PART 2

Urban Development Plans for Target Three Cities

Part 2: Urban Development Plans for Target Three Cities

The urban development plans for target three cities are written from the next pages in order of followings;

- Mandalay 2040 (the page sub-number is “2-MDY-xx”)
- Pathein 2040 (the page sub-number is “2-PTN-xx”)
- Mawlamyine 2040 (the page sub-number is “2-MWM-xx”)

Urban Development Plan for Mandalay 2040

Urban Development Plan for Mandalay 2040

1 Introduction and Planning Framework

1.1 Background of the Plan

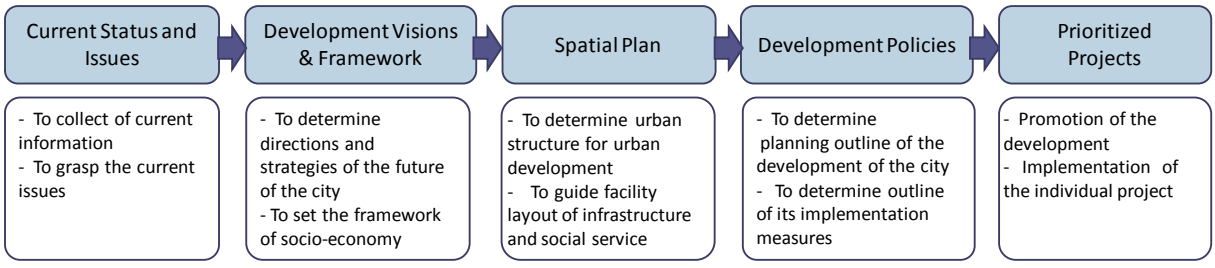
- Due to the promotion of economic deregulation after shifting the policy to emphasize reforms on international relations and economy since 2011, Myanmar has been more powerful as a new investment frontier in Asia as well as worldwide. Myanmar's gross domestic product (GDP) per capita is estimated to reach the level of middle-income countries by 2030 in case economic reforms and foreign direct investments continue steadily.
- The Government of Myanmar formulated the "National Comprehensive Development Plan (NCDP)" in 2014 through the Ministry of National Planning and Economic Development, which indicates the development policies of the whole country and presents the guidelines of comprehensive development of all sectors and strategic national development goals.
- In parallel, the Ministry of Construction (MOC) has been preparing the "Urban and Regional Development Planning Law" to be enacted soon in 2016 in order to support formulating urban development plans within the country systematically and to enforce management system in implementing the plans for local authorities.
- To accelerate economic development in the whole country, Mandalay shall be definitely required to have important role as a national growth center with Yangon. To promote the required roles, it is urgent to clarify the future development vision, to formulate the urban development plan of Mandalay, and share the plan with the citizens.

1.2 Objectives of the Plan

- The primary objectives of the urban development plan of Mandalay 2040 are as follows:

  a) To present development visions and strategies with spatial and structure plan for the target year of 2040,
  b) To present urban and infrastructure development policies for the realization of the development visions, and
  c) To propose a roadmap of key projects.

- The main items and flow of the urban development plan are shown in Figure 1.2.1.

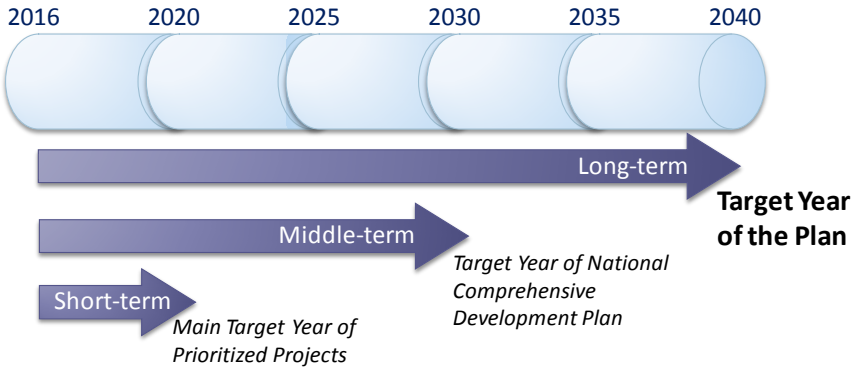


Source: JICA Study Team

Figure 1.2.1 Main Items and Flow of the Urban Development Plan

1.3 Target Year

- The target year of the plan is set at 2040. Benchmarks are also set in 2030 as middle-term and in 2020 as short-term, as shown in Figure 1.3.1.



Source: JICA Study Team

Figure 1.3.1 Target Year of the Urban Development Plan

1.4 Target Area

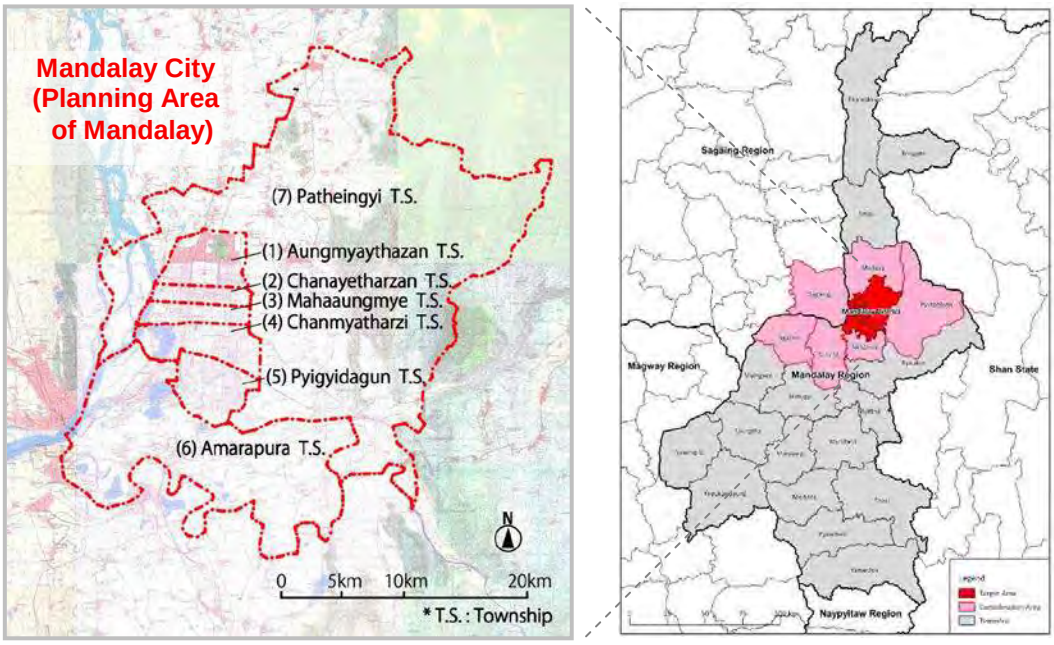
- Mandalay is located in the middle of Myanmar, which is about 390 km north of Nay Pyi Taw and about 700 km north of Yangon. Mandalay District, corresponding to Mandalay City Development Committee (MCDC) management area, is about 900 km^2 which stretches 46 km east-west and 40 km north-south.

- The planning area of Mandalay (hereafter referred as "Mandalay City") consists of all seven townships, namely: Aungmyetharzan, Chanayetharzan, Mahaaungmye, Chanmyatharzi, Pyigyidagun, Amarapura, and Patheingyi Township belonging to Mandalay District, Mandalay Region. The total area is approximately 900 km^2. The names and areas of the target townships, and their maps are shown in Table 1.4.1 and Figure 1.4.1, respectively.

Table 1.4.1 Name and Area of Townships of Planning Area of Mandalay

Township	Area (km^2)
Aungmyetharzan	28.6
Chanayetharzan	13.1
Mahaaungmye	14.8
Chanmyatharzi	25.8
Pyigyidagun	25.6
Amarapura	207
Patheingyi	594
Total	909

Source: MOC Conceptual Plan and JICA Study Team



Source: JICA Study Team

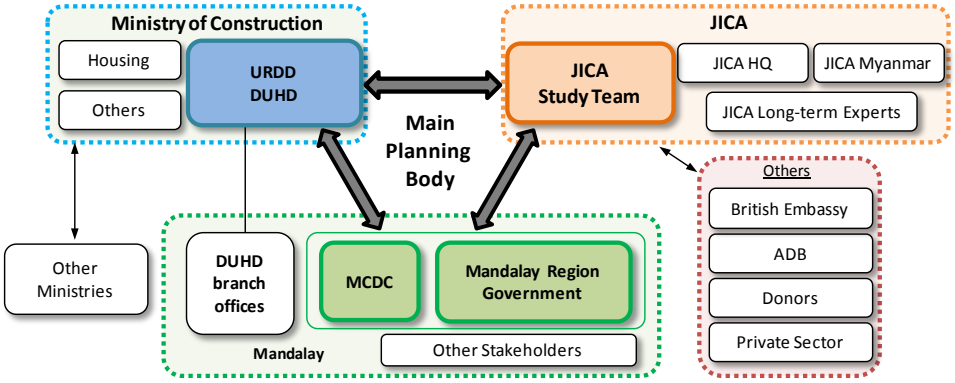
Figure 1.4.1 Planning Area of Mandalay

- Taking a broad view (large-scale view) is also necessary to identify the linkage of individual city with its surrounding cities from various viewpoints especially in terms of its geographical feature, and transportation and logistics function. The broad view including the surrounding areas, namely: Tada-U Township and Ngazun Township in the southwest, Sintgaing Township in the south, Pyinoolwin Township in the east, Madaya Township in the north, and Sagaing Township in the west, is considered.

1.5 Planning Organizations and Process

- The urban development plan of Mandalay City was made through close cooperation of MCDC, Mandalay Region Government, Urban Regional Development Division (URDD) of the Department of Urban and Housing Development (DUHD) under the Ministry of Construction (MOC), and the Japan International Cooperation Agency (JICA) Study Team, based on the existing conceptual plans.

- Additionally, stakeholders participated in the planning works through the discussions in a series of workshop meetings. Necessary information inputs from relevant ministries and opinions from stakeholders were also collected for an appropriate planning process. Figure 1.5.1 shows the planning organizations.



Source: JICA Study Team

Figure 1.5.1: Planning Organizations

- The plan was formulated with public involvement in its planning process. There are two types of meetings as follows:
  - Workshop Meeting: to discuss with the counterpart (C/P) and related organizations; and
  - Seminar: to collect opinions of various stakeholders such as representatives of local communities.

- The planning process is shown in Figure 1.5.2. Results of the workshops and seminars are summarized in Appendix-A.

Source: JICA Study Team

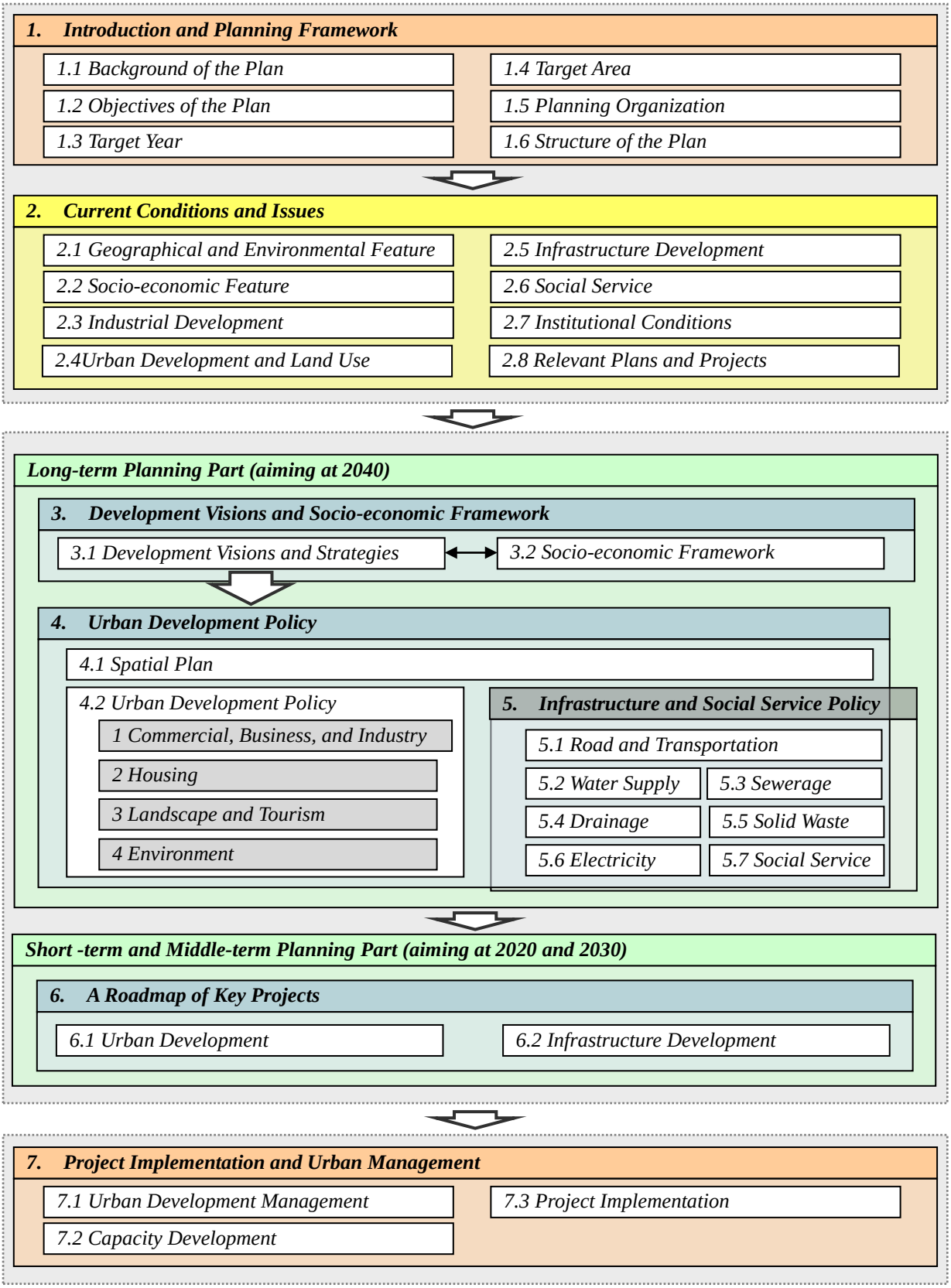
Figure 1.5.2: Public Involvement in the Planning Process

1.6 Approval of the Plan

- According to the drafted "Urban and Regional Development Planning Law" examined by MOC, the city conceptual plan is defined to be formulated by MOC (union ministry) and submitted to the National Urban and Housing Development Central Committee. In line with this regulation, this plan shall be approved at the national level with the consensus of the regional government.

1.7 Structure of the Plan

- Referring to the existing conceptual plans and considering the general requirement of an urban development plan, the structure and basic contents of the plan are framed as shown in Figure 1.7.1. The plan shall have seven chapters. The main body of the plan shall consist mainly of two parts (long-term and short/middle-term) in order to satisfy the requirements for both sharing the future image and encouraging actions.



Source: JICA Study Team

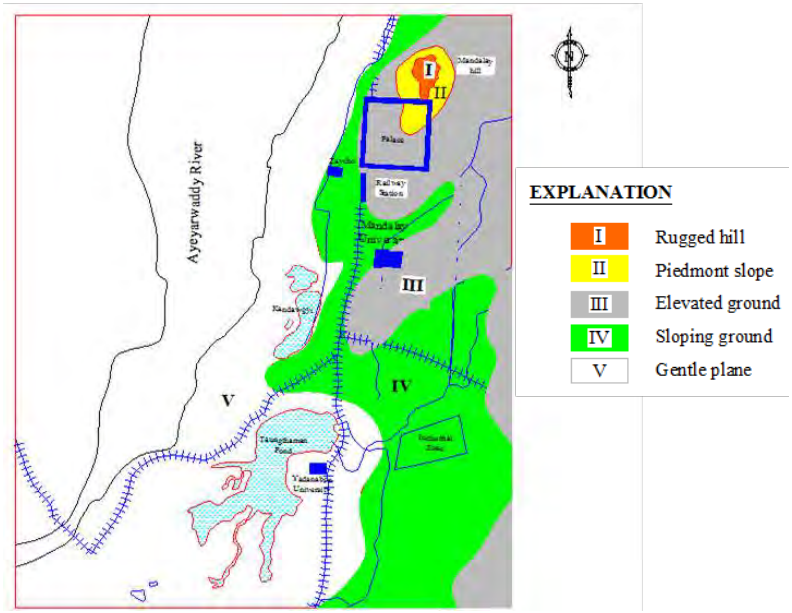
Figure 1.7.1 Structure of the Urban Development Plan

2 Current Conditions and Issues

2.1 Geographical and Environmental Feature

2.1.1 Geography

- Mandalay City is situated in the flat central dry zone of Myanmar, called "Central Belt", 716 km north of Yangon, sitting on the east bank of the Ayeyarwady River. It was founded in 1857 as the royal capital. It sits on the Sagaing Fault, the tectonic plate boundary between the India and Sunda plates. Having the royal palace backed by 240 m high Mandalay Hill on the north, this old capital stretches its boundary south along the Ayeyarwady bank. Geographically, Mandalay City sits on a general sloping ground from northeast to southwest of the city, as illustrated in Figure 2.1.1.

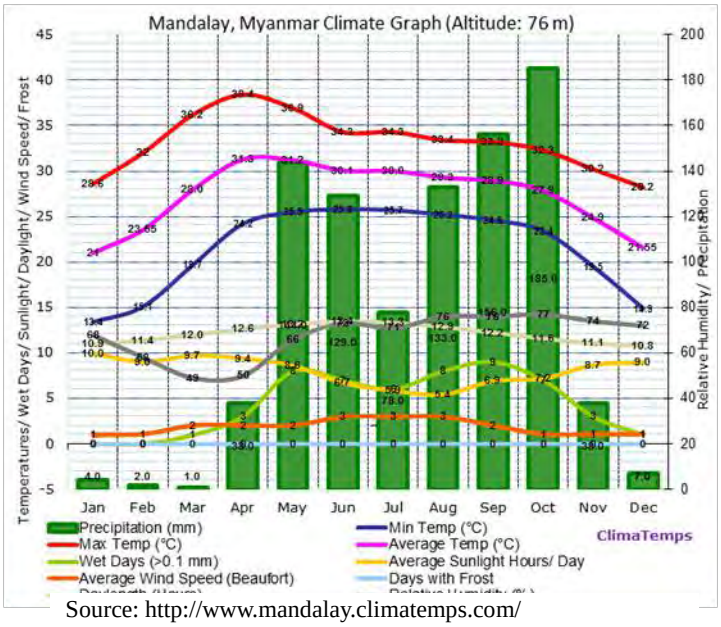


Source: Eyn Keey, Yangon University, "Seismic Microzones of the Mandalay-Amarapura Area"

Figure 2.1.1 Geographical Outline of Mandalay

2.1.2 Climate

- Mandalay features a tropical wet and dry climate under the Köppen climate classification, with noticeably warmer and cooler periods of the year. Mandalay is very hot during the months of April and May, with average high temperatures easily exceeding 35 °C. It is not uncommon to see high temperatures surpassing 40 °C during these two months in the city. Mandalay also features wet and dry seasons of nearly equal length, with the wet season running from May through October and the dry season covering the remaining six months.



Source: http://www.mandalay.climatemps.com/

Figure 2.1.2 Mandalay Climate and Temperature

- The mean annual temperature is 27.3 °C. Average monthly temperatures vary by 10.3 °C. Total annual precipitation averages 915 mm which is equivalent to 915 L/m². On average, there are 2,991 hours of sunshine per year.

- Figure 2.1.2 shows the climate and temperature of Mandalay.

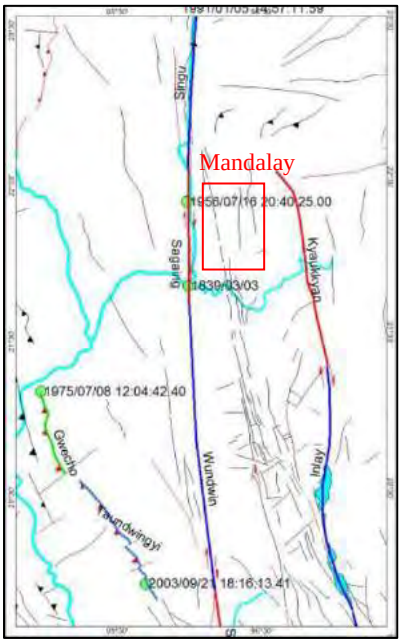
2.1.3 Natural Disaster

- The major natural disaster concerns of the city are mainly drought and earthquake, and occasional flooding in the lowland area.

Earthquake

- The Sagaing Fault, where Mandalay City sits, is the most prominent active fault in Myanmar. Figure 2.1.3 shows the approximate location of the fault which is shown in thick continuous lines, and dashed line where inferred; "a" means active fault. The highest seismic zone comprises of the western part of Mahaaungmye Township; and the second highest zone consists of the western part of Amarapura, Chanmyatharzi, and Chanayetharzan townships, and the westernmost part of Patheingyi Township.

- The last major earthquake was recorded back in 1956 in Sagaing with magnitude of 7.0, where several pagodas were severely damaged and above 50 people were reported dead, while the April 2016 magnitude 6.8 earthquake with an epicenter at a depth of 130 km had no major damage. Thus, the specialists anticipate another big earthquake in the region in the near future. Figure 2.1.3 shows the active faults around Mandalay City and Central Myanmar. Table 2.1.1 shows the seismicity of Mandalay Region (1429-2012).



Source: Myanmar Engineering Society (MES), "SEISMIC SOURCES IN MYANMAR", June 2011

Figure 2.1.3 Active Faults around Mandalay City and Central Myanmar

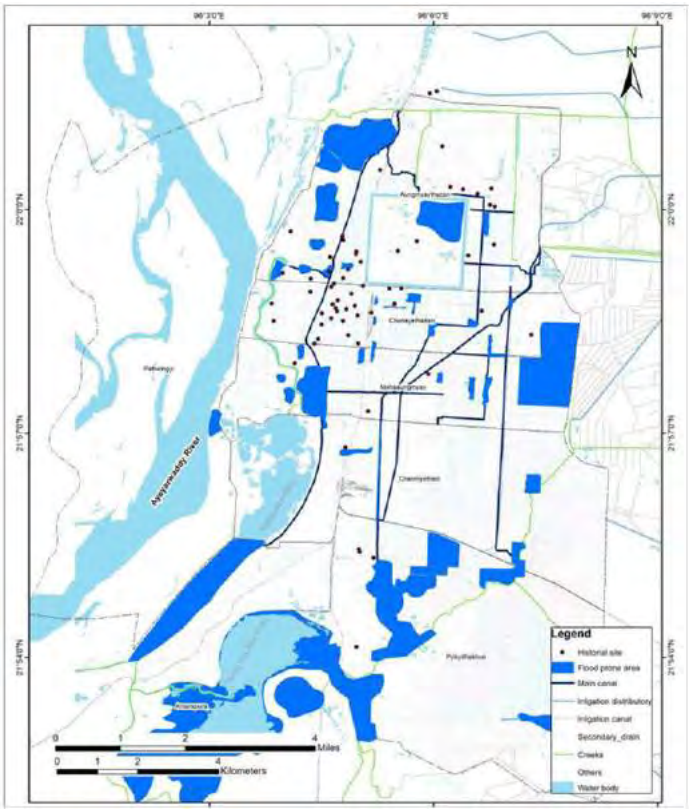
Table 2.1.1: Seismicity of Mandalay Region (1429-2012)

Date	Location	Magnitude or brief description
1429	Innwa	Fire-stoping enclosure walls fell
1467	Innwa	Pagodas, solid and hollow, and brick monasteries destroyed
24, July, 1485	Mandalay	3 well-known pagodas fell
1501	Innwa	Pagodas, etc. fell
6, June, 1620 10, Sept, 1646	Innwa Innwa	Ground surface broken, river fishes were killed after quake
11, June, 1648	Innwa	
1, Sept, 1660	Innwa	
3, Apr, 1690	Innwa	
15, Sept, 1696	Innwa	4 well-known pagodas destroyed
8, Aug, 1714	Innwa	Pagodas, etc. fell; the water from the river gushed into the city
15, Jul, 1771	Innwa	
9, June, 1776	Innwa	A well-known pagoda fell
26, April, 1830	Innwa	
21, Mar, 1839	Innwa	Old palace and many buildings demolished
23, Mar, 1839	Innwa	Pagodas and city walls fell; ground surface broken; the rivers' flow was reversed for some time; Mingun Pagoda shattered; about 300 to 400 persons killed
16, July, 1956	Sagaing (Mandalay)	Several pagodas severely damaged
11, Nov, 2012	Thabeikkyin (Sagaing and Mandalay)	Richter Scale 6.8. Death toll 18 and 115 injured. 181 houses, 58 pagodas, 79 monasteries, 20 schools and 9 government buildings were totally collapsed. 2315 houses, 605 pagodas, 527 monasteries and 126 government buildings were damaged. Total lost is 8140.12 million

Source: Mandalay Earthquake Scenario Planning Summary 26 February 2015

Flooding

- Mandalay City also has some potential causes of floods such as lack of urban drainage facility, the Ayeyawardy flooding, and large river discharge from Shan Plateau to the city. Particularly, the south west part of the city is prone to flooding due to its topographic features (Figure 2.1.4).



Source: Asian Development Bank (ADB)

Figure 2.1.4 Flood Prone Area in Mandalay

2.2 Socio-economic Feature

- Mandalay City, administered by MCDC, is currently composed of seven townships, which also form the Mandalay District. Five out of the seven townships are fully urbanized areas which have long constituted the city. Amarapura Township and Patheingyi Township were incorporated into the city in 2011 and 2015, respectively. Mandalay District with a population of 1.7 million occupies 28% of Mandalay Region in terms of population size. About 76.4% of the district population are urban residents as shown in Table 2.2.1.

Table 2.2.1 Population of Mandalay District by Township in 2014

Region/ District/Township	Population (thousand)			Urban Population
	Total	Urban	Rural	
Mandalay Region	6,166	2,143	4,022	34.8%
Mandalay District	1,727	1,319	407	76.4%
Aungmyetharzan	266	266		100.0%
Chanayetharzan	197	197		100.0%
Mahaaungmye	241	241		100.0%
Chanmyatharzi	284	284		100.0%
Pyigyidagun	238	238		100.0%
Amarapura	238	81	157	34.0%
Patheingyi	264	13	251	4.9%

Source: The 2014 Myanmar Population and Housing Census

- Table 2.2.2 illustrates the gross regional product (GRP) of Mandalay District and its sectoral composition from 2011/12 to 2015/16. Service sector accounts for about 60% of the entire economy, and industry and agriculture sectors constitute a little less than 40% and about 4%, respectively. The proportion has been largely constant for the last five years, while it is observed that some particular sub-sectors such as construction and communication are increasing their

presence recently. As Table 2.2.3 indicates, the sectoral composition of GRP is quite different between the five townships that are fully urbanized and the two townships that have newly joined the district (Amarapura and Patheingyi). The agriculture sector still takes up a certain share of the economy (i.e., 17% and 24% in 2014/15) in the latter two townships.

Table 2.2.2 Gross Regional Product (GRP) of Mandalay District by Sector: 2011/12-2015/16
(At current prices; in MMK million)

Sectors	2011-2012		2012-2013		2013-2014		2014-2015		2015-2016 (Provisional)	
	Value	% composition	Value	% composition	Value	% composition	Value	% composition	Value	% composition
AGRICULTURE	71,899	3.8%	80,405	3.8%	98,494	4.1%	101,034	3.7%	108,053	3.5%
Agriculture	44,093	2.3%	50,339	2.4%	64,241	2.6%	61,924	2.3%	62,454	2.0%
Livestock and Fishery	27,381	1.5%	29,634	1.4%	33,698	1.4%	38,053	1.4%	45,166	1.5%
Forestry	425	0.0%	432	0.0%	555	0.0%	1,057	0.0%	433	0.0%
INDUSTRY	657,519	35.0%	765,030	36.0%	880,815	36.3%	1,031,435	37.9%	1,173,326	38.0%
Energy		0.0%		0.0%		0.0%		0.0%		0.0%
Mining	2,132	0.1%	2,294	0.1%	3,286	0.1%	3,759	0.1%	4,861	0.2%
Processing and Manufacturing	551,306	29.3%	643,439	30.3%	720,823	29.7%	813,602	29.9%	957,890	31.1%
Electric Power	31,286	1.7%	41,516	2.0%	43,697	1.8%	56,690	2.1%	64,191	2.1%
Construction	72,795	3.9%	77,782	3.7%	113,009	4.7%	157,384	5.8%	146,383	4.7%
SERVICES	1,151,559	61.2%	1,278,547	60.2%	1,447,520	59.6%	1,587,693	58.4%	1,802,763	58.5%
Transportation	641,464	34.1%	686,418	32.3%	712,555	29.4%	747,769	27.5%	818,636	26.5%
Communications	65,302	3.5%	62,646	2.9%	119,157	4.9%	153,367	5.6%	184,424	6.0%
Financial Institutions	4,702	0.2%	7,079	0.3%	9,712	0.4%	12,083	0.4%	14,438	0.5%
Social and Administrative Services	25,001	1.3%	36,231	1.7%	54,843	2.3%	63,257	2.3%	82,217	2.7%
Rental and Other Services	41,303	2.2%	54,290	2.6%	64,545	2.7%	69,490	2.6%	73,586	2.4%
Trade	373,787	19.9%	431,884	20.3%	486,707	20.1%	541,728	19.9%	629,460	20.4%
GROSS REGIONAL PRODUCT	1,880,977	100.0%	2,123,982	100.0%	2,426,828	100.0%	2,720,162	100.0%	3,084,142	100.0%

Source: Ministry of National Planning and Economic Development

Table 2.2.3 Gross Regional Product (GRP) of Mandalay District by Township in 2014/15
(Percentage Composition)

Sectors	Aungmyetharzan Township	Chanayetharzan Township	Mahaaungmye Township	Chanmyatharzi Township	Pyigyidagun Township	Amarapura Township	Patheingyi Township
AGRICULTURE	1%	1%	1%	2%	0%	17%	24%
Agriculture	0%	0%	0%	0%	0%	11%	19%
Livestock and Fishery	1%	1%	1%	1%	0%	6%	4%
Forestry	0%	0%	0%	0%	0%	0%	0%
INDUSTRY	36%	33%	38%	26%	50%	36%	35%
Energy							
Mining							2%
Processing and Manufacturing	32%	29%	32%	11%	39%	30%	19%
Electric Power	1%	2%	1%	2%	1%	2%	10%
Construction	3%	3%	5%	13%	9%	4%	4%
SERVICES	63%	66%	61%	73%	50%	47%	41%
Transportation	30%	34%	29%	47%	17%	18%	19%
Communications	6%	6%	7%	11%	5%	1%	2%
Financial Institutions	1%	1%	0%	0%	0%	0%	0%
Social and Administrative Services	3%	3%	2%	3%	1%	3%	3%
Rental and Other Services	3%	3%	3%	4%	1%	2%	2%
Trade	20%	19%	21%	7%	26%	23%	15%
GROSS REGIONAL PRODUCT	100%	100%	100%	100%	100%	100%	100%

Source: Ministry of National Planning and Economic Development

- Among the labor force aged ten years and over of Mandalay District, only 8% of the population is engaged in the agricultural sector, while 56% and 27% belong to the service and industrial sectors, respectively. This is in contrast with the situation of the Union and Mandalay Region, both of which still hold agriculture as the largest sector in terms of engaging population (Table 2.2.4).

Table 2.2.4 Population of Employed People Aged Ten Years and Over by Sector in 2014

		Agriculture	Industry	Service	Not Stated/ Not Applicable	Total
Population						
Union	Persons	11,026,852	2,626,966	6,070,683	1,336,030	21,060,531
Mandalay Region	Persons	1,087,208	506,604	926,322	194,823	2,714,957
Mandalay District	Persons	62,017	201,742	410,717	65,198	739,674
Sector Share						
Union	%	52%	12%	29%	6%	100%
Mandalay Region	%	40%	19%	34%	7%	100%
Mandalay District	%	8%	27%	56%	9%	100%

Source: The 2014 Myanmar Population and Housing Census; Data from Ministry of Immigration and Population

2.3 Industrial Development

2.3.1 Industrial Activities

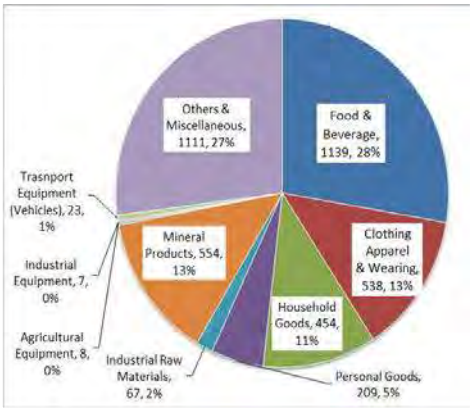
- Mandalay City is a national economic growth center with the second largest population in Myanmar. It is located at the junction of the Central North-South Corridor connecting Yangon, Nay Pyi Taw, and Myikyina; the Northern Corridor linking to Lashio, Muse, and China to the east; and the corridor going to Tamu and India to the west, as envisaged by the National Spatial Development Framework. Hence, the city serves as an administrative and economic hub with industrial and commercial concentrations as well as an important tourism base with a lot of religious and cultural heritages.

- According to "Myanmar Industry Directory 2015-16", Mandalay Region had the greatest number of registered industries among all regions and states in Myanmar in 2014, with a total of 7,281 private industries. Particularly, there are more medium- and small-scale industries in the region than in Yangon Region. Table 2.3.1 and Figure 2.3.1 show the number of industries in Mandalay District by size and by sub-sector in 2015-16, respectively. Major types of industries are "Food and beverage" (28% of the total number of industries), "Others and miscellaneous" (27%), "Mineral products" (13%), "Clothing apparel and wearing" (13%), and "Household goods" (11%) in descending order.

Table 2.3.1 Number of Industries by Size in Mandalay District in 2015-16

Size of Industries	Number of Industries	Number of Employees
Large	908	19,177
Medium	1,256	7,704
Small	1,946	7,935
Total	4,110	34,816

Source: Ministry of Industry, Directorate of Industrial Supervision and Inspection, Mandalay Regional Office



Source: Ministry of Industry, Directorate of Industrial Supervision and Inspection, Mandalay Regional Office

Figure 2.3.1: Number of Industries by Sub-sector in Mandalay District in 2015-16

- In Mandalay Region, there are three existing industrial zones which were established under the supervision of the Mandalay Regional Government since the 1990s as seen in Table 2.3.2, and Yatanarpon Cyber City was established in 2007 which is categorized as a "new industrial zone".

One of the three industrial zones is the Mandalay Industrial Zone located in Pyigyidagun Township at the south part of Mandalay City. The industrial zone forms the largest scale of industrial accumulation in the country, housing about 1,400 businesses in 2013, most of which are domestic companies in areas such as food processing, agricultural machinery, metal processing, construction materials, and auto repair[1]. However, it is reported that the industrial zone is facing a challenge because there actually remain many vacant lands and plots partly due to speculation of land buyers, which increases the prices of the lands and is hindering business development in the city[2].

Table 2.3.2 Industrial Zones (IZ) in Mandalay Region

Industrial Zone	Location	Year of Establishment	Area (acres)	No. of Factories*
Mandalay IZ	Pyigyidagun Towinship, Mandalay District	1995	1239.33	1,379
Meikhtila IZ	Meikhtila District	1995	385.45	295
Myingyan IZ	Myingyan District	1995	163.59	265
Yatanarpon ICT Park	Pyi Oo Lwin District	2007	10,000	16
Myotha Indusrtial Park	Myingyan District	2013 (under development)	10,337	-

Note: * as of February 2013
Source: Myanmar Industry Directory 2015-16; JETRO (Yangon), 2013; Myotha Industrial Park Website

2.3.2 Foreign Investment

- Table 2.3.3 shows the total investment amounts of permitted enterprises under the Foreign Investment Law, in Mandalay Region as well as in the entire Union and in Yangon Region for comparison purpose. In 2014-2015, only seven enterprises were permitted with the increased investment of USD 667 million in Mandalay Region out of the 211 total enterprises with USD 8,011 million permitted in Myanmar. According to the Mandalay Regional Government, there are currently 22 foreign direct investment (FDI) projects in the region, out of which 11 projects are in the industry sector, four are investing into the hotel and tourism sector, and three are in the energy sector[3].

Table 2.3.3 Total Investment of Permitted Enterprises under the Foreign Investment Law in Mandalay Region

(USD Million)

Region	2010-2011		2011-2012		2012-2013		2013-2014		2014-2015	
	No. of Enterprises	Foreign Investment	No. of Enterprises	Foreign Investment	No. of Enterprises	Foreign Investment	No. of Enterprises	Foreign Investment	No. of Enterprises	Foreign Investment
UNION TOTAL	**24**	**19,999 ***	**13**	**4,644 ***	**94**	**1,419 ***	**123**	**4,107 ***	**211**	**8,011 ***
Mandalay Region	-	-	1	26	2	65	2	82	7	667 *
Yangon Region	3	64 *	5	33 *	80	834 *	102	2,745 *	154	3,767

Note: * Increased in investment value.

[1] JETRO Yangon Office, "Data Collection of Industrial Zones in Myanmar", February 2013.
[2] Myanmar Times (Website), "Diverted industrial land hinders development for Mandalay businesses", August 4, 2014.
[http://www.mmtimes.com/index.php/business/property-news/11255-diverted-industrial-land-hinders-development-for-mandalay-businesses.html]
[3] Presentation material of "Mandalay Region 2nd Five-Year Regional Development Plan" presented by Director of Mandalay Region Planning Office at the Workshop on Myanmar Industrial Development Vision (MIDV) and the Next Five-Year Plan on February 2, 2016.

Source: MNPED Central Statistical Organization, "Myanmar Data CD-ROM 2015", February 2016. (Originally from Directorate of Investment and Company Administration)

- According to the Directorate of Investment and Company Administration (DICA) website, a total of 13 enterprises (including both foreign and domestic companies) were permitted to invest in Mandalay Region by the Myanmar Investment Commission in 2015. Fields of the investments include hotel, wood-based business, garment, cement, metal industry, and so on. Among them, three enterprises plan to invest in Mandalay District (Table 2.3.4).

Table 2.3.4 List of Enterprises Permitted by Myanmar Investment Commission in 2015 for Mandalay District

Name of Company	Location	Type of Investment Business	Form of Investment	Date of issue
Regal Hospitality Co., Ltd.	Mingalar Mandalay Projects Compound, Chanmyatharzi Township, Mandalay Region.	Hotel	Myanmar Citizen Investment	27-2-2015
Hydrotek Supreme Mandalay Co. Ltd.	Mandalay Region, Amarapura Township	Central wastewater treatment plant and collection system for Mandalay Industrial Zone	Joint Venture	28-4-2015
Northwood Industry Limited	Pyigyidagun Township, Mandalay Region.	Manufacturing and marketing of wood-based products including sawn timber, flooring, veneer, plywood, and furniture	Foreign Investment	11-9-2015

Source: Directorate of Investment and Company Administration (DICA) Website

2.3.3 Orientation of Development

- The Second Five-Year Development Plan of Mandalay Region (FY 2016-17 to FY 2020-21) aims to generate development of the region through the following measures:

  a) Improving agricultural base production industries;
  b) Developing transportation as junction of road, river, and airways; and
  c) Hotel and tourism development through the existing ancient and cultural inheritances and historical places.

  In addition, the plan aims to develop the industrial and service sectors through capital formation and technology development. The target five-year average growth rate is 8.9%, and the percentage compositions of the sectors is planned to be 21%, 32%, and 47% for agriculture, industry, and service sectors in 2020-21, respectively.

- As shown above, Mandalay City is located at a strategic position and endowed with many resources to play even more important roles in the industrial development of Myanmar. On the other hand, according to interviews with concerned experts and various survey reports, the city has been facing challenges which can be summarized as follows:

  a) Limited amount of foreign investment in the past compared with Yangon;
  b) Underdevelopment of infrastructure for production and logistics;
  c) Scarcity or drain of quality human resources to Yangon and abroad; and
  d) Lack of capacity of local industries in technology, human resources, finance, information, and so on.

- Looking at the above-mentioned feature of the city where industrial and service sectors dominate in terms of GRP and the engaged population, raising the general level of the industrial activities should be prioritized through the following approaches:

a) Upgrading a capacity level of the local industries by strengthening linkages with foreign firms as well as by developing favorable physical and social environments to attract quality human resources; and
b) Promoting efficiency of economic activities by providing infrastructure and establishing logistic hubs.

2.4 Urban Development and Land Use

2.4.1 Urban and Housing

- The current urban area of Mandalay City is composed of the following different characteristic zones. Their features and issues of urban space and buildings are described as follows:

Central Urban Area

- The central urban area, which is shown in Figure 2.4.1, is located around the palace between Nadi Canal in the east, Shwe Ta Chaung Canal in the east, and the 12th Street in the north. The area with grid road pattern extends up to around the Mandalay University and the old airport site.

Source: JICA Study Team:
Figure 2.4.1 Photo of Central Urban Area in Mandalay

- The old downtown area consists of commercial buildings, residential buildings, and mixed buildings. The residential district has relatively good environment and it is equipped with roads with enough width.
- The commercial and business buildings, which were constructed as low buildings, are reconstructed and replaced with five to six-storey buildings. Some buildings are reconstructed to seven to ten-storey commercial buildings along the wide arterial roads such as the AH1 and 35th Street. Most of the residential buildings and mixed use buildings in the downtown area are flat of two to three-storey buildings. Some of these buildings, which face major street with wide grid pattern roads, are being reconstructed and replaced with apartment buildings of four to six floors.
- The current environment of urban space is relatively good, but it is notable that the lack of public facilities such as parking space, green open space, and other facilities might arise according to progress of their densification.

Surrounding Area of the Old Downtown

- In the surrounding area of the old downtown area, the urban area is composed of flat and two to three-storey buildings as shown in Figure 2.4.2. These areas spread in the periphery of the central downtown as extension areas. The west side of the Shwe Ta Chaung Canal in the west of the city is a typical urban area of this character. Most of the buildings are wooden and are constructed in narrow housing site. The following are the issues to be improved in their living environment:

Source: JICA Study Team
Figure 2.4.2 Photo of Surrounding Area of the Old Downtown in Mandalay

a) Housing district which is composed of narrow winding roads,
b) High density residential area with small-scale wooden buildings, and
c) Lack of land use balance between residential and public facilities.

New Housing and Business Development Areas

- Residential development is ongoing in the east and south of the old airport. In the east of the old airport, residential area is underdeveloped, which is integrated with business and commercial facilities. Midrise apartment buildings with 3-10 stories and detached housings are constructed in this area. These buildings and facilities are constructed in the planned development area and their living environment is excellent.

- In the southeast and south of the city, a new housing development area is continuously extended from the northern central business district (CBD) area and reaches to the surrounding areas of the industrial areas in the south as shown in Figure 2.4.3. The residential area is formed by grid pattern streets and reinforced concrete (RC) structures with brick, or flat or two to three-storey wooden buildings are constructed. In some residential blocks in the southeast, five-storey apartment housings are under construction. These areas are orderly developed, but there remain issues to be improved regarding the condition of their infrastructure.

Source: JICA Study Team

Figure 2.4.3 Photo of New Housing and Business Development Areas in Mandalay

Informal Settlements

- Barracks and shanties are observed in the city area as shown in Figure 2.4.4. They are used for living and commercial purpose, and are observed in the following areas:

  a) River bank of the Ayeyarwady River,
  b) Narrow space along the canals in the city,
  c) Narrow space along the railway track, and
  d) Road shoulder of arterial road under the street trees.

  Most of these structures are considered forming informal settlements and their formalization is necessary.

Source: JICA Study Team

Figure 2.4.4 Photo of Informal Settlements in Mandalay

Former Agriculture Villages

- According to the expansion of the urban area of Mandalay City, some of the former villages around the Mandalay urban area (shown in Figure 2.4.5) were included into the urban area of Mandalay. In these areas, the typical buildings are wooden flat or two-storey buildings with rural construction style. Their living condition and buildings are popular as those of rural village, but functionally poor and fragile against disasters as a part of urbanized area.

Source: JICA Study Team

Figure 2.4.5: Photo of Former Agriculture Villages in Mandalay

2.4.2 Land Use and Regulations

Land Use

- A land use pattern was developed based on the analysis of the 2015 satellite imagery covering only the urban area, and using the 2012 imagery for other areas. Looking at the land use, built-up area shares 16.7% of Mandalay City; in contrast, it seems to dominate in the five townships. Table 2.4.1, Table 2.4.2, Figure 2.4.6, and Figure 2.4.7 show the land use of Mandalay City.

