconstruction works proposed in this study is estimated based on the following conditions and assumptions, however, these are subject to change due to finalization on the Indonesian authorities.

The project cost estimation is based on the advance programs arranged in URRP for BAC. The preliminary cost estimate of flood control and drainage improvement is shown in Table 4.6.12.

Table 2.3.4 Preliminary Cost Estimate of Flood Control

Components	**Cost Items**	**Task**	**Amount (million rupiahs)**
Planned Floodway in southern BAC	Direct construction cost	From Kr. Titi Paya to Kr. Kon Keumeh	12,854
		From Kr. Kon Keumeh to Kr. Lhueng Paga	10,791
		From Kr. Lhueng Paga to Kr. Daroy	12,831
		From Kr. Daroy to Tunnel, width 50 m	8,705
		Tunnel Three	1,440
		From Outlet Tunnel to Floodway, 58 m wide	18,889
	Physical contingency		6,551
	Price escalation		6,551
	Engineering services		6,551
		Subtotal	85,162
River Normalization		Kr. Daroy	6,710
		Kr. Neng	13,310
		Kr. Lhueng Paga (upstream)	3,982
	Physical contingency		2,400
	Price escalation		2,400
	Engineering services		2,400
		Subtotal	31,203
Total			116,365

Source: Additional Study Team, 2006

d. Tentative Implementation Plan

The implementation schedule of flood control plan is set up as shown in Figure …..

Table 2.3.5 Tentative Implementation Schedule for Urban Drainage Sector

Description	2010	2011	2012	2013	2014	2015
Flood Canal Plan in the south part of BAC	▬	▬	▬	▬	▬	▬
River Normalization	▬	▬				

Source: Additional Study Team, 2006

e. Annual fund requirement

The annual fund requirement is estimated based on the project cost estimate and implementation schedule as shown below:

Table 2.3.6 Annual Fund Requirement for flood control

Components	(unit: million rupiahs)					
	2010	**2011**	**2012**	**2013**	**2014**	**2015**
Construction of Floodway in southern part of BAC	16,710	14,028	16,680	11,316	1,872	24,556
River normalization	8,723	17,303	5,177			
Total	25,433	31,331	21,857	11,316	1,872	24,556

Source: Additional Study Team, 2006