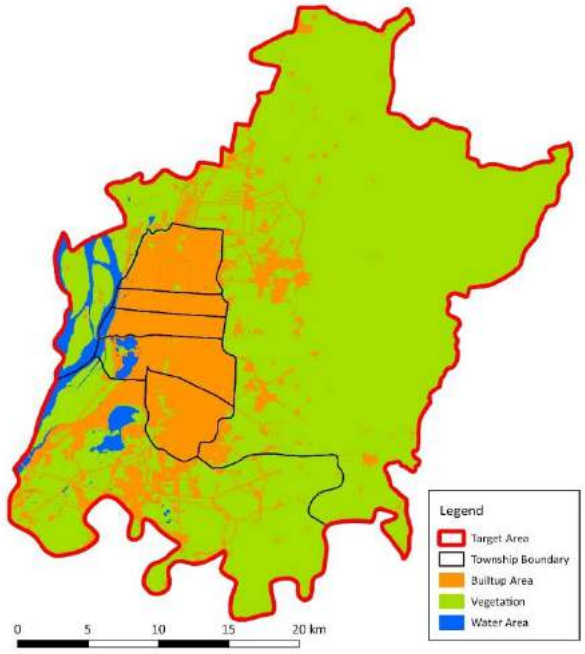
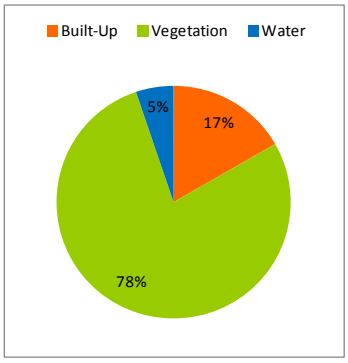


Table 2.4.1 Current Land Use (General) of Whole Mandalay City

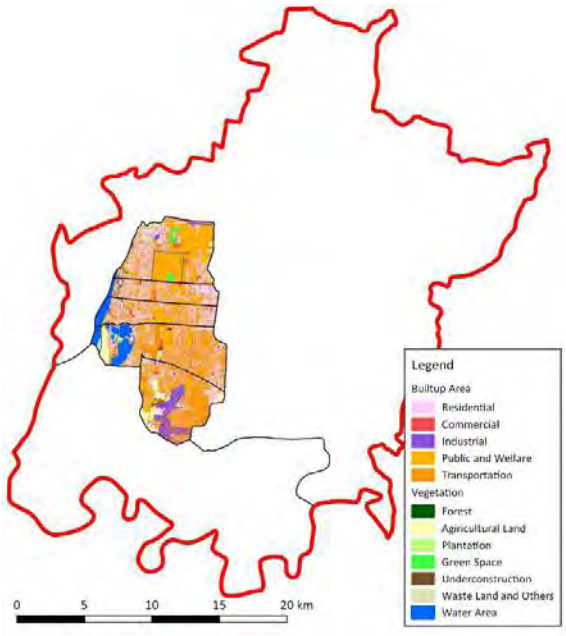
Type	Built-Up	Vegetation	Water	Total
Area (ha)	15,165.6	71,042.8	4,746.0	90,954.3
Share	(16.7%)	(78.1%)	(5.2%)	(100.0%)

Source: JICA Study Team



Source: JICA Study Team

Figure 2.4.6 Current Land Use (General) of Whole Mandalay City



Source: JICA Study Team

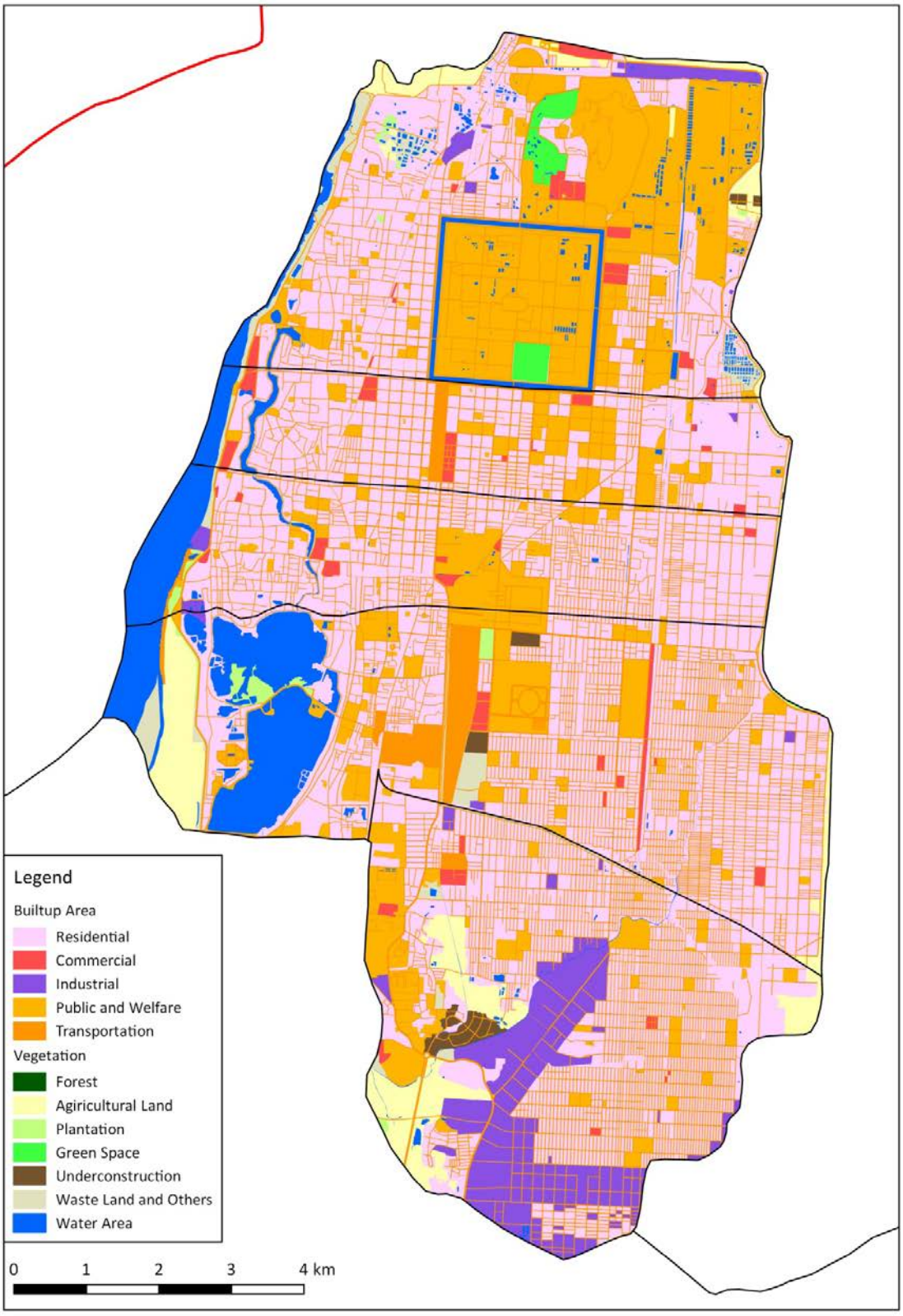
Figure 2.4.7 Current Land Use (Detailed) of Part of Mandalay City (Mainly Urban Area)

Table 2.4.2 Current Land Use (Detailed) of Part of Mandalay City

Type		Area (ha)	Share
Built-up	Residential	5,716	51%
	Commercial	168	2%
	Industrial	543	5%
	Public	2,055	18%
	Transit	950	8%
Vegetation	Forest	0	0%
	Agricultural	470	4%
	Plantation	49	0%
	Green Space	72	1%
	U.Construct	55	0%
	Others	205	2%
Water	River	281	3%
	Channel	148	1%
	Lake	338	3%
	Pond	122	1%
Total		11,172	100%

Source: JICA Study Team

- Based on the analysis of the 2015 satellite imagery, land use was sub-categorized into 15 types targeting only the urban area of Mandalay (five townships) as shown in the figure and table above and as detailed below.



Source: JICA Study Team

Figure 2.4.8 Current Land Use (Detailed) of Urban Area of Mandalay (Enlargement)

Building Regulation

- According to the "Building Rules, Regulations and Procedures, and Responsibilities" issued by the Building and Warehouse Department, MCDC, regulations related to building, land use, and development procedure exist in Mandalay City as shown in Table 2.4.3.
- It must be emphasized that the streets surrounding the palace have the regulation which control building heights along the streets to up to four stories.

Table 2.4.3 Regulation of Building and Land Use Development Procedure in Mandalay

Items	Specification	Exact Area or Street
Building height control	Not to allow high rise buildings to be more than four stories.	26 B Street, 80 Street, 66 Street, 12 Street along the moat
High-rise buildings inspection	Building permission up to 12 stories to be checked and issued by MCDC; and buildings more than 12 stories will be inspected and surveyed by the Committee for Quality Control of High-rise Building Projects (CQHP).	-
Place to be left in the plot	The rest space must be 5 ft in front, 4 ft at the back, and 2 ft each at both sides of the building in the downtown area.	From Shwe Ta Chaung to 72 Street, 26 Street to 35 Street
	Space must be left at 12 ft in front, 6 ft at the back, and 3 ft each at both sides of the building.	In other area of the city
MCDC permission proposal	Soil test report and structural design calculation are needed for the buildings which have four stories and more.	-
Ground level of building	The plinth height must be at a minimum of 1.5 ft higher than the nearest road level.	-
Building wall height	Building wall height must be 12 ft on the ground floor and 10 ft each on the upper floors.	-

Source: JICA Study Team

2.4.3 History, Landscape, and Tourism

History of the City

- The year when the Yadanarbon Mandalay Palace was founded was indicated by the verses "*Oak Kyaw Kyit Aye Mandalay*", "*Inn Gyin Kyar Ount Yandanarbon*" to be 1221 Myanmar Year (Era) (ME) in Myanmar traditional practice of taking note of numerical numbers. Mandalay was established simultaneously with seven Buddha places in 1332 ME, 6th wan of Kason. Yadanarbon, Mandalay can be divided into three river lanes, namely: the Ayeyarwady River, the Dhokehtawaddy River, the Matayar River, and Shan Plateau; and designated the boundary as a wide region that is 35 mi from north to south and 15 mi from east to west.
- During the establishment, the year was during the Buddhist era when monuments and city are established with a square shape. There were 2,400 tar (tar = Myanmar measurement, 1 tar = 2 mi) in the four walls of the city and 600 tar for each wall. The wall of the city is situated straight from east to west and from north to south, and a city gate in each of the walls of the city and the middle gate is situated straight from east to west and north to south of the palace. There are 54 wards (pya kwet in Myanmar language) in the east, west, north, and south; and it is founded by designating the boundary called east ward, west ward, north ward, and south ward. In 1993, Mandalay City has five townships. In addition to the four townships of Aungmyetharzan, Chanayetharzan, Mahaaungmye, and Chanmyatharzi, Pyigyidagun Township has been included and its area is 45.72 mi^2.

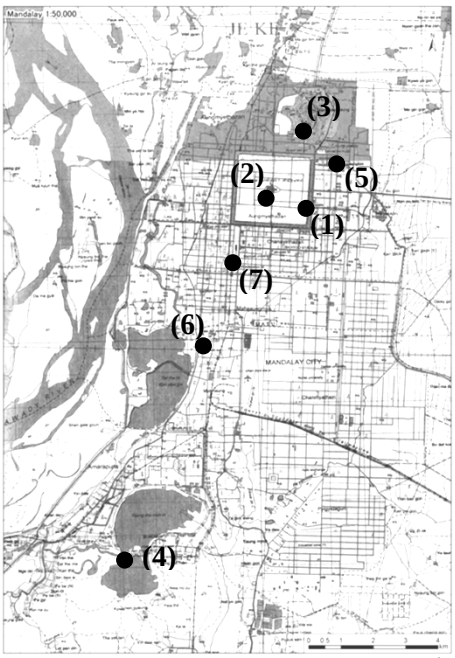
Tourism and Landscape

- The most prominent characteristics of Mandalay City townscape, shown in Figure 2.4.9, are the old palace and the grid pattern city which are formed during the era of the last royal capital.

Mandalay Hill is the symbol of the city which can be seen from the city area. Wooden heritages such as the bridge and monastery are also attractive tourism destinations of Mandalay.

Mandalay Hill and Old Palace (1)
These are symbols of the city and attract both residents and tourists.

Old Palace Site (2)
The site, which stretches to about 2 km^2, is used for museum and garrison.



Location of the Places in the Pictures

View from Mandalay Hill (3)
On top of the hill, there is a famous pagoda which has a panoramic view.

U-bein Bridge (4)
Wooden bridge built during the mid-19th century crosses Taungthaman Lake.

Shwenandaw Monastery (5)
This monastery, which is famous for teak carvings, was built in 1880.

Maha Muni Pagoda (6)
This is one of the most important pagodas in Mandalay.

City Center Townscape (7)
This is one of the typical townscapes from the main road (Street No. 78).

Source: JICA Study Team

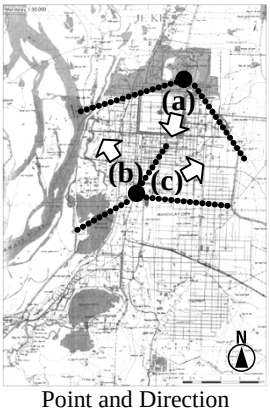
Figure 2.4.9 Characteristics of Mandalay

- There are two 25-storey buildings in Mandalay City (one of them is under construction as of May 2016), which are the highest buildings there. Other existing high-rise buildings are around 7-10 stories, and some new under construction high-rise buildings around ten-stories can be seen in the city. Figure 2.4.10 shows a panoramic view and high-rise buildings in Mandalay City.

(a) Panoramic view from Mandalay Hill towards south

(b) Panoramic view from the 8th floor of a building in Mandalay City towards northwest

(c) Panoramic view from the 8th floor of a building in Mandalay City towards northeast



Point and Direction of the Views (a)-(c)

Source: JICA Study Team (the pictures were taken in May 2016)

Figure 2.4.10 Panoramic View and High-rise Buildings in Mandalay City

Issues on Tourism and Landscape

- **Threat of Damage on Landscape and Heritage Area**: Mandalay City has unique historical characteristics including the old palace and grid pattern town; and religious places including Mandalay Hill, Yan Kine Hill, and numerous pagodas and monasteries around the city. On the other hand, many buildings including high-rise and modern designed ones are being constructed around the city, and there is a risk that those new buildings will bring serious harm to the landscape and heritage area which shaped Mandalay's inherent atmosphere. It is urgently necessary to make and implement regulation on height and conservation zoning for construction development in the city.

- **Lack of Tourism Zone Development**: Mandalay City has a variety of heritage resources to visit; and hotels and restaurants for tourist are increasing gradually. However, most of the places are located separately; and therefore, there are few places for tourist to stay for some quality time. This deteriorates tourist's satisfaction and lose the precious chance to earn revenue from them. Tourism zones with hotels, restaurants, and goods shops where tourist can stay for some quality time should be developed around existing commercial area, new suburban area, or tourism resources in a harmonized manner with the area.

- **Poor Connection of Each Tourism Zone**: There are a variety of heritage resources in Mandalay City itself and its surrounding areas including Sagain, Inwa, and Mingun. The variety itself is a quite large merit to attract tourists. However, these areas are located separately and access from each other is also not smooth. To improve the connection, some interventions such as making transport hub which connects tourism places or connecting close heritages spatially with pedestrian route, green area, and shopping street are necessary.

2.5 Infrastructure

2.5.1 Transport and Road

- Grid Pattern Road Network: The road network in the city center has a grid pattern. Accordingly, it is quite easy not only for the citizens but also for tourists to express their destination such as "corner of roads 35 and 73". It makes exploring the city by combination of public transport and walking easy. Proper street signboard system on each street will work effectively.

- Existing Road Capacity: Currently, traffic congestion is only observed on Sagaing-Mandalay Street. However, the capacity of other roads is going to be saturated in the near future based on the JICA Study Team's estimation of saturation ratio. Thus, measures to increase the road capacity in the city should be addressed now. However, the city center is already densely built-up; and widening and new construction of roads will be quite difficult. Capacity maximization of existing roads will be urgently needed. MCDC is implementing the upgrading of the signal system and this project will be useful. It is noted that there are two types of signal lighting in Mandalay although the other cities have uniform standard type. Citizens in Mandalay might be familiar with it but the tourists might be confused on the signal direction. The types of signal should be uniform in future.

- New Road Network: Urbanization of Mandalay is expanding in the southeast direction. MIC (Myanmar Investment Commission) and other high-tech industrial park/residential area are proposed. A new backbone road network to support the development will be necessary. The ring road network will function well not only as a new backbone but also as a diversion road to avoid congestion in the city center.

- Parking Space: The road network in Mandalay has a relatively wide width. However, the outer lane is often occupied by parked vehicles. The MCDC established a guideline for commercial buildings on the necessity to install parking space. But it is not actually materializing since there is no legal binding force. The development of controlled on-road and off-road parking will be required.

- Public Transport: Buses are under operation based on the route network established by the government agency. Even though only small buses (light-size truck type) are in service, no passenger queuing is observed in the city. The demand of the buses is still less than the capacity of the current system.

- Future Public Transport: The project cost of the proposed bus rapid transit (BRT) is USD 60 million but feasibility such as financial viability was not confirmed yet. Traffic demand should be examined to justify the economic and financial feasibility of the proposed project.

- Truck Terminal: Pyi Gyi Mingalar Truck Terminal is the sole logistic truck terminal in the city. The terminal has recently opened but is already getting saturated. Possible expansion or relocation in suburban area shall be considered based on the comprehensive urban planning.

- Emergency Road Network: Mandalay has earthquake risk since the city is located in the vicinity of the Sagaing Fault. Emergency road network should have adequate road width under the possible blockade by debris of building and proper connection with emergency activity spaces such as hospital, open spaces, airport, and government buildings.

- Aging Railway Infrastructure: As in other railway lines in the country, the infrastructure such as signal system, station building, railway crossing, and railway track are not well maintained and updated.

- Railway Infrastructure in Urban Area: Mandalay City has a circular-like railway network in the city center. However, the circular network has not been utilized well and forwarding dead-head

car is operating only once a day without passengers while the railway track is located in a prime location in the city.

- Draft Restriction: There is a severe draft restriction during the dry season. In order to clear the shallow waterway, cargo weight must be reduced and the number of ships must be increased. Safety issues in the narrow waterway may become serious especially during the dry season.
- Port Handling Demand: Cargo handling volume is significantly increasing and the passenger volume is decreasing year by year.
- Cargo Handling: There is no modern port facility. Cargo is carried manually. Generally, the advantage of inland water transportation is the large cargo/bulk transportation and mass transit. However, the cargo size is limited by the manual transport capacity for loading and unloading. In order to utilize the inland transport further, mechanization of loading/unloading will be required.
- New Port: Mandalay's new port is being planned with modernized port facilities. Location of the port shall be determined carefully not only considering the factors of the harbor side such as the water depth but also the urban planning and connectivity with the road network.
- Old Airport in Mandalay City: In the vicinity of the old airport, urban development is accelerated with shopping malls, stadiums, and residences. The MCDC has positioned this area as the new CBD. The old airport divides the existing city center and the new CBD. The future utilization of the old airport is a major issue on urban planning.
- Mandalay International Airport (MIA) in Tada-U: Renovation and upgrading of the airport facilities are being conducted by a private concessionaire. The capacity of the airport facilities will be sufficient for the future passenger demand of up to 3 million pax per year. Stable economic development of Mandalay City and its surrounding area is expected to enhance the airport demand. The upgrading of the basic infrastructure such as water supply, sewerage, and power supply is also accelerated in Tada-U Township.
- Accessibility of MIA: Public transportation shall be developed to access the airport. The improvement of the bus service proposed by the road sector shall cover the access improvement to the airport.

2.5.2 Water Supply

- Currently, serviced population has reached 0.7 million and the average service ratio is about 57% in Mandalay City as shown in Table 2.5.1. This is insufficient water supply service for urban life and urban development.

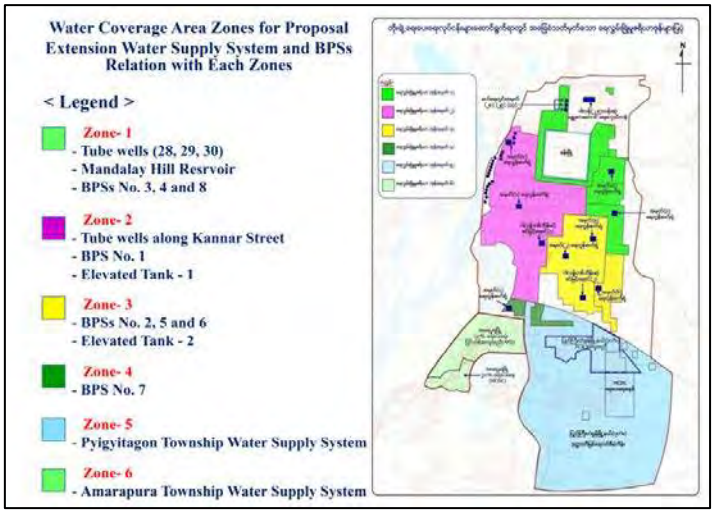
Table 2.5.1 Water Supply Service Ratio in Each Township

Township	Population	Population Served	Ratio (%)
1. Aungmyetharzan	254,898	224,128	88%
2. Chanayetharzan	229,847	220,653	96%
3. Mahaaungmye	233,557	185,687	80%
4. Chanmyatharzi	199,519	89,317	45%
5. Pyigyidagun	157,062	7,158	5%
6. Amarapura	207,678	1,414	1%
7. Patheingyi (no service)	-	-	-
Total	1,282,561	728,357	57%

Source: JICA Study Team

- The expansion project of the water supply system is urgently required at Pyigyidagun and Amarapura townships. Pyigyidagun Township has a water supply coverage of only 5%, but it will cover up to 30% through JICA grant aid in the near future. Construction of a new water treatment plant (WTP) which utilizes surface water, extension of pipeline, and distribution reservoir will be

required for more extension. Technical assistance for capacity development for the operation of rapid sand filtration system will be required due to lack of knowhow. Improvement of electric supply is required in order to have stable water supply.



Source: MCDC

Figure 2.5.1 **Extension Water Supply System and BSPs in Mandalay**

- In the eastern area, upgrading of distribution reservoir and pumping facilities will be required for improvement of low pressure, and quality of water supply is not good.
- Due to the deterioration and drawdown of groundwater, the public water supply system to industrial zone will be required in order to minimize groundwater usage by each factory's tube well. Broad-based groundwater management with regulation is required.
- Reason of high non-revenue water (NRW) (nearly 50% included in pipeline's NRW of 36%) shall be investigated and appropriate measures shall be implemented. Technical assistance for NRW reduction is required.

2.5.3 Sewerage

- There is no public wastewater treatment plant (WWTP) to collect and treat wastewater in Mandalay City. Wastewater from households, commercial, industrial, and public sector in the city is disposed by pit toilet or septic tank at their own space. There are also many households which cannot use a toilet in clean sanitary condition. Local residents continue dumping their trash to the existing drainage channels, and this causes discharge of offensive odor and degradation of water environment.

Source: JICA Study Team

Figure 2.5.2 Dumped Trash to the Existing Channel and Gutter

- To decrease the risk of waterborne infectious diseases and groundwater contamination, a new WWTP with appropriate treatment process, such as conventional activated sludge process, will be required urgently. A comprehensive sewerage master plan considering a sewerage project technique in which low cost and flexible development according to the actual condition of the area is possible shall be required.

2.5.4 Drainage

- There are nine main drainage channels, three drainage pumps, two retention ponds, and many sluice gates in Mandalay City. These facilities do not have enough capacity against heavy rains. Thus, low-lying areas located in the northwestern and southeastern areas of Mandalay City are sometimes flooded (few times in a year).

Source: MCDC, JICA Study Team

Figure 2.5.3 Flooding at Street and Pump Station

- The intricate canal system serves as the drainage network for stormwater during the rainy season, but they are not enough. Upgrading of the drainage network and pumping facilities based on the master plan shall be required. According to the existing and future modeled hydrological conditions, including the impact of climate change and urban development, various options to improve drainage will be proposed, e.g., project on dredging the canals and the drainages, project on removing hydraulic bottlenecks, and implementation of nonstructural measures to manage the drainage network using remote control monitoring system.

2.5.5 Solid Waste

- The final disposal sites are simple dumping sites without any pollution control facility (no landfill liner and no drainage of leachate). Waste is dumped on the landfill site by trucks, and waste pickers sort recyclable waste (cans, bottles, and metals) before the bulldozer pushes the waste and compact it. Rubbers are sorted and are burnt in an open oven, which is an improper method.

Source: MCDC, JICA Study Team

Figure 2.5.4 Garbage Truck and Kyar Ni Kan Final Disposal Site

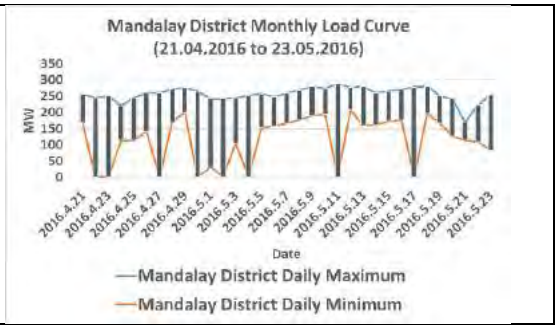
- According to the Pollution Control and Cleansing Department (PCCD), another issue is the practice of backfilling of low ground level plots of land (flood prone areas) using solid waste, a cheaper way than using earth and sand. These improper landfill works will pose high risk on health and high impact on the environment.
- The total waste collection per day has increased from 259 t in 2005 to 779 t in 2014. Due to this rapid growth of waste to be landfilled, the handling capacity of the final disposal sites can last only for four or five years. Shortage in the capacity of final disposal sites is the most serious issue.

2.5.6 Electricity

- In Mandalay City, electricity is transmitted at 230 kV and 132 kV; and distributed at 33 kV, 11 kV and 0.4 kV voltage levels. Thus, the district itself is supplied by five primary substations which include two 230 kV and three 132 kV substations. The electricity consumption of Mandalay City is more than half of that of the total Mandalay Region and the peak hours are in the morning and evening. In Myanmar, as well as in Mandalay, the months of April and May are considered as the maximum demand months, and also during the dry season, in which due to the lack of water in the reservoir, the output of the hydropower plants that are the main source of power is at the minimum. Frequent power shutdown takes place in Mandalay City during this period of the year due to lack of power supply, line fault, system down, and scheduled load shedding.

Mandalay District Primary Substation

No.	Substation	Voltage (kV)	Transformer (MVA)
1	Shwesaryan	230/33	60
2	Myaukpyin	230/33/11	100 x 2
3	Aungpinlae	132/11	31.5
		132/33	30
4	Tagundine	132/33	80
		132/33	30
		132/11	18
5	Industrial Zone-2	132/11	18



Source: JICA Study Team

Figure 2.5.5 List of Mandalay City Primary Substation and Daily Maximum and Minimum Load

- Although there is no power plant in Mandalay City and/or no power plant is directly connected to any of its primary substations, the existence of Myanmar-China natural gas pipeline from Shwe Gas station which goes through Mandalay provides the practicality to build a power plant.

- While some of the primary substations are in good condition and some need to be rehabilitated, all of these are running at around 80% or above the loading capacity during the peak season of the year. Considering the Mandalay Electricity Supply Corporation's (MESC) forecasted value of 15% increase in demand, it can be said that most of the primary substations will be overloaded by next summer.

Table 2.5.2 Preliminary Capacity Assessment of Primary Transformers in Mandalay City

Substation	Primary Voltage kV	Transformer Rating MVA	Allowable Load (p.f=0.8) MW	2015 (Maximum)		2016 Demand Forecast (+15%)			2017 Demand Forecast (+15%)			2018 Demand Forecast (+15%)		
				MW	% Loading (p.f=0.8)	MW	% Loading (p.f=0.8)	Remaining Capacity (MW)	MW	% Loading (p.f=0.8)	Remaining Capacity (MW)	MW	% Loading (p.f=0.8)	Remaining Capacity (MW)
Aungpinlae	132	31.5	25.2	17.7	70.23	20.355	80.8	5	23.4	92.9	2	26.9	106.8	-2
		30	24	18.6	77.5	21.39	89.1	3	24.6	102.5	-1	28.3	117.9	-4
Tagundine	132	18	14.4	10.6	73.61	12.19	84.7	2	14.0	97.4	0	16.1	112.0	-2
		30	24	15.2	63.33	17.48	72.8	7	20.1	83.8	4	23.1	96.3	1
		80	64	59.4	92.81	68.31	106.7	-4	78.6	122.7	-15	90.3	141.2	-26
Shwesayan	230	60	48	30	62.5	34.5	71.9	14	39.7	82.7	8	45.6	95.1	2
Myaukpyin	230	100	80	65.8	82.25	75.67	94.6	4	87.0	108.8	-7	100.1	125.1	-20
		100	80	65.7	82.12	75.555	94.4	4	86.9	108.6	-7	99.9	124.9	-20
Zone 2	132	18	14.4	9	62.5	10.35	71.9	4	11.9	82.7	2	13.7	95.1	1

Source: JICA Study Team based on the survey data

- The three private companies that are solely responsible to maintain 11 kV or less voltage level distribution system in Mandalay City also collect electricity tariff from end-users. While calculating the distribution loss, MESC's node consideration is from the primary substation to 33 kV and/or 11 kV transformers, and private companies consider from 11 kV transformers to end-user. The distribution loss according to MESC is null and distribution loss exists for the private distribution companies.

2.6 Social Service

2.6.1 Education

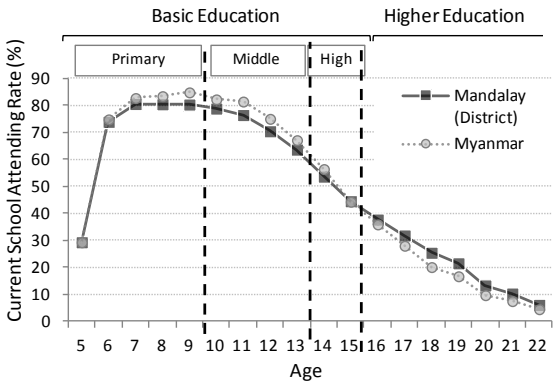
- The literacy rate in Mandalay City is more than 95% and it is higher than those in the surrounding area and the whole Myanmar, which indicates basic education prevails more widely in the city.

- School attendance in Mandalay City decreases gradually after the completion of the primary education cycle as shown in Figure 2.6.1 and the similar trend is shown in whole Myanmar. One of the main reasons of the gradual decrease is the economic difficulty of the household which cannot pay the opportunity cost to have their children go to school and another is because school location is too far from home to commute.

- Preparation of facilities for primary and middle school education in Mandalay City is at lower level than the whole Myanmar. In particular, the number of students per middle school in Mandalay City is significantly higher, which is approximately 2,000 as shown in Figure 2.6.2. Looking at the distribution by township, Chanmyatharzi and Pyigyidagun, which are relatively new urbanized areas, have a higher ratio of students per primary and middle school. It indicates that the development of facilities has not caught up with the recent increasing population.

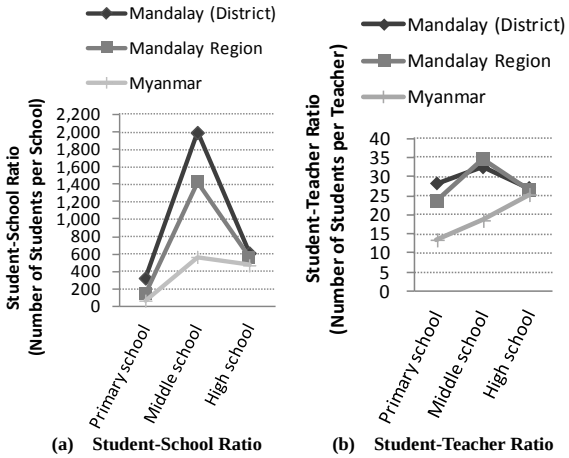
- Provision of sufficient number of teachers is one of the indicators to measure the quality of education. The ratio of student-teacher of primary and middle school in Mandalay City are 14-15 points higher than the ratio of whole Myanmar. In particular, Chanmyatharzi and Pyigyidagun Township have higher number in the city and it also indicates delay of development for educational staff.

  Ratio of population whose highest level of education completed is under primary school in Mandalay City is 16-17% lower than the surrounding area and whole Myanmar as shown in Figure 2.6.3. Also, ratio of population whose highest level of education completed is more than university or college in Mandalay City is also higher than the surroundings. It suggests higher educated people are more concentrated in the city compared to the surrounding area.



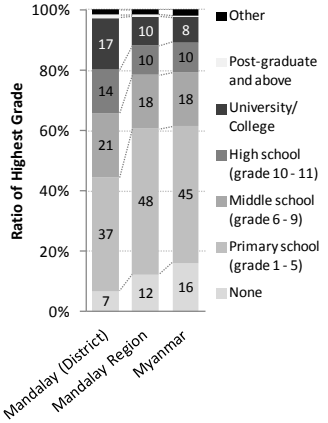
Note: The above relation between age and school does not reflect the students who have repeated the school years.
Source: JICA Study Team based on the 2014 Myanmar Population and Housing Census

Figure 2.6.1 School Attendance Rate



Source: JICA Study Team based on the 2014 Myanmar Population and Housing Census

Figure 2.6.2 Student-School Ratio and Student-Teacher Ratio

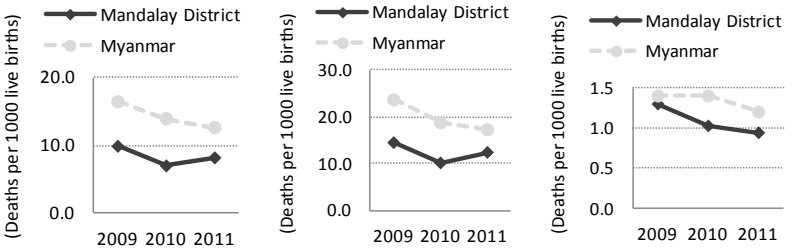


Source: JICA Study Team based on the 2014 Myanmar Population and Housing Census

Figure 2.6.3 Composition of Population Who are 25 Years and Over by Highest Level of Education

2.6.2 Health

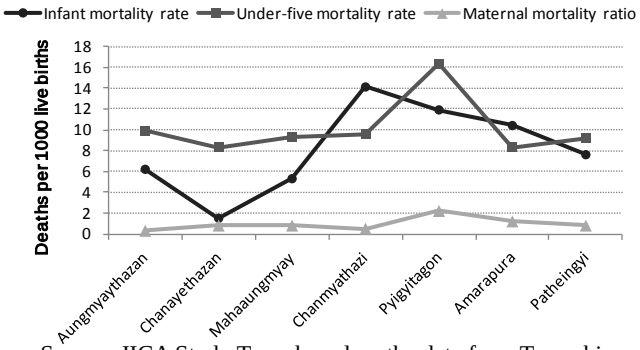
- Basic health indicators of infant mortality rate, under-five mortality rate, and maternal mortality rate in Mandalay City have been in better state than whole Myanmar as shown in Figure 2.6.4, which indicates residents in Mandalay City have better access to health facilities on average. There are, however, regional gaps of the indicators in Mandalay City. Figure 2.6.5 shows the indicators by township in the city, and Pyigyidagun Township has higher mortality rates than others.



(a) Infant Mortality Rate **(b) Under-five Mortality Rate** **(c) Maternal Mortality Rate**

Source: JICA Study Team based on the data from Township Health Profile 2011, Ministry of Health, Myanmar

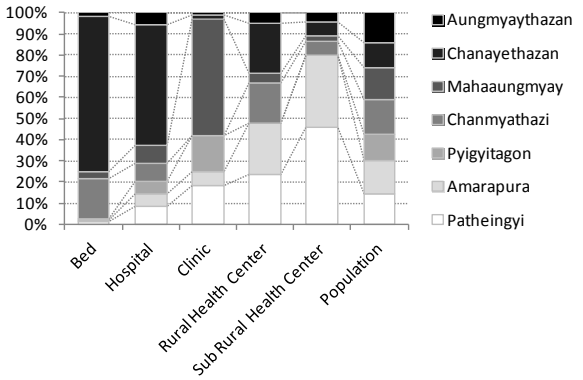
Figure 2.6.4 Basic Health Indicators of Mandalay City



Source: JICA Study Team based on the data from Township Health Profile 2011, Ministry of Health, Myanmar

Figure 2.6.5 Basic Health Indicators by Township in Mandalay City

- There are 35 hospitals, 292 clinics, 21 rural health centers, and 65 sub-rural health centers in Mandalay City. The distribution pattern varies by type of health facilities as shown in Figure 2.6.6. The numbers of hospitals and beds are concentrated in Chanayetharzan Township and it works as the medical center of the city, while Amarapura and Patheingyi are covered by a number of rural health centers and sub-rural health centers. On the other hand, Pyigyidagun has fewer health facilities per population which are located far from Chanayetharzan. The bad accessibility from there to the health service facilities must affect the higher mortality rates above.



Source: JICA Study Team based on data from GAD in Mandalay

Figure 2.6.6 Distribution of Health Facilities by Township in Mandalay City

2.6.3 Poverty

- United Nations Development Programme (UNDP) implemented integrated household living conditions surveys in the whole Myanmar area in 2005 and 2010. The following table shows the percentage of the population who were poor in Mandalay Region and whole Myanmar. The ratio of poor population in both urban and rural areas of Mandalay Region decreased from 2005 to 2010. The poor ratio in urban area of Mandalay Region in 2010 is 14.1%, which is 17.5% lower than the rural area.

Table 2.6.1 Percentage of Poor Population

(unit: %)

	Urban		Rural		Total	
	2005	2010	2005	2010	2005	2010
Mandalay Region	24.1	14.1	44.7	31.6	38.9	26.6
Myanmar Total	21.5	15.7	35.8	29.2	32.1	25.6

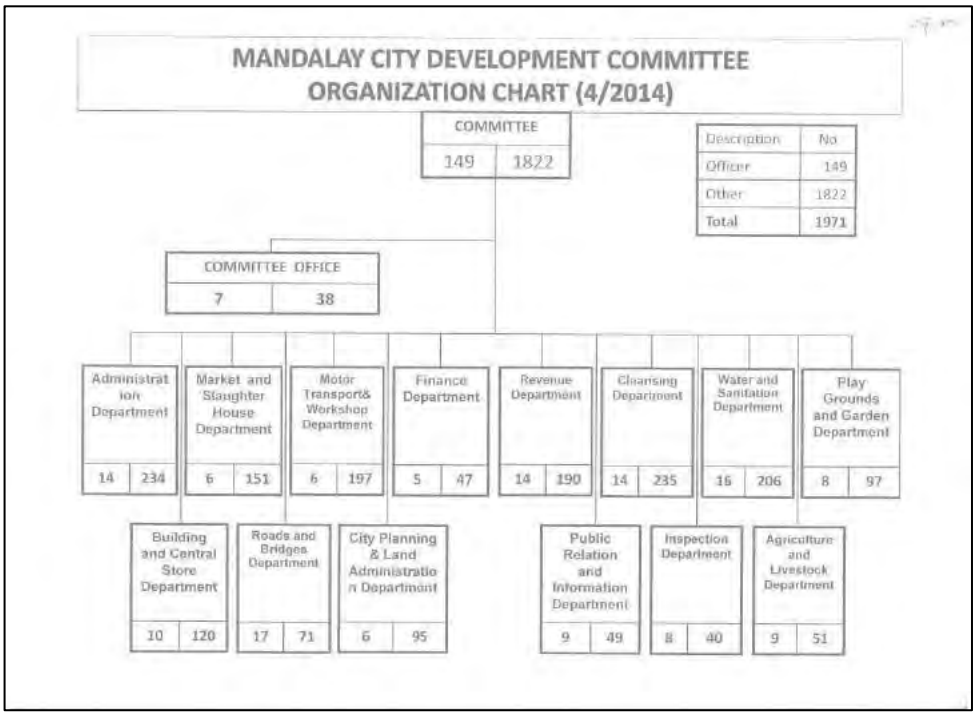
Note: Poverty lines were set as MMK 162,136 per adult equivalent per year in 2005 and MMK 376,151 in 2010
Source: Integrated Household Living Conditions Survey in Myanmar (2009-2010), UNDP

2.7 Institutional Conditions

- The 2008 Constitution brought a major reform on subnational governance and municipal governance. By introducing the 14 states and regions system as its subnational governance system, the Department of Development Affairs which had the responsibility over the municipal development was taken out from the Ministry of Boarder Affairs (MoBA) then placed under the total control of the state and regional government.

- However, municipal affairs in Yangon and Mandalay cities are organized differently from the rest of the country as described above. Mandalay City, currently consisting of seven townships, is managed by MCDC, which was established by the Mandalay City Development Law (1992, revised in 2002 and 2015). MCDC has delegated administrative functions under the authority of the Mandalay Regional Government. Thus, they are not fully autonomous local governments.

- MCDC is taking care of municipal service delivery and public works (waste management, water supply, roads and bridges, parks and sports grounds, street lighting, funeral services, and firefighting), city planning, urban land administration, tax collection (including business licensing and registration), public health, and urban development. These objectives are being implemented by the following 14 departments as shown in Figure 2.7.1.



Source: ADB, "TA-8472 MYA: Preparing Mandalay Urban Services Improvement Project Final Report, Vol. 1 Main Report", June 2015, based on MCDC, 2014

Figure 2.7.1 MCDC Organization Chart

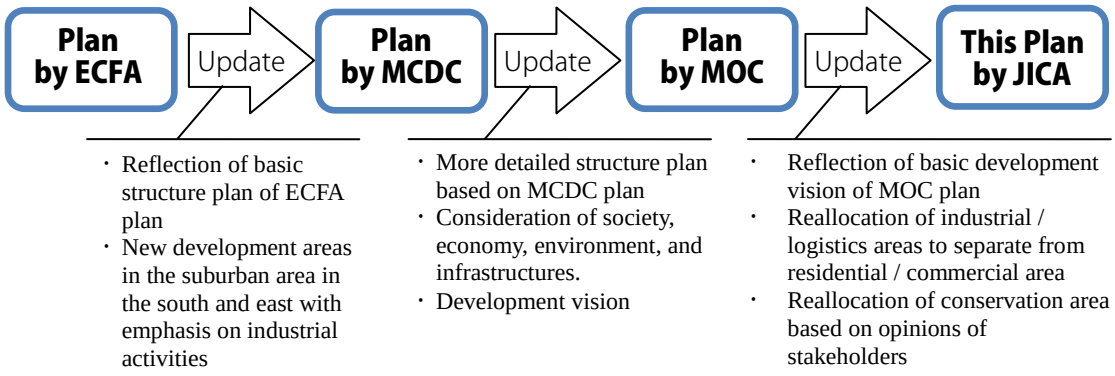
- MCDC is now managed by committees consisting of nine members that are partly elected by the public. The chairman of MCDC is the Minister of Development Affairs in the Mandalay Regional Government, whereas the committee's chairman also acts as the city mayor.

2.8 Relevant Plans and Projects

2.8.1 Existing and Past Plans

Outline

- In the past 30 years, there were three master plans for Mandalay, namely plans made by ECFA, MCDC and MOC. The following figure shows relations between the plans briefly. And following sections describes background and contents of the plans.



Source: JICA Study Team

Figure 2.8.1 Relations between Mandalay Master Plans

Master Plan by ECFA (1996)

- The Engineering Consulting Firms Association, Japan (ECFA) made an urban master plan of Mandalay according to an agreement with MCDC in 1996. This master plan made development concepts including conceptual structure plan and implementation plan based on the review of development trend in that period. The plan includes infrastructure plan such as transportation, water supply, sewage, and electricity.

- It planned three city cores in the northern area of the city, namely: i) existing CBD to serve as regional business center; ii) new CBD to serve as international business center; and iii) new civic center to be the service area for the city population. The southern area was planned as suburban area consisting of regional industrial park, national heritage park, export processing zone with National Highway-1, and new access road to international road. This structure idea had been utilized as a basic development concept of Mandalay.

Master Plan by MCDC (2012)

- Based on the plan made by ECFA above, MCDC prepared a 30-year city development plan in 2012, target year of which is 2040. While the plan basically followed the structure idea of the ECFA plan, it includes new development areas with emphasis on industrial activities such as industrial zone, trade zone, and hotel zone in the suburban area in the south and east. It reflected demands of urban and economic expansion which increased since the ECFA plan.

Conceptual Plan by MOC (2013)

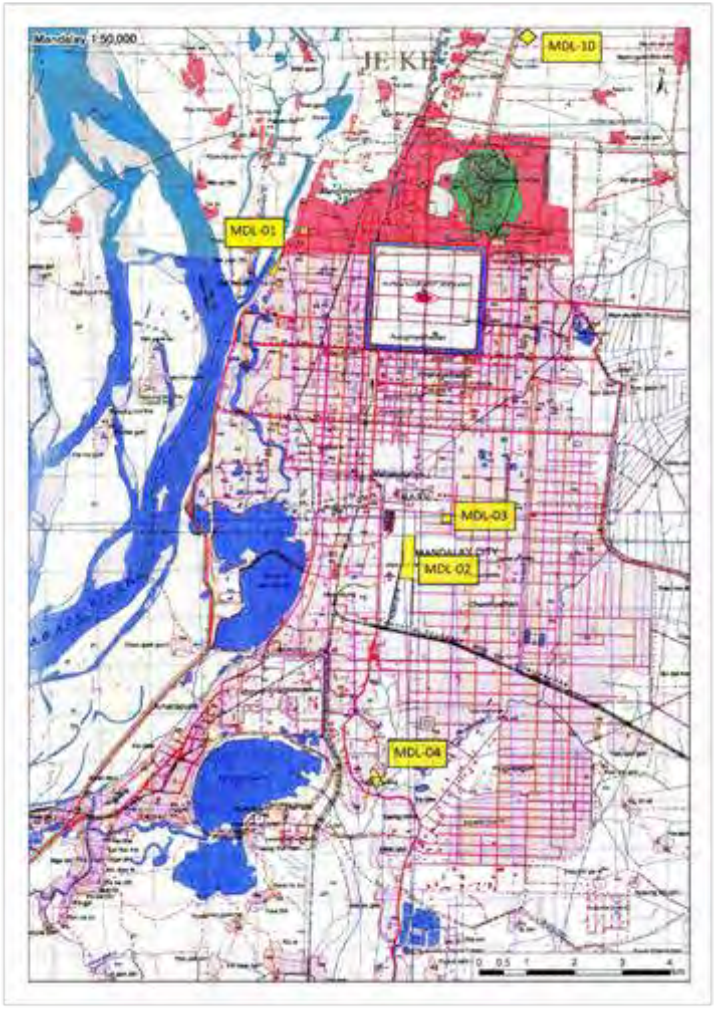
- Government of Myanmar laid down a policy on urban and regional development. It urged regional/state government to make long-term plans for urban development for their region which consider comprehensive points including society, economy, environment, and infrastructures. To follow the policy and to complement the MCDC plan, Mandalay Region Government and the Ministry of Transportation requested MOC to support the preparation of the plan. MOC completed the preparation of the Mandalay Urban Development Conceptual Plan in consultation with the Mandalay Region Government, transportation minister, mayor, and MCDC committee members.
- The MOC conceptual plan defined the development areas in more detail as shown in Figure 2.8.2 based on the MCDC plan above.
- One of the remarkable issues, however, is that currently Mandalay City does not have effective means to control urban development to realize any structure plan under the pressure of rapid urban development. Therefore, the plan is not yet implemented.

Source: Mandalay Urban Development Conceptual Plan, MOC

Figure 2.8.2 Structure Plan for Mandalay City in MOC Plan

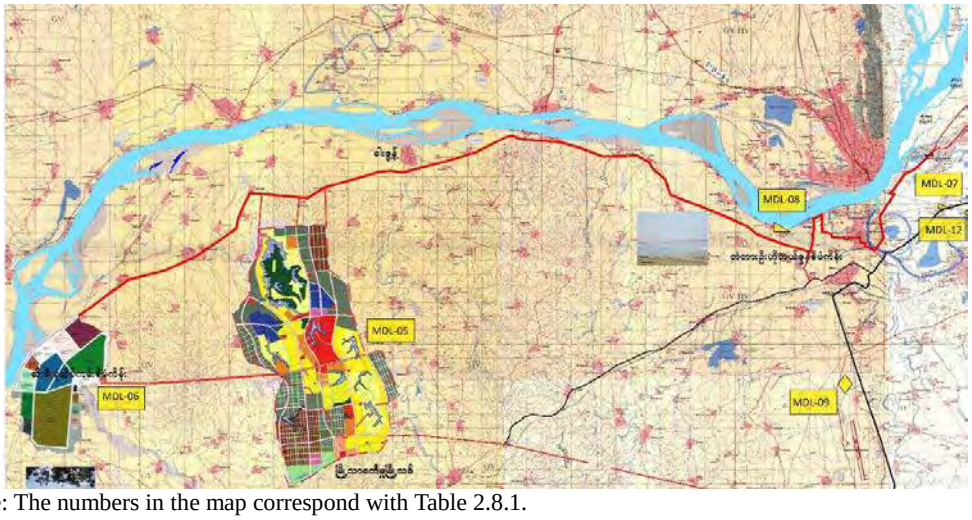
2.8.2 Ongoing and Planned Projects

- In Mandalay City, some large-scale projects are ongoing such as “Mingalar Mandalay”, “Mandalay Industrial Trade Center Project (MITC)” in existing urban area. These projects will bring its city center function southward in the future due to their volumes and facilities. Considering the suburbs of Mandalay City, Myotha Industrial Park and other unidentified projects will be triggered to expand Mandalay City’s function as one of the largest hubs of Myanmar in the context of international logistics. Figure 2.8.3, Figure 2.8.4, and Table 2.8.1 summarize the major development projects in Mandalay.



Note: The numbers in the map correspond with Table 2.8.1.
Source: JICA Study Team

Figure 2.8.3 Location of Major Development Projects in Mandalay City



Note: The numbers in the map correspond with Table 2.8.1.
Source: JICA Study Team

Figure 2.8.4 Location of Major Development Projects in Surrounding Area of Mandalay City

Table 2.8.1 List of Major Development Projects in Mandalay City and Its Surrounding Area

No.	Name	Development Facility	Developer	Status
MDL-01	Low cost rental housing project for squatters	Low cost housing	Myanmar Government and MCDC	Completed
MDL-02	Mingalar Mandalay CBD	Mixed-used complexes for commercial, residential, hospital, and public facilities	JV of Private Company (New Star Light Co., Ltd and C.A.D Co., Ltd) and MCDC	Under Construction
MDL-03	Mandalay City Convention Center and Commercial Complex Project	Mixed-used complexes for commercial, residential, hospital, and entertainment purpose	JV of Private Company (Mandalay Investment and Development Group) andMCDC	Under Construction
MDL-04	Mandalay Industrial Trade Center Project	Mixed-used complexes for exhibition centre, trade and industrial zones, residential, and commercial purpose	Mandalay Garden City Construction Group	Under Construction
MDL-05	Myotha Industrial Park (MIP)	Large scale industrial park (10,337 acres)	JV of Mandalay Regional Government and Mandalay Myotha Industrial Development Public Co. Ltd. (MMID)	Under Construction
MDL-06	Semeikhon Port (SMP)	Commercial river port with modern port facilities and port supportive industries	JV of Mandalay Regional Government and Mandalay Myotha Industrial Development Public Co. Ltd. (MMID)	Under Construction
MDL-07	Grand City (Jade Garden)	Mixed-used complexes including commercial purpose	Tet Lann Company, Man Amara Development Company Limited, Alpha Leo Construction Company and Aye Aye Khaing Co Ltd	Under Construction
MDL-08	Tada-U Hotel Zone	Tourism facilities	Myanmar Tourism Development Public Co.,Ltd	Under Construction
MDL-09	Whole Sales Market	Commercial facilities	Mandalay Green City Co.,Ltd	Proposed
MDL-10	Mannaykarit Housing Project	Housing	Thanti Thitsar Co.,Ltd	Under Construction
MDL-11	Special Business Zone	Business zone	NA	Proposed
MDL-12	Myit Nge Dry Port	Dry port	Joint Venture of Ministry of Transport and Communication and Private Sector	Proposed
MDL-13	Yay Taw University	University	NA	Proposed
MDL-14	Ethnic Housing	Housing	NA	Proposed
MDL-15	Upgrading High-quality Bus Terminal	Bus Terminal	NA	Proposed

Source: JICA Study Team

3 Development Visions and Socio-economic Framework

3.1 Development Visions and Strategies

3.1.1 Development Visions

Necessity

- Development visions are the ideal future images of each city, which can be attained through addressing problems and issues, catering to the citizens' needs, and integrating foresight of the stakeholders and experts regarding urban planning and other disciplines. Without setting clear development visions, it would be difficult to implement an integrated urban development plan efficiently. Consequently, the administration would come to a deadlock, as there are a number of concerned sectors playing important roles in developing, improving, and managing a large city.

Definition of Development Visions

- For the planning, the study formulates the development vision and strategies for the vision. The definitions of the development vision in the master plan are described as follows:

  a) **Development Vision**: Development direction and development concept of the city, which is realized under the execution of the master plan. Development vision consists of "Statement of Vision", "Key Drivers of the Vision", and "Strategies for the vision".
  b) **Statement of Vision**: The statement of the vision expresses the image of the future city. It summarizes related key drivers and strategies.
  c) **Key Drivers of the Vision (Pillars)**: Statement of the vision consists of several related key drivers. These key drivers correspond to major sector development field of the city and they are expected to become strengths and opportunities which lead to the realization of the vision.
  d) **Strategies for the Vision**: Strategies are development measures to be taken for the realization of the vision. These consist of measures such as:
     - Enhancement of current strength of the city;
     - Improvement of weakness of the city, which hinders progress of urban development and its favorable environment; and
     - Integration of existing development programs and introduction of new urban functions which give added value to current urban resources.

Formulation Process

- For the formulation of the development vision, the study refers to the following planning resources and takes the following process:

  a) **Development visions and targets in the existing planning document**: The development visions and targets have been formulated and they are described in the related planning documents such as the development plan of the city and the region. Some visions are stated in related national development plans and sector development plans. The conceptual plan of MOC set the five matters below as significant characteristics and strength of Mandalay City. The study considers these matters as base of pillars of the vision for further discussion.
     - Historic and cultural city; center of tourism business
     - Transportation center of local and abroad
     - Development corridors and trade center
     - By-polar development concept
     - Education and healthcare center
  b) **Results of analysis of the current conditions and issues**: The result of the analysis of current conditions of the city is useful to identify remarkable development fields to be

respected for the urbanization, environmental improvement, and industrial promotion of the city. These results, which are described in Chapter 2, were informed through the workshops and seminars held in Mandalay.

c) **Discussions among stakeholders**: In the workshops and seminars in Mandalay, the current conditions of the city were explained with major development resources, ongoing activities, and planning issues. After sharing the necessary planning information and recognizing the issues, the development vision was discussed among the stakeholders of city development attendees of the seminar and workshops. By discussing the order of priority of development subjects and their relationships, the prior key drivers of the vision were summarized.

d) **Formulation of development vision**: By summarizing the key drivers of the vision, the statement of the development vision was determined. Then, the realization processes of the development vision were examined as the strategies for the vision.

Resources and Challenges of Mandalay

- From the view of spatial features of the city, urban development, infrastructure services, and economic development, the following matters are raised as resources of Mandalay to be applied for the future development:

< Resources >

a) Trade and logistics center of upper Myanmar
b) Connectivity to China, Thailand, and India
c) Accumulation of small and medium industries and commerce
d) Multi-faceted industry in the city
e) Broad range of agricultural productions in the area
f) Rich cultural and historical tourism resources
g) Rich mineral resources in the region
h) Abundant potential labor force from rural areas
i) A center of higher education institutions

- From the abovementioned view, the following matters are raised as challenges of Mandalay to be resolved and improved for the future development:

< Challenges >

a) Disaster risks of water flood and earthquake (fault line)
b) High density residential area in the center of the city
c) Harmonization of heritages with development
d) Less foreign investment compared with Yangon
e) Underdevelopment of infrastructure for production and logistics
f) Drain of qualified human resources to Yangon and abroad
g) Saturated capacity of current logistic area
h) Lack of capacity of local industries in technology, human resources, finance, and information

Development Vision for Mandalay 2040

- The abovementioned features of the city (resources and challenges) are grouped into four themes through the discussions with stakeholders and attendees of the workshop in March 2016 and seminar in May 2016.

a) Logistic HUB
b) High-tech and Education
c) Culture and Tourism
d) Resilient and Green

- Then, the development vision of Mandalay City was established to be "national growth center", as one core city of "Two-polar Strategy". It intends that by 2040, Mandalay will be known as a successful city at a crossroads of international trade, home to an expanding, modern and high-tech economy, and with a rich cultural history that attracts increasing numbers of international visitors.

Source: JICA Study Team

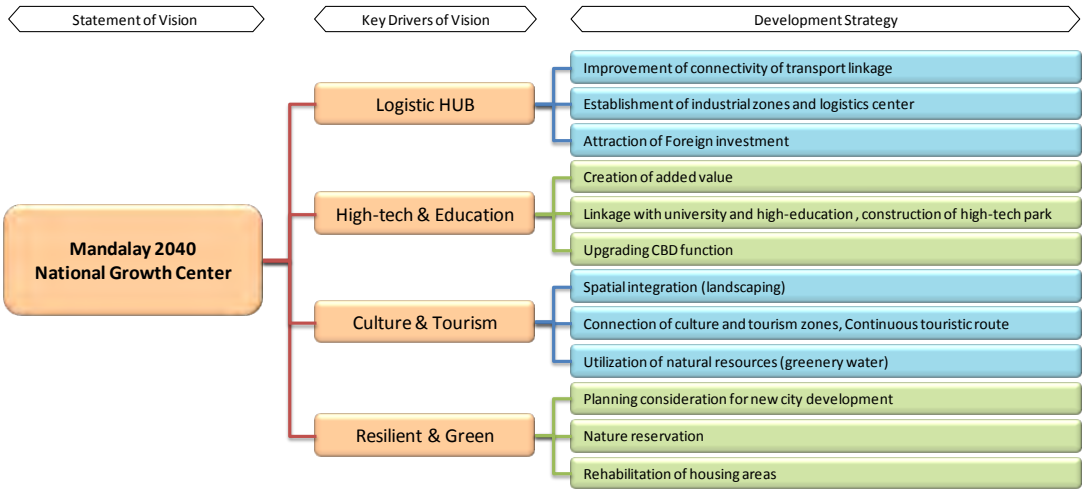
Figure 3.1.1 Development Vision for Mandalay 2040

3.1.2 Development Strategy

- Strategies are development measures to be taken for the realization of the vision. These consist of measures such as:

  a) Enhancement of current strength of the city;
  b) Improvement of weakness of the city, which hinders progress of urban development and its favorable environment; and
  c) Integration of existing development programs and introduction of new urban functions which give added value to current urban resources.

- The strategies to be considered and introduced for each key driver of the development vision are shown in Table 3.1.2.



Source: JICA Study Team

Figure 3.1.2 Development Strategy in Linkage with Development Vision

Logistic Hub

- As a national growth center under two-polar growth strategy, Mandalay City has an important role to be a logistic hub city. And it is expected to tap into foreign investments, by seizing the opportunity of increasing ASEAN connectivity. According to the current strong industrial features of the city, it is expected that the city will continue to develop its role as a logistics hub for Myanmar, benefitting from a location on key east-west and north-south transport corridors, and bringing domestic and international trading networks together in one location. The following measures are proposed in order to achieve the above development goals:

    - **Improvement of connectivity of transport linkage**: At first, it is necessary to improve current logistic circulation corresponding to the future development plan of Mandalay. The linkages below are necessary to be developed and improved. By strengthening spatial linkage and traffic connections, the business connections between local industries and foreign firms in new development area, such as Myotha Industrial Park, are expected in order to upgrade manufacturing technology for other industries such as auto-parts and electronics. Road Network Improvement and Disaster Road Network Development Project proposed as a key project by JICA Study Team (as discussed in 6.2), for example, is in line with this strategy.

        a) Linkage between current city and future industrial development areas
        b) Outer ring road, which connects between new development areas

    - **Establishment of industrial zones and logistics center**: Considering the saturated capacity of the current industrial zone and necessity of introduction of space for new industries, it is necessary to prepare or construct new industrial zones. It is recommended to prepare industrial areas with different features, such as information and research industry, light industry, and heavy industry; so that they can be located in suitable areas with supporting living facilities of workers. Also to correspond to the increase of industrial products and volume of cargo, areas for logistics service and other auxiliary services are expected to be constructed along the transport linkage. Along the lines with this strategy, JICA Study Team has selected various key projects such as Southern Gateway Industrial Zone Development Project and New Logistic Terminal Project.

    - **Attraction of foreign investment**: The specific features of diverse industrial zones are expected to attract foreign investment for particular purpose. The international airport can be a trigger for it. Additionally, improvement of river ports, dry ports, and other logistic-related facilities will accelerate the use of industrial facilities of the region as whole. Myotha Industrial Park, located at the surrounding area, will also accelerate the strengthening of the manufacturing sector. Under a new investment law that is expected to come into existence in the near future, the local government may consider focusing on inviting foreign manufacturers in the garment industry and other light assembling industries at the initial stage. These exporting industries are expected to fulfill the potential of Mandalay City as a logistic hub.

High-tech and Education

- Mandalay City has a broad range of accumulation of local industries. Its tradition of manufacturing has led the industrial development of the county, and this forms one of Mandalay's unique characters. Based on the city's long history of international trading, and their combination with the research and business development skills of the city's universities and entrepreneurial business community, the city is expected to provide a platform for the development of a modern and high-tech economy.

    - **Creation of added value**: Utilizing the accumulation of local manufacturing industries, the foundation of solid manufacturing sector is expected to be built by strengthening supporting

industries such as construction materials, various parts and equipment, packaging, plastic products, office supply, and foodstuff for domestic market by increasing local production. In order to establish a dense and matured manufacturing base, the government needs to create favorable environments for the local industries by providing various kinds of infrastructure and developing industrial zones targeting for particular groups of industries as stated above, as well as by other necessary measures such as financial and technical supports. The sound manufacturing base would induce multinational corporations to choose Mandalay and look for closer linkages with the local businesses. This will provide the local industries with good opportunities to create added value. The attempt of creating additional value to the current industries is expected to lead the expansion of new industry, which will be introduced in the new developed areas.

- **Linkage with university and high education, construction of high-tech park town**: For the high-tech industries, it is important to consider relation with concerned research and development sectors. In order to keep advantage of industrial sectors, it is necessary to offer the place for fundamental research, study on product development, and their product facilities. Also, the living space of researchers, engineers, and workers is an important factor for the company and their specialist to consider in choosing their business areas. In order to get competitive advantage against other cities in Myanmar and overseas, it is desirable to establish close relations between these facilities spatially and functionally. For their realization, land preparation near current educational facilities in the east of the city is important to invite these industrial facilities. Moreover, construction of integrated high-tech park is recommended in these areas. Based on this strategy, JICA Study Team has proposed Eastern Gateway Hi-Tech City Development Project shown in 6.2.

- **Upgrading CBD function**: The current central areas of Mandalay City are occupied with many old style and traditional buildings and most of them are not suitable for contemporary business needs and functions. In order to promote business and industrial development in the city, preparation and provision of a suitable business environment are necessary to attract these investors. Corresponding to the development needs, new business district is desired to be introduced in the current central area of the city. The current old airport site is considered as a candidate area for this purpose.

Culture and Tourism

- Mandalay City attracts tourists as the last royal capital of the Konbaung Dynasty with a lot of tourism heritages and destinations. By utilizing and enhancing such existing assets, tourism sector can encourage economical development in the early stage. A city is valued by its heritage and its cultural assets. Inheriting these cultural resources and utilizing them in harmony with its new function, the city is expected to carry out further development in its role as a world-class tourist destination and act as a hub for tourism in the central and northern parts of the country.

  - **Spatial integration (landscaping)**: At first, for utilization of historical and cultural heritages of the city in harmony with the urban function of Mandalay City, it is necessary to avoid damaging their spatial value by unregulated development around these heritages. In order to keep the current historical value in the city landscape and townscapes, it is necessary to formulate corresponding spatial zoning plan and to regulate construction activities in the surrounding area of the heritages.

  - **Connection of culture and tourism zones, continuous touristic route**: For the creation of touristic activities as an industry of the city, it is necessary to consider continuous activities of tourist with its spatial linkage. For enhancing the touristic value of the city, individual heritage zones, which are created by landscaping around the heritages, are to be spatially connected to make a spatial network. These linkages will attract visitors with interest and conduct further discovery of the city. The historical paths, current pedestrian route,

continuous green areas, and water courses are utilized for creation of touristic network of the city by its landscape treatment.

- **Utilization of natural resources (greenery water)**: Several large-scale lakes in the west of the city, picturesque scenes from the bank of the Ayeyarwady River, Mandalay Hill, and Yankin Hill near the center of the city of Mandalay offer other touristic value with their unique spatial features and landscapes. These spaces could be utilized as touristic resources through proper spatial treatment such as conservation, restoration, and addition of new touristic values such as hotel development. Their spatial developments are to be positioned in the plan of the abovementioned touristic route.

Resilient and Green

- To be a sustainable and livable city, conservation and creation of green, open space, and historical and cultural heritage must be prioritized properly in the city development plan. The city of Mandalay aims to be a beacon of sustainable development using energy-efficient infrastructure and sustainable building techniques. In order to carry out this planning theme, promotion of a 'compact city' plan is introduced to protect and conserve the natural environment, and to realize a resilient city to natural and man-made disasters.

  - **Planning consideration for new city development**: Mandalay City has risks of earthquake and flooding of Ayeyarwady River. Countermeasures to avoid and mitigate such risks must be taken in urban development and management especially the location of residential areas. Corresponding to this planning requirement, future development area needs to be selected carefully by reflecting the result of the analysis on former disaster record, and its development should be controlled by the city plan. Furthermore, environmental pollutions and wastes should be controlled to secure the safety of life. Attention on these matters is to be reflected in the planning of urbanization areas and their land use plans.

  - **Nature reservation**: In addition to the abovementioned spatial controls, preservation of nature areas around the city is important to reduce the damages of natural disasters. Nature area, such as marshland and paddy field around the city, functions as a natural retention pond of the area. From this view, development in these natural and agricultural areas needs to be modestly controlled. This planning policy is also reflected as strategy of development for the new development areas.

  - **Rehabilitation of housing areas**: Several districts in the periphery of the city are taking over wooden buildings of rural style in old ages. And some of these districts are occupied with small-scale shack-like building and shops. These districts have been expanded without proper spatial plan and controls. The environment of these areas is very weak against natural disasters and risks of fire. As the countermeasure for this situation, the rehabilitation of the housing areas should be planned to be executed through the application of urban redevelopment planning and/or land readjustment.

3.2 Socio-economic Framework

3.2.1 Demographic Framework

- The future population of Mandalay City for the next 25 years was forecasted in line with the population growth projections of the Union and regions/states that were made by the JICA Study Team prior to examining the growth scenario of the city population. In considering the estimates of the city population, assumptions were made on the future urban population ratios of Mandalay Region and future shares of Mandalay City in the increased urban population of the region at the forecast year, while taking into account the past figures presented in the 1983 and 2014 census reports. The assumptions are elaborated as follows:

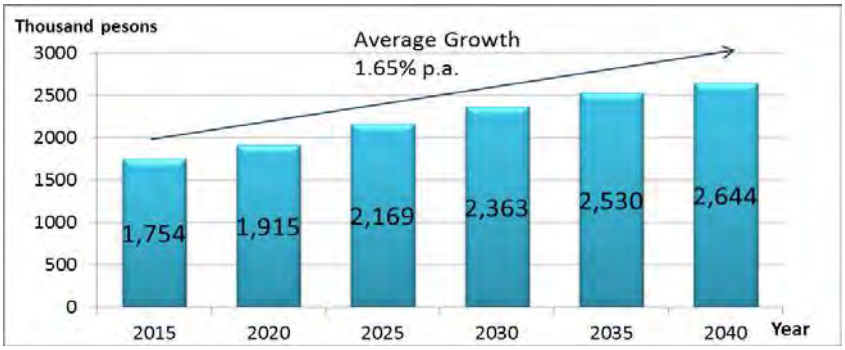
- Urban population rate of Mandalay Region is assumed to increase to 42% in 2040 from 35% in 2015.
- Mandalay City's (District's) share in the total urban population of the region is assumed to reach 67% in 2040 from 62% in 2015.

- Based on the assumptions, the city population is forecasted to reach **2.64 million in 2040 from 1.75 million in 2015, showing an increase of 890,000 persons**. This corresponds to the average growth rate of 1.65% per annum during 2015-2040. Figure 3.2.1 shows the forecasted population until 2040.

Table 3.2.1 Population Estimates of Mandalay City (District) from 2015 to 2040

	(1983)	(2014)	2015	2020	2025	2030	2035	2040	Annual Growth Rate (2015-40)
Mandalay Region									
Total Population (thousand)	4,578	6,166	6,221	6,468	6,983	7,386	7,677	7,789	0.90%
Urban Population (thousand)	1,214	2,143	2,177	2,393	2,724	2,954	3,147	3,272	1.64%
Rural Population (thousand)	3,364	4,022	4,044	4,075	4,260	4,432	4,529	4,518	0.44%
Urban Population Rate	27%	35%	35%	37%	39%	40%	41%	42%	
Rural Population Rate	73%	65%	65%	63%	61%	60%	59%	58%	
Mandalay District (City)									
Total Population (thousand)		**1,727**	**1,754**	**1,915**	**2,169**	**2,363**	**2,530**	**2,644**	**1.65%**
Urban Population (thousand)		1,319	1,350	1,508	1,743	1,920	2,077	2,192	1.96%
Rural Population (thousand)		407	404	407	426	443	453	452	0.44%
Share in Urban Population of Region		62%	62%	63%	64%	65%	66%	67%	
Share in Rural Population of Region		10%	10%	10%	10%	10%	10%	10%	

Source: JICA Study Team



Source: JICA Study Team

Figure 3.2.1 Population Forecast of Mandalay City (Mandalay District)

- MOC's conceptual plan for Mandalay City developed in 2013 forecasts the population growth for 30 years (2011-2041) using three different growth rates of 1.01%, 1.8%, and 2.1%. It is understood that the above population forecast estimated by the JICA Study Team is close to the middle option of the conceptual plan in terms of annual growth rate. ADB's study on Mandalay Urban Services Improvement Project (June 2015) and UN HABITAT's Demographic Study of Mandalay (July 2015) have also projected annual growth rates of population until 2040 in a close range to the above forecast (ADB: 1.68% and UN HABITAT: 1.73% for moderate scenario).

3.2.2 Economic Framework

- The future economic growth of Mandalay City for the next 25 years was forecasted in line with the economic growth projections of the Union and regions/states that were made by the JICA Study Team prior to examining the growth scenario of the city economy. The average annual growth rates of the Union's GDP and Mandalay Region's GRP during this period were estimated to be 7.1% and 8.0% respectively by the JICA Study Team, considering the existing projections made by the Myanmar government and international organizations. The GRP of Mandalay City was forecasted based on the urban/rural ratio of productivity per person in employed person aged 10 years or over, and the population scenarios already forecasted by the JICA Study Team. The urban/rural productivity ratio was calculated to be 1.75:1.00 from the GDP of Myanmar by industry in 2014/15 and corresponding urban and rural populations. An assumption was made on the ratio held constant for the next 25 years by considering that apart from expected increases in productivity of manufacturing and service sectors, productivity of agricultural sector will also increase because of the progress of mechanization and the use of proper fertilizers, which will have a certain effect to push rural productivity.

- Reflecting on the proportion of the calculated productivity index of Mandalay City to that of Mandalay Region, the GRP of Mandalay City was computed as shown in Table 3.2.2. **The GRP is forecasted to grow 8 times and reach MMK 18,700 billion in 2040** from MMK 2,270 billion in 2015 at constant prices. **The GRP per capita is forecasted to grow 5.5 times arriving at over MMK 7 million in 2040** from MMK 1.3 million.

Table 3.2.2 GRP of Mandalay City (District) from 2015 to 2040

Item	2015	2020	2030	2040	Average Annual Growth Rate
Mandalay Region: GRP (MMK billion)	6,456	10,449	23,128	44,653	8.0%
Mandalay District: GRP (MMK billion)	2,274	3,852	9,162	18,691	8.8%
Mandalay District: Population (thousand)	1,754	1,915	2,363	2,644	1.7%
Mandalay District: GRP per capita (MMK million)	1.30	2.01	3.88	7.07	7.0%
Mandalay Region: GRP Index (A)	7,854	8,263	9,602	10,243	
Mandalay District: GRP Index (B)	2,767	3,046	3,804	4,288	
(B)/(A)	35.2%	36.9%	39.6%	41.9%	

Note: GRP figures forecasted are based on 2010/11 prices.
Source: JICA Study Team

4 Urban Development Policy

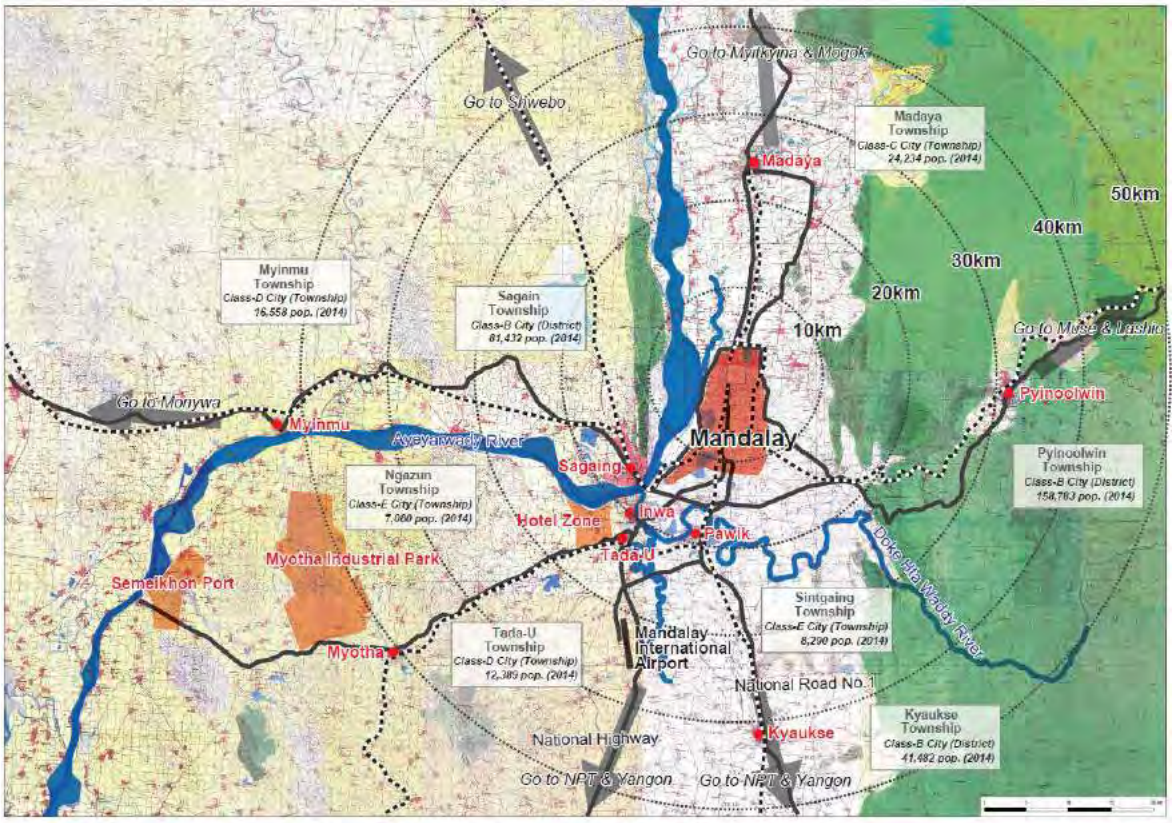
4.1 Spatial Plan

4.1.1 Planning Conditions in a Broad View

- As Mandalay City, which consists of seven townships, is the second largest city in Myanmar, the affected area is much larger than other cities in terms of urban, industrial, logistic, and other relevant activities. When the future spatial and structure plan of Mandalay City is considered, the relationship with its surrounding areas, such as Madaya, Pyinoolwin, Kyaukse, Pawik, Tada-U, Inwa, Myotha, and Sagain, must also be taken into account in the planning work.

- Regarding relationships with surrounding townships, three townships which are classified as Class-B City by MOC, namely: Sagain Township, Pyinoolwin Township, and Kyaukse Township, shall be important for the future urban development of Mandalay City. Because it is the capital of Sagain Region, development of Sagain can be promoted by means of inland water transportation under cooperation with Mandalay City. In linkage with China's trade, Pyinoolwin located between Mandalay and China, would be also important for logistics function as well as tourism.

- Development of Myotha Industrial Park and Semeikhon Port, located in the suburbs 50 km from the center of Mandalay City, would serve as big trigger in the expansion of Mandalay City's function as one of the largest hub of Myanmar in the context of international logistics. Mandalay International Airport shall also be required to function for logistics and tourism in connection with Mandalay City and surrounding cities more than ever as the logistics center of upper Myanmar.



Source: JICA Study Team

Figure 4.1.1 Planning Conditions in Broad View of Mandalay

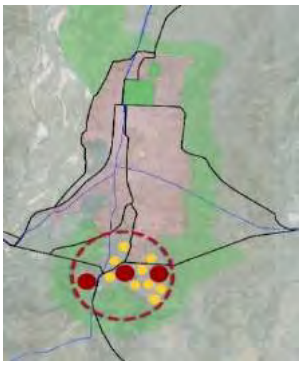
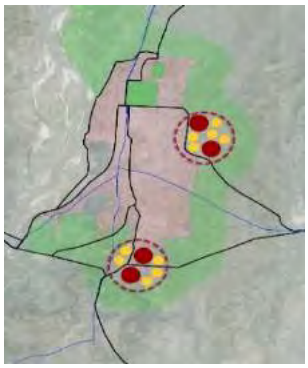
4.1.2 Options of Urban Development Structure

- The projected city growth needs to be addressed spatially in terms of space for further expansion of the city as well as regeneration of the core area. After discussions with various stakeholders, three options were suggested for the future growth of Mandalay City. The city growth would comprise of industries and workplaces (represented in maroon), tourist centers (represented in pink), and residential development (represented in yellow) as seen in the following Table 4.1.1.

- The first option puts the emphasis of development on the southern part of the city. The projected quantum of the second option's development would be divided mainly into two cores. The third option aims at creating multiple growth pockets through regeneration, redevelopment, and greenfield development.

  As Option 3, three cores development concept, seemed preferable among all options according to the result of a series of meetings with the stakeholders, the spatial plan was made basically in line with the direction of Option 3. On the other hand, some good points of the other two options were also adopted partly in the spatial planning work.

Table 4.1.1 Three Options of Urban Development Structure in Mandalay

Option	Option 1	Option 2	Option 3
Concept	One Core Development	Two Cores Development	Three Cores Development
No. of Core	1	2	3
Direction	South	Northeast and South	Southeast
Image map			
Key Features	• Creating a compact development zone along the Yangon Expressway as an extension of the existing industrial zone. • The new development will share and utilize the existing industrial infrastructure. • New industrial pockets would be supported by residential to create self-sufficient parcels. • No expansion towards the wetlands and hills in the northern part of the city thereby conserving the ecological zones.	• Creation of two development cores. • One of the cores would be located towards the southern part of the city in close proximity to the industrial zone and the other towards the northeastern part of the city. • The traffic would be split in two directions. Therefore, traffic would be better managed.	• Creating a "cyber satellite city" as an eastern gateway. • Expansion of the existing industrial area towards the southwest. • The northeastern part of the city remains as a green "conservation zone"

Source: JICA Study Team

4.1.3 Spatial Plan

- In light of the past trends and considerations of logistics function and some large-scale development projects, the urbanization of Mandalay City is likely to extend outward, especially southwards in connection with Yangon and China along highway and national road, rather than northwards. Additionally, the upgraded Mandalay International Airport might accelerate this future trend.

- The CBD, which is the center of Mandalay City including Zegyo Market, has limited potential for future expansion of its central business function due to no surplus land for new development and complicated land ownership. To be a national growth center, development of new CBD is necessary which will lead business and economic activities of Myanmar as well as Mandalay. Regeneration of the old airport area by creating a new CBD in the vicinity of the new railway station is recommendable. The location of new CBD is able to utilize existing asset of railway and trunk road for securing effective traffic as the center of city area.

- Population increase of Mandalay City by 2040 is 917,000. Setting 200 person/ha as appropriate population density of new town, the required land for the new town development mainly for residential function would be 45 km^2 (10,992 acre). The required lands have been allocated in the spatial plan.

- Hi-tech new town development was proposed at the gateway from China in good connection with southwards (to NPT and Yangon) by the outer ring road and with the technological university of Mandalay. In terms of topographical feature, high-lying area of the location is also suitable to minimize flood risk from activities of research and development.

Table 4.1.2 Required Land for Future Population Increase

Items	Population of 2015	Population of 2040	Population Increase	Density of New Town (person/ha)	Required Land (ha)	Required Land (km^2)	Required Land (acre)
Mandalay	1,754,000	2,644,000	890,000	200	4,450	45	10,992

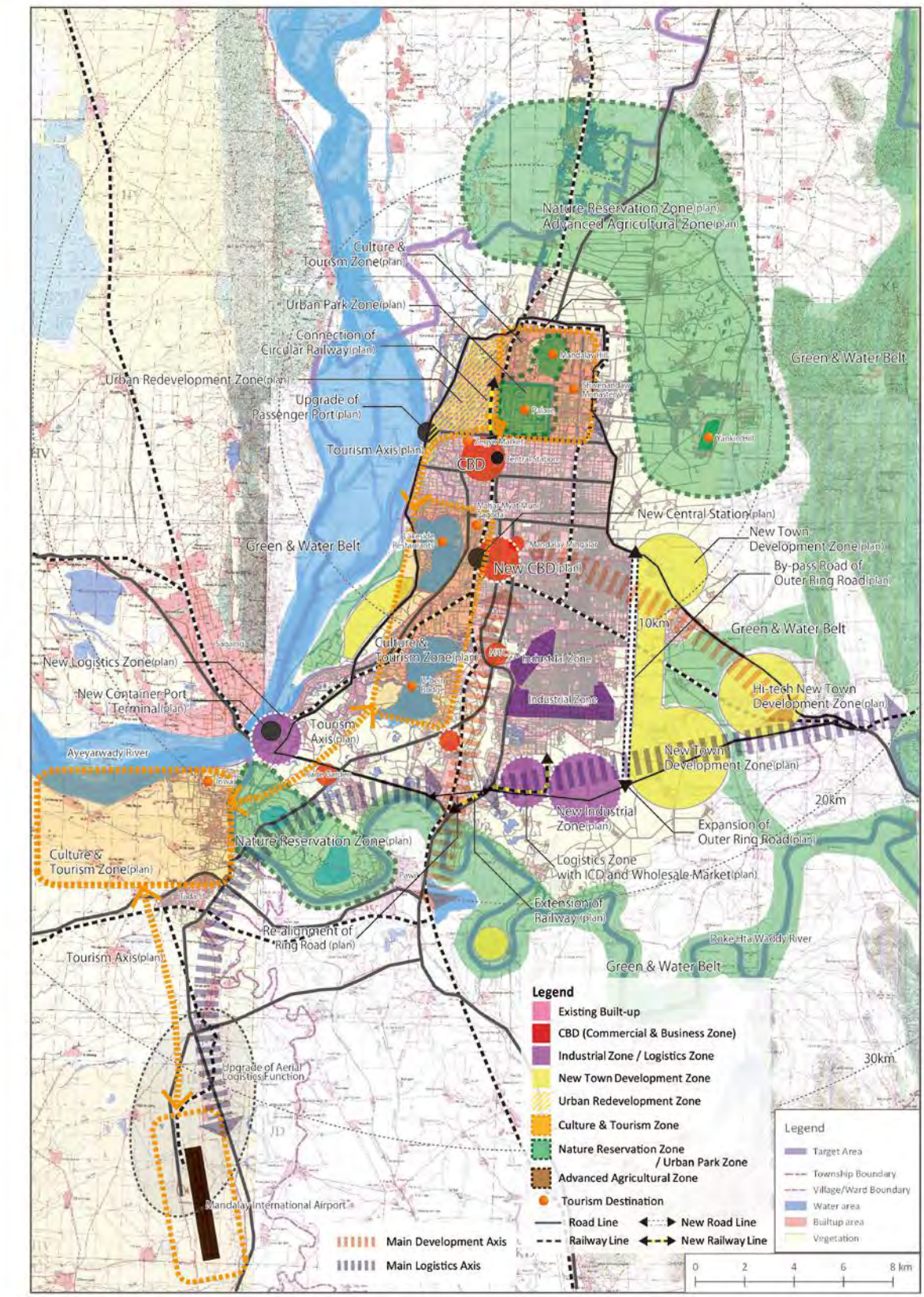
Source: JICA Study Team

Table 4.1.3 Proposed Zones and Contents in the Spatial Plan of Mandalay

Items / Zones	Characteristics of Zone	Proposals in the Spatial Plan
Existing Built-up (Residential and Mixed-use)	Current urbanized areas which are covered by buildings mainly for residential, commercial, and mixed-use.	All areas would be upgraded gradually in terms of environment, infrastructure, and social services.
CBD (Commercial and Business)	Current center of commercial and business area leading economic activities of Mandalay. It includes a traditional market.	Although existing CBD function must be kept in the future, it is likely more for tourism attracting foreign tourists.
Industrial Zone Logistics Zone	Industrial and logistic function must be in good connection with other focal cities and countries by roads, railways, and water.	New industrial zones and logistics zones were proposed to be located southwards of the city. These locations have better accessibility with Yangon and China.
Urban Redevelopment Zone	In existing built-up area, low-level residential areas (informal houses) seem to exist without access to proper infrastructure.	An area along the Ayeyarwady River shall be improved with proper road system and infrastructure.
New CBD (Commercial and Business Zone)	To accelerate economic growth, development of highly functional commercial and business area is necessary.	New CBD is proposed to be located 5 km south from current CBD utilizing the old airport area and the railway depot.
New Industrial Zone New Logistics Zone	To be a logistic hub and high-tech city, expansion of industrial and logistic function is important.	Development of a logistic hub (terminal port) along Ayeyarwady River and expanded industrial zones along the outer ring road are recommendable.

New Town Development Zone (Residential and Mixed-use)	New town includes function of not only residential but also some commercial and business as mixed-use.	Development of new town with an area of 45 km^2 in total is necessary in the future. Creating a "high-tech satellite city" as an eastern gateway is proposed as key project.
Culture and Tourism Zone	To encourage tourism development, promoting culture and tourism zone is recommendable to conserve and utilize historic and natural resources. Improvement of access is also necessary.	Three culture and tourism zones have been proposed, namely "Mandalay Palace and Hill Zone", "Two Lake Zone", and "Inwa Zone". Street No.26 connecting between the River and Palace passing Zegyo Market has also good potential as a Tourism Axis.
Urban Park Zone Green and Water Belt Zone	To upgrade urban environment, both urban parks inside the city and green and water belts surrounding the city are necessary.	Mandalay Palace and Hill must be conserved and utilized as urban park of Mandalay and as symbol of the city. Hills, mountains and rivers can function as appropriate green and water belts.
Nature Reservation Zone Advanced Agricultural Zone	Nature reservation zone and advanced agricultural zone where development activities are basically prohibited are important to avoid urban sprawl and to keep the city more compact and efficient.	Agricultural areas in the northeast and river area in the southwest are recommended to be nature reservation zones of Mandalay.

Source: JICA Study Team



Source: JICA Study Team

Figure 4.1.2 Proposed Spatial Plan of Mandalay City

4.2 Urban Development Policy

- To achieve the development visions and strategies for 2040, development by sectors which are (1) Commercial, Business, & Industry, (2) Housing, (3) Landscape and Tourism, and (4) Environment and Agriculture, must be a basement as well as infrastructure development and social service improvement. Schematic relationship of the visions (four key drivers) and sectors are as shown in Table 4.2.1.

Table 4.2.1 Schematic Relationship of Visions and Sectors

Sectors / Key Drivers	Commercial, Business, & Industry	Housing	Landscape & Tourism	Environment & Agriculture
Logistic HUB	++	+		
High-tech & Education	++	+	+	+
Culture & Tourism	+		++	++
Resilient & Green		++	+	++

Note: ++ Strong Relation, + Relation
Source: JICA Study Team

4.2.1 Commercial, Business, & Industry

- The following Table 4.2.2 shows the development policies of commercial, business, and industry in Mandalay City, especially for achieving a future city to be logistic HUB and High-tech & Education. In order to execute these policies, spatial control is a common and principal measure to be taken by the local and central governments for the realization of urban development policies and projects. These control measures are expected to be executed based on the law, by-laws, and other legal frameworks. Concrete measures are described in Chapter 7.1.2 of this report.

Table 4.2.2 Development Policies of Commercial, Business, & Industry in Mandalay

Commercial, Business, and Industry Policy	1) Creation of New CBD Core 2) Satellite Town Development 3) Construction of Logistic Hub 4) Construction of New Industrial Zones 5) Restructuring of Current Central Business District 6) Restructuring of Touristic Functions

Source: JICA Study Team

- **1) Creation of New CBD Core**: New CBD is expected to be introduced in order to enhance the commercial and business functions of the current urban area of Mandalay City and to offer new functions corresponding to the present time. These functions are expected to be installed in the location, which ensures close relation with current central areas of the city spatially and functionally. The old airport area is considered as one of the suitable areas for this development purpose. The following functions are expected to be introduced in the area:

a) Business and commercial buildings;
b) Service facilities (e.g., hotels and conventions);
c) Residential facilities, which are integrated with the urban environment; and
d) Passenger transport facilities (Construction of new linkage with railway and related development of current railway cargo terminal area are proposed for the long-term development).

- **2) Satellite Town Development**: The construction of satellite town aims at the introduction of new industrial function and formulation of workers' living environment. These functions are planned to be constructed in the east area of the city as the satellite town. The development intends to create new industrial spaces, which are specialized for research and development functions. The following functions are expected to be introduced in the area:

    a) Research and development facility;
    b) Educational facilities (university and research institutes which are related to industrial technologies);
    c) Production facilities;
    d) Residential facilities for researchers and workers; and
    e) Commercial and business facilities which support workers' daily life.

- **3) Construction of Logistic Hub**: In order to supplement the current capacity of logistic functions of the city and to realize efficient distribution of cargo and products in the region, the new logistic hub is planned to be constructed in the south of the city along the current arterial road. For the determination of its location, the following matters and functions need to be taken into consideration:

    a) Easy accessibility from current and future arterial road to the site;
    b) Connection of major regional road to all directions (location near the important node of current road network);
    c) Selection of location, which is close to current and future development area;
    d) Selection of site in the outskirt of the city in order to avoid traffic congestion and accident; and
    e) Connectivity of other transport modes (air, water, railway traffic).

- **4) Construction of New Industrial Zones**: In order to correspond with the demand of new industrial activities, several industrial zones are planned to be constructed in the outskirt of the city. According to the expected function of the industrial area and their major product, suitable candidate area will be set as follows:

    a) New industrial zone in the south and southeast of the city: for light industries and low pollution industry;
    b) High-tech industrial zone: this zone will be constructed as integrated development area with research and development institute, educational facilities, and living spaces;
    c) Industrial area with new container port in the southwest of the city: this area is expected to function in concert with logistic industries (e.g., package and export processing); and
    d) Industrial areas for heavy industries and polluted industries: these industrial zones are needed to be planned in the remote area of the city. Placement in Myota Industrial Park could be considered as a candidate allocation.

- **5) Restructuring of Current Central Business District**: In accordance with the progress of industrial and commercial development in the city and its periphery area, some of the business and commercial functions are expected to move to these new development areas. In relation to this industrial relocation, restructuring of the function of the current central business district is prospected. The following functions are planned to be strategically introduced in the area:

    a) Touristic business (hotels, restaurants, and shops for tourist);
    b) Craft industry;
    c) Service business (such as information, knowledge industry); and
    d) Public facilities which correspond to the new demand of the city (parking, green and park space).

- **6) Restructuring of Touristic Functions**: Below areas are considered as suitable areas for touristic development by enhancing the spatial value. By forming touristic networks and spatial

linkages in addition to the current touristic areas and monuments in the old city, the touristic value of Mandalay City is expected to be raised with new touristic market.

a) Waterfront area of the river bank of Ayeyarwady River (after spatial improvement of current informal settlement)
b) Lakeside area in the west of the city (need to be controlled as moderate development)
c) Culture and tourism zone in the south of Mytinge River
d) Surrounding area of the new airport

4.2.2 Housing

- In accordance with the population growth, increase of migrants as workers due to new demand of industrial areas and change of living styles, corresponding housings are expected to be supplied in conformity to the city plan. Paying attention to be resilient and green as one of the key drivers of the visions is necessary viewpoint for housing development. Typical housing demands and issues for the realization of the development vision of Mandalay City are concluded in Table 4.2.3.

Table 4.2.3 Development Policy of Housing in Mandalay

Housing Policy	1) Continuation of Development in Current Housing Development Area (South of the Current City) 2) Redevelopment of Existing High Dense Housing Area (Northwest of the City) 3) Formalization of Illegal Settlement 4) Construction of Modern Housings (New CBD and New Town Area) 5) Preparation of Housings Around Industrial Areas for Workers

Source: JICA Study Team

- **1) Continuation of Development in Current Housing Development Area (South of the Current City)**: Current urbanized area is extending to the south of the city, and it forms residential districts with ordinal grid pattern streets. These areas are satisfactorily prepared and housings are adequately constructed except insufficient infrastructure supply (water and water treatment). These areas are located between the industrial areas in the south and the old city in the north, and it is expected to be a residential area of workers of the working places. Utilization of prepared residential site by guiding its appropriate development will realize low-cost housing supply.

- **2) Redevelopment of Existing High Dense Housing Area (Northwest of the City)**: Residential areas in the west of Shwe Ta Chaung Canal are irregularly developed with many narrow streets. In order to improve their spatial condition, it is expected to reorganize their living environment by application of urban redevelopment project and land adjustment project schemes. These planning methods aim at the reorganization of residential zones and securing public spaces (roads and social facilities) by reconstruction of current low houses to middle/high-rise new apartment houses. For its realization, participatory involvement of current residents, public sector (local governments), and private developer is indispensable. Assistance in planning and project coordination needs to be continuously offered for its realization.

- **3) Formalization of Illegal Settlement**: Before the improvement of the current informal housings, it is necessary to prepare social housings and affordable housings where the residents of these areas will settle. In order to advance this improvement activity, related assistance, such as vocational training, for helping current residents' resettlement should be introduced in parallel.

- **4) Construction of Modern Housings (New CBD and New Town Area)**: Preparation of modern living facilities with international standards is important for attracting investors from other regions and countries especially for the development in CBD and new town areas. In these

areas, brilliant living environment is expected to be planned and prepared in integration with commercial/business spaces and functions.

- **5) Preparation of Housings Around Industrial Areas for Workers**: Migration of workers is expected for the new industrial areas to be developed. In order to promote industrial investment to these areas and to avoid deteriorated living conditions, housing supply for the workers is considered in relation with this development. These housing areas need to be located near the working site and living facilities (commercial and social facilities). Generally, housing developers are interested in housings for the medium income class, but they are not interested in the housing business for low income workers because of their unprofitable business prospect. Guidance and provision of social housing by public entities need to be introduced for the realization of balanced development and housing supply.

4.2.3 Landscape and Tourism

- Unique landscape and tourism resources accumulated over the years exist everywhere around the city. To emphasize culture & tourism as one of the key drivers of the vision, landscape and tourism development is fundamental factor. The precious and various resources have large potential to attract a lot of tourists around the world. To establish a world-class culture and tourism city by utilizing and enhancing the landscape and tourism function of Mandalay City, the policies in Table 4.2.4 should be considered.

Table 4.2.4 Development Policy of Landscape and Tourism in Mandalay

Landscape and Tourism Policy	1) Heritage and Landscape Conservation 2) Tourism Zone Development 3) Connection of Culture and Tourism Zones, Continuous Touristic Route

Source: JICA Study Team

- **1) Heritage and Landscape Conservation**: Appropriate conservation is necessary for culture and heritage like traditional scenery, social lives, relations, and composition of social tradition. High-rise and modern buildings are, however, being developed in the city with recent economic growth and inflow of investment. There is a risk that these new buildings will bring serious harm to the landscape and heritage area which shaped Mandalay's inherent atmosphere. In order to keep the current historical value of the city landscape and townscapes, it is necessary to formulate a corresponding spatial zoning plan and to regulate construction activities in the surrounding area of the heritages. As a first step towards conservation, conservation zones should be identified. Mandalay Palace and Mandalay Hill represent Mandalay's landscape and heritages and therefore, the area surrounding them should be especially regulated.

- **2) Tourism Zone Development**: Most tourism places including heritage, hotel, restaurant, and shopping store are located separately and therefore, there are few places for tourists to stay for some quality time. This deteriorates the tourist's satisfaction and loses the precious chance to earn revenue from them. Tourism zones with a variety of tourism functions where tourist can stay for some quality time should be developed around existing commercial area and new suburban area. The surrounding of the heritage area is also recommended as long as the new development is done in a harmonized manner with the area. In such zones, it is required to develop and upgrade hotels and services to international standards to cater to the needs of increasing tourists. And to support and accelerate tourism business in these zones, handicraft business, which has been an active business in Mandalay City, should be preferentially encouraged. The following are prominent areas:

    a) Inwa and its western area

- The area has good accessibility to airport, river view, and many heritage buildings of Inwa and Pinya era, such as Mae Nu religious brick building and other religious buildings.
- It needs to be controlled as moderate development.

b) Lakeside area in the west of the city (Accessibility to lake view and new CBD, but needs to be controlled as moderate development)

- The area has good accessibility to lake view, new CBD, and heritages including Tat-Thay Lake, Kan Taw Gyi green area, U Pein Bridge and Taung Tha Man Lake, Maha Gandar Yone Monastery, Ma Soe Yane religious school
- It also needs to be controlled as moderate development.

c) Surrounding area of the new airport

- The location adjacent to the airport, the future main gateway to Mandalay City, has large potential as a tourism zone.
- Height of buildings should be controlled according to aviation regulation.

· **3) Connection of Culture and Tourism Zones, Continuous Touristic Route**: For the creation of touristic activities as the industry of the city, it is necessary to consider continuous activities of tourists with its spatial linkage. It will enhance Mandalay's attraction from outside and it increases touristic value for both tourists and the city. One of the ways to make the linkage is creating or including tourist routes which connect individual tourism zones by continuous historical paths, green areas, water courses, and shopping street. On the other hand, distant areas from Mandalay City including Sagain, Inwa, and Mingun should also be connected well. To improve the connection, transport hub should be developed which connects tourism places, and the new central railway station in new CBD area will play this role.

4.2.4 Environment and Agriculture

· To develop Mandalay City as culture and tourism city and resilient and green city by 2040, environmental concerns shall be addressed in its development policy. There are four main concerns to be taken into consideration, namely: nature conservation, pollution control, living conditions, and natural hazard and agriculture.

Table 4.2.5 Environmental Policy in Mandalay

Environmental Policy	1) Creation of Natural Reserve 2) Pollution Control 3) Building Livable Urban Settlement 4) Disaster Preparedness 5) Agriculture, Food Processing and Logistics Promotion

Source: JICA Study Team

· **1) Creation of Natural Reserves**: For keeping clean water resources and farm production, it is crucial to designate areas as natural reserves. The Shwetachung and Ngwetachaung creeks, Nadi River, Payandaw Creek, Mnadalay Moat, Kandawgyi and Taungthaman Lake, and other water resources near the city are to be designated as clean water resources. As food supply zone, mainly northeast of the city and wetland in the southwest of the city are to be set aside from future development planning. On top of designating natural reserves, to avoid eventual degradation of reservation zones, it is highly recommended to create a "green belt" for protecting the water storage and nature so as to link all the strategic conservation zones and to stop the uncontrolled urban sprawl.

- **2) Pollution Control**: As Mandalay City is growing as a national growth center, equipped with enhanced logistic hub function, increasing traffic is foreseen. Also, higher population density is expected in the city center. The growth of Mandalay City would cause pollution in air, water, noise, and odor. Thus, the urban planner shall take necessary action in advance to control expected increase in pollutions. Some recommendation and special considerations are to keep heavy traffic away from the city center, to mandate any new development projects to be equipped with wastewater treatment, and to consider setting a specific noise, vibration, and odor standard as well as standard for aggregated air pollution for the area.

- **3) Building Livable Urban Settlement**: **As** Mandalay grows as a compact city, the city center area shall have high density as new developments are concentrated in the limited space. This type of development tends to create nuisances in living condition and increases stress in urban infrastructure, urban service, and among people. For providing better living environment to urban residence, allocating spaces for building recreation parks and man-made lakes (apart from natural lakes) would increase amenity of urban residence. Such spaces would provide green shade over the urban area, which is also beneficial for mitigating hot and dry weather.

- **4) Disaster Preparedness**: Mandalay City lies along the Sagaing Fault and is very prone to earthquake. It is highly recommendable to create strategic open space for temporal refugee space and post-disaster operation. Also, re-planning of the streets is considered for protection from fire triggered by earthquake. Flooding has been seen in some specific areas, such as topographically low areas and areas with weak drainage system. Those areas that are topographically prone to flooding shall be avoided from new development to avoid high cost of development, as stated in the discussion for natural conservation aspect. It is also recommended to reconstruct the river front with walkable promenade which can serve as flooding protection and as amenity to the visitors and residence.

- **5) Agriculture, Food Processing, and Logistics Promotion**: Mandalay is one of the largest places for food consumption in Myanmar and also an important logistic hub for foods and feedstuff from China, Sagain, and highlands such as Pyinoolwin which produces coffee, potato, and chickpea seeds. Although necessity of agriculture activities within Mandalay City will decrease in the future, it must be conserved for keeping not only for self-service capacity of Mandalay but also for proper urban environment. Additionally, food logistic function must be promoted more as national growth center under a concept of “Food Valley” of Mandalay. Food logistic center and wholesale market with cold storage should be provided as one of the logistic hub facilities most probably along the outer ring road.

5 Infrastructure Development and Social Service Policy

- Not only to achieve the development visions and strategies for 2040 but to realize a livable city for all citizens, infrastructure and social service improvement is fundamental. Policies by sectors were set as follows;

5.1 Road and Transportation

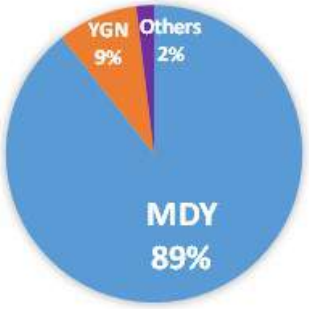
5.1.1 Demand Analysis

Road Transport

- Any holistic traffic engineering survey such as person trip survey to capture the people's mobility in Mandalay City has not been conducted so far. The number of person trips introduced in this report has been tentatively estimated based on limited available information such as the number of registered vehicle. A comprehensive traffic survey should be conducted immediately since it is essential for urban planning and transportation planning to obtain the accurate data to capture the mobility of people and goods.

- The Road Transport Administration Department (RTAD) Mandalay maintains statistical data of the number of registered vehicles in Mandalay District. At present, the only available information to estimate the overall traffic volume is the number of registered vehicles. In Myanmar, most vehicles are registered in Yangon and Mandalay. Moreover, the registered plate of these vehicles has not been properly updated but the vehicles are used in the city outside their registered city. Therefore it is often difficult to make a correlation between the number of registered cars and actual traffic volume. Figure 5.1.1 shows the traffic counting by vehicles' registered plate. In Mandalay, the number of registered vehicles correlates with the number of vehicles since the majority of vehicles (89%) are properly registered in Mandalay. The vehicle registration system in Myanmar shall be improved at a national level.

(Mandalay : MDY)



Note: Abbreviations such as MDY (Mandalay Region), MON (Mon Region), AYY (Ayeyarwady Region) stand for the registered regions and are indicated on the plate of each car.
Source: Traffic Count Survey by the JICA Study Team

Figure 5.1.1 Observation of Registered Plate in Three Cities

- Figure 5.1.2 presents the estimation results of the number of trips by each transportation mode based on the number of registered vehicle. The number of trips of bus users is 55,020 trips per day according to the statistical information from RTAD and Vehicle Management Committee (VMC). The average number of trips based on the estimation results except non-mechanized trips is compared with the actual surveyed results of Yangon City (surveyed in 2013) in Table 5.1.1. The average of the mechanized trip rates of Mandalay (0.97) and Yangon (0.99) are almost equal as shown in Table 5.1.2. Accordingly, the estimated modal rate in Table 5.1.1 is considered to be appropriately representing the trend of the mechanized trips. The notable difference of mechanized transportation mode between the two cities is that the citizens of Mandalay and Yangon prefer using motorcycle (trip rate = 88%) and buses (72%), respectively.

Table 5.1.1 Preliminary Estimation of Modal Rate of Public Transport

Indicators	Unit	Private Car	Motorcycle	Light Truck	Urban Bus	Urban Rail	Total
Reistered Vehicle	(vehicle)	51,043 (*1) (6.2%)	749,310 (*1) (91.1%)	21,213 (*1) (2.6%)	807 (*2) (0.1%)	0 (0.0%)	822,373 (100%)
Population	(pop)	1,754,000	1,754,000	1,754,000	-	-	-
Car Ownership Rattio	(cars/1,000 pops)	29	427	12	-	-	-
Average Trip Rate	(trips/day)	2 (*3)	2 (*3)	2 (*3)	-	-	-
Estimated Daily Trips	(trips/day)	102,086 (6.0%)	1,498,620 (88.3%)	42,426 (2.5%)	55,020 (3.2%)	0 (0.0%)	1,698,152 (100%)
			Modal Rate of Public Transport		**(3.2%)**		

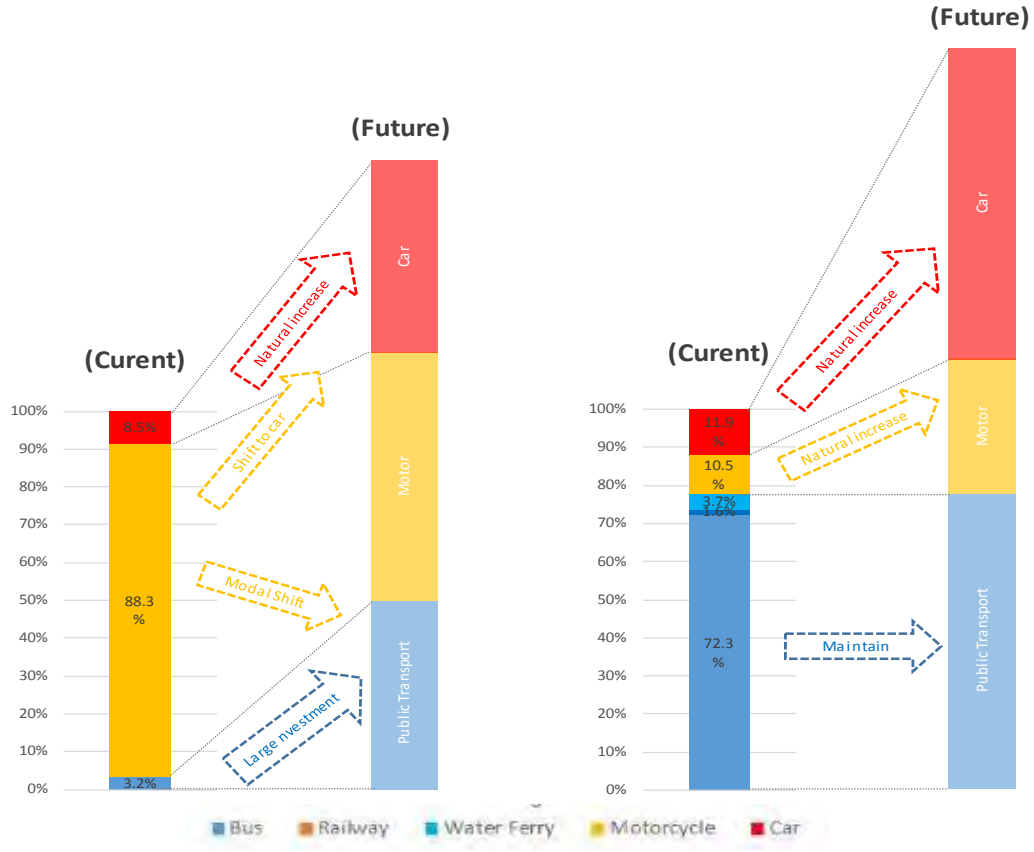
Note: (*1) RTAD Statistics, 2016, (*2) Data prepared by RTAD, (*3) Assumption by the JICA Study Team
Source: JICA Study Team

Table 5.1.2 Estimated Trip Rate of Mandalay and Actual Trip Rate of Yangon

Indicators	Mandalay	Yangon
Total Number of Trips	1,698,152	5,063,723
Population	1,754,000	5,100,000
Trip Rate excluding NMT	0.97	0.99

Source: JICA Study Team

- Figure 5.1.2 proposes the preferable modal share of Mandalay compared with that of Yangon based on the estimated modal rate mentioned above. The future targeted rate of Yangon in Figure 5.1.2 is referred from the result of Yangon Urban Transportation Master Plan (YUTRA). On the other hand, the targeted rate of Mandalay is tentatively proposed by the JICA Study Team.



Source: JICA Study Team

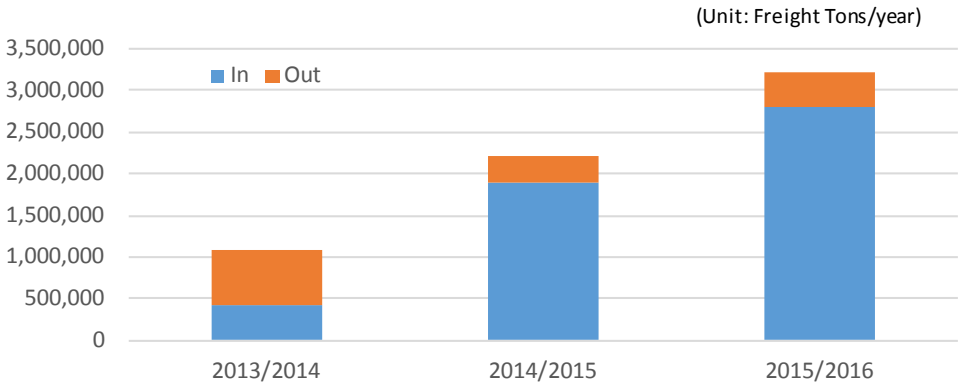
Figure 5.1.2 Preferable Modal Share of Mandalay and Yangon

- In Yangon, motorcycle has been forbidden to enter the city to control the traffic congestion and road safety. Accordingly, the modal rate of bus is remarkably high (72% of all trips). Yangon City

shall maintain the number of trips of public transportation (bus) and is challenged to achieve 30% of the modal rate of public transportation (high quality bus and railway service) in the future. On the other hand, it is difficult to increase the modal share of public transport in Mandalay since the current modal share of public transport is quite low (only 3.5%) and people prefer using convenient private traffic such as motorcycle. An administrative measure, e.g., restriction of the motorcycle ride, giving public transport users the preferential treatment in addition to introduction of more convenient public transport, is needed to change the current situation in Mandalay. If these administrative measures are not conducted, motorcycle users will own cars along with the economic development and traffic congestion would be serious in Mandalay similar to the current situation of Yangon.

Port and Logistic Transport

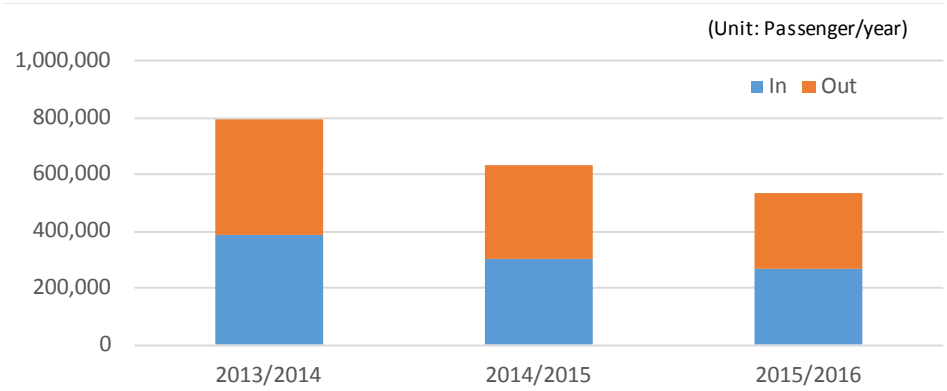
- Figure 5.1.3 shows the cargo handling volume of Mandalay Port showing the increasing trend at a pace of 1 million tons a year even after the completion of the expressway (Yangon-Nay Pyi Taw-Mandalay). However, the cargo handling in Mandalay Port is quite inefficient due to manpower handling and old dated port and shipping facilities. Modernization of the port facility such as containerization shall be urgently required to fulfill the future cargo handling demand.



Source: JICA Study Team based on Statistical Data of DMA

Figure 5.1.3 Cargo Handling Volume of Mandalay Port

- On the other hand, the passenger volume of Mandalay Port has a tendency to decrease as shown in Figure 5.1.4. This tendency might be the result of the modal shift of passenger demand to highway bus from passenger ship after the completion of the expressway.



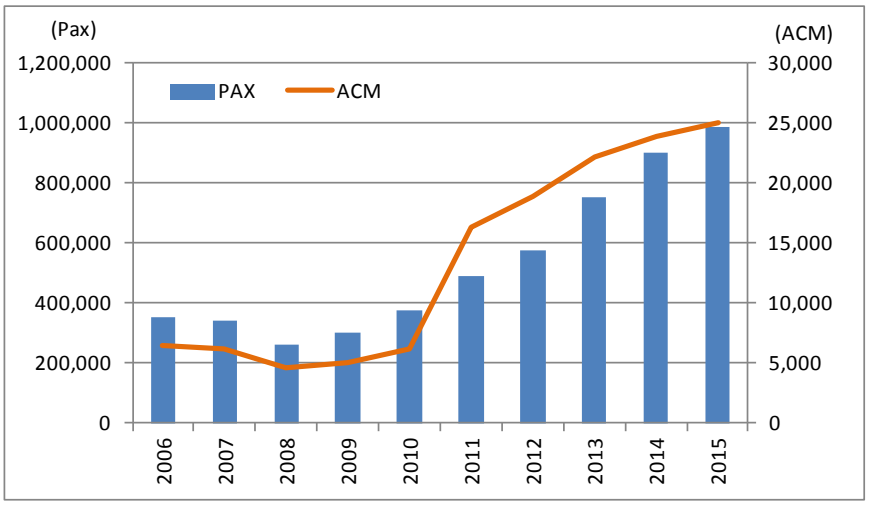
Source: JICA Study Team based on Statistical Data of DMA

Figure 5.1.4 Passenger Volume of Mandalay Port

- Pyi Gyi Mingalar Truck Terminal located in Amarapura Township (southern part of Mandalay City) is the hub distribution terminal in the central regions of Myanmar. According to the Lorry and Truck Management Committee (LTMC), new distribution warehouses are being constructed in the southern part of Mandalay City since the capacity of the truck terminal is going to be saturated. This terminal does not have a custom clearing function. The plan and location of the new terminal development such as dry port and inland container depot (ICD) shall be consistent with the proposed urban planning, new road network, and also the proposed location of the modernized new container port.

Airport Transport

- Mandalay International Airport opened in 2000, relocating from the old airport in the city center. The airport was designed for an annual passenger volume of 3,000,000 pax. The current annual passenger volume of the airport is still around 1,000,000 pax and has enough capacity for the future demand.



Note: Pax - Annual Passenger Volume, ACM - Annual Aircraft Movement
Source: JICA Study Team based on Statistical Data of DCA

Figure 5.1.5 Current Traffic at Mandalay International Airport

- Mandalay International Airport (MIA) is operated by the private company which has the concession right of ownership for 30 years since 2015. This private company is improving airport facilities.

- Other private companies provide pickup service for MIA. The public transportation system such as bus network shall be provided to improve the accessibility of the airport.

5.1.2 Development Policy

- This study has preliminarily analyzed the current conditions, issues, and the demand of transportation. Based on these results of the analysis, development policy is proposed to back up the urban development plan proposed in this study.

Table 5.1.3 Development Policy of Road and Transportation in Mandalay

Road and Transportation Policy	1) Modal Shift to Public Transportation 2) Upgrading of Bus Service 3) Revitalization of Urban Railway Asset 4) Upgrading and Strengthening of Road Network 5) Modernization of Logistic Facility 6) Upgrading and Improvement of Aerial Logistics Function

Source: JICA Study Team

- **1) Modal Shift to Public Transportation:** Serious traffic congestion is not observed in the city at present. However, due to the current very high modal share of private transportation (i.e., motorcycle), traffic congestion in the near future will be a clear and present issue to be concerned about. Introduction of high-quality public transportation and converting the transportation use from private transportation to public transportation shall be implemented immediately. In line with the development of public transportation, non-motorized transport (NMT) (e.g., pedestrian and bicycle) facilities such as pedestrian network shall be upgraded to enhance the access to the public transport system and also to attract tourism.

- **2) Upgrading of Bus Service:** City bus service is available in Mandalay, but the level of service such as quality of bus and scheduled operation needs to be improved and the ridership is still quite low. Since it is essential for future traffic demand to accelerate the modal shift to public transportation, the improvement of the level of bus service shall be implemented immediately. The bus network shall cover the airport line to improve the accessibility of the newly opened Mandalay International Airport.

- **3) Revitalization of Urban Railway Asset:** Although the circular-like railway track available in the central area of Mandalay City, such precious infrastructure asset has not been used by the citizens. This railway asset shall be improved and utilized properly. The upgrading to commuter railway or replacement to other transportation mode such as exclusive bus lanes will be considered. The revitalization of the railway asset should be carefully considered with engineering and quantitative justification since the investment cost of the project will be high.

- **4) Upgrading and Strengthening of Road Network:** The road network shall be upgraded and strengthened to back up and accelerate the proposed urban development of Mandalay City. The road network shall also contain the disaster road network since Mandalay is located in the vicinity of the Sagaing Fault. For the densely built up area where road widening is impractical due to social environmental issue, the capacity of the road network will be maximized by the upgrading of traffic control systems such as advanced traffic signals, intelligent transport systems (ITS), and the restriction of on-road parking and development of off-road parking lots. The pedestrian facility shall also be improved.

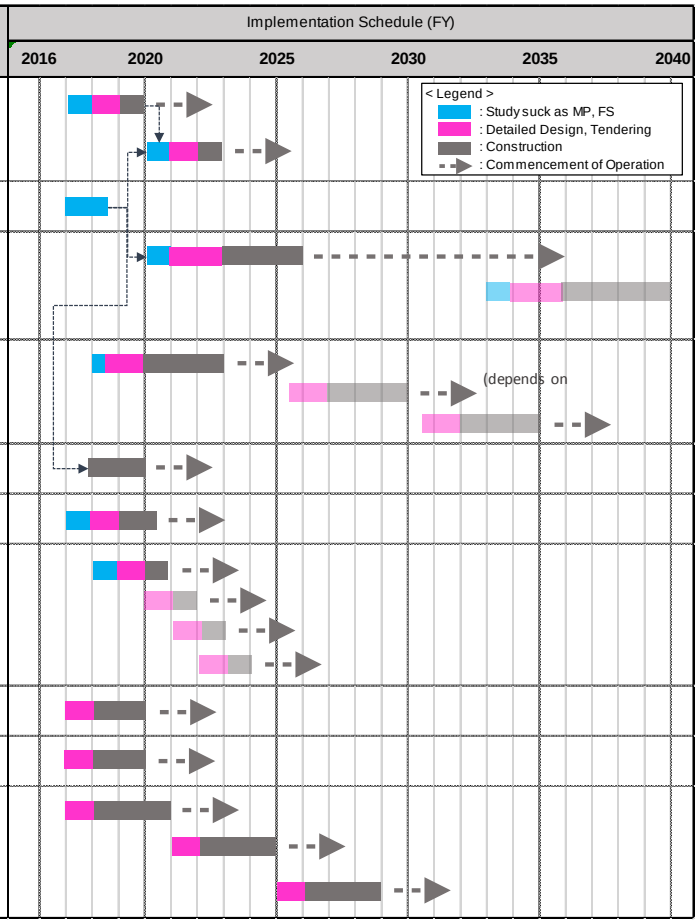
- **5) Modernization of Logistic Facility:** Cargo volume continues to increase year by year while passenger volume decreases. The current port operation supported by manual cargo handling is going to reach the limit in the near future and cargo handling shall be urgently mechanized and containerized. The new logistic terminal (i.e., dryport and ICD) shall be developed connecting to the new mechanized port with more efficient logistic functions such as custom clearance facility since the existing Phy Gyi Mingalar (PGM) Truck Terminal is going to be saturated.

- **6) Upgrading and Improvement of Aerial Logistic Function:** Most of the air navigational aid equipment in Mandalay International Airport were installed in 2000 during the opening of the airport. Therefore, providing and renewal of the airport navigational safety operation for aircraft movements including freighter, airport communication, navigation, surveillance, and weather equipment are urgently required.

5.1.3 Implementation Schedule

- The proposed implementation schedule of the transportation infrastructure development is shown in Figure 5.1.6.

No.	Project/Study Name	Status	Implementation Schedule (FY)
1	Bus Service Upgrading Project	Short-term	
2	Comprehensive Urban Transport Master Plan	Short-term	
3	Commuter Railway Development Project	Middle to Long-term	
4	Road Network Improvement Project	Middle to Long-term	
5	Disaster Road Network	Short-term	
6	Traffic Control/Management Project	Short-term	
7	Comprehensive Parking Master Plan	Short to Middle-term	
8	New Container Port Project	Short-term	
9	New Logistic Terminal Project	Short-term	
10	Improvement of M-N-Y Expressway	Short to Middle-term	



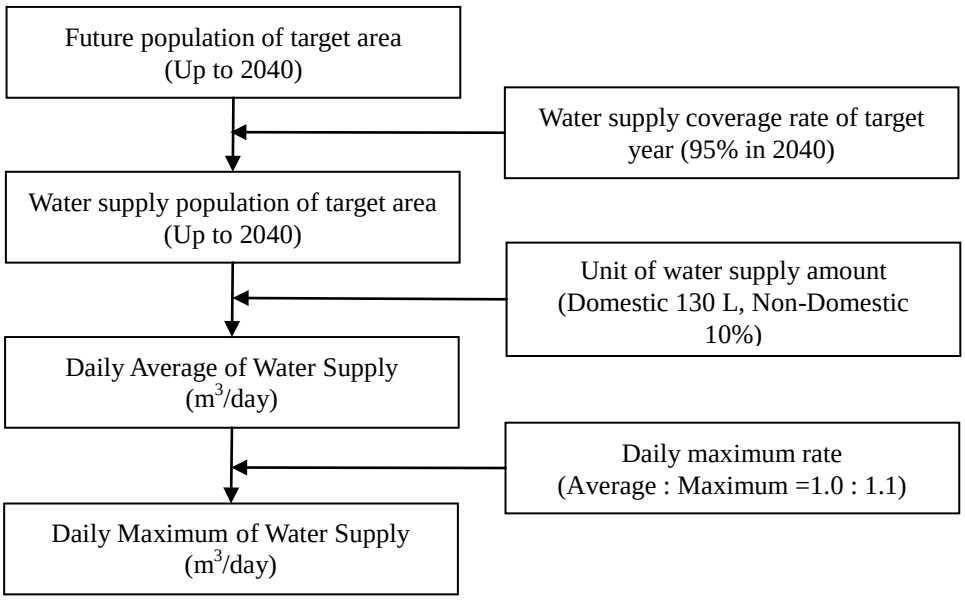
Source: JICA Study Team

Figure 5.1.6 Implementation Schedule (Road and Transportation)

5.2 Water Supply

5.2.1 Demand Analysis

- Flow of water demand forecast on the target year for Mandalay City (seven townships) is shown in Figure 5.2.1. The future population of the target year shall be based on the future population value by this study.



Source: JICA Study Team

Figure 5.2.1 Flow of Water Demand Forecast for Mandalay

- The design water supply population is the future population multiplied by the water supply coverage rate of the target year. Although the water supply coverage rate is different according to the status of use of wells, from the position of public health or living environment, it should target the highest possible level. In this study, the water supply coverage rate has been set at 95% by referring to the report of FASEP / French Grant entitled "Sustainable Development of Urban Infrastructure and Services in Mandalay (August 2015)" and the interview with MCDC. The forecast of the design water supply population for every target year is shown in Table 5.2.1.

Table 5.2.1 Served Population of Water Supply in Mandalay City Up to 2040

Year	2015	2020	2025	2030	2035	2040
Urban Area Population (thousand)	1,350	1,508	1,743	1,920	2,077	2,192
Rural Area Population (thousand)	404	407	426	443	453	452
Total Population (thousand)	1,754	1,915	2,169	2,363	2,530	2,644
Service Coverage Rate (%)	55%	71%	83%	92%	95%	95%
Served Population (thousand)	965	1,360	1,800	2,174	2,404	2,512

Source: JICA Study Team

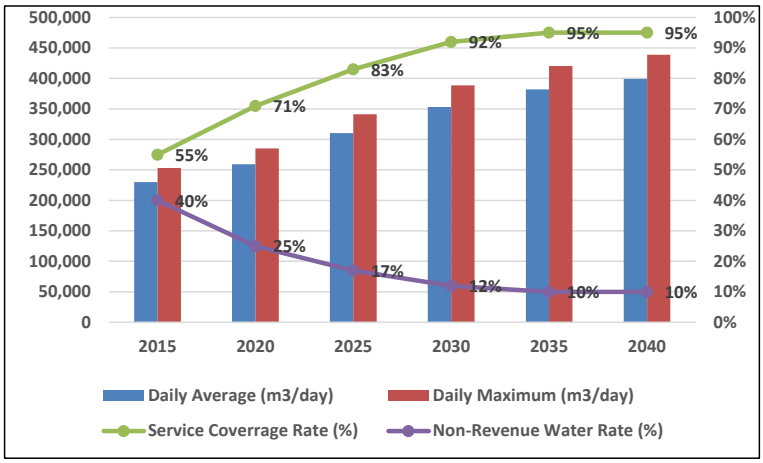
- In this study, each specification and demand of water supply are presumed based on the JICA report entitled "Preparation Study for Water Supply Development in Mandalay, Myanmar (April 2015)" and the interview with MCDC. As a result, the demand of water supply in Mandalay City is forecasted to be about 399,000 m^3/day in 2040, and this demand is about 2.6 times that in 2015. To meet this increasing water demand, new water source is needed, and Myitnge River is a candidate for surface water source. The forecasted demand of water supply of Mandalay City for each target year is shown in Table 5.2.2 and Figure 5.2.2. The specifications used for the calculation of the water supply demand are as follows:

a) Water demand per unit for domestic use: 130 liters per person per day (lpcd)
b) Non-domestic use rate: 10% of domestic use
c) Non-revenue water rate: 40%-10% of total demand volume
d) Daily maximum rate: 1.1 times the daily average

Table 5.2.2 Demand of Water Supply in Mandalay City Up to 2040

Year	2015	2020	2025	2030	2035	2040
Served Population (thousand)	965	1,360	1,800	2,174	2,404	2,512
Domestic Use (lpcd)	130	130	130	130	130	130
Non-Domestic Use Rate (%)	10%	10%	10%	10%	10%	10%
Non-Revenue Water Rate (%)	40%	25%	17%	12%	10%	10%
Daily Maximum Rate	1.1	1.1	1.1	1.1	1.1	1.1
Demand for Water Supply Daily Average (m^3/day)	153,328	216,089	286,000	345,424	381,969	399,129
Demand for Water Supply Daily Maximum (m^3/day)	168,661	237,698	314,600	379,966	420,166	439,042

Source: JICA Study Team



Source: JICA Study Team

Figure 5.2.2 Demand of Water Supply in Mandalay City Up to 2040

5.2.2 Development Policy

- Development of all kinds of infrastructures will support the achievement of the four development visions shown by "Mandalay 2040 - National Growth Centre". Moreover, the development policy of water supply which is set up aiming at the sector vision “Prompt Extension of Water Supply Area with Safety and Stability” and based on the analysis of current water supply system in Mandalay City is shown in Table 5.2.3.

Table 5.2.3 Development Policy of Water Supply in Mandalay

Water Supply Policy	1) Rehabilitation of Existing Water Supply System 2) Extension of Water Supply System 3) Reduction of Non-revenue Water and Modernize the System 4) Increase the Production to Meet the Future Water Needs 5) Improve the Water Distribution Condition and Pressure Management

Source: JICA Study Team

- **1) Rehabilitation of Existing Water Supply System:** Existing old water supply pipes shall be restructured and renovated. A disinfection system shall be installed for each production system (under JICA grant).

- **2) Extension of Water Supply System:** Water distribution pipes shall be installed for non-served area by enhancing the water supply system in creating distribution loops. The target extension of the service coverage is 95% for seven townships in 2035.
- **3) Reduction of Non-revenue Water and Modernize the System:** For improvement of water leakage, specialized staff shall do a leak detection using modern equipment and monitoring systems. The target of reduction of non-revenue water is 10% in 2035.
- **4) Increase the Production to Meet the Future Water Needs:** The majority of customers do not have continuous supply. MCDC shall be supplying water 24/7 for all customers. Rehabilitation and extension of WTP 8 are required in the near future. Also, new water source like river surface water is required in Pyigyidagun Township.
- **5) Improve the Water Distribution Condition and Pressure Management:** Some problems in the performance and operation of the system, particularly the operation of reservoirs, operation of pumping stations, lack of any production monitoring systems, and poor overall maintenance functional systems, shall be improved. Also, build up of the pump and keeping the minimum residual pressure are required.
- The development goal and performance indicators for quantitatively evaluating the effect of the water supply project in Mandalay City are shown in Table 5.2.4.

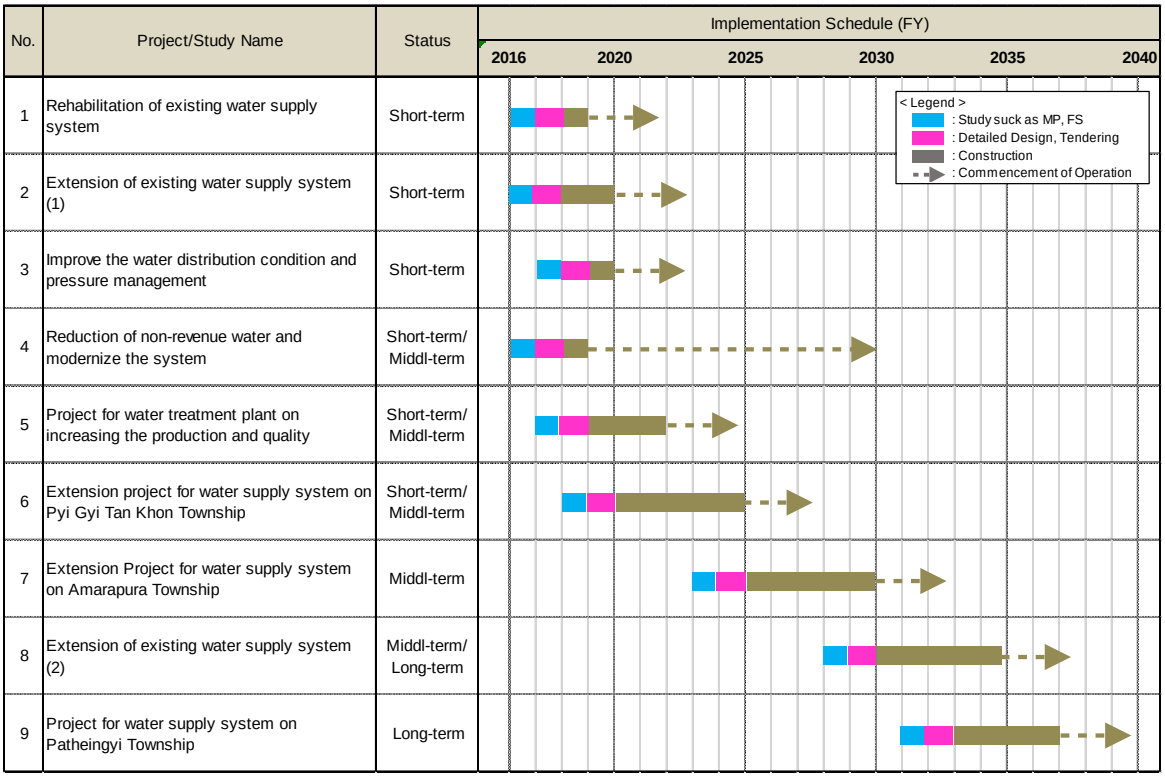
Table 5.2.4 Development Goals and Performance Indicators of Water Supply in Mandalay

Development Goals		Performance Indicators (PI)
Customer Service Levels	Service quantity	24 / 7
	Extension of the service coverage	95% for 7 townships
Water Quantity	Increase the surface water production	by 2025 (e.g., Myitnge River)
	Rehabilitation of tubewells	100% by 2020
	Build up of the pump and keep the minimum residual pressure	100% by 2025
	Reduction of NRW and modernize the system	NRW 10% by 2035
	Enhance the water supply system in creating distribution loops	100% by 2040
Water Quality (Matching WHO Guideline)	Rehabilitation and extension of WTP 8	100% by 2025
	Install disinfection system for each resource	100% by 2020

Source: JICA Study Team

5.2.3 Implementation Schedule

- The proposed implementation schedule of the water supply infrastructure development is shown in Figure 5.2.3.



Source: JICA Study Team

Figure 5.2.3 Implementation Schedule for Mandalay (Water Supply)

5.3 Sewerage

5.3.1 Demand Analysis

- To decrease the risk of waterborne infectious diseases and groundwater contamination, a new WWTP with appropriate treatment process, such as conventional activated sludge process, will be required urgently. For the sewerage system of Mandalay City, comprehensive master plan will be required due to the lack of strategy for sewerage development at present. Then, in this plan, the sewerage demand shall be presumed as follows:

  a) Target of the sewerage system: Urban area (Rural area will have individual sewage system);
  b) Domestic sewage demand: Presumed to be the same volume as water supply;
  c) Industrial wastewater: Not included (Industrial area will have individual sewage system); and
  d) Volume of infiltration and inflow: 10% of domestic sewage.

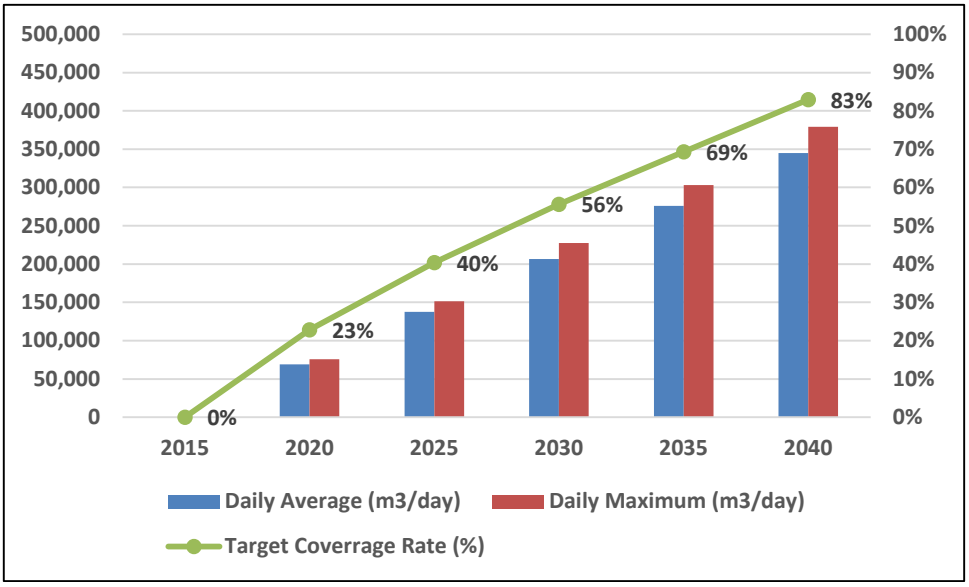
- The demand of sewerage in the urban area of Mandalay City is forecasted to be about 345,000 m^3/day in 2040. For preserving sanitary water environment in the urban area, the development of "efficiently and advanced sewage treatment system" is required according to the increase of sewage discharge. The forecasted demand of sewerage for each target year in the urban area of Mandalay City is shown in Table 5.3.1 and Figure 5.3.1.

Table 5.3.1 Demand of Sewerage in Mandalay (Urban Area) Up to 2040

Year	2015	2020	2025	2030	2035	2040
Target Coverage Rate (%)	0%	23%	40%	56%	69%	83%
Covered Population (thousand)	0	438	876	1,314	1,753	2,192
Domestic Sewage (lpcd)	130	130	130	130	130	130

Non-Domestic Sewage Rate (%)	10%	10%	10%	10%	10%	10%
Infiltration and Inflow Rate (%)	10%	10%	10%	10%	10%	10%
Daily Maximum Rate	1.1	1.1	1.1	1.1	1.1	1.1
Demand for Sewerage Daily Average (m^3/day)	0	68,897	137,795	206,692	275,747	344,802
Demand for Sewerage Daily Maximum (m^3/day)	0	75,787	151,575	227,361	303,322	379,282

Source: JICA Study Team



Source: JICA Study Team

Figure 5.3.1 Demand of Sewerage in Mandalay (Urban Area) Up to 2040

5.3.2 Development Policy

- Currently, the water quality in the rivers and lakes in Mandalay City is deteriorating due to the discharging of sewage from many houses or factories. Therefore, to recover the healthy water environment, development of sewerage is required as soon as possible. Aiming at the sector vision of "Realization of Comfortable Life and Healthful Water Environment" and referring to the interview with MCDC, the development policy of sewerage set up based on the analysis of current situation of Mandalay City is shown in Table 5.3.2.

Table 5.3.2 Development Policy of Sewerage in Mandalay

Sewerage Policy	1) Improve the Water Environment in Public Areas (River and Lake) 2) Improve the Sanitary Living Environment 3) Use the Flushing-clean Toilet 4) Develop the Beautiful City with Wealthy Water and Green

Source: JICA Study Team

- **1) Improve the Water Environment in Public Areas (River and Lake):** To recover the healthy water environment, a sewerage system shall be developed speedily. According to the Mandalay Urban Services Improvement Project of ADB, the wastewater discharge standards of WWTP were proposed through phased approach (BOD; Short term: 60 mg/L, Medium term: 30 mg/L, Long term: 20 mg/L). In the long term, it would be desirable to encourage the reuse of wastewater. In this context, more stringent wastewater discharge standards will be required with a limiting BOD of 20 mg/L. The proposed approach for wastewater treatment is Phase1) Simplified treatment initially, and Phase 2) Achieve the discharge standards in the medium to long term. It shall also be integrated with the treatment of sludge collected from septic tanks.

- **2) Improve the Sanitary Living Environment**: The south areas particularly had lower levels of surface water pollution due to absence of waterborne sanitation and the proliferation of latrines discharging to the groundwater. Various wastewater such as wastewater from kitchen, bath, flush toilet water, and the like shall be purified in the sewerage system.

- **3) Use the Flushing-clean Toilet**: To improve poor sanitary conditions and public health, MCDC shall promote replacing a pit latrine with a flush toilet and a septic tank for households.

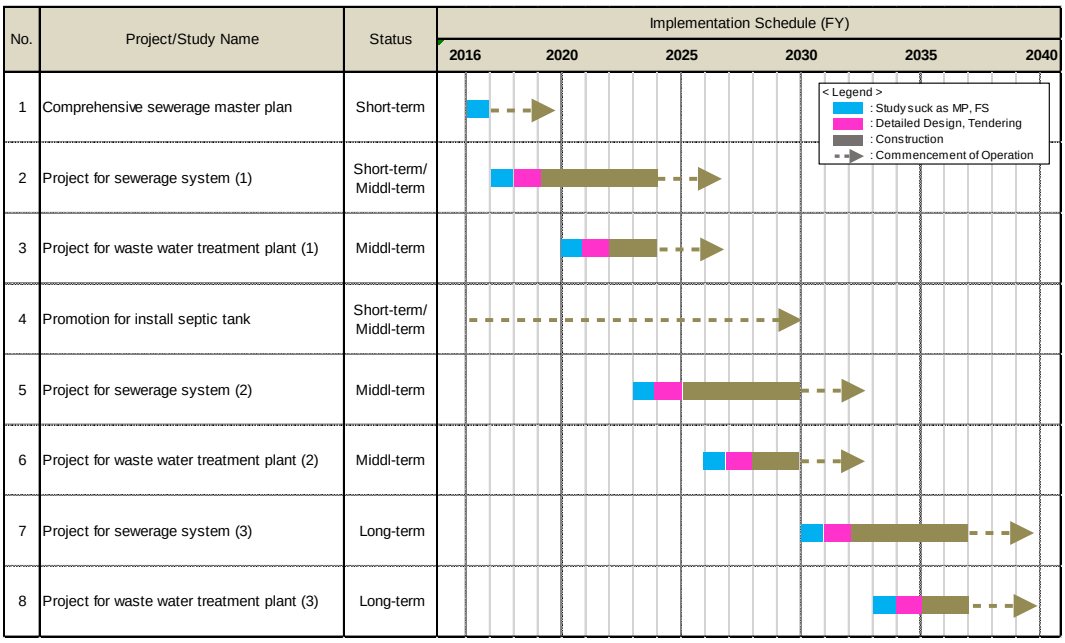
- **4) Develop the Beautiful City with Wealthy Water and Green:** MCDC promotes preservation of pure water and rich green, improvement in living environment, and cooperating with urban development. Clean water by the sewerage system and the restored living things make up wealthy water/green environment.

- At first, sewerage planning needs the following tasks: (1) Field survey of the topography, geology, and water quality; (2) Study of basic specifications like target area, collected population, and sewage quality; and (3) Consideration of sewerage type selection, collected zone, capacity and location of WWTP, and main pipe route. The development goal of sewerage of Mandalay City is shown as follows:

  a) Make a sewerage master plan for efficient and economic development;
  b) Consider a sewerage project technique in which low cost and flexible development according to the actual condition of the area is possible;
  c) Complete the sewerage development in the urban area by 2040;
  d) Promote installation of septic tank at every house until development of sewerage;
  e) Put the proper operation and maintenance of septic tank into practice;
  f) Promote connection with sewerage and collect a charge for use; and
  g) Try for the financial soundness of sewerage project.

5.3.3 Implementation Schedule

- The proposed implementation schedule of the sewerage infrastructure development is shown in Figure 5.3.2.



Source: JICA Study Team

Figure 5.3.2 Implementation Schedule for Mandalay (Sewerage)

5.4 Drainage

5.4.1 Demand Analysis

- The urban drainage situation of Mandalay City is quite complex, due to an intricate system of natural rivers and creeks, as well as man-made canals. Some parts of Mandalay City are flooded several times a year. Floods may occur from three different major causes and interacting forces:

  a) Lack of urban drainage facilities, causing inundation in the low and flat areas of the city;
  b) Riverine flooding from the Ayeyarwady River; and
  c) Large inflows to the urban drainage system of the city from rivers descending largely from the Shan Plateau to the east of the city.

5.4.2 Development Policy

- About the large-scale protection against flooding, a wide scope project including lake and river project is required. As development policy of drainage in mainly urban area, the drainage facilities meeting the five-year rainfall intensity shall be improved. Aiming at the sector vision of "Reduce Flood Damage for Urban Safety Management" and referring to the interview with MCDC, the development policy of drainage set up based on the analysis of the current situation of Mandalay City is shown in Table 5.4.1.

Table 5.4.1 Development Policy of Drainage in Mandalay

Drainage Policy	1) To Reduce the Frequency of Flooding in Urban Area (once every five years) 2) To Utilize the Existing Drainage as much as possible with Necessary Upgrade and Extension

Source: JICA Study Team

- **1) To Reduce the Frequency of Flooding in Urban Area:** On the improvement of drainage facilities, an indicator termed as rainfall return period is set up as the planning target. Based on the consideration of actual condition and cost benefit, five-year return period shall be used for the long-term target. Reducing the flooding of two-year return period for short-term target shall be carried out by relatively modest investments.

- **2) To Utilize the Existing Drainage as much as possible with Necessary Upgrade and Extension:** Drainage of the internal runoff should be enabled by improvements (cleaning and dredging) of the drainage canals, and extensions of the relevant pumping stations.

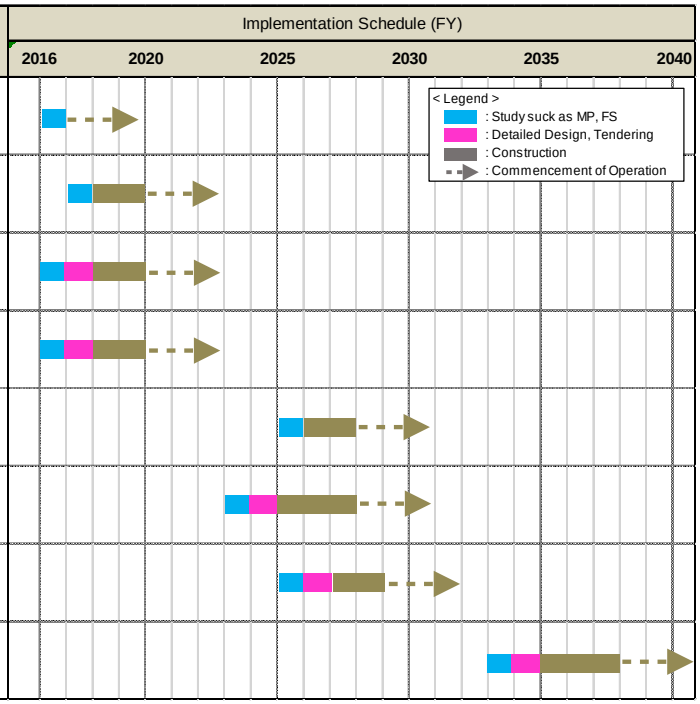
- In the case of drainage planning, the target area and design conditions are considered first, and it is necessary to study the improvement, utilizing it effectively, after calculating the capacity of the existing drainage. The development goals of drainage in Mandalay City are as follows:

  a) Make a drainage master plan by utilizing the existing facilities effectively;
  b) Improvement of urban drainage facilities causing inundation;
  c) Some drainage should be enabled by improvement (cleaning and dredging) of the bottom; and
  d) Extension of the relevant pumping stations (Kan Daw Gyi, Shwe Ge).

5.4.3 Implementation Schedule

- The proposed implementation schedule of the drainage infrastructure development is shown in Figure 5.4.1.

No.	Project/Study Name	Status
1	Comprehensive storm water drainage master plan	Short-term
2	Project for cleaning and dredging of the existing drainage canals (1)	Short-term
3	Project for improvement of urban drainage facilities (1)	Short-term
4	Project for extension of the relevant pumping stations (1)	Middl-term
5	Project for cleaning and dredging of the existing drainage canals (2)	Middl-term
6	Project for improvement of urban drainage facilities (2)	Middl-term
7	Project for extension of the relevant pumping stations (2)	Middl-term
8	Project for improvement of urban drainage facilities (3)	Long-term



Source: JICA Study Team

Figure 5.4.1 Implementation Schedule for Mandalay (Drainage)

5.5 Solid Waste

5.5.1 Demand Analysis

- There are two main dumpsites in Mandalay, managed by MCDC, serving each of the three townships. Domestic and industrial wastes that are dumped are mixed, and can include some wastes harmful to the environment such as batteries of mobile phones and PC. Moreover, the collected waste has increased significantly over the recent years. Actually, according to the interview with MCDC, the remaining life/capacity of existing dumpsites is as short as four or five years. Also, the existing dumpsites have inappropriate operation conditions (no leachate confinement nor treatment, no biogas confinement nor treatment, no soil cover on the waste).

  a) Kyar Ni Kan Dumpsite (in the north): 450 ton/day for Aungmyetharzan, Chanayetharzan and Mahaaungmye townships.
  b) Taung Inn Myount Inn Dumpsite (in the south): 300 ton/day for Chanmyatharzi, Pyigyidagun and Amarapura townships.

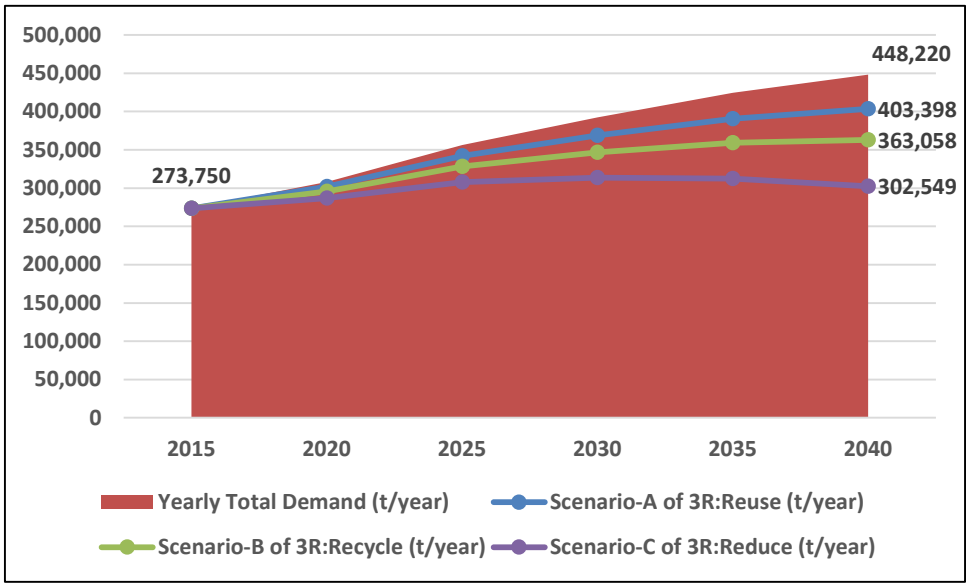
- Based on the present collected garbage, the demand of solid waste is roughly calculated. As a result, the demand of solid waste in the urban area of Mandalay City is forecasted to be about 448,000 t/year in 2040. The 3R Policy (Reduce, Reuse, and Recycle) is required for reducing the solid waste which continues to increase. Therefore, the scenarios of 3R are assumed as below. The forecasted demand of solid waste for each target year based on the scenario of the 3R Policy in the urban area of Mandalay City is shown in Table 5.5.1 and Figure 5.5.1.

  a) Scenario-A: reduce 10% by reuse of available material from waste.
  Reuse (10% by 2040)
  b) Scenario-B: in addition, reduce 10% by recycle of organic material.
  Reuse (10%) + Recycle (10% by 2040)
  c) Scenario-C: moreover, reduce 15% by incineration of waste.
  Reuse (10%) + Recycle (10%) + Reduce (15% by 2040)

Table 5.5.1 Demand of Solid Waste in Mandalay (Urban Area) Up to 2040

Year	2015	2020	2025	2030	2035	2040
Urban Population (thousand)	1,350	1,508	1,743	1,920	2,077	2,192
Unit Volume (t/thousand-p/day)	0.56	0.56	0.56	0.56	0.56	0.56
Demand of Solid Waste (t/day)	750	844	976	1,075	1,163	1,228
Yearly Total Demand (t/year)	273,750	308,060	356,240	392,375	424,495	448,220
Scenario-A of 3R: Reuse Rate (%)	0%	2%	4%	6%	8%	10%
Scenario-A of 3R: Reuse (t/year)	273,750	301,899	341,990	368,833	390,535	403,398
Scenario-B of 3R: Recycle Rate (%)	0%	2%	4%	6%	8%	10%
Scenario-B of 3R: Recycle (t/year)	273,750	295,861	328,311	346,703	359,293	363,058
Scenario-C of 3R: Reduce Rate (%)	0%	3%	6%	9%	12%	15%
Scenario-C of 3R: Reduce (t/year)	273,750	286,804	307,791	313,508	312,428	302,549

Source: JICA Study Team



Source: JICA Study Team

Figure 5.5.1 Demand of Solid Waste in Mandalay (Urban Area) Up to 2040

5.5.2 Development Policy

- For solving the issue of solid waste, and for comfortable and beautiful urban development, a comprehensive action of 3R by united local government and citizen is needed. Aiming at the sector vision of "City Beautiful Movement with a Sound Material - Cycle Society" and referring to the interview with MCDC, the development policy of solid waste set up based on the analysis of the current situation of Mandalay City is shown in Table 5.5.2.

Table 5.5.2 Development Policy of Solid Waste in Mandalay

Solid Waste Policy	1) Realization of Solid Waste Management with Stability and Safety for Long Term 2) Promote 3R (Reduce, Reuse, and Recycle) 3) Guide of Environment Activity for City Beautiful Movement 4) Reduce Environmental Impact by Disposal of Hazardous Wastes Properly

Source: JICA Study Team

- **1) Realization of Solid Waste Management with Stability and Safety for Long Term:** Waste management encompasses management of all processes and resources for proper handling of solid waste, from maintenance of waste transport trucks and dumping facilities to compliance with health codes and environmental regulations.

- **2) Promote 3R (Reduce, Reuse, and Recycle):** Reduce: The first and most effective component of the waste hierarchy is reducing the waste created. Consumers are encouraged to reduce their waste by purchasing in bulk, buying items with less packaging, and switching to reusable instead of single-use items. Reuse: Much of this waste can immediately be reused to minimize the strain on the environment and municipal waste management. For example, consumers can refill a purchased bottle of water with water from home to minimize the number of plastic bottles being discarded. Recycle: When waste is eventually discarded, segregating items for recycling from other waste is important. Recyclables include glass, newspaper, aluminum, batteries, cardboard, and many other materials.

- **3) Guide of Environment Activity for City Beautiful Movement:** Promotion of 3R policy for a sound material-cycle society is a basic action, and all of the local government, citizen, and company should have a positive attitude about 3R. MCDC shall promote it through public relations, forum, personnel training project, campaign, and other events.

- **4) Reduce Environmental Impact by Disposal of Hazardous Wastes Properly:** Hazardous waste should not be dumped into a landfill like other waste. It needs to be disposed of responsibly to prevent hazards to human and environmental health.

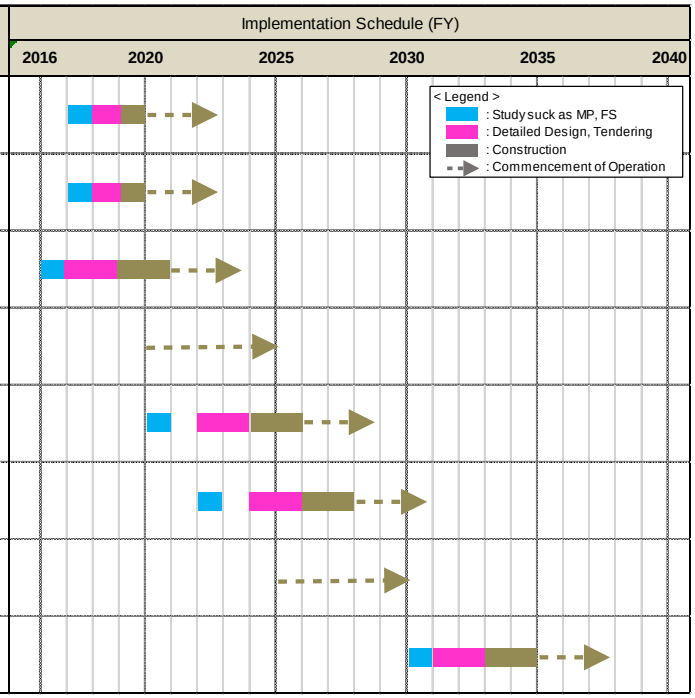
- The development goal of solid waste in Mandalay City is shown as follows:

  a) Make a comprehensive strategic planning for collection and reuse of available material in the source of waste.
  b) Provide a recycle system for organic material by separate collection.
  c) Construct an incineration plant for reducing of solid waste (A waste-to-energy plant is a waste management facility that combusts wastes to produce electricity. This type of waste power generation plant shall sometimes be built through public-private partnership.).
  d) Segregate all hazardous waste to avoid cross-contamination and construct some management facilities for it.
  e) Construct one more final disposal site with proper reclamation and treatment method.

5.5.3 Implementation Schedule

- The proposed implementation schedule of the solid waste infrastructure development is shown in Figure 5.5.2.

No.	Project/Study Name	Status
1	Comprehensive strategic planning of reusing of solid waste and Promotion of the project	Short-term
2	Construction of the recycling system by separate collection of organic waste	Short-term
3	Construction of the final disposal site by a proper reclamation and treatment method (1)	Short-term
4	Project for capacity development of solid waste management (1)	Middl-term
5	Proper collection of hazardous wastes, and construction of treatment facilities	Middl-term
6	Construction of incineration facilities for decreasing solid waste	Middl-term
7	Project for capacity development of solid waste management (2)	Middl-term
8	Construction of the final disposal site by a proper reclamation and treatment method (2)	Long-term



Source: JICA Study Team

Figure 5.5.2 Implementation Schedule for Mandalay (Solid Waste)

5.6 Electricity

5.6.1 Demand Analysis

- In Mandalay City, the distribution sector is under the private sector. The private companies that maintain the distribution system purchase electricity from the Ministry of Electric Power and Energy (MOEPE) and sell to the end user. In this case, MOEPE's responsibility is limited to delivering the electricity from the primary substations to the distribution substations and counting non-technical distribution loss in between these two nodes. While delivering the electricity from the primary substations to the distribution substations in Mandalay City, MOEPE has no non-technical loss, so MOEPE considers the distribution loss of Mandalay City as zero. However, from the private distribution company's point of view, distribution loss exists due to the usual reasons. Thus, installation of digital meters at the end user side may be taken as one of the measures to reduce distribution loss.

- While estimating the power consumption and/or peak demand of Mandalay City, frequent suspension of power supply associated with equipment failure and/or shortage of power supply, amount of scheduled load shedding, and distribution loss shall be taken into account. Unfortunately, a well-maintained trend of detailed database has not been available in Myanmar's power systems, which makes it very difficult for a good estimation of the consumption and peak demand forecast even when using conventional theorems. Thus, making a strong, detailed, real time, errorless, and digitalized database is truly essential for appropriate planning and design of a superior power system and electrical infrastructure equipment. Installation of SCADA system with centralized/regional control provision would be the first step to start a digitalized database.

- The yearly peak demand trend till 2015 is shown in the following Table 5.6.1. The peak demand means the maximum value of the power demand during a given period. In general, the average power consumption per hour is employed.

Table 5.6.1 Peak Demand Growth Trend of Mandalay City

Year	Peak Demand (MW)	Demand Growth Rate
2010	127.7	-
2011	153.22	20.0%
2012	173.60	13.3%
2013	196.66	13.3%
2014	248.22	26.2%
2015	292	17.63%

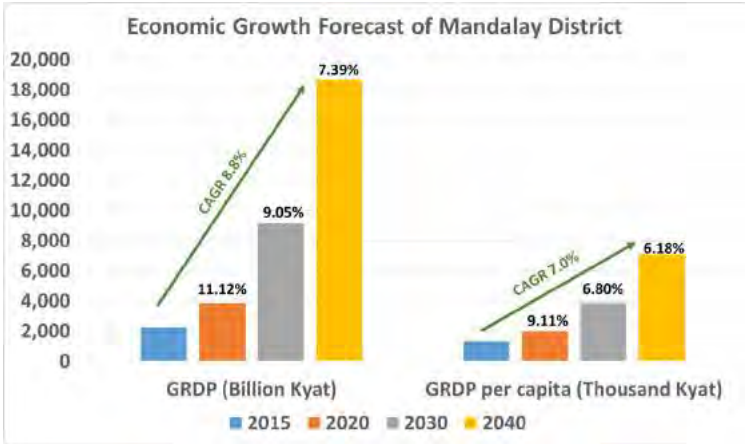
Source: JICA Study Team based on the Final Report of 'Preparatory Survey on Distribution System Improvement Project in Main Cities' by JICA

- Table 5.6.1 above shows the substations' peak demand only while the amount of scheduled load shedding and distribution loss are not included in the above statistical data. Although the past trend is usually considered to be the base for forecasting power consumption, it becomes uncertain in cases where the abnormal growth rate of the past few years continues in the future. In a potentially developing area like Mandalay City, where the scope of development is large, it could be considered as a stereotype. In the short term, the compound annual growth rate (CAGR) of the past trend may be considered to estimate the peak demand forecast. The CAGR of peak demand in this case is 17.99%, while MESC considers the peak demand growth rate forecast at 15% increment in load. Due to the limited statistical data and unavailability of any concrete future development plan, the medium-term or long-term demand forecast estimations by conventional methods would not be able to receive any concrete result. Thus, along with creating database, a concrete urban power and electrical infrastructure development master plan shall be formulated.

- The conventional and ancient methodology of power demand forecast is broadly classified into macro and micro methods. Macro method makes an analysis from the viewpoint of the general situation. The power demand and peak power are forecasted by finding and using a certain (i.e., GRP, GRP per capita) trend or correlation to the power consumption and vice versa. Micro method makes a detailed analysis of demand by categorizing it into constituents, and the total power demand is derived from estimations made for each constituent. The demand forecast using the micro method for Mandalay City is not possible with the current database. However, the peak demand forecast is made by the JICA Study Team based on macro method and the spatial plan is shown below.

- Firstly, the loads are divided into two parts, namely, public (Any loads other than the industrial load) and industrial (Industrial zone, SEZ). The estimation is done from the supply-side point of view. The industrial load could be estimated based on the land use area (acre or hector), scale of industry, etc. As soon as the urban development plan has concrete definition of future industrial area, scale of industry, and project implementation time schedule becomes available, the forecast would be possible for industrial load (i.e., 1 hector= 4 or 5 MW, Phase-1,2,3, etc.). Industrial demand growth trend data could also be used whenever available. Public load forecast has been done based on GRP and GRP/capita forecast.

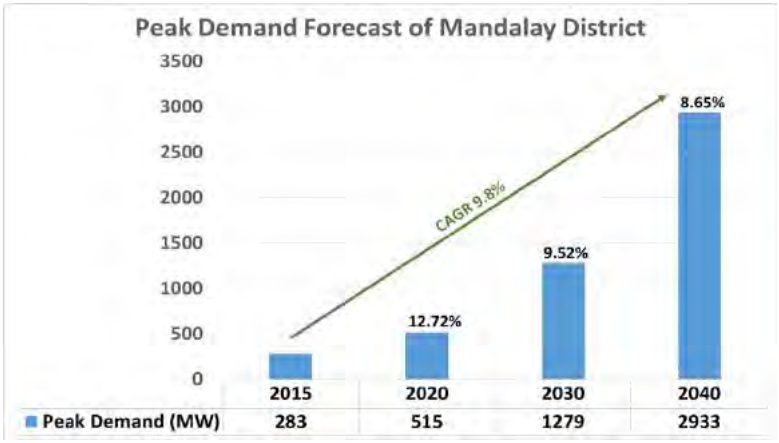
- According to the population growth forecast by the JICA Study Team, the average growth rate of Mandalay City's population is calculated as 1.7% per annum until the year 2040. The forecast of GRP (in current price) and GRP per capita (in constant price) of Mandalay City made by the JICA Study Team is shown in Figure 5.6.1. In this forecast, CAGR of GRP and GRP per capita are 8.8% and 7.0%, respectively and the breakdown of growth rate is shown in the following Figure 5.6.1.



Source: JICA Study Team

Figure 5.6.1 Forecast of GRDP and GRDP per capita of Mandalay City

- The GRP growth trend data (Table 2.2.3) shows the values in current price. In order to decide the desired coefficient value, the trend has been converted to constant price. By comparing the GRP growth trend in constant price and the peak demand growth trend (Table 5.6.1), a rough estimation of elasticity value equal to 1.4 has been predicted for Mandalay City. MOEPE's elasticity value for Myanmar is also the same. As both the GRP growth trends and peak power demand trends are based on limited time period of history and various conditions on data, so the elasticity value may have a certain degree of deviation. But for the moment, this is assumed to be the best value of elasticity. The forecasted growth rate of peak power demand is assumed to be equal to 'elasticity value' times the forecasted 'GRP per capita growth rate'. By considering the abovementioned data, the peak demand growth forecast for public load till 2040 is made and is shown in Figure 5.6.2. The CAGR of this forecast is 9.80%.



Source: JICA Study Team

Figure 5.6.2 Peak Demand Forecast of Mandalay City

- In order to get a more precise result in the future, many other modern approaches using weather forecast and intelligent algorithm could be used depending on the available data.

5.6.2 Development Policy

- Based on the current condition, issues, and demand forecast analysis, development policy shall be imposed to back up the urban development plan proposed in this study.

Table 5.6.2 Development Policy of Electricity in Mandalay

Electricity Policy	1) Distribution Loss Reduction 2) Developing Digital Database 3) Comprehensive Urban Energy and Electric Power System Development Plan 4) Upgrading and Strengthening of Primary Substations Network 5) Involvement of MESC and/or MOEPE in Urban Planning

Source: JICA Study Team

- **1) Distribution Loss Reduction:** Any raise in electricity tariff by the transmission department may lead to an even more increased electricity tariff by the private distribution companies on the end-users, taking into account that private distribution companies have to deal with distribution loss, maintenance, and on top of it making their own profit. This may also lead to a further vulnerable situation where these private companies will lose the motivation to maintain the distribution system equipment resulting in increase in distribution loss and/or customers losing the faith on these companies. As distribution loss reduction by their own fund would be an expensive task for these private companies, one policy encouraging the end-users to use digital meters by themselves can be adopted primarily. Another policy could be to encourage the distribution companies to buy and operate small- to medium-scale generators/power plants by themselves as both on- and off-grid power supply source.

- **2) Developing Digital Database:** Any electricity-related plan and/or design is basically based on detailed data analysis. Making an efficient, detailed, real-time, errorless, and digitalized database of Mandalay itself would solve many problems in the power system as well as should give Mandalay City a superior power system and electrical infrastructures such as smart cities in the future. Installation of SCADA system with centralized/regional control provision would be the first step to start a digitalized database.

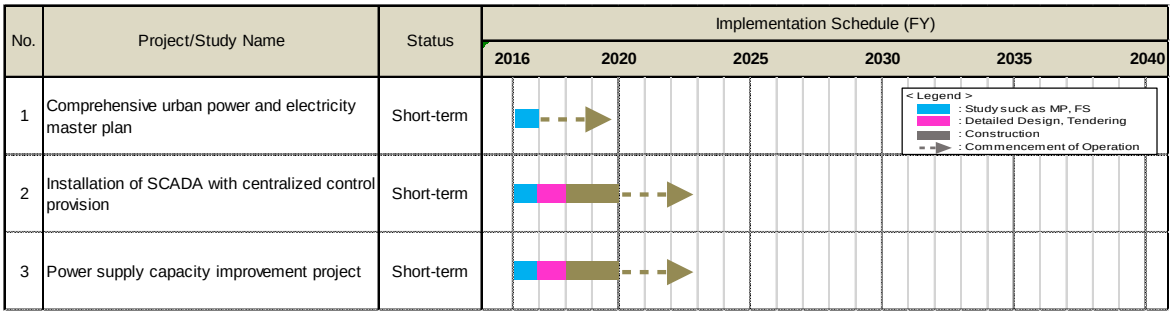
- **3) Comprehensive Urban Energy and Electric Power System Development Plan:** Although Myanmar has formulated an electricity master plan, developing a comprehensive study on energy and power infrastructure of a city like Mandalay shall ensure the synchronization of the future development plan and the urban electricity master plan.

- **4) Upgrading and Strengthening of Primary Substations Network:** In Mandalay City, the electricity supply depends on the capacity of the primary substations. The primary substation facilities shall be upgraded on emergency basis.

- **5) Involvement of MESC and/or MOEPE in Urban Planning:** The JICA Study Team's estimation of peak demand forecast and the MESC's peak demand forecast are different. One of the reasons behind this difference is that MESC is not updated about the information of future urban development plans such as development ratio made by the other bodies of Myanmar government. Thus, direct involvement of MESC and/or MOEPE while formulating these development plans and/or development committee is recommended.

5.6.3 Implementation Schedule

- The proposed implementation schedule of the electrical infrastructure development is shown in Figure 5.6.3.



Source: JICA Study Team

Figure 5.6.3 Implementation Schedule (Electricity)

5.7 Social Service

- Benefits from the achievements of the master plan including economic growth and improvement of environmental condition should be shared with all the people in the community. This means not only increasing the incomes of the poor, but also addressing the needs of the disadvantaged and excluded groups. In addition, the development should allow them to fully participate and contribute in the process of growth. To achieve inclusive development, it is key to provide equal opportunity and accessibility to social services for all the people which include all classification in any income groups. To secure the provision of social service, the following development policy should be aimed for:

Table 5.7.1 Development Policy of Social Service in Mandalay

Social Service Policy	1) Provision of Equal Opportunity of Education and Employment for All People 2) Provision of Healthy and Secure Living Environment for All People 3) Provision of Social Safety Net for All People

Source: JICA Study Team

- **1) Provision of Equal Opportunity of Education and Employment for All People**: Education helps provide children with opportunities to fulfill their potential and is critical to all aspects of social development. The access to education is however limited, particularly for low income groups and minorities. Attendance rates of primary school (primary school age) in Mandalay City is 74-80%, although Myanmar's constitution guarantees access to free and compulsory primary education to all children. In addition, attendance rates of students in basic education schools, middle school, and high school decrease gradually with the increase of their age. These are mainly caused by economic difficulties, poor access mode to schools, and gap in the number of schools. Measures to reduce these students should be taken. At the same time, Mandalay City has good foundations to be the main city for education and technology services. Mandalay should also promote investing in these services. Regarding employment, labor market and employment opportunities have many gaps concerning those classified as vulnerable groups such as lower education levels, poverty, and persons with disabilities. New graduates from universities also have difficulties to find immediate employment. The hidden demands of vulnerable groups and new entrants to the labor market should be clarified and matched with appropriate jobs. The following recommended supports should be considered to provide equal opportunity of education and employment:

  - Preparation of school allocation plan according to the estimated future population and number of students;
  - Develop regulations that lead to greater complementarities between private and public schools;
  - Upgrading teacher quality with pre-service and in-service teacher training programs;

- Operation of school bus service and launching mobile school program in remote area;
- Spread of scholarship program for children with economic difficulties;
- Improvement of infrastructures for educational institutions such as laboratory and library;
- Invest in human resource development program, integration of research and development program with Mandalay Technology University, and setting up an information technology (IT) Centre with the cooperation of Yadanarpone Teleport;
- Enhancement of job matching network with various employment opportunities, target of which includes students who graduated from higher education facilities; and
- Provision of vocational training which targets special job seekers including those who retired from schools earlier, person with disabilities, poverty groups, and females.

- **2) Provision of Accessibility to Healthy Life for All People**: Quality of life is closely related to health condition. In addition, good health condition gives a positive impact on productivity and amount of labor force. On the contrary, health problem may increase the risk of poverty through lost earnings and increased health expenditures. The health facilities by type are, however, not equally distributed in Mandalay City currently. The gap of service level should be balanced by establishing necessary health facilities, which should be matched with the appropriate assignment of qualified health workers as well. The following recommendations should be considered to enhance the health status of the community:
  - Improve supply and access of healthcare services for all area, considering number, type, and transportation;
  - Establish appropriate and sustainable health financing scheme;
  - Training of health provider (in-service and on-the-job) and appropriate assignment of qualified health workers;
  - Launch program for promotion of public health, such as education and information about the spread of diseases;
  - Introduce health insurance system particularly for the urban poor community;
  - Community support system for elderly people to provide healthcare, social care, and protection in their daily life activities.
- **3) Provision of Social Safety Net for All People**: Participation of socially vulnerable groups to the growth process of the city will contribute in realizing an inclusive development. Actually, there are people who are in socially vulnerable groups which are in poverty, have low level education, and with disabilities. For example, not a few percentages of Mandalay residents, 16% according to data from GAD, are in poverty. And most of them originally belong to such situation where it is hard to get out of the poverty cycle. On the other hand, anyone has a potential to fall into the socially vulnerable due to accidents including recession, serious injury or disease, debilitation due to getting older, and becoming a single or no parent family. It is quite important to provide social support for them to get opportunity to have livelihood and secured lives. The following recommendation should be considered to support the socially vulnerable people's life:
  - Survey on the existing condition of socially vulnerable groups including the poor, orphans, and people with disabilities regarding living condition, education, employment, and health for appropriate support;
  - Provision of affordable housings for low income household;

- Promotion of human development programs such as skill enhancement training and vocational training;
- Financial support including scholarship and grant for orphans and children with disabilities;
- Promotion of universal design (barrier-free) in public facilities, public transportation, and; footpath

6 A Roadmap of Key Projects

6.1 Development Aspects

- The plan assumes three development aspects with targets. The following describes the concrete projects and activities for each development phase.

6.1.1 Development of Principal Infrastructure and Service and Promotion of Housing Development

- The plan focuses on the completion of currently ongoing project and preparation/construction of the principal infrastructure networks and social service. It intends to accommodate migrant persons for the new industries and to prepare basis for urban infrastructures for the following development. The following are planned to be executed in the development aspect:

    - Public transportation improvement (refer to key projects of no.6, & 8 in the next page)
    - Traffic management improvement (no.7, 10, 11)
    - Arterial roads network development (no.9)
    - Logistics function improvement (no.12, 13, 14,& 15)
    - Basic infrastructure development (no.16, 17, 18, 19 & 20)
    - Ordinal housing supply (necessary to construct principal infrastructure networks)

6.1.2 Improvement of Urban Environment

- The improvement of current urban areas is planned in the development aspect, after completion of construction of basic infrastructure services and ensuring their basic supply. Improvement of current low quality residential area is important from the view of reduction of disasters. These improvement activities are expected to contribute to attract investment from other regions and overseas countries. And some developments for new housing are planned to start after thorough examination of spatial planning and business plans.

    - Urban environment improvement (no.4 & 5)
    - Disaster risk mitigation (no.5)Commencement of new housing development
    - Improvement of residential environment by urban redevelopment and land readjustment
    - Informal settlements formalization

6.1.3 Promotion of Commercial, Business, Industrial Areas and Development of New Towns

- After examination and formulation of planning and business schemes, the developments for new industrial areas, new town areas, and new CBD areas are planned to start in the development aspect. Because of their extensive development area, their developments need to progress by stages. The development plans also need to be reviewed and modified according to the demand of housings and business facilities if necessary.

    - Commercial and business area development (no.1)
    - Industrial zone development (no.2)
    - New town and housing development (no.3)

6.2 Key Projects

・ To achieve the development vision and realize the spatial plan written in the previous section, 20 key projects, which are focal actions to be commenced in the short term (5 from urban development sector and the other 15 from infrastructure development sector), are selected and described in detail in this section. Some projects could be commenced in the middle term because discussion and preparation works are recommendable to be started as soon as possible. Table 6.2.1 summarizes these projects and the following section describes each project.

Table 6.2.1 List of Key Projects

Sector	Project Name	Vision (Key Drivers)			
		Logistic HUB	High-tech Education	Culture Tourism	Resilient Green
Urban Development	1. New CBD Development Project	+	++		
	2. Southern Gateway Industrial Zone Development Project	+	++		
	3. Eastern Gateway Hi-Tech City Development Project	+	++	+	
	4. Palace Park Creation Project			++	+
	5. Riverfront Area Improvement Project			+	++
Infrastructure Development	6. Bus Service Upgrading Project	++	+	+	
	7. Comprehensive Urban Transport Master Planning Project	++	+		
	8. Commuter Railway Development Project	++	+		
	9. Road Network Improvement and Disaster Road Network Development Project	+			++
	10. Traffic Control and Management Project	+	+	+	
	11. Comprehensive Parking Master Planning Project	+	+	+	
	12. Project for Mandalay Inland Port Establishment	++			
	13. New Logistic Terminal Project	++			
	14. Upgrading and Improvement of Airport Navigational Facility Project	++		+	
	15. Mandalay-Nay Pyi Taw-Yangon Expressway Improvement Project	++			
	16. Mandalay Urban Services Improvement (Water Supply)	+	+	+	+
	17. Water Supply Expansion Project (in Pyigyidagun Township)	+	+	+	+
	18. Mandalay Urban Services Improvement (wastewater and drainage management)	+	+	+	+
	19. Solid Waste Management Project	+	+	+	+
	20. Power Supply Capacity Improvement Project	+	+	+	+

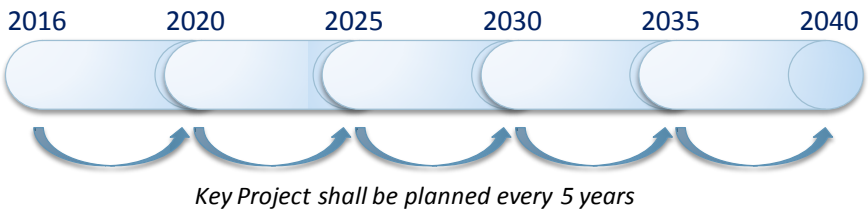
Note: ++ Strong Relation, + Relation
Source: JICA Study Team

Table 6.2.2 Implementation Schedule and Rough Cost Estimation of Key Projects

No.	Project Name	Implementation Schedule	Rough Cost Estimation (million USD)	Status*	Implemented by
1	New CBD Development Project		250	-	-
2	Southern Gateway Industrial Zone Development Project		770	-	-
3	Eastern Gateway Hi-Tech City Development Project		490	-	-
4	Palace Park Creation Project		19	-	-
5	Riverfront Area Improvement Project		10	-	-
6	Bus Service Upgrading Project		80	-	-
7	Comprehensive Urban Transport Master Planning Project		1	-	-
8	Commuter Railway Development Project		300	-	-
9	Road Network Improvement and Disaster Road Network Development Project		30	-	-
10	Traffic Control and Management Project		20	Partially ongoing	MCDC without doner's support
11	Comprehensive Parking Master Planning Project		1	-	-
12	Project for Mandalay Inland Port Establishment		30	Ongoing (design stage)	MOTC (IWT) supported by JICA
13	New Logistic Terminal Project		—	Ongoing	MR using PPP scheme
14	Upgrading and Improvement of Airport Navigational Facility Project		15	-	-
15	Mandalay-Nay Pyi Taw-Yangon Expressway Improvement Project		30	-	-
16	Mandalay Urban Services Improvement (Water Supply)		55	Ongoing (F/S started)	MCDC supported by ADB
17	Water Supply Expansion Project (in Pyigyidagun Township)		50	-	-
18	Mandalay Urban Services Improvement (wastewater and drainage management)		64	Ongoing (F/S started)	MCDC supported by ADB
19	Solid Waste Management Project		14	-	-
20	Power Supply Capacity Improvement Project		20	-	-

Note:
1) * " - " in the status column means the project is in proposal stage and its implementation body is not yet determined.
2) The rough cost of No.19) Solid Waste Management Project is counted as phase-1 only. (Referring Preparing Mandalay Urban Services Improvement Project by ADB)
Source JICA Study Team

- It is recommendable that the key projects are planned every five years through the monitoring regard on progress of conducting projects and change of circumstances. According to drafted "Urban and Regional Development Plan", a master plan shall be formulated every 5 – 10 years under the conceptual plan. In this context, re-planning of key projects shall be one of the works in master planning.



Source: JICA Study Team

Figure 6.2.1 Image of Planning Cycle for Key Projects

1. New CBD Development Project

Table 6.2.3 New CBD Development Project

Current Status and Issues	The site of the old airport in Mandalay City is currently dysfunctional and underutilized. The site occupies a prime location in the center of Mandalay City in close proximity to the lakes, the Mahamuni Paya, the University of Mandalay as well as the IT University. The city lacks an organized and modern CBD. There is no space where the citizens of Mandalay City can go for leisure, shopping, or cultural activity. This site has the potential to be developed as a modern and well planned CBD which is well serviced by the future railway station. The old railway depot can be a future extension of this CBD.
Purpose	To develop the old airport site into a CBD, culture and leisure destination.
Main Scope	・ Development of a central CBD and a leisure space for citizens ・ To create a central park surrounded by malls, hotels, office towers, cultural spaces, and new cultural landmarks like art museums, libraries, and interpretation centers. ・ Strengthening the tourist potential of Mandalay City by creating a zone of hotels, outdoor eating streets, cafes, and other tourist facilities.

Source: JICA Study Team

Source: JICA Study Team

Figure 6.2.2 Images of New CBD Development Project

2. Southern Gateway Industrial Zone Development Project

Table 6.2.4 Southern Gateway Industrial Zone Development Project

Current Status and Issues	In line with the proposed spatial plan, enough vacant land is available towards the southern part of the city along the Yangon-Mandalay Road for development of an industrial zone. This industrial zone will create a good network between the proposed logistics port, existing industries, and the Mandalay International Airport. It can also benefit from the existing infrastructure.
Purpose	The purpose is to develop a logistics and industrial zone connected to the port and existing industries.
Main Scope	・ To develop a southern gateway to the city with industry and logistics as the main function ・ Utilize the existing road and service infrastructure along the Yangon-Mandalay Road to create an expansion to the existing industrial area ・ Creating new business opportunities and jobs

Source: JICA Study Team

Source: JICA Study Team

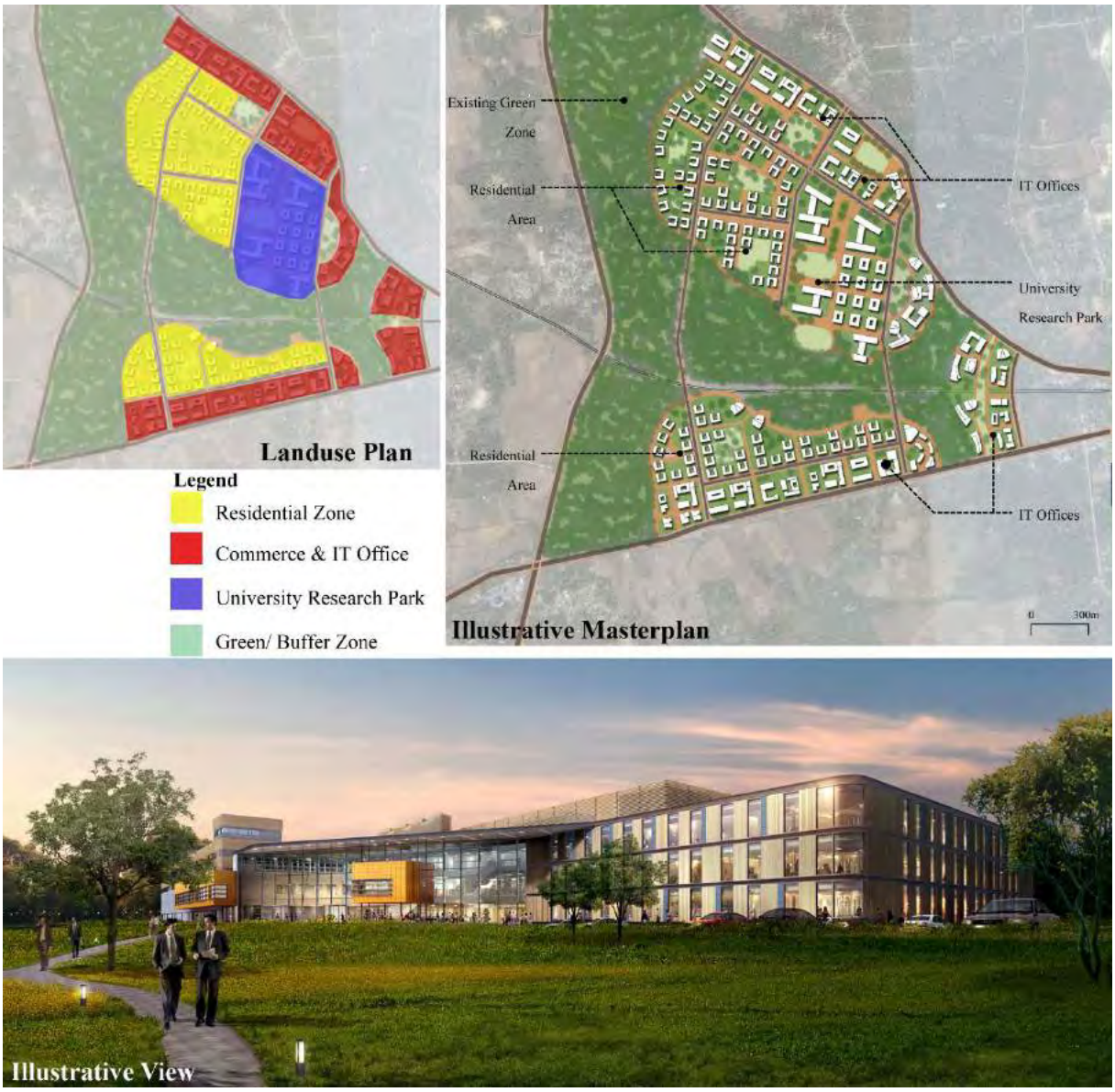
Figure 6.2.3 Images of Southern Gateway Industrial Zone Development Project

3. Eastern Gateway Hi-Tech City Development Project

Table 6.2.5 Eastern Gateway Hi-tech City Development Project

Current Status and Issues	Vacant land is currently available for development of a cyber (IT) city along National Highway 3 towards the eastern part of the city. This zone will be linked with the Cyber (IT) University situated in close proximity and will have functions related to IT offices, university research parks, and residential areas.
Purpose	The purpose is the creation of a new sub-centre towards the eastern part of the city, linked with National Highway 3.
Main Scope	・ Creating a self-sustainable module with integrated living, working, and university functions. ・ Creating a green city with playgrounds, green buffer, and plantation areas for the residents. ・ Developing world-class business and IT/cyber offices ・ To boost business opportunities in Mandalay.

Source: JICA Study Team



Source: JICA Study Team

Figure 6.2.4 Images of Eastern Gateway Hi-Tech City Development Project

4. Palace Park Creation Project

Table 6.2.6 Palace Park Creation Project

Current Status and Issues	The Mandalay Palace remains like an inaccessible island of green within the city. The land use on its edges does not respond to the palace. There is a potential to develop the palace as a city park open to its residents, where citizens can spend their evenings. It can become a place where temporary events can be hosted and weekly heritage street markets can be organized.
Purpose	To develop the palace as a grand public park with tourist facilities and commerce in its vicinity
Main Scope	・ Creating a grand public park. ・ Creating tourist infrastructure. ・ Landscape development and creating spaces for various functions within the palace. ・ Creating spaces for heritage markets, small event spaces, open cafes, and other recreational areas. ・ Linking the palace with other parts of the city through pedestrian boulevards and trams.

Source: JICA Study Team

Source: JICA Study Team

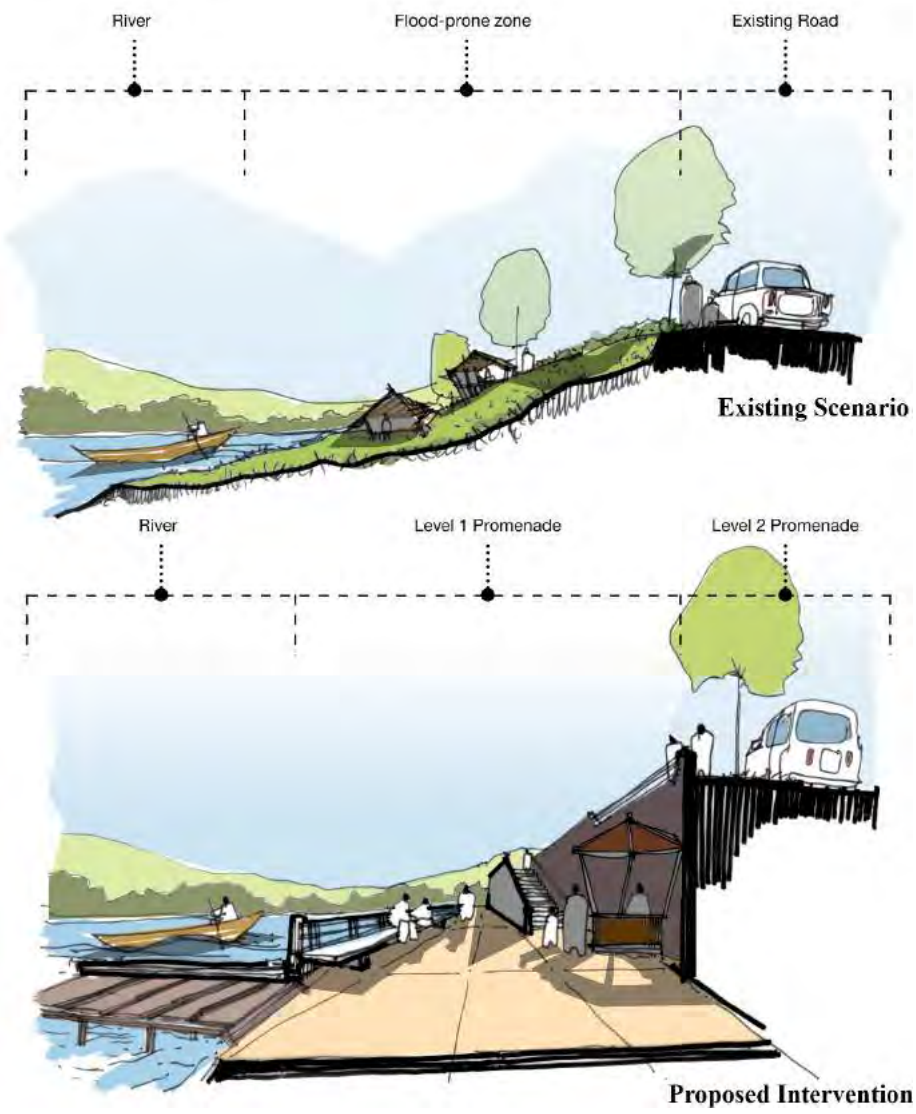
Figure 6.2.5 Images of Palace Park Creation Project

5. Riverfront Area Improvement Project

Table 6.2.7 Riverfront Area Improvement Project

Current Status and Issues	The land on the eastern bank of the Ayeyarwady River is low lying and flood prone. There is lack of proper flood control infrastructure. There is currently no connection of the city with the river. There are no open spaces, plazas or streets which open towards the river. Excessive boating and fishing-related activities are done in this area. A lot of encroachment is also observed along the river.
Purpose	The purpose is to create a leisure and open space for the residents of the city. Also to connect the city with the river and create flood resilience.
Main Scope	・ Creating flood control infrastructure. ・ Creating open space for the citizens. ・ Creating avenues for various activities like fishing, boating, and other informal activities. ・ Creating connections across the Myo Patt Road.

Source: JICA Study Team



Source: JICA Study Team

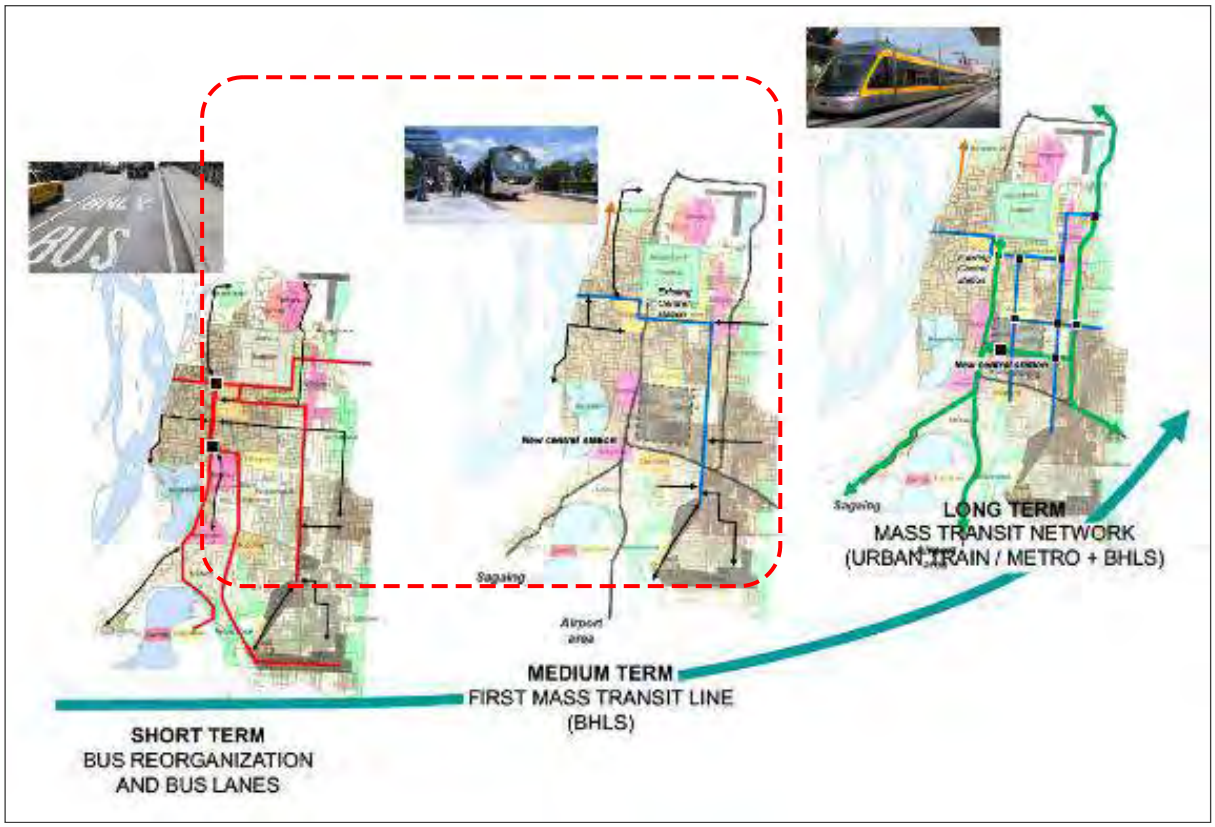
Figure 6.2.6 Images of Riverfront Area Improvement Project

6. Bus Service Upgrading Project

Table 6.2.8 Bus Service Upgrading Project

Current Status and Issues	Mandalay citizens enjoy using convenient private transportation mode such as motorcycle. Public transportation system, such as bus network, is available but not used properly.
Purpose	Modal shift to "public transportation system" from private transportation by developing high-quality bus service
Main Scope	・ Construction of the main backbone of large-size bus network such as BRT ・ Re-structuring of the existing bus network ・ Introduction of high-quality bus fleet including modernized ticketing system ・ Establishment or strengthening of the bus operation authority/corporation ・ Technical assistance (TA) to the bus operation authority/corporation

Source: JICA Study Team



Source: FASEP – French Grant/Urban Services Improvement Project, Final Report Vol. IV

Figure 6.2.7 Images of Bus Service Upgrading Project

7. Comprehensive Urban Transport Master Planning Project

Table 6.2.9 Comprehensive Urban Transport Master Planning Project

Current Status and Issues	Traffic data such as traffic count and person trip data is not available and quantitative demand analysis could not be conducted. It is essential to estimate the traffic demand for the project implementation.
Purpose	Establishment of comprehensive urban traffic master plan
Main Scope	・ Traffic surveys ・ Demand forecast ・ Preparation of term-wise development plan

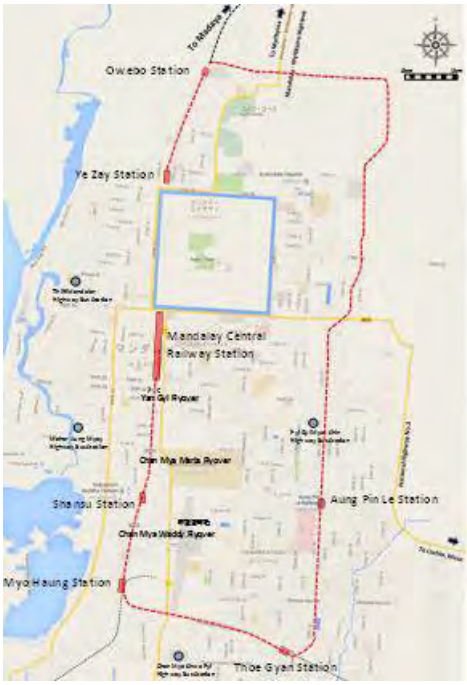
Source: JICA Study Team

8. Commuter Railway Development Project

Table 6.2.10 Commuter Railway Development Project

Current Status and Issues	Circular-like railway track is available in the city surrounding the densely built-up central area. However, this valuable asset has not been used by the citizens of Mandalay.
Purpose	Modal shift to “public transportation system” from private transportation by utilizing the existing railway track in the city
Main Scope	・ Construction of the high-quality light rail transit (LRT) system ・ Network modification for existing railway service between Mandalay Railway Station and Ye Zay Railway Station ・ Establishment of the LRT operation authority/corporation ・ Technical assistance (TA) to the LRT operation authority/corporation

Source: JICA Study Team



(Urban Railway Track in Mandalay)

(Current Condition: Railway Track and Station)

(Image of LRT: LRT in Sapporo City)

Source: JICA Study Team, www.city.sapporo.jp

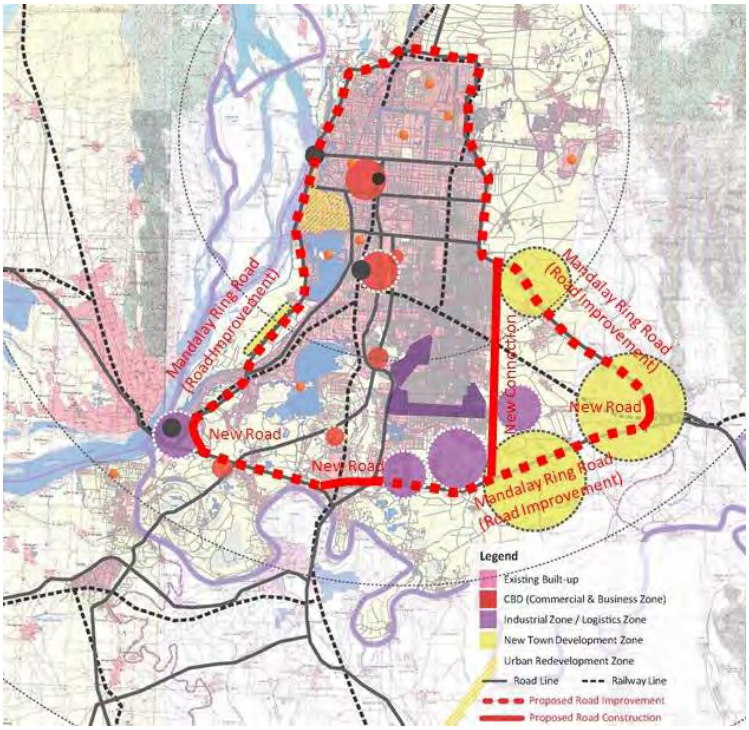
Figure 6.2.8 Images of Commuter Railway Development Project

9. Road Network Improvement and Disaster Road Network Development Project

Table 6.2.11 Road Network Improvement and Disaster Road Network Development Project

Current Status and Issues	Traffic congestion is observed on the main arterial road during the peak hours. Urbanization and development are concentrated in the city center.
Purpose	Decentralization of the current urban center and reduction of traffic congestion in the future through development of the new and strengthened road network
Main Scope	・ Upgrading of the Mandalay Ring Road (4-lane arterial with service road) ・ Construction of the new urban arterial road to back up the proposed spatial plan ・ Establishment of the Urban Road Design Guideline (TA)

Source: JICA Study Team



Source: JICA Study Team

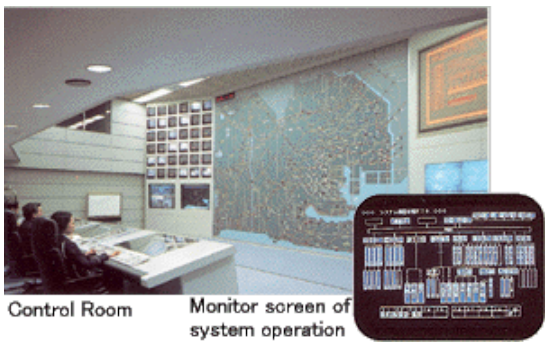
Figure 6.2.9 Proposed Road Network

10. Traffic Control and Management Project

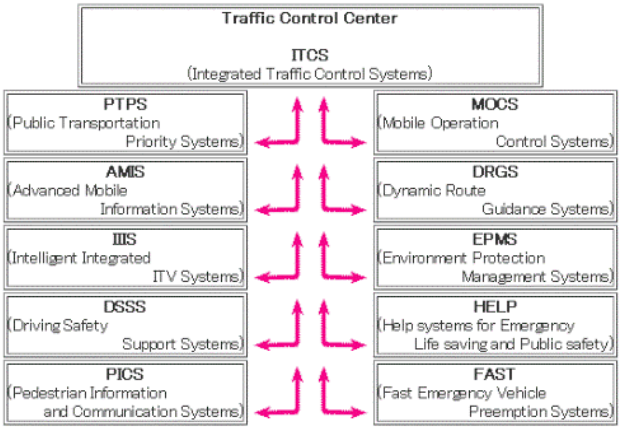
Table 6.2.12 Traffic Control and Management Project

Current Status and Issues	Traffic congestion is observed on the main arterial road during the peak hours. Urbanization and development are concentrated in the city center.
Purpose	Maximization of the road capacity by introducing synchronized traffic signal system and advanced traffic control center
Main Scope	・ Upgrading of the traffic signals, installation of the new traffic signals ・ Cabling of the fiber optic network ・ Minor civil works for the lane re-configuration of intersections ・ Upgrading of the traffic control center ・ Technical assistance (TA) to MCDC/traffic police

Source: JICA Study Team



(Traffic Control Center in Japan)



(Function of Traffic Control Center in Japan)

Source: www.police.pref.kanagawa.jp

Figure 6.2.10: Image of Traffic Control and Management Project

11. Comprehensive Parking Master Planning Project

Table 6.2.13 Comprehensive Parking Master Planning Project

Current Status and Issues	On-road parking induce road blockade reducing the capacity of the road network.
Purpose	Establishment of the comprehensive parking master plan
Main Scope	・ Parking surveys ・ Demand forecast ・ Preparation of term-wise development plan

Source: JICA Study Team

12. Project for Mandalay Inland Port Establishment

Table 6.2.14 Project for Mandalay Inland Port Establishment

Current Status and Issues	Outdated port facilities by manual cargo handling
Purpose	Improvement of the current “slow, costly, unsafe, and low security” operation
Main Scope	Construction of the new port around the logistic corridor proposed in the spatial plan including jetty, trestle, container yard, warehouses, port office, and cargo handling equipment

Source: JICA Study Team

Source: www.police.pref.kanagawa.jp

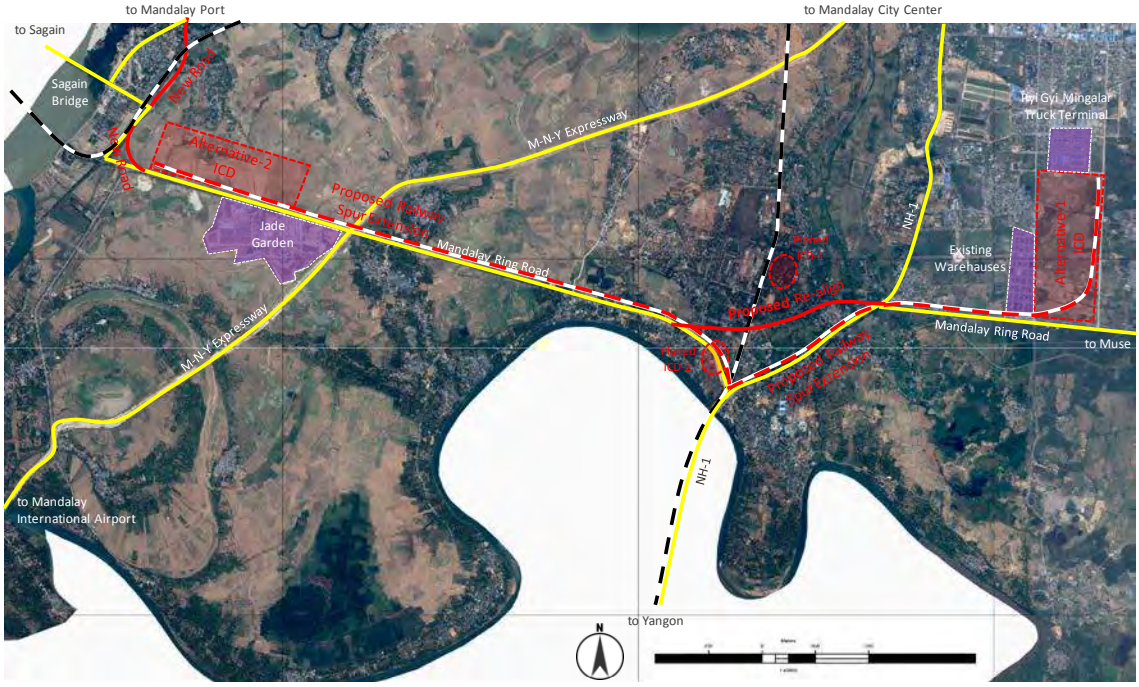
Figure 6.2.11 Current Conditions and Image of New Container Port

13. New Logistic Terminal Project

Table 6.2.15 New Logistic Terminal Project

Current Status and Issues	Outdated port facilities by manual cargo handling
Purpose	Expansion of the Pyi Gyi Mingalar Truck Terminal and simplifying and speed up of the custom clearance process
Main Scope	・ Expansion of the terminal ・ Custom clearance function in the terminal ・ Railway extension to the terminal

Source: JICA Study Team



Source: JICA Study Team

Figure 6.2.12 Proposed Location of New Logistic Terminal Project

14. Upgrading and Improvement of Airport Navigational Facility Project

Table 6.2.16 Upgrading and Improvement of Airport Navigational Facility Project

Current Status and Issues	Outdated airport navigational facilities for air traffic control including control tower.
Purpose	Providing the airport navigational safety operation for aircraft movements
Main Scope	・ Communication Equipment ・ Navigation Equipment ・ Surveillance Equipment ・ Weather Equipment

Source: JICA Study Team


(Localizer)


(Glide Path)


(VOR/DME)


(Surveillance Radar)


(AWOS)


(Control Tower)

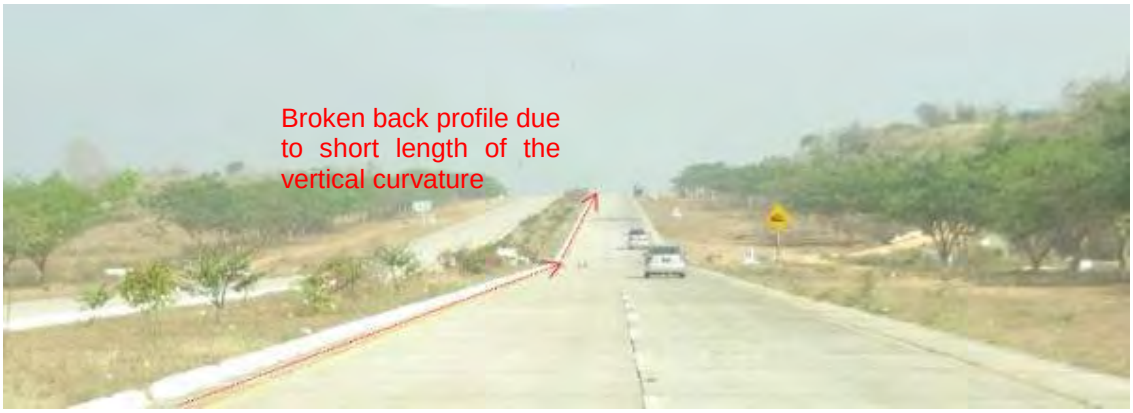
Figure 6.2.13 Existing Air Navigation Facilities at Mandalay International Airport

15. Mandalay-Nay Pyi Taw-Yangon Expressway Improvement Project

Table 6.2.17 Mandalay-Nay Pyi Taw-Yangon Expressway Improvement Project

Current Status and Issues	Restriction of large truck use and improper geometric design and safety facility such as traffic lighting
Purpose	Improvement of traffic safety and strengthening of logistic corridor
Main Scope	・ Improvement of the alignment (horizontal/vertical) ・ Improvement of cross section especially super elevation ・ Strengthening of pavement structure ・ Improvement of Mandalay Airport access road

Source: JICA Study Team



Source: JICA Study Team

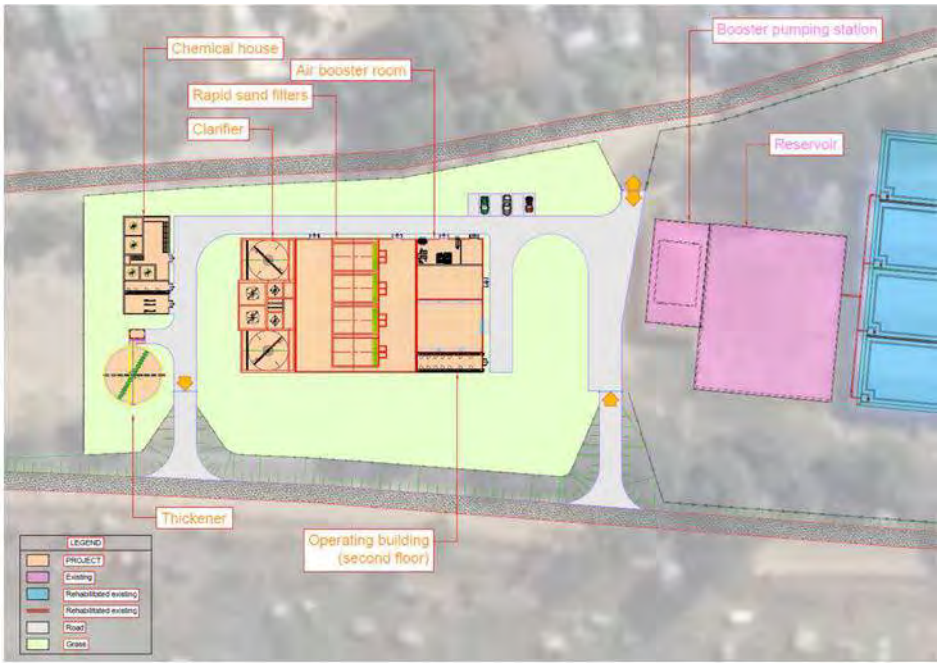
Figure 6.2.14 Lack of Length of Vertical Curvature

16. Mandalay Urban Services Improvement (Water Supply)

Table 6.2.18 Mandalay Urban Services Improvement (Water Supply)

Current Status and Issues	Depending for underground water on water source has the consumption and qualitative issue. Switching to surface water resources will require to improve the existing service areas against significant increases of demand. Comprehensive asset management system and monitoring system is needed to the suitable managing.
Purpose	This project component is aimed at increasing the access of the population of Mandalay to improved water supply services as below. ・ Improved Monitoring & System Management ・ Rehabilitation & Upgrading of the Existing Water Supply System ・ Extensions to the Existing Supply Area
Main Scope	・ Component 1: Extension of a new plant by 38,000 m3/day on land adjacent to the current No.8 water treatment plant together with the improvements of the existing tube-wells recharged by the Ayerarwaddy. ・ Component 2: Replacement of water meters, connections, pipelines and valves in the distribution system for reduction of Non-Revenue Water. ・ Component 3: Construction of 19.1km of main transmission lines and 116km of distribution systems for improvement of coverage and capacity, Installation of improved water-meters and level meters, and Rehabilitation of existing reservoirs and pumps.

Source: Preparing Mandalay Urban Services Improvement Project by ADB (June 2015)



Source: Preparing Mandalay Urban Services Improvement Project by ADB (June 2015)

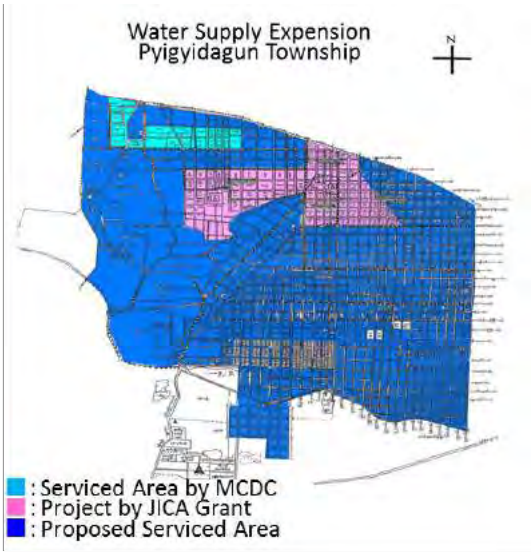
Figure 6.2.15 Component 1: Layout of Water Treatment Plant Extension on the Ayeyarwaddy

17. Water Supply Expansion Project (in Pyigyidagun Township)

Table 6.2.19 Water Supply Expansion Project (in Pyigyidagun Township)

Current Status and Issues	Presently, piped water supply from largely ground water is being provided only in four townships as Aungmyetharzan, Chanayetharzan, Mahaaungmye and Chanmyatharzi, and a small part of Pyigyidagun. Water supply service is very low in Pyigyidagun Township although urban development will be expected in the area.
Purpose	Expansion project of water supply system in Pyigyidagun Township
Main Scope	・ Water treatment plant with Dohthawaddy River as water source ・ Water reservoir, distributing pump, and pipe network

Source: JICA Study Team



Source: JICA Study Team, Based on MCDC's data

Figure 6.2.16 Image of Water Supply Expansion Project (in Pyigyidagun Township)

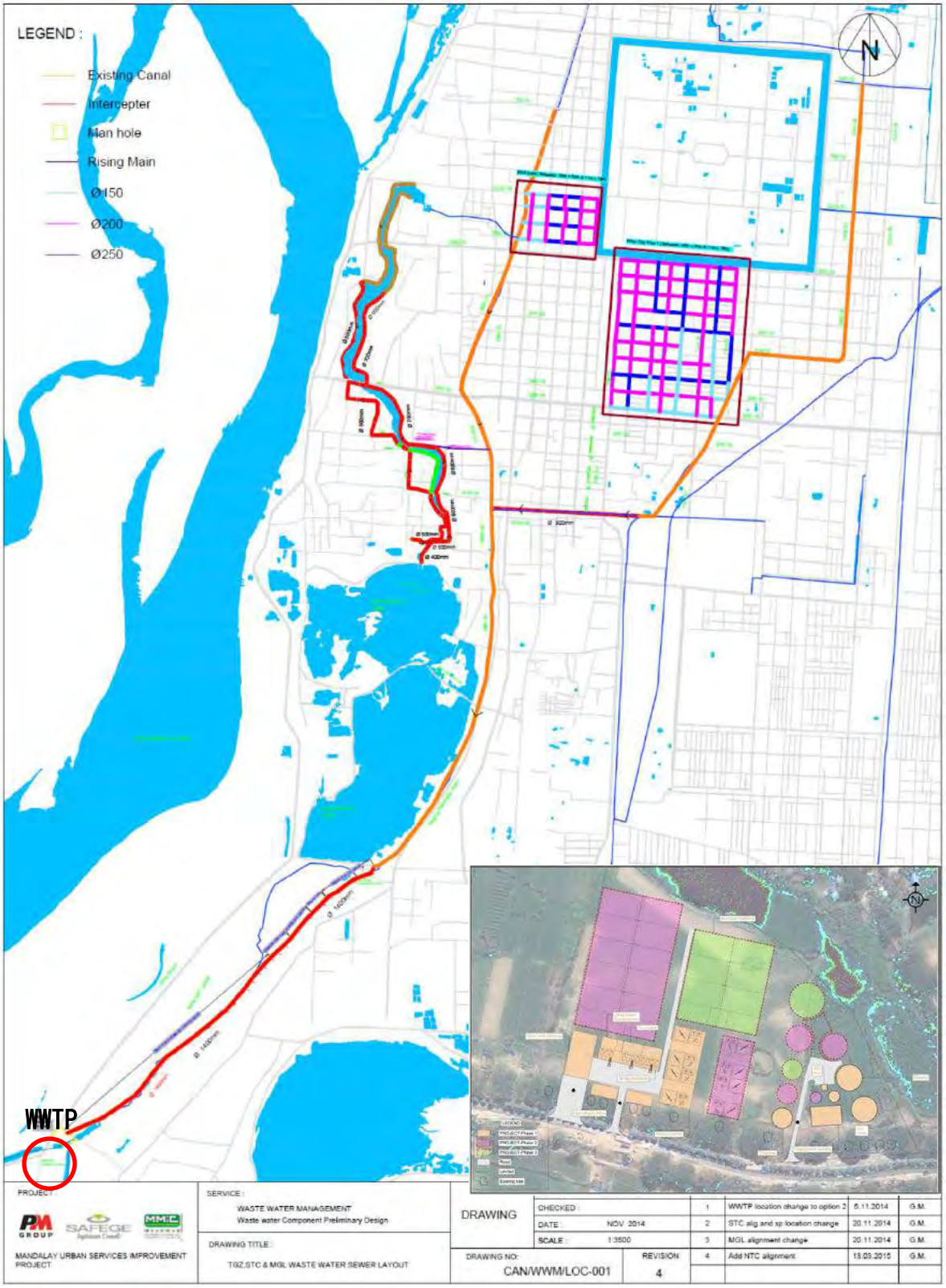
18. Mandalay Urban Services Improvement (wastewater and drainage management)

Table 6.2.20 Mandalay Urban Services Improvement (wastewater and drainage management)

Current Status and Issues	There is no piped sewerage system nor centralized wastewater treatment plant, therefore the environmental impacts are consequently high with pollution of watercourses and groundwater. There is no separate system for the discharge of storm water and urban wastewater, therefore the drainage canals in the city have to function in case of floods to discharge excess flood waters with regard to flood management.
Purpose	This project has two components as below. ・Component 1 is aimed at reducing the amount of wastewater discharged directly to the environment together with overall improvements in wastewater management. ・Component 2 is aimed at reducing the frequency of flooding from less than 6 months to 1 in 1 year locally and 1 in 2 years on main canals with reduction in mixing with wastewater effluents.
Main Scope	Component 1: Mandalay Wastewater & Septage management ・ Wastewater Interceptors and associated overflows ・ Enhanced septage removal ・ Wastewater and septage treatment and disposal ・ Improved wastewater connections Component 2: Mandalay Urban Drainage ・ Upgrade and extend of existing drainage system, and get better control and low

	O&M requirements ・ Improvements (cleaning and dredging) of the drainage canals, and extensions of the relevant pumping stations

Source: Preparing Mandalay Urban Services Improvement Project by ADB (June 2015)



Source: Preparing Mandalay Urban Services Improvement Project by ADB (June 2015)

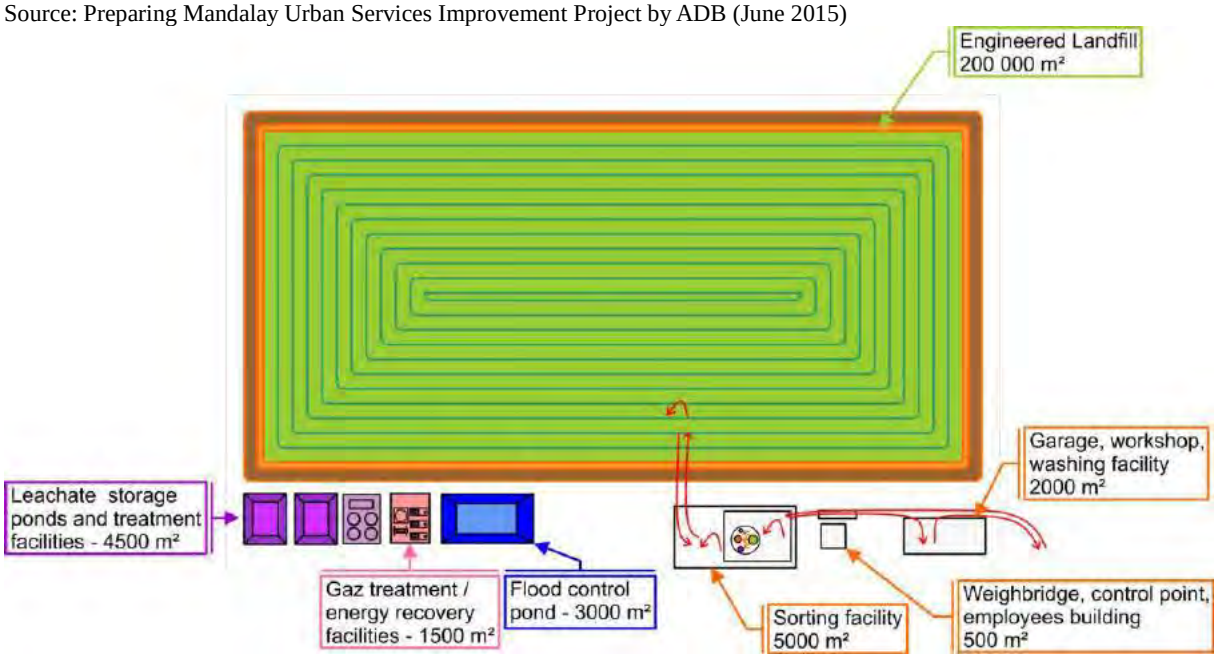
Figure 6.2.17 Image of Mandalay Wastewater & Septage Management (Component 1)

19. Solid Waste Management Project

Table 6.2.21 Solid Waste Management Project

Current Status and Issues	Waste collected by MCDC has increased over recent years, nevertheless there remains still more amounts of uncollected waste. With regard to existing disposal facilities, the remaining life of the 2 dumpsites is short. The existing dumpsites have inappropriate treatment conditions (No leachate confinement nor treatment, No biogas confinement nor treatment, No cover of the waste etc.)
Purpose	The issue of disposal facility capacity and inappropriate treatment condition will be solved. (Exclude the consideration about a contract of waste disposal signed between MCDC and ORGANICS MANDALAY LLC)
Main Scope	・ New landfill capacity 3,000,000 ton (area 25 ha) ・ Phase-1 (2015-2020): Cell creation (35%), Leachate and Gaz treatment (100%), Final cover (20%), Electricity (100%), Recirculation (30%), Road access and Electricity supply (80%) ・ Improvement existing incinerator for medical wastes (Build a confined and appropriated feeding facility, Build a confined ash collection facility, Upgrade the smoke treatment equipment, and Connect the facility to the power network)

Source: Preparing Mandalay Urban Services Improvement Project by ADB (June 2015)



Source: Preparing Mandalay Urban Services Improvement Project by ADB (June 2015)

Figure 6.2.18 Image of Solid Waste Management Project (New Landfill)

20. Power Supply Capacity Improvement Project

Table 6.2.22 Power Supply Capacity Improvement Project

Current Status and Issues	Currently, the overall capacity of primary substations are almost full during peak demand. Also, existing primary transformers shall be overloaded during peak hours by 2017.
Purpose	Ensuring the supply reliability of electric power
Main Scope	・ Building new 230 kV substation and/or ・ Upgrading 132 kV substations to 230 kV substations ・ Enable well-planned cascade connections to ensure N-1 contingency condition

Source: JICA Study Team

Source: JICA Study Team

Figure 6.2.19 Image of Power Supply Capacity Improvement Project

6.3 Future Image of Mandalay 2040

- A bird's eye view of the future urban image of Mandalay was drawn in CG. The view from southwest shows the lake in the left side and the new CBD in the right side.

Source: JICA Study Team

Figure 6.3.1 Bird's Eye View of the Future Urban Image of Mandalay

7 Project Implementation and Urban Management

7.1 Urban Development Management

7.1.1 General View of Urban Development Management by Official

- Spatial control is a common and principal measure to be taken by the local and central government for the realization of urban development policies and projects. These control measures are expected to be executed based on the law, by-laws and other legal frameworks.

- The following shows the spatial control zones, which are expected to be introduced for the realization of planning items:

  a) Boundary of urbanization area: This determines the areas which can be used and developed for the future development. The area is composed of urbanization area, urbanization control area, and development restricted area.
  b) Zoning of land use: The land use determines the permitted activities of land and buildings. The planning index, such as floor area ratio (FAR), building coverage ratio (BCR), open space ratio, and maximum height of building, are prescribed in relation with land use zoning in many cases. It also relates to the development capacity of each area.
  c) Boundary of specific urban development project: In order to secure the land for the future infrastructure facilities and urban development for public purpose, the areas are designated in advance. Moreover, the construction activities in these areas will be restricted.

- For the enforcement of the abovementioned control measures, detailed contents of planning items should be examined in the following detailed planning study. Currently, the legal spatial control measures have not been formulated and are under preparation in Myanmar. The contents of planning items should be adjusted based on the formulation of legal systems, which will be set in the future.

7.1.2 Application of Urban Development Management in Mandalay

Area Classifications

- To realize the spatial plan of Mandalay for 2040, the development activities of the private and public sectors should be guided and promoted properly. This shall also contribute in avoiding uncontrollable urban sprawl so that Mandalay can be a compact city. In this context, Mandalay City shall be classified into four areas for further examination during the formulation of the detailed plan as follows:

  1) **Urbanized Area;** which is current built-up area (e.g., CBDs, residential, and industrial zones). Public sector shall improve urban environment and infrastructure continuously. Some areas shall be target of urban redevelopment;
  2) **Urbanization Promotion Area;** which is suitable for future urban development by 2040. Public sector shall develop key infrastructure and social service in cooperation with private sector by means of PPP scheme. The areas shall be reserved for development of new towns, CBDs, and industrial and logistics zones;
  3) **Urbanization Control Area;** in which development activities shall be controlled properly but not prohibited. Public sector shall not have positive responsibility for development of infrastructure and social service. Private sector who is interested in a project activity must develop by itself. The areas shall also be utilized for urban parks, tourism, and/or green and water belt; and
  4) **Urbanization Restricted Area;** in which development activities must be prohibited strictly. The areas shall be reserved for nature reservation and high-value agriculture development.

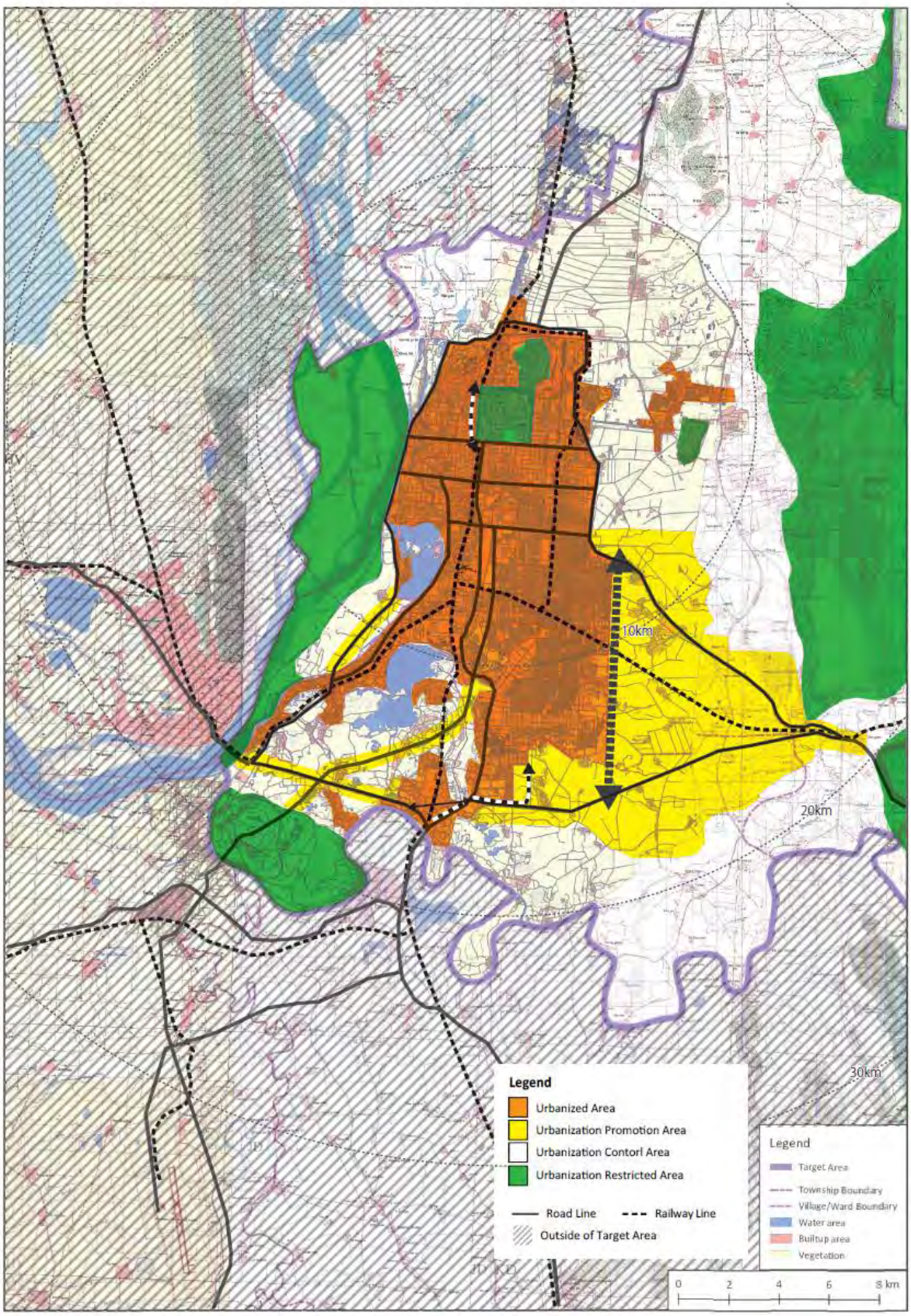
- The four types of classified areas mentioned above shall correspond to zones which are proposed in the spatial plan in the previous section as shown in Table 7.1.1 below.

Table 7.1.1 Matrix of the Area Classification and the Spatial Plan

Classified Areas / Zones	Urbanized Area	Urbanization Promotion Area	Urbanization Control Area	Urbanization Restricted Area
Existing Built-up (Residential and Mixed-use)	■			
CBD (Commercial and Business)	■			
Industrial Zone Logistics Zone	■			
Urban Redevelopment Zone	■			
New CBD (Commercial and Business Zone)	■	■		
New Industrial Zone New Logistics Zone		■		
New Town Development Zone (Residential and Mixed-use)		■		
Culture and Tourism Zone	■	■	■	■
Urban Park Zone Green and Water Belt Zone	■	■	■	
Nature Reservation Zone Advanced Agricultural Zone			■	■

Note: Colored (gray) cell means classified area in which each zone is located
Source: JICA Study Team

- Under the proposed area classification framework, zoning regulation must be discussed by the local and union government to control land and building use, FAR (floor area ratio), BCR (building coverage ratio), or building height to encourage proper urban development with necessary infrastructure and social service. The zoning regulation system is expected to be introduced as earlier stage as possible.



Source: JICA Study Team

Figure 7.1.1 Proposal of Area Classification of Mandalay

Zoning of Land Use

- Now, MCDC and engineering consultants examine the land use zoning system, which consists of 16 land use categories, in order to apply it to Mandalay City. Based on the principle of land use by this study, detailed boundary of land use area should be designated in the further examination for the formulation of the detailed plan. Also, legal system needs to be enacted in parallel for effective control.

Boundary of Specific Urban Development Project

- The following are candidate areas, which need to be designated for the area. Their precise boundary should be examined in the following study for the detailed plan.

  a) Development areas for new industrial areas, housing development areas, and new CBD areas
  b) Urban redevelopment area and land readjustment area for the upgrading of current residential area
  c) Road site (including widening)
  d) Sites for major infrastructure facilities, such as water supply, wastewater treatment, electricity, transport.

7.2 Capacity Development

7.2.1 Capacity Development in Urban Management

- With the new economic policy of the country under the new government established in April 2016, it is foreseen that there will be further rapid economic development especially in regionally important cities such as Mandalay. Without appropriate development management, the city could risk its valuable cultural asset, people's health, rich farmland, and environment under uncontrolled urban development eventually.

- MCDC is the primary organization responsible for Mandalay's urban development and management, although current responsibility only covers a part of what would be necessary. Thus, capacity development as an urban service provider as well as an urban development manager is urgently required for MDCD.

- Particular urgency is identified in planning and issuing approvals and licenses for new development applications, for example. As MCDC itself recognizes the necessity of introducing a zoning policy, current development projects and their permissions are relatively randomly conducted from the view of land use purpose. Continuous practice might cause serious nuisance in people's living environment, or irrevocable damage to the natural environment. To avoid such future damages, it is highly recommendable to introduce education or training program on urban planning and urban management for MCDC officers. This would also enable MCDC to closely communicate with the union government officer on urban planning at more practical level which would be necessary for the strategic growth of Mandalay City in the coming decades.

7.2.2 Capacity Development in Project Implementation

- As observed, Mandalay City is going to work on multiple urban projects in the coming decade for providing better urban service and living environment to residents as well as visitors.

- Another key area to invest in human resource within MCDC is the area of project management to successfully complete all the necessary urban development projects. Other than Yangon City, Mandalay City is one of the first cities to face this kind of large-scale development at a fast pace. It is foreseen that MCDC will conduct urban development projects under international cooperation. But for smooth and successful project implementation, it is urgently recommended

to prepare MCDC officers to get used to internationally standardized method for project implementation and management.

7.2.3 Options for Capacity Development

- Although either training or education program for capacity development in urban planning and management and project implementation can be provided through "on-the-job" training based upon necessity, there is no doubt about the importance of preparing the master plan for capacity development in urban planning and management, which would benefit the future development of the country itself. To respond to urgent needs, "on-the-job" training will suffice for the temporal capacity to cope with the immediate urban development, but in the long run, the well planned capacity building under the master plan will ensure the environmentally, economically and socially responsible urban development in Mandalay (Myanmar).

7.3 Project Implementation

- In order to implement the development programs, which are described in Chapters 4, 5, and 6; and to realize balanced development as a whole, provision of support and intervention for the project and by public entities are necessary for their adequate implementation. For this purpose, the central government and local government are expected to take a role in the following implementation schemes:

  a) Project implementation by government
  b) Subsidization for implementation
  c) Project coordination by government

- For the project implementation for Mandalay, the measures below are recommended to be taken by the government.

7.3.1 Project Implementation by Government

- The following are considered as the projects which shall be implemented under the governments' initiative. Especially, it is necessary to consider the government's initiative for the implementation of unprofitable development project.

  a) Construction of basic infrastructure facilities
  b) Unprofitable development project (e.g., construction of social housing and affordable housings)

7.3.2 Subsidization for Implementation

- Subsidization is effective for promotion of small-scale urban development activities which are not conducted by large-scale investors. For the development of Mandalay, the following development activities are recommended to be subsidized for their implementation:

  a) Upgrading of individual buildings for disaster prevention (e.g., construction of fireproof building); and
  b) Small-scale urban redevelopment project and land readjustment project (spatial improvement by introduction of collective housings)

7.3.3 Project Coordination by Government

- Generally, large-scale development with profitable business program interests private investors, and its development tends to individually progress without effective control. The government's involvement in project coordination is expected for appropriate project realization and its management. Especially for the following development projects, it is necessary to coordinate individual development projects under public entities by planning, licensing, and construction in order to secure their suitability under a public-orientated development:

a) New CBD development project
b) Logistic zone development, new industrial zone development
c) Logistic zone development around the new container port terminal
d) New town development, hi-tech new town development.

APPENDIX-A: PLANNING PROCESS

- The plan was formulated with public involvement during the planning process. There are two types of meetings as follows:
  - Workshop Meeting: to discuss with the counterpart (C/P) and related organizations; and
  - Seminar: to collect opinions of various stakeholders such as representatives of local communities.

The planning process is shown in Figure A.1.

Source: JICA Study Team

Figure A.1 Public Involvement in the Planning Process

A.1 Kick-off Meeting

- The kick-off meeting was held on 19 January 2016 (Tuesday) in Nay Pyi Taw, chaired by Director General of DUHD, and participated by MOC, relevant ministries, and representatives from the target three cities. Through the discussions after the opening remarks and explanation of the project outline, all participating organizations basically agreed on the methodology and contents of the study. Table A.1 shows the summary of the result of the kick-off meeting and some pictures from the meeting are shown in Figure A.2.

Table A.1 Summary of Result of the Kick-off Meeting

Title of the Meeting	Kick-off Meeting
Date and Time	19 January 2016 (Tuesday), 13:00-14:15
Venue	Nay Pyi Taw (Meeting Room of MOC)
Chairperson	Director General, DUHD
Total Number of Participants	39 participants
Participated Organizations	MOC, DUHD, General Administration Department (GAD), MCDC, JICA
Agenda	1. Opening Remarks (Chairperson) 2. Explanation of the Study Outline (JICA Study Team) 3. Discussion

Source: JICA Study Team

Introduction | Presentation of the Study Outline

Source: JICA Study Team

Figure A.2 Pictures of Kick-off Meeting

A.2 1st Workshop Meeting

- The 1st workshop meeting of Mandalay was held on 18 March 2016 (Friday) in Mandalay (Mandalay Hill Resort), chaired by Deputy Director General of DUHD, and participated by MOC, relevant organizations, and the JICA Study Team. Table A.2 shows the summary of result of the 1st workshop meeting and some pictures from the workshop are shown in Figure A.3.

Table A.2 Summary of Result of the 1st Workshop in Mandalay

Title of the Meeting	Urban Development Planning Workshop
Date and Time	18 March 2016 (Friday), 13:00 – 17:30
Venue	Mandalay Hill Resort Hotel
Chairperson	Deputy Director General, DUHD
Total Number of Participants	36 participants
Participated Organizations	DUHD, MCDC, Ministry of Rail Transportation (MORT), Department of Agriculture (DOA), Department of Meteorology and Hydrology (DMH), DLMS, Directorate of Industrial Supervision and Inspection (DISI), Department of Health (DOH), DORD, Environmental Conservation Department (ECD), Forest Department, Department of Population (DOP), Transport Division, GAD
Agenda	1. Opening 2. Session 1: Review of Current Status 3. Session 2: Planning Framework 4. Session 3: Spatial Planning 5. Closing

Source: JICA Study Team

Group Discussion | Group Photo at the Mandalay Workshop

Source: JICA Study Team

Figure A.3 Pictures of the 1st Workshop in Mandalay

A.3 2nd Workshop Meeting

- The 2nd workshop meeting of Nay Pyi Taw was held on 3 May 2016 (Tuesday) in Nay Pyi Taw, chaired by Deputy Director General of DUHD, and participated by MOC, relevant organizations, and the JICA Study Team. Table A.3 shows the summary of result of the 2nd workshop meeting and some pictures from the workshop are shown in Figure A.4.

Table A.3 Summary of Result of the 2nd Workshop in Nay Pyi Taw

Title of the Meeting	Urban Development Planning Workshop
Date and Time	3 May 2016 (Tuesday), 13:00 – 17:30
Venue	Office 40, Ministry of Construction, Meeting Room
Chairperson	Deputy Director General, DUHD
Total Number of Participants	40 participants
Participated Organizations	DUHD, DAN, DH, Ministry of Religious Affair and Culture (MORAC), Ministry of Transport and Communications (MOTC), Planning Department, GAD, Township Development Committee (TDC), MCDC, Myanmar Engineering Society (MES), ECD, DALMS

Agenda	1. Review of Current Status 2. Planning Framework 3. Spatial Planning

Source: JICA Study Team

Discussions

Discussions

Source: JICA Study Team

Figure A.4 Pictures of the 2nd Workshop

A.4 Seminar

- The seminar was held on 9 May 2016 (Monday) in Mandalay (Mandalay Hill Resort), chaired by Deputy Director General of DUHD and participated by MOC, relevant organizations, JICA, and the JICA Study Team. Table A.4 shows the summary of result of the seminar and some pictures from the seminar are shown in Figure A.5.

Table A.4 Summary of Result of the Seminar in Mandalay

Title of the Meeting	Urban Development Planning Seminar
Date and Time	9 May 2016 (Monday), 13:00 – 17:30
Venue	Mandalay Hill Resort Hotel
Chairperson	Deputy Director General, DUHD
Total Number of Participants	67 participants
Participated Organizations	DUHD, MCDC, TDC, Planning Department, DAR, DAN, Forest Department, ECD, DMH, Mandalay Technological University (MTU), MU, Mandalay General Hospital (MGH), Companies, Merchants, ChinDwin College
Agenda	1. Planning Framework and Development Vision 2. Socio-economic Framework 3. Industrial Development 4. Urban Development Policy 5. Infrastructure

Source: JICA Study Team

Group Discussion

Group Photo

Source: JICA Study Team

Figure A.5 Pictures of the Seminar

A.4 3rd Workshop Meeting

- The 3rd workshop meeting of Nay Pyi Taw was held on 16 June 2016 (Thursday) in Nay Pyi Taw, chaired by Director General of DUHD and participated by MOC, relevant organizations, and the JICA Study Team. Table A.5 shows the summary of result of the 3rd workshop meeting and some pictures from the workshop are shown in Figure A.6.

Table A.5 Summary of Result of the 3rd Workshop in Nay Pyi Taw

Title of the Meeting	Urban Development Planning Workshop
Date and Time	16 June 2016 (Thursday), 13:00 – 17:30
Venue	Office 40, Ministry of Construction, Meeting Room
Chairperson	Director General, DUHD
Total Number of Participants	40 participants
Participated Organizations	DUHD, MORAC, MOTC, Myanmar National Police Force (MNPF), Ministry of Hotels and Tourism (MOHT), ECD, GAD, MCDC, TDC, The Asia Foundation
Agenda	1. Study Outline, Progress and Planning Framework 2. Vision and Strategies 3. Spatial Plan 4. Prioritized Projects 5. Urban Development Management

Source: JICA Study Team

Discussion

Group Photo

Source: JICA Study Team

Figure A.6 Pictures of the 3rd Workshop

A.5 Meeting with the Mandalay Mayor

- Courtesy call meeting with the Mayor in Mandalay was done by MOC, JICA, the JICA Study Team, and MCDC.

Table A.6 Summary of Result of Courtesy Call Meeting with Mandalay Mayor

Mandalay	Title of the Meeting	Courtesy Call Meeting with Mandalay Mayor
	High Ranking Official Attendance	Mayor, Mandalay City Development Committee
	Date and Time	20 June 2016 (10:30 – 12:15)
	Venue	MCDC Office, Meeting Room
	Total Number of Participants	19 participants
	Participated Organizations	MCDC, DUHD

Source: JICA Study Team

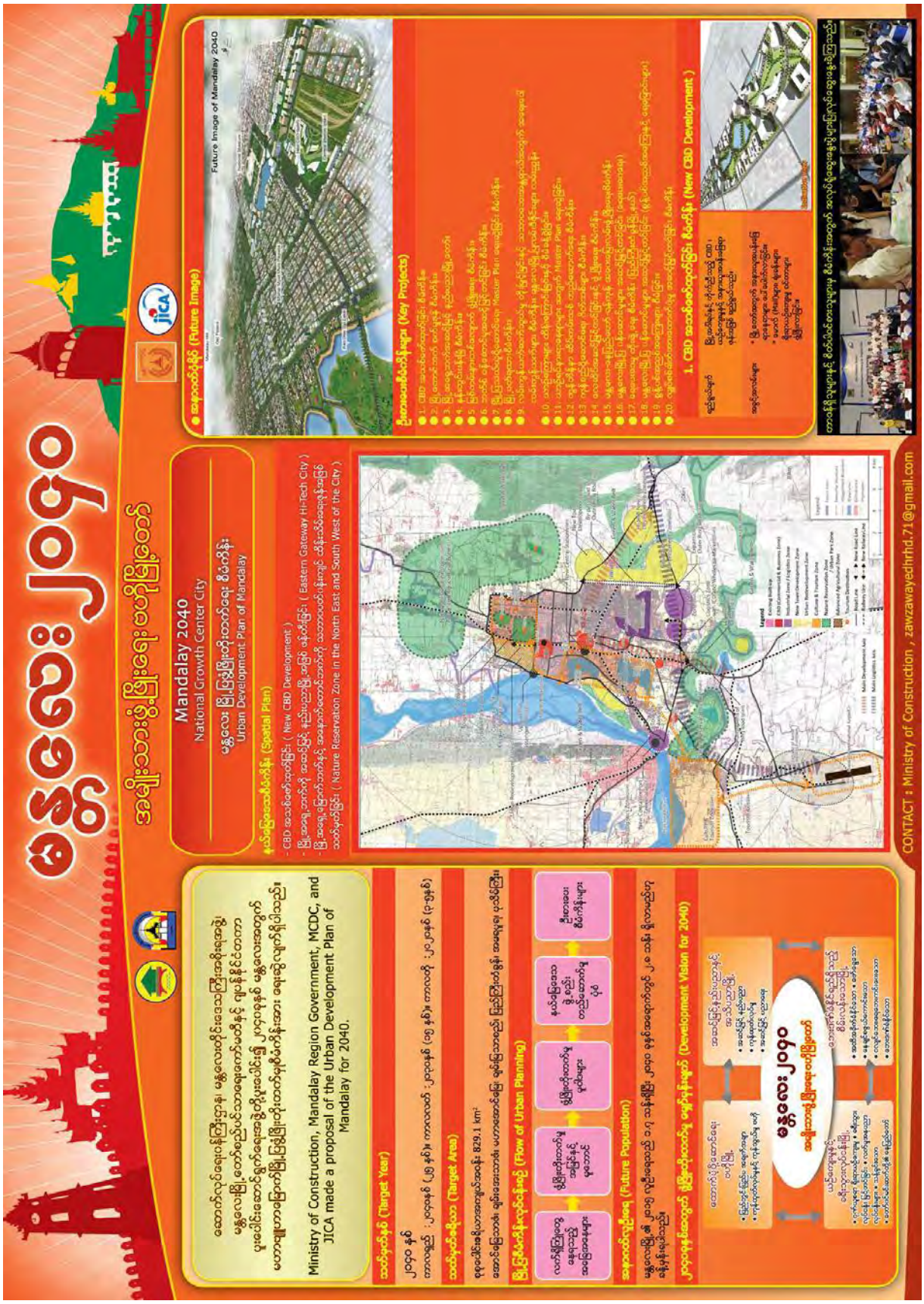
Meeting with Mayor

Meeting with Mayor

Source: JICA Study Team

Figure A.7 Pictures of the Meeting with the Mandalay Mayor

APPENDIX-B: POSTER



Urban Development Plan for Pathein 2040

Urban Development Plan for Pathein 2040

1 Introduction and Planning Framework

1.1 Background of the Plan

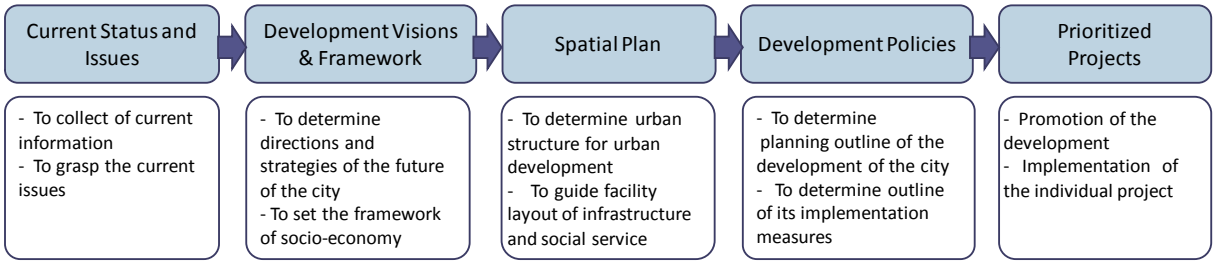
- Due to the promotion of economic deregulation after shifting the policy to emphasize reforms on international relations and economy since 2011, Myanmar has been more powerful as a new investment frontier in Asia as well as worldwide. Myanmar's gross domestic product (GDP) per capita is estimated to reach the level of middle-income countries by 2030 in case economic reforms and foreign direct investments continue steadily.
- The Ministry of National Planning and Economic Development of the Government of Myanmar formulated the "National Comprehensive Development Plan (NCDP)" in 2014, which indicates the development policies of the whole country and presents the guidelines of comprehensive development of all sectors and strategic national development goals.
- In parallel, the Ministry of Construction (MOC) has been making the "Urban and Regional Development Planning Law" to be enacted soon in 2016 in order to support the formulation of urban development plans within the country systematically and to enforce management system in implementing the plans for local authorities.
- To accelerate economic development in the whole country, Pathein shall be definitely required to have an important role as regional center of Ayeyarwady Delta. To promote the required role, it is urgent to clarify the future development vision, formulate the urban development plan of Pathein, and share the plan with the citizens.

1.2 Objectives of the Plan

- The primary objectives of the urban development plan of Pathein 2040 are as follows:

  a) To present development visions and strategies with spatial and structure plan by 2040,
  b) To present urban and infrastructure development policies for the realization of the development visions, and
  c) To propose a roadmap of key projects.

- The main items and flow of the urban development plan are shown in Figure 1.2.1.

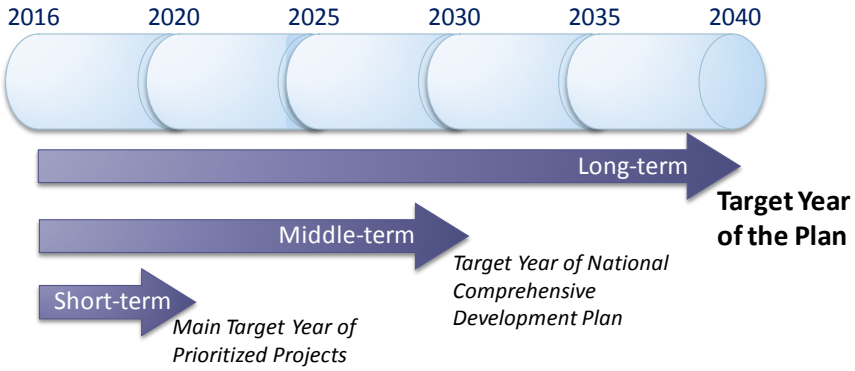


Source: JICA Study Team

Figure 1.2.1 Main Items and Flow of the Urban Development Plan

1.3 Target Year

- The target year of the plan is set in 2040. Benchmarks are also set in 2030 as middle-term and in 2020 as short-term as shown in Figure 1.3.1.



Source: JICA Study Team

Figure 1.3.1 Target Year of the Urban Development Plan

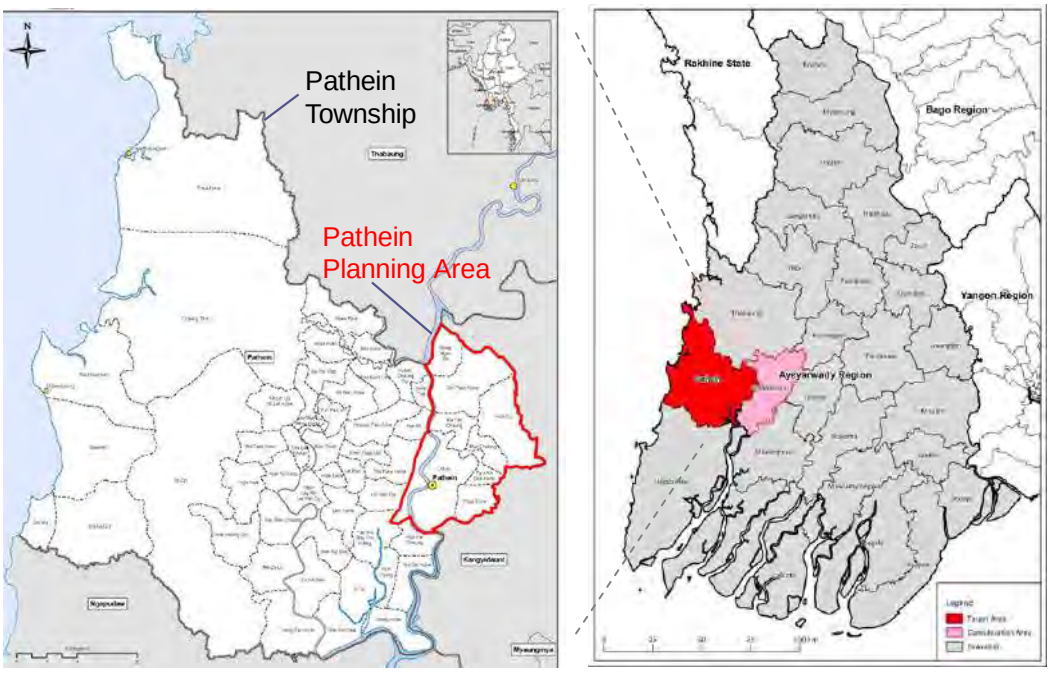
1.4 Target Area

- Pathein is located in the southwest area of Myanmar, which is about 150 km west of Yangon and 40 km east from the coast line. Pathein Township is about 1,450 km^2, which stretches 50 km east and west, and 68 km north and south.
- The planning area of the Pathein plan is the eastern side of Pathein Township from the Pathein River. The area consists of Pathein urban area, which consists of 15 wards and seven villages, namely: Shwe Myin Tin, Zin Pyun Kone, Koe Su, Ma Yan Chaung, Myo Chaung, Pyin Ka Doe Kone, and Pauk Kone Village, belonging to Pathein Township, Pathein District, Ayeyarwady Region.

Table 1.4.1 Name and Area of Townships of Planning Area of Pathein

Urban and Village		Area (km^2)
Urban	Pathein Urban (15 wards)	46.0
Village	Shwe Myin Tin	12.2
	Zin Pyun Kone	31.9
	Koe Su	30.8
	Ma Yan Chaung	10.8
	Myo Chaung	9.0
	Pyin Ka Doe Kone	6.9
	Pauk Kone	11.8
Total		159.4

Source: JICA Study Team



Source: JICA Study Team

Figure 1.4.1 Planning Area of Pathein

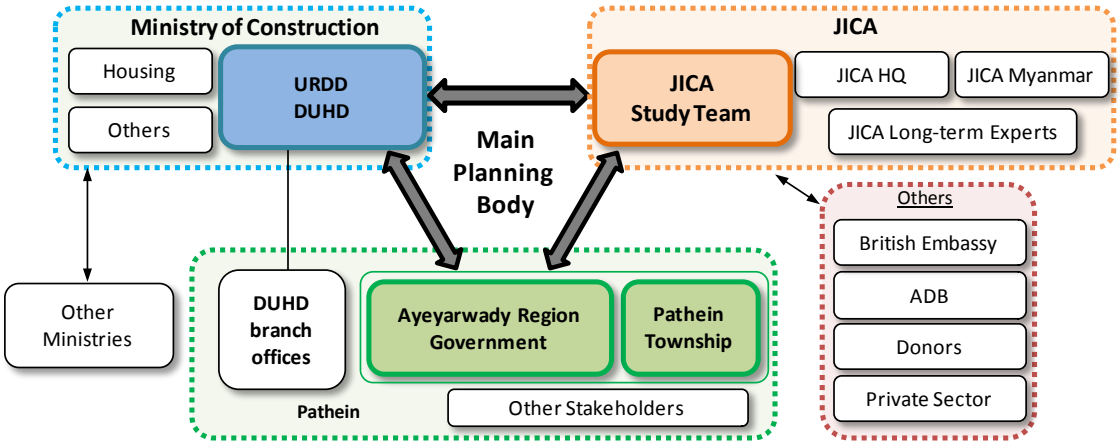
The total area is approximately 160 km^2. The name and area of target urban and villages, and the map are shown in Table 1.4.1 and Figure 1.4.1, respectively.

- Taking a broad view (large-scale view) is also necessary to identify the linkage of individual city with its surrounding cities from various viewpoints especially of its geographical feature, and transportation and logistics function. The broad view including the surrounding area, namely, villages of same Pathein Township which are located on west bank of the Pathein River and Kangyidaunt Township, is considered.

1.5 Planning Organizations and Process

- The urban development plan of Pathein was made by close cooperation of Ayeyarwady Region Government, Pathein Township, Urban Regional Development Division (URDD) (Department of Urban and Housing Development: DUHD) of MOC, and the JICA Study Team, based on the existing conceptual plans.

- Additionally, stakeholders participated in the planning works through discussions in a series of workshop meetings. Necessary information inputs from relevant ministries and opinions from stakeholders were also collected as part of an appropriate planning process as shown in Figure 1.5.1



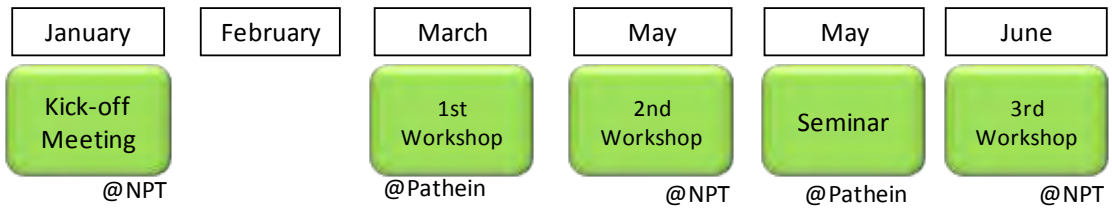
Source: JICA Study Team

Figure 1.5.1 Planning Organizations

- The plan was formulated with public involvement during the planning process. There are two types of meetings as follows:

  - Workshop Meeting: to discuss with the counterpart (C/P) and related organizations; and
  - Seminar: to collect opinions of various stakeholders such as representatives of local communities.

The planning process is shown in Figure 1.5.2.



Source: JICA Study Team

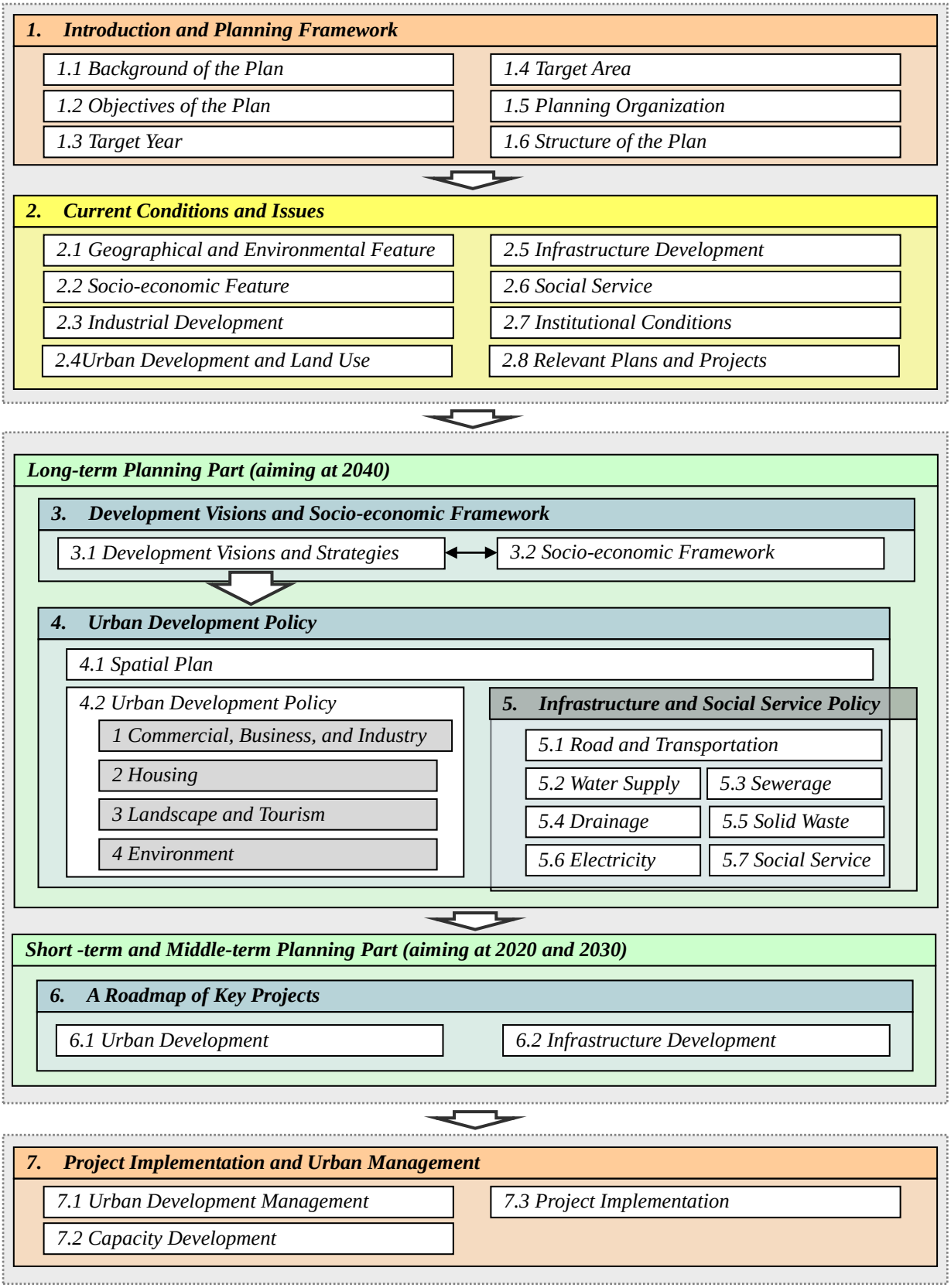
Figure 1.5.2 Public Involvement in the Planning Process

1.6 Approval of the Plan

- According to the drafted "Urban and Regional Development Planning Law" examined by MOC, the city conceptual plan was defined to be formulated by MOC (union ministry) and submitted to the national urban and housing development central committee. In line with this regulation, this plan shall be approved at the national level with consensus of regional government.

1.7 Structure of the Plan

- Referring to the existing conceptual plans and considering the general requirement of an urban development plan, the structure and basic contents of the plan are framed as shown in Figure 1.7.1. The plan shall have seven chapters. The main body of the plan shall consist mainly of two parts (long-term and short/middle-term) in order to satisfy the requirements for both sharing future image and encouraging actions.



Source: JICA Study Team

Figure 1.7.1 Structure of the Urban Development Plan

2 Current Conditions and Issues

2.1 Geographical and Environmental Feature

2.1.1 Geography

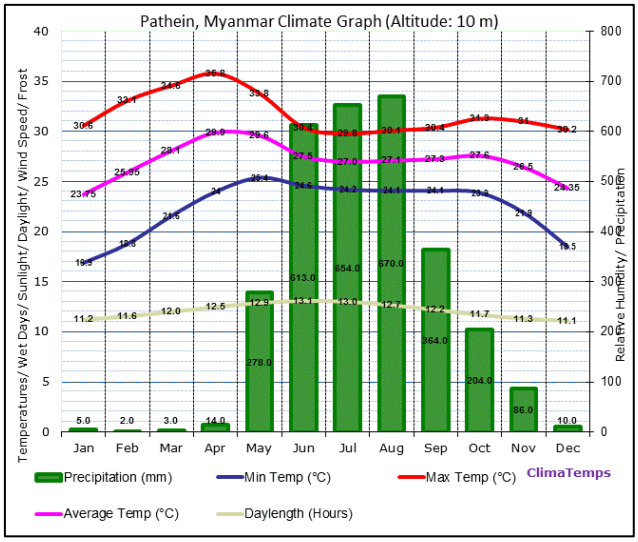
- Pathein (Bassein) is situated in the Lower Burma Delta, Ayeyarwady basin, with its tributaries such as the Chindwin, Shweli, and Myitnge rivers. Pathein, located in the western edge of the Ayeyarwady Region, is about 150 km west of Yangon, at 16°45'N, 94°45'E, 10 m, and is the capital city of the third most populated Ayeyawardy Region. The Lower Burma Delta is a level flat plain with the exception of low western hills, the extension of the Rakhine Mountain Range. It has beautiful silver sand Ngwe Saung Beach and Chaungtha Beach along the coast of Bengal, 40 km west from the city.

- Pathein Township is about 1,450 km^2, which stretches 50 km east and west, and 68 km north and south. It lies on the Pathein River which is a western branch of the Ayeyarwady River. Although it is located 104 km from the sea mouth via the Ngawun River, it is the most important delta port outside of Yangon. Pathein functions as a transit port of call for ferryboats carrying passengers or cargo plying between Yangon and the northern and eastern parts of Myanmar, and most of the rice export out of the Ayeyarwady Region leave from Pathein Port.

2.1.2 Climate

- The monsoonal climate in the delta leads to an average annual rainfall of about 1,500-2,000 mm in the north increasing to 2,500 mm in the southeast and 3,500 mm in the southwest. Over 90% of the rain falls between mid-May and mid-November. During the monsoon season, the maximum and minimum temperatures in the coastal zone are about 37°C and 22°C, respectively. There are often strong winds from the south and southwest, causing rough seas. Cyclone can cause serious storm surges. The period from mid-October to mid-February is generally dry and cool. Temperatures rise after February, and April and early May are characterized by hot, variable weather with pre-monsoon squalls.

- Pathein has a tropical monsoon climate according to the Köppen climate classification system. Pathein experiences a sustained period of extraordinary rainfall from June through August. The dry season which runs from December through April, generally sees noticeably cooler temperatures than the remainder of the year. Figure 2.1.1 shows the average temperature and rainfall in Pathein.



Source: http://www.pathein.climatemps.com/

Figure 2.1.1 Climate and Temperature of Pathein

2.1.3 Natural Disaster

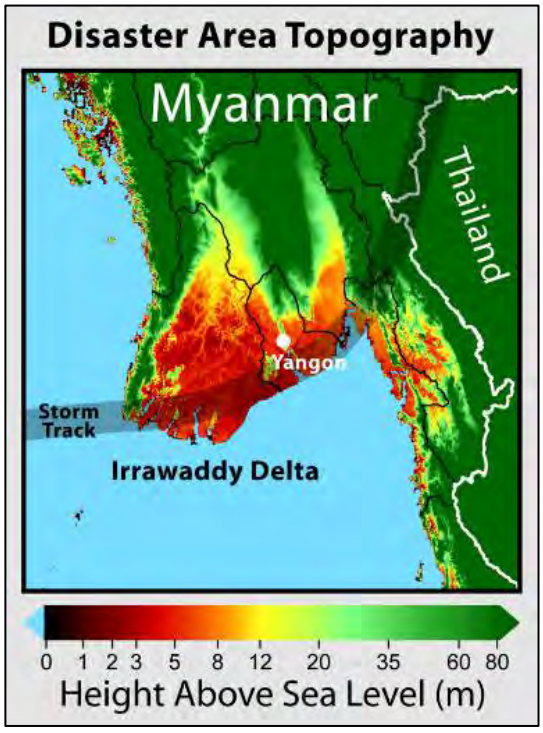
- The 2013 Global Climate Risk Index identified Myanmar as one of the countries most affected by severe weather disasters in the period from 1992 to 2011 due to Myanmar's location, topography, climate, and geology. The major natural disasters in Myanmar are forest fire, landslides, earthquake, floods, drought, cyclones, and storm surges. Among all of these, more than 70% of disaster accounts for man-made forest fire, then flooding ranked second with11%.

Cyclone during Monsoon

- The major natural disaster concerns of Pathein are mainly flooding and potentially seasonal cyclone. Pathein Township's coast line is facing Bengal Bay, which receives frequent cyclone hits during pre- and post-monsoon periods (between April and May, and between October and December, respectively). However, historically, the actual cyclone hit causing severe damages rarely happened in Pathein and it was not severely damaged since 2008 Nargis (Figure 2.1.2). In the historic record, the last direct hit of cyclones with over 1,000 deaths was recorded in May 1975[1].

Flooding

- Flooding is a constant natural disaster problem in Pathein. In Figure 2.1.3, the green patched area shows the flooding prone areas in the city. These areas are mostly located either near the drain releasing points or low lands along branches of the Pathein River. According to the Pathein Township Development Organization, the frequency of flooding causing damages is around once a year by heavy rain or storm. Flooding starts from the drain releasing points to the Pathein River by river water flowing backwards from the drain system into the city.



Source: Robert A. Rohde

Figure 2.1.2 Topographic Map of the Region of Burma Affected by Cyclone Nargis

Source; Pathein Township Development Organization

Figure 2.1.3 Flood Prone Area in Pathein

[1] "Hazard Profile of Myanmar", July 2009

2.2 Socio-economic Feature

- Pathein City is the urban area of Pathein Township, which is one of the seven townships in Pathein District. The district has the largest population in Ayeyarwady Region. The total population of Pathein Township is 287,000, out of which 170,000 or 59% of people are urban residents as shown in Table 2.2.1.

- The target area of this plan covers Pathein City and seven village tracts in Pathein Township as shown in Table 2.2.2. The population of these villages ranges from 2,000 to 9,000 and the total population of the seven villages is 33,000. A total of 203,000 people live in the target area.

Table 2.2.1 Population of Pathein District by Township in 2014

Region/ District/Township	Population (thousand)			Urban Population
	Total	Urban	Rural	
Ayeyarwady Region	6,185	873	5,312	14.1%
Pathein District	1,631	304	1,327	18.6%
Kangyidaunt	178	11	167	6.2%
Kyaungon	163	16	147	9.8%
Kyonpyaw	236	24	212	10.2%
Ngaputaw	169	11	158	6.5%
Pathein	287	170	117	59.2%
Yekyi	105	11	94	10.5%
Thapaung	154	7	147	4.5%
Ngayokaung (ST)	41	3	38	7.3%
Hainggyikyun (ST)	115	15	100	13.0%
Shwethaungyan (ST)	50	3	46	6.0%
Ngwehsaung (ST)	44	14	30	31.8%
Ngathaingchaung (ST)	89	19	70	21.3%

Source: The 2014 Myanmar Population and Housing Census

Table 2.2.2 Population of Target Area in Pathein Township in 2014

Township/City(Ward)/Village Tract	Population (thousand)
Pathein Township	287.1
City (Ward)	169.8
Village Tract	117.3
Shwe Myin Tin	7.9
Ma Yan Chaung	3.1
Zin Pyun Kone	8.7
Koe Su	3.9
Pauk Kone	4.4
Myo Chaung	2.0
Pyin Ka Doe Kone	3.1

Source: MOC

- Table 2.2.3 illustrates the gross regional product (GRP) of Pathein Township and its sectoral composition from 2010/11 to 2014/15 on the basis of the 2010-11 price. While the proportion of the agricultural and industrial sectors in the total GRP has declined over the five years, the service sector increased its share from 52% in 2010-11 to 66% in 2014-15. The agriculture sector now accounts for 17% of the township economy. In the industry sector, processing and manufacturing has also lost its share from 8% in 2010-11 to 5% in 2014-15. In the service sector, transportation and communications have increased their presence in the economy.

Table 2.2.3 Gross Regional Product (GRP) of Pathein Township by Sector: 2010/11-2014/15
(At 2010-11 Constant Prices; MMK in million)

Sectors	2010-2011		2011-2012		2012-2013		2013-2014		2014-2015	
	Value	% com-position	Value	% com-position	Value	% com-position	Value	% com-position	Value	% com-position
AGRICULTURE	**63,692**	**26.9%**	**60,131**	**23.7%**	**64,611**	**21.7%**	**67,000**	**18.7%**	**68,186**	**16.5%**
Agriculture	36,400	15.4%	31,664	12.5%	33,108	11.1%	32,517	9.1%	33,948	8.2%
Livestock and Fishery	25,089	10.6%	27,103	10.7%	30,035	10.1%	33,218	9.3%	33,145	8.0%
Forestry	2,203	0.9%	1,364	0.5%	1,468	0.5%	1,264	0.4%	1,093	0.3%
INDUSTRY	**49,628**	**21.0%**	**49,407**	**19.5%**	**60,755**	**20.4%**	**62,145**	**17.3%**	**72,162**	**17.5%**
Energy	5,735	2.4%	6,068	2.4%	6,074	2.0%	5,694	1.6%	6,181	1.5%
Mining	89	0.0%	67	0.0%	99	0.0%	184	0.1%	259	0.1%
Processing and Manufacturing	18,964	8.0%	17,819	7.0%	20,069	6.7%	18,577	5.2%	20,617	5.0%
Electric Power	15,724	6.7%	12,528	4.9%	12,793	4.3%	14,402	4.0%	14,149	3.4%
Construction	9,116	3.9%	12,925	5.1%	21,721	7.3%	23,288	6.5%	30,956	7.5%
SERVICES	**123,025**	**52.1%**	**144,168**	**56.8%**	**172,966**	**58.0%**	**229,970**	**64.0%**	**272,260**	**66.0%**
Transportation	68,432	29.0%	90,310	35.6%	104,355	35.0%	139,161	38.8%	170,108	41.2%
Communications	6,538	2.8%	7,034	2.8%	17,263	5.8%	35,185	9.8%	42,244	10.2%
Financial Institutions	432	0.2%	731	0.3%	854	0.3%	1,400	0.4%	1,900	0.5%
Social and Administrative Services	6,504	2.8%	6,458	2.5%	7,326	2.5%	7,899	2.2%	8,450	2.0%
Rental and Other Services	10,410	4.4%	9,907	3.9%	11,655	3.9%	14,185	4.0%	16,245	3.9%
Trade	**30,708**	13.0%	29,728	11.7%	31,513	10.6%	32,140	8.9%	33,313	8.1%
GROSS REGIONAL PRODUCT	**236,345**	**100.0%**	**253,706**	**100.0%**	**298,332**	**100.0%**	**359,115**	**100.0%**	**412,608**	**100.0%**

Source: Ministry of National Planning and Economic Development

- Table 2.2.4 shows that 46% of the total labor force aged ten years and over of Pathein Township is engaged in the service sector. This proportion is much higher than that of the Union and Ayeyarwady Region. On the other hand, the township has a relatively small portion of people working in the agricultural sector (32%) compared with the Union and the Ayeyarwady Region. 16% of the total labor force is employed in the industry sector.

Table 2.2.4 Population of Employed People Aged Ten Years and Over by Sector in 2014

		Agriculture	Industry	Service	Not Stated/ Not Applicable	Total
Population						
Union	Persons	11,026,852	2,626,966	6,070,683	1,336,030	21,060,531
Ayeyarwady Region	Persons	1,671,324	190,023	579,097	129,943	2,570,387
Pathein Township	Persons	36,534	18,309	53,798	7,196	115,837
Sector share						
Union	%	52%	12%	29%	6%	100%
Ayeyarwady Region	%	65%	7%	23%	5%	100%
Pathein Township	%	32%	16%	46%	6%	100%

Source: The 2014 Myanmar Population and Housing Census; Data from Ministry of Immigration and Population

2.3 Industrial Development

2.3.1 Industrial Activities

- The city of Pathein is the capital of Ayeyarwady Region which is known as the "Barn of Myanmar" for its production of a variety of crops and other agricultural products. Located in the Ayeyarwady Delta, the region is also Myanmar's major supply source of fishery products. Pathein City is a central point for trading of these products as well as interaction of people, utilizing riverine and road connections with major cities such as Yangon and other places in the country.

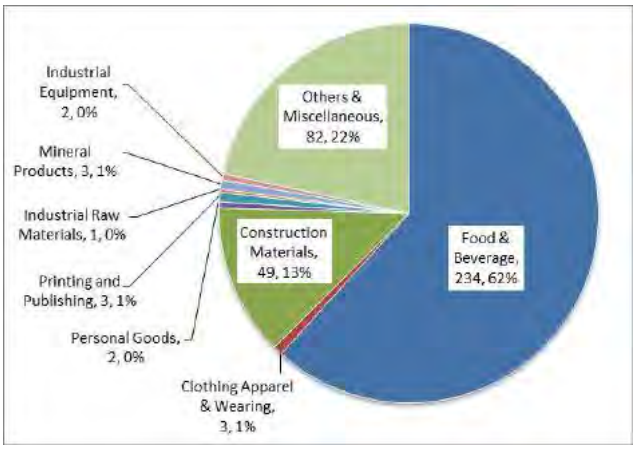
- According to "Myanmar Industry Directory 2015-16", the Ayeyarwady Region had the third largest number of registered industries in Myanmar after Mandalay Region and Yangon Region in 2014, with a total of 5,809 private industries. More than 80% of the total industries are small scale ones. Table 2.3.1 and Figure 2.3.1 show the number of industries in Pathein Township by size and by sub-sector in 2015-16, respectively. Major types of industries are "Food and beverage"

(62% of the total number of industries), "Others and miscellaneous" (22%), and "Construction materials" (13%), in descending order.

Table 2.3.1 Number of Industries by Size in Pathein Township in 2015-16

Size of Industries	Number of Industries	Number of Employees
Large	60	5,623
Medium	77	583
Small	242	866
Total	379	7,072

Source: Ministry of Industry, Directorate of Industrial Supervision and Inspection, Ayeyarwady Regional Office



Source: Ministry of Industry, Directorate of Industrial Supervision and Inspection, Ayeyarwady Regional Office

Figure 2.3.1 Number of Industries by Sub-sector in Pathein Township in 2015-16

- In Ayeyarwady Region, there are three existing industrial zones (IZs) which were established under the supervision of the Ayeyarwady Regional Government since the 1990s as seen in Table 2.3.2. The oldest one, Pathein Industrial Zone, is located in Ward 13 of Pathein City, mostly with locally owned enterprises for products such as machinery, housewares, and food processing. Apart from the industrial zone, there are factories such as rice mill, oil mill, salt mill, and ice mill along the Nga Won River in the city.

Table 2.3.2 Industrial Zones in Ayeyarwady Region

Industrial Zone	Location	Year of Establishment	Area (Acre)	No. of Factories*
Pathein IZ	Pathein Township and Pathein District	1993	106.31	54
Hinthada IZ	Hinthada District	1995	86.21	9
Myaungmya IZ	Myaungmya District	1995	108.69	9

Note: * as of February 2013
Source: Myanmar Industry Directory 2015-16; JETRO (Yangon), 2013

- Recently, in the same area as Pathein Industrial Zone, the Pathein Industrial Park was opened by the Delta Industrial Group (DIG), which is a group of mostly Yangon-based local companies and individuals, mainly to cater to the garment industry. The industrial park project covering nearly 300 acres of land aims to invite 50-60 factories with over 2,000-3,000 laborers working in each factory[2]. The first garment factory was opened in 2013 by DIG itself. Currently, other garment manufacturers such as Hakers Enterprise and Dong Long Garment are operating too, and a total of 4,000 local people are employed[3]. More garment factories engaged in cutting, making, and packing (CMP[4]) businesses and some other industries such as communication and steel structure are planning to invest too.

[2] DIG Website [http://digayeyarwaddy.com/project]
[3] Pathein Township Second Five-Year Development Plan (2015-16 to 2020-21)
[4] The Cutting, Making, and Packing (CMP) system is a form of production on consignment in which the main raw materials (fabrics, ancillary materials, etc.) are provided by overseas buyers and imported free of charge, then cut, sewn and packed in the domestic factories, after which all of the finished products are exported. (Kudo, 2012)

- In the tourism sector, according to the conceptual plan, there are six private hotels and 44 guest houses in Pathein City, but hotels with international standard are very limited. About 25 to 30 miles to the west of Pathein City, there are two famous beach places along the Bay of Bengal, namely Ngwe Saung and Chaungtha beaches. The two places have 50 hotels and can accommodate about 5,000 visitors[5]. It is reported that a resort project including holiday villas and a five-star hotel along Ngwe Saung Beach is underway by Ayeyarwady Co., which is a consortium of 20 companies. The project is considered to be the first holiday villa project in Myanmar and planned to complete the first phase by the end of December 2017. There is another plan to build a new city in Ngwe Saung by a Hong Kong-based company, H&Co.

2.3.2 Foreign Investment

- Table 2.3.3 shows the total investment amount of permitted enterprises under the Foreign Investment Law in Ayeyarwady Region as well as the total in the Union for comparison purpose. In 2014-2015, six enterprises were permitted in Ayeyarwady Region with the investment of USD 166 million out of the total of 211 enterprises with USD 8.011 billion permitted in Myanmar.

Table 2.3.3 Total Investment of Permitted Enterprises under the Foreign Investment Law in Ayeyarwady Region

(USD in millions)

Region	2010-2011		2011-2012		2012-2013		2013-2014		2014-2015	
	No. of Enterprises	Foreign Investment	No. of Enterprises	Foreign Investment	No. of Enterprises	Foreign Investment	No. of Enterprises	Foreign Investment	No. of Enterprises	Foreign Investment
UNION TOTAL	**24**	**19,999 ***	**13**	**4,644 ***	**94**	**1,419 ***	**123**	**4,107 ***	**211**	**8,011 ***
Ayeyarwady Region	-	-	1	73	1	20	3	11	6	166

Note: * Increased in investment value.
Source: MNPED Central Statistical Organization, "Myanmar Data CD-ROM 2015", February 2016. (Originally from the Directorate of Investment and Company Administration)

- According to the Directorate of Investment and Company Administration (DICA) website, a total of seven enterprises (including both foreign and domestic companies) were permitted for investment in Ayeyarwady Region by the Myanmar Investment Commission in 2015. Among them, four investments will go to the garment industry in Pathein City by foreign companies as shown in Table 2.3.4.

Table 2.3.4 List of Enterprises Permitted by Myanmar Investment Commission in 2015 for Pathein Township

Name of Company	Location	Type of Investment Business	Form of Investment	Date of Issue
Heshan (Myanmar) Garments Company Limited	Pathein Township, Pathein District	Manufacturing of Garments on CMP Basis	Wholly Foreign Owned Investment	5 June 2015
Myanmar Knitting Factory Limited	Pathein Township, Economic Zone	Manufacturing of Garments on CMP Basis	Wholly Foreign Owned Investment	19 June 2015
Pathein Just Company Limited	Pathein Township	Manufacturing of Garment on CMP Basis	Wholly Foreign Owned Investment	11 September 2015
Newtop Myanmar Company Limited	Pathein Township	Manufacturing of Garments on CMP Basis	Wholly Foreign Owned Investment	30 October 2015

Source: Directorate of Investment and Company Administration (DICA) Website

[5] Pathein Township Second Five-Year Development Plan (2015-16 to 2020-21)

2.3.3 Orientation of Development

- The Second Five-Year Development Plan of Ayeyarwady Region (FY2016-17 to FY2020-21) aims to generate the development of region through the following measures:

  a) Supporting the union export earnings by expanding quality rice productions;
  b) Improving fishery production; and
  c) Enhancing hotel and tourism.

  The targeted five-year average growth rate is 7.1%, and the percentage composition of industrial sectors is planned to be 45%, 15%, and 40% for agriculture, industry, and service sectors in 2020-21, respectively.

- At the township level, the Second Five-Year Development Plan of Pathein Township targets to increase its GRP value at 2010-11 price from MMK 582,316 million in 2015-16 to MMK 807,563 million in 2020-21 at the average annual growth rate of 6.8%. Its sectoral composition is targeted to be 14%, 38%, and 48% for agriculture, industry, and service sectors in 2020-21, respectively. There is a large difference in the targeted composition between the Ayeyarwady Region and Pathein Township, which indicates that the main role of Pathein City is to function as "industry sector" as well as "service center" catering to the entire region of Ayeyarwady, in terms of trading and transporting agricultural and fishery products produced in the region, and other services including tourism.

- As regards manufacturing sector, there is a positive sign of increasing investments in a newly developing industrial park by domestic as well as foreign companies in the garment sector based on CMP business. Main incentives for the investors include low land and labor costs compared to setting up their factories in Yangon Region.

- On the other hand, according to the "Resource Mapping of Pathein District" prepared by the planning office, it is recognized that manufacturing industries in and outside of the traditional industrial zone of the city are faced with many difficulties which are restricting industrial development of Pathein. The difficulties include the following:

  a) Insufficiency of electric power as the main problem;
  b) Weakness in technology, education, and investments;
  c) Weakness in work force at a basic level;
  d) Weakness in establishing industries based on regional resources;
  e) Weakness in technology to make best quality products; and
  f) Weakness in connecting to new markets

2.4 Urban Development and Land Use

2.4.1 Urban and Housing

- The current urban area of Pathein is composed of the following different characteristic zones. Their features and issues of urban space and buildings are described as follows:

Central Urban Area

- The central urban area of Pathein (shown in Figure 2.4.1) is located in Myoma Ward and Bo Tae Gone Ward. The area is composed of the riverside area and business/administration area.

Source: JICA Study Team

Figure 2.4.1 Photo of Central Urban Area

- The riverside area consists of jetties for passenger, trade area, commercial area, and logistics area of water cargo. Most of the commercial and business buildings in this area are flat and low and medium-rise buildings with two to four stories. Some are reconstructed and replaced with five- to six-floor buildings. These buildings are built of reinforced concrete, bricks, and mixed structure. They are durable enough to survive natural disasters and fire accidents. Because of high agglomeration of trading facilities in the area, public spaces such as parking and loading are not sufficient in the area and traffic is congested as a result.

- Business and administration functions are located in the hinterland of the water front area. Administrative offices, cultural facilities, and sports facilities are located in this area. Their density is relatively lower than the riverside area and the urban environment in the area is well regulated and kept in good condition. But there is little space for development, which corresponds to functional expansion in the future.

Surrounding Areas of the Old Downtown

- Residential areas composed of residential buildings, small commercial buildings, and mixed-use buildings, extended in Bo Tae Gone Ward, Yodayar Gone Ward, Mayan Cho Ward, and Aung Chan Thar Ward surround the abovementioned central area as shown in Figure 2.4.2. They form the old city area as a whole.

Source: JICA Study Team

Figure 2.4.2 Photo of the Surrounding Areas of the Old Downtown

- Most of the buildings are flat or two-storey building and their development density is low. The urban environment of these areas is quite good with sufficient road and specific problems are not observed in these areas.

Outer Area of the Old City Area

The following characteristic land uses are observed in the surroundings of the abovementioned old city area:

- In the north and south of the old downtown along the Pathein River and Strand Road, there are rows of buildings of warehouses and they compose the logistics area. Most of these buildings are used for

Source: JICA Study Team

Figure 2.4.3 Photo of the Outer Area of the Old City Area

food provisions and reserves. A small number of food processing facilities is also located in the area.

- In the northeast of the old city area between the airport, there are green open spaces. The area is composed of golf links, the Kanthozin Lake, public park, and the Pathein University, which generates well established urban recreation space with education and touristic function.

Planned Development Area

- There are several planned housing developments in the periphery of the old city area (Figure 2.4.4) (Ohmar Darni Ward, Papa Wadi Ward, Yaekyi Oo Ward). In these areas, housing sites with regular grid pattern roads for detached housing are prepared and provided. The area is developed in the former paddy field and roads in the area are raised as an embankment. But many housing lots are not reclaimed and wooden rural style housings, which are similar to those in agricultural village and paddy field, are constructed there. There are insufficient infrastructure facilities such as water supply, wastewater facilities, and drainage in these areas. In addition, the road width in these areas is not enough for traffic of automobiles, so the residents depend on bike, bicycle, and light vehicles for transportation. From these views, the areas have issues to be improved as a present-day residential area.

Source: JICA Study Team

Figure 2.4.4 Photo of the Periphery of the Old City Area

Recent Housing Development Areas

- Residential developments are under construction recently in the southeast of Koethein Ward, Kimnalin Kyun Ward, and Myat Toe Ward, as shown in Figure 2.4.5. In these development areas, buildings are constructed in the housing lots, which are reclaimed like the district road. The roads have enough width for automobiles. In addition to detached housings for individual families, apartment housings with five stories are constructed by several housing developers. These development areas are located near the industrial area in the northeast of the city, and they are expected to supply modern type housings for young families and migrant workers.

Source: JICA Study Team

Figure 2.4.5 Photo of the Housing Development Area

Western Bank of the Pathein River

- There is frequent water transport service between the west bank of the Pathein River (Figure 2.4.6) and the center of Pathein City. It carries commuting persons, shoppers, and carriers of agricultural products. In the surrounding area of the jetty, there is a village with commercial and residential buildings. And some sites along the river are equipped with their own pier and are used for industrial functions.

Source: JICA Study Team

Figure 2.4.6 West Bank of Pathein River

2.4.2 Land Use and Regulations

Land Use

- A land use pattern was developed based on the analysis of the 2015 satellite imagery that covers only the urban area, and using the 2012 imagery for other areas. Land use for built-up shares 22.5% of the Pathein planning area, especially in the urban area. Generally, vegetation area dominates with 71.3% of the land use of Pathein planning area. Table 2.4.1, Table 2.4.2, Figure 2.4.7, and Figure 2.4.8 show the current land use of Pathein planning area.

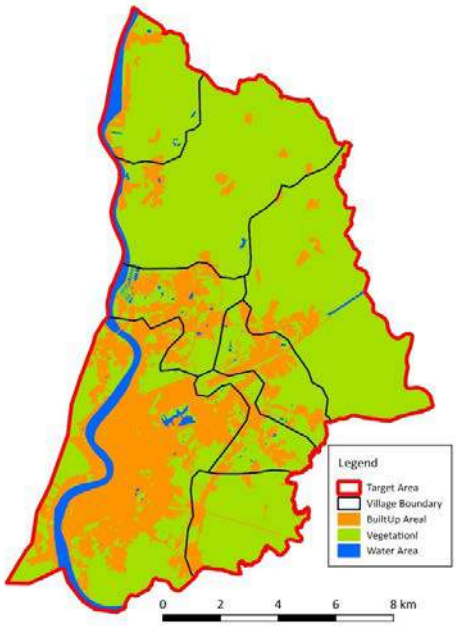
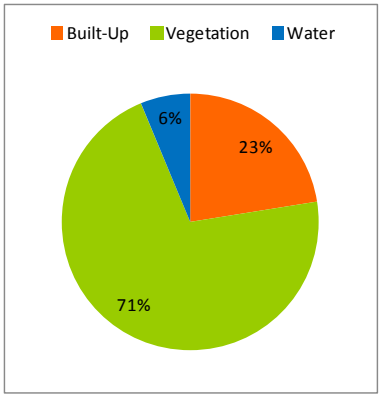


Table 2.4.1 Current Land Use (General) of Pathein Planning Area

Type	Built-Up	Vegetation	Water	Total
Area (ha)	3,611	11,448	1,006	16,064
Share	(22.5%)	(71.3%)	(6.2%)	(100.0%)

Source: JICA Study Team



Source: JICA Study Team

Figure 2.4.7 Current Land Use (General) of Pathein Planning Area

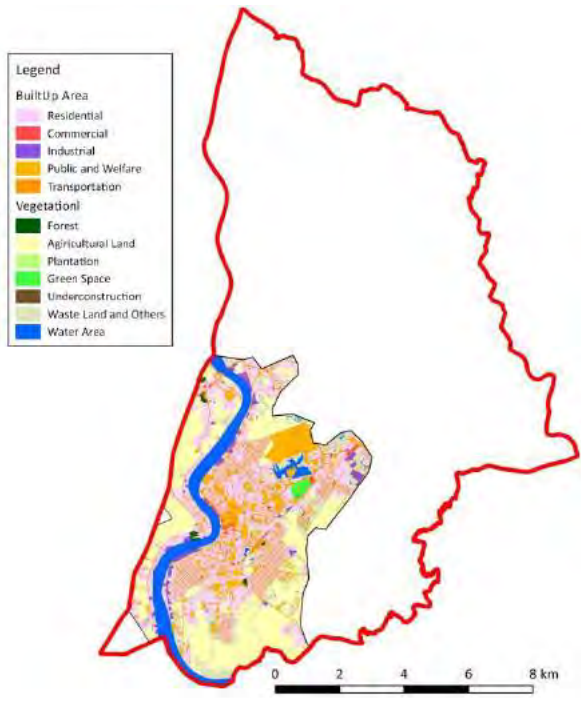


Table 2.4.2 Current Land Use (Detailed) of Urban Area of Pathein

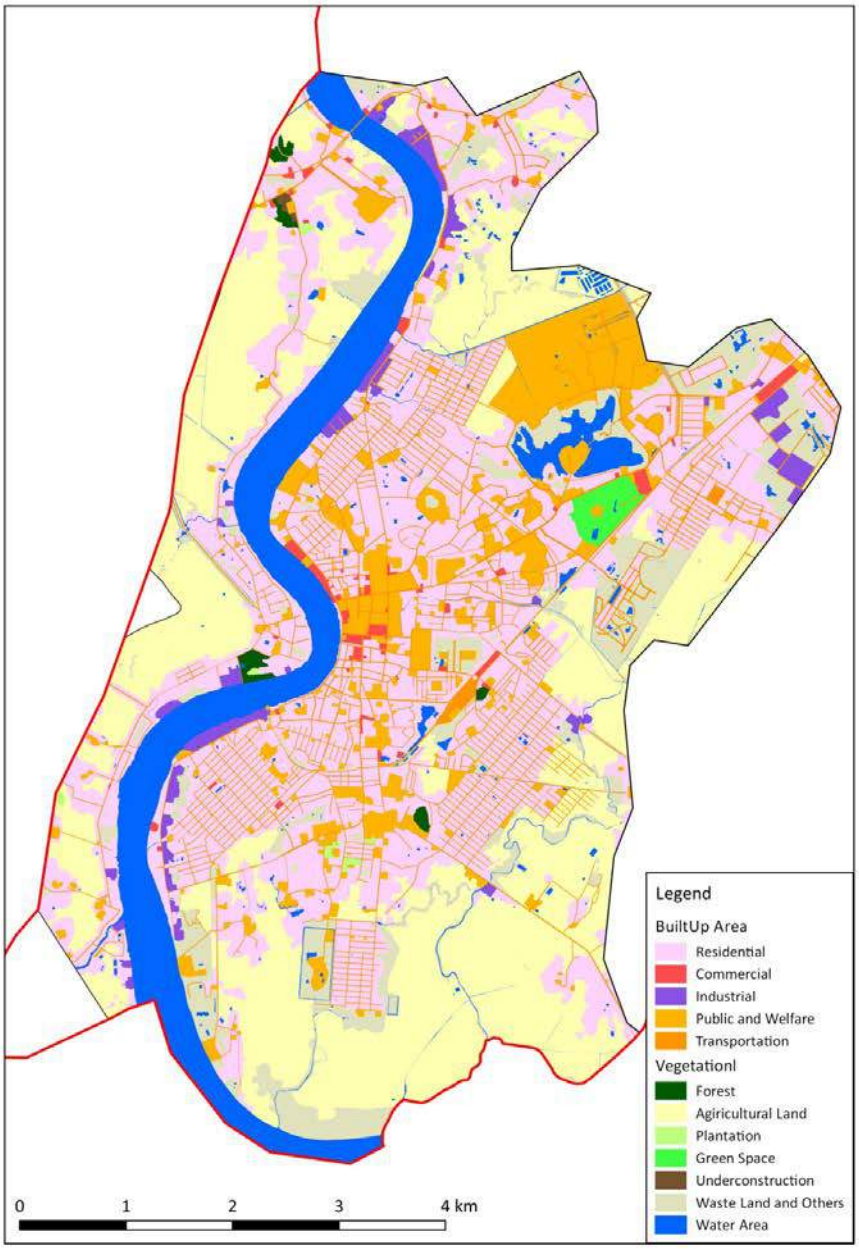
Type		Area (ha)	Share
Built-Up	Residential	1,580	35%
	Commercial	30	1%
	Industrial	73	2%
	Public	366	8%
	Transit	159	4%
Vegetation	Forest	16	0%
	Agriculture	1,300	29%
	Plantation	9	0%
	Green space	25	1%
	U. construct	2	0%
	Others	423	9%
Water	River	1,775	39%
	Channel	442	10%
	Lake	19	0%
	Pond	75	2%
Total		4,528	100%

Source: JICA Study Team

Source: JICA Study Team

Figure 2.4.8 Current Land Use (Detailed) of Urban Area of Pathein

- Based on the analysis of the 2015 satellite imagery, land use was sub-categorized into 15 types targeting only the urban area of Pathein (127 ha is blank from the whole urban area) as shown in the figure and table above and detailed below.



Source: JICA Study Team

Figure 2.4.9 Current Land Use (Detailed) of Urban Area of Pathein (Enlargement)

Building Regulation

- According to the interview survey, Pathein does not have any specific regulations related to building and land use.

2.4.3 History, Landscape, and Tourism

History of the City

- Pathein was named as Thinzawarnargaya when the King Thiri Da Mar Thaw Ka was the ruler during the Buddhist year 218. The Shwe Muttaw Pagoda was constructed by King Thiri Da Mar

Thaw Ka. In year 536, the name was changed as Pathein. Later it was called Pathi when King Ka Lar Pa Thi was the ruler. In year 595, the Wunna brothers assassinated King Ka Lar Pa Thi and the name was changed from Pathi to Pathein again. In year 600, King Thamukawtha was the ruler and the country was very crowded and developed, this time it was named as Nargayawaypula; but after his death, the place was once again called Pathein until now.

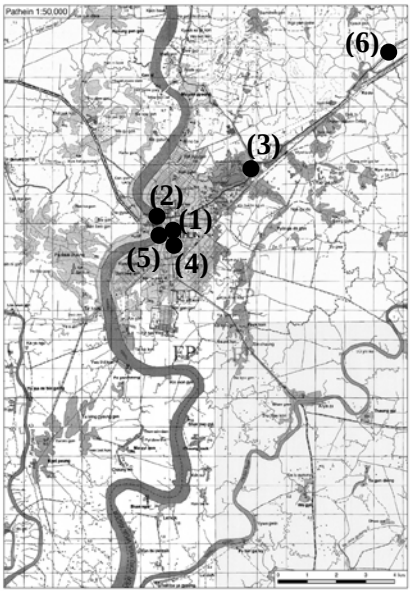
- Pathein was formed officially through the announcement letter from Minister of Home Affairs and Minister of Religious Affairs dated 6 Aug 1998 and 31 March 1995, respectively.

Tourism and Landscape

- Since Pathein City is quite flat like the the delta area of Ayeyarwady River, there is no topographical landmark such as mountain or hill. Waterfront of rivers and lakes feature unique character of the city. Chaungtha Beach and Ngwesaung Beach facing the Bay of Bengal have tourism potential in close relationship with Pathein City as transport hub connecting with Yangon. Figure 2.4.10 shows photos of unique characteristics of Pathein City.

Shwemokhtaw Pagoda (1)
This historical pagoda is located at the city center as a landmark of the city.

Riverside Plaza (2)
Facing the Pathein River, there is a plaza which has an open space for the public.



Location of the Places in the Pictures
(* No.7 is out of the map)

Lakes (3)
In the city center, there are two large lakes which provide amenity space.

City Center Townscape (4)
In the city center, relatively low-rise buildings can be seen.

Pathein River and Jetty (5)
Along the Pathein River, there are jetties for cargos and passengers.

Paddy Fields in Countryside (6)
Huge area of paddy fields surrounds the city of Pathein as the delta area.

Chaungtha Beach (7)
From 1.5 hours distance from Pathein by car, there are two popular beaches.

Source: JICA Study Team

Figure 2.4.10 Characteristics of Pathein City

2.5 Infrastructure

2.5.1 Transport and Road

- Road Traffic Demand: Traffic congestion is not observed in the city. The large demand for public transportation might not be expected.
- Road Network: The future road network shall be proposed taking into account the new industrial area in Kyaui Tan and the proposed urban spatial planning.
- Public Transportation: Considering the city size and narrow streets in the urban area, small size vehicles (such as paratransit cars) will be suitable for the public transportation of the city.
- Truck and Bus Terminals: Accessibility of the existing truck and bus terminals might be improved by widening the access road. Relocation based on the proposed new urban center will be an option in case road widening cannot be implemented.
- Abandoned Railway Track: The railway track between Pathein Station and the river bank has not been used for a long time. The DUHD, MOC proposed this abandoned railway track to be replaced by a new road.
- Cargo Handling: There is no modern port facility. Cargo is carried manually. Generally, the advantage of inland water transportation is the large cargo/bulk transportation and mass transit. However, the cargo size is limited by the manual transport capacity for loading and unloading. In order to utilize the inland transport further, mechanization of loading/unloading will be required.

2.5.2 Water Supply

- Currently, there is no modern water supply system in Pathein City. Residents get domestic water by using dug-well and tube-well. Also, five bottled water factories are playing important role in drinking water supply in Pathein City. Figure 2.5.1 shows a public dug-well and drinking water production facility.

Source: JICA Study Team

Figure 2.5.1 Public Dug-well and Drinking Water Production (PET-Bottle)

- On the Myanmar Three Cities Water Supply Management Improvement Project (March 2013), the Ministry of Health, Labor, and Welfare (MHLW) Project Team of Japan collected information and data in Pathein City.
- Based on the results of these survey and discussion, the MHLW Project Team made proposals for the improvement of water supply management in the city. Since water supply development needs to fulfill the future water demand, it is necessary to establish the planning framework based on the population growth forecast and to decide the target for development of water supply system as

master plan. Since the terrain of Pathein and the nearby area is characterized by flat land, the location of the facilities should be decided taking into consideration the possibility of minimizing the energy cost.

- Selection of water source is the most important factor in the planning of the water supply system. Water quality analysis during both the dry season and rainy season should be conducted for all possible water sources (both surface water and groundwater sources). Also, since water supply facilities would be used for much long term, the selection of water source should be considered based on the land use of residential, commercial, and industrial for the urban development plan.

- As other matter, they have a plan to develop water supply system with a joint stock company in Thailand. The proposal is called build-own-transfer (BOT) concession with long-term contract. This is the concept of giving priority to private benefit in water tariff. But it should provide highly convenient and profitable contents to residents or local residents without high tariff.

2.5.3 Sewerage

- There is no public wastewater treatment plant (WWTP) to collect and treat domestic wastewater in Pathein City. Domestic wastewater is discharged without appropriate treatment to street drainage, and finally flows into rivers and ponds. Also, there are many households which cannot use toilet with clean sanitary conditions. These mainly cause water pollution. Figure 2.5.2 shows image of existing river and channel.

Source: JICA Study Team

Figure 2.5.2 Existing Channel and River

- Although water injection type toilet without a septic tank has become extensively popular, toilet of this type should be changed with proper septic tank or connected to sewerage system. Furthermore, there are no night soil treatment plants for human waste in Pathein City, and excreta or excess sludge removed from a pit toilet or septic tank is thrown into the existing final dumping site without stabilization pond system.

- A sewerage system project is strongly required in Pathein City. However, the sewerage system project requires long time and large funds.

2.5.4 Drainage

- The capacity of the existing drainage and channel in Pathein City is not enough for heavy rains. So, low-lying areas in the city are sometimes flooded every year.

- Most drainage canals which are dug manually do not have the hardness for drainage canal lining. There are not enough gates, banks, and pumps which prevent flooding in the low-lying areas.

- Some drainage canals have accumulated soil sediments, and many plants are growing at the bottom that inhibits the flow as shown in Figure 2.5.3.

Source: JICA Study Team

Figure 2.5.3 Growing Plants at the Drainage Bottom

2.5.5 Solid Waste

- The final disposal sites are simple dumping sites without any pollution control facility (no landfill liner and no drainage of leachate). The improper landfill will pose high risk on health and high impact on the environment.
- Some collecting vehicles and filling facilities are severely decrepit. Solid waste is collected by Pathein City Development Committee (CDC) truck and dumped to the Nan Thar Kone final disposal site shown in Figure 2.5.4.

Source: JICA Study Team

Figure 2.5.4 Nan Thar Kone Final Disposal Site in Pathein

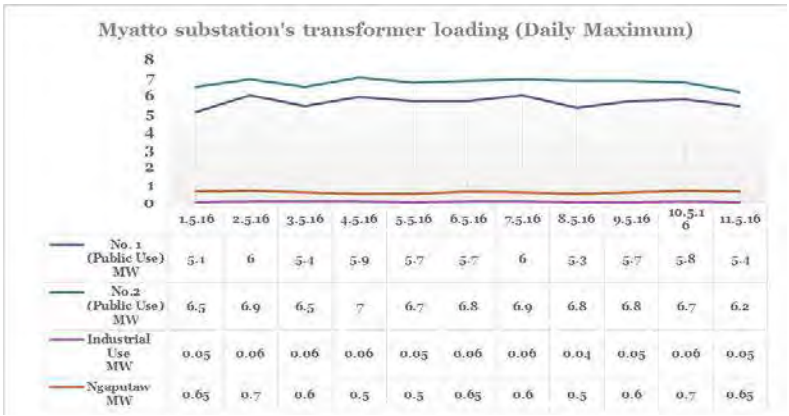
- Collected solid waste is rapidly increasing in Pathein City, making the capacity of the final disposal sites insufficient. So, Pathein CDC shall start the 3R policy (recycle, reuse, and reduce) for environmental efforts.

2.5.6 Electricity

- In Pathein District, at the transmission level, the voltages are 230 kV and 66 kV. The input of the newly established Pathein primary substation (230/66/11 kV, 50 MVA x 2), in order to supply Pathein District, comes from Athoke Power Substation with a 230 kV transmission line. There are six outgoing active feeders and one spare feeder on the 66 kV secondary side of the substation.

- The target area of this study is supplied by the 66 kV Myatto Substation (3 X 10 MVA, 66/11 kV and 1 X 10 MVA, 66/33 kV). Among the four 66 kV transformers, one 66/11 kV is used to supply the industrial load, two 66/11 kV are used to supply the other loads in the target area, and the 66/33 kV transformer is used to supply the Ngaputaw area which is located outside the target area. Figure 2.5.5 shows the maximum transformer loading of Myatto Substation on specified dates.

- The electricity distribution of the target area is done by 11 kV distribution system.



Source: JICA Study Team based on MOEPE data

Figure 2.5.5 Myatto Substation's Transformer Loading

- The capacity of the Myatto Substation's transformers was assessed based on the latest available loading data and the Electricity Supply Enterprise (ESE) demand forecast. The result of the basic assessment is shown in Table 2.5.1. The transformer load shown Table 2.5.1 does not include the amount of scheduled load shedding; and thus, the actual peak load of Myatto Substation is larger than the values shown here. As seen from the assessment, the No.1 and No.2 power transformers will be overloaded during peak season by the year 2017. Cascading connections on the secondary side of the transformers are not available at this moment. Hence, load sharing between transformers is also impossible.

Table 2.5.1 Preliminary Capacity Assessment of 66 kV Power Transformers in Myatto Substation

NO	Substation Name	Transformer	Voltage kV	Transformer Rating MVA	Allowable Load (p.f=0.8) MW	7th May 2016 (maximum load)		2017 Demand Forecast (+20%)			2018 Demand Forecast (+20%)		
						MW	% Loading (p.f=0.8)	MW	% Loading (p.f=0.8)	Remaining Capacity (MW)	MW	% Loading (p.f=0.8)	Remaining Capacity (MW)
1	MYATTO	No. 1 (Pubulic Use)	66/11	10	8	6	75	7.2	90.0	0.80	8.6	108.0	-0.64
		No. 2 (Public Use)	66/11	10	8	6.9	86	8.28	103.5	-0.28	9.9	124.2	-1.94
		Industrial Use	66/11	10	8	0.06	1	0.072	0.9	7.93	0.1	1.1	7.91
		Ngaputaw	66/33	10	8	0.6	8	0.72	9.0	7.28	0.9	10.8	7.14

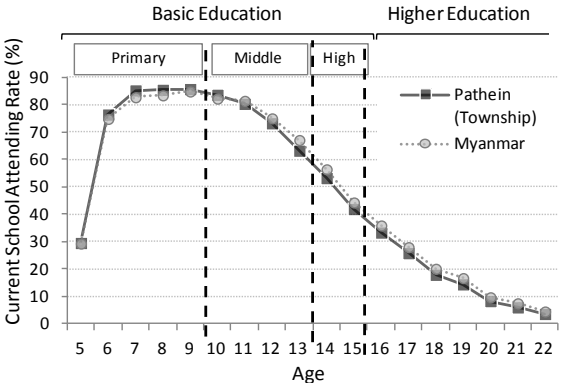
Source: JICA Study Team based on the MOEPE data

- Currently, the distribution loss rate in Pathein Township is 17% according to the ESE.

2.6 Social Service

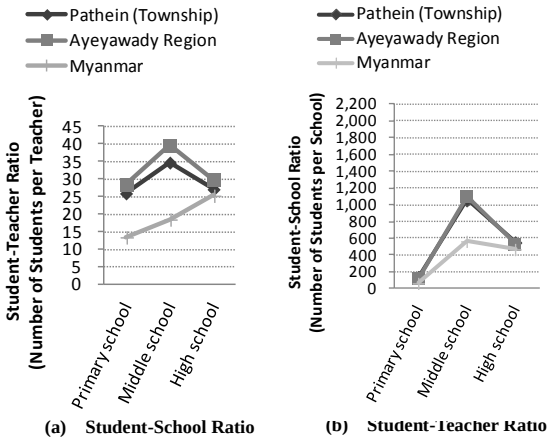
2.6.1 Education

- The literacy rate in Pathein urban area is more than 96% and it is higher than that in the surrounding area and whole Myanmar, which indicates basic education prevails more widely in the urban area.
- School attendance in Pathein Township decreases gradually after the completion of the primary education cycle as shown in Figure 2.5.1 and similar trend is shown in whole Myanmar. One of the main reasons of the gradual decrease are economic difficulty of the household which cannot pay opportunity cost to have their children go to school and another is because school is located too far from home to commute.
- Preparation of facilities for primary and middle school education in Pathein Township is in lower level than that of entire Myanmar. In particular, the number of students per middle school in Pathein Township is especially higher, which is beyond 1,000 as shown in Figure 2.6.2. And there is a tendency that facilities are insufficient in new urbanized areas with increasing number of housing and children.
- Provision of a sufficient number of teachers is one of the indicators to measure the quality of education. The ratio of student/teacher on primary and middle school in Pathein Township are nine and six points higher than the ratio of whole Myanmar.
- Ratio of population whose highest level of education completed is under primary school in Pathein Township is 10-15% lower than that of the surrounding area and whole Myanmar as shown in Figure 2.6.3. And population ratio whose highest level of education completed is more than a university or college degree in Pathein Township is also higher than that of its surroundings. It suggests higher educated people are more concentrated in the city compared to the surrounding area.



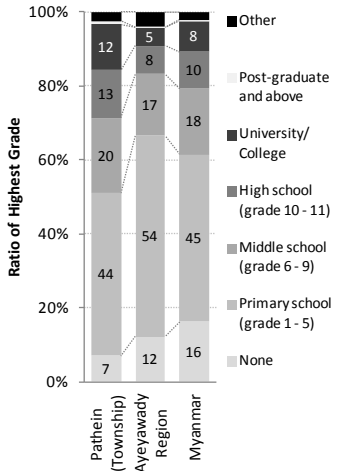
Note: The above relation between age and school does not reflect the students who have repeated the school years.
Source: JICA Study Team based on the 2014 Myanmar Population and Housing Census

Figure 2.5.1 School Attending Rate



Source: JICA Study Team based on the 2014 Myanmar Population and Housing Census

Figure 2.6.2 Student-School Ratio and Student-Teacher Ratio

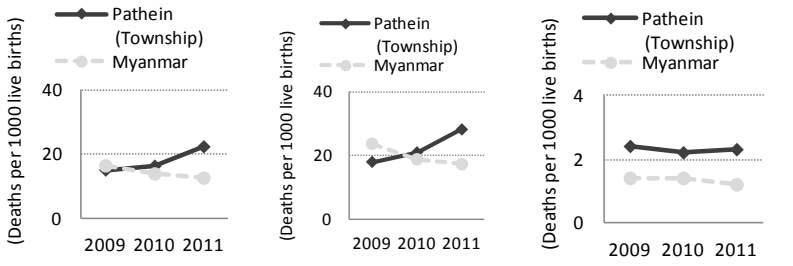


Source: JICA Study Team based on the 2014 Myanmar Population and Housing Census

Figure 2.6.3 Composition of Population Who Are 25 Years and Over by Highest Level of Education

2.6.2 Health

- Basic health indicators such as infant mortality rate, under-five mortality rate, and maternal mortality rate in Pathein Township worsened or did not improve in recent years as shown in Figure 2.6.4. The health indicators are mostly worse than those of whole Myanmar.



(a) Infant Mortality Rate **(b) Under-five Mortality Rate** **(c) Maternal Mortality Rate**

Source: JICA Study Team based on the data from Township Health Profile 2011, Ministry of Health, Myanmar

Figure 2.6.4 Basic Health Indicators of Pathein Township

- There are seven hospitals, eight clinics, eight rural health centers, and 43 sub-rural health centers in Pathein Township. There are some construction projects in Pathein urban area like the new Ayeyarwady General Hospital which is being upgraded (under construction) with 500 beds, and Ayeyarwady United Specialist Centre as shown in Figure 2.6.5. Most of the hospitals are located in urban areas, and rural areas are mainly covered by rural/sub-rural health centers.

(a) New Ayeyarwady General Hospital under Construction **(b) Ayeyarwady United Specialist Centre which is being opened**

Source: JICA Study Team

Figure 2.6.5 Hospitals in Pathein Township

2.6.3 Poverty

- The United Nations Development Programme (UNDP) implemented integrated household living conditions surveys in whole Myanmar in 2005 and 2010. Table 2.6.1 shows the percentage of the population who were poor in Ayeyarwady Region and whole Myanmar. Ratio of poor population in urban area slightly decreased from 2005 to 2010. And the ratio of the urban area in Ayeyarwady in 2010 was 10.8% lower than the rural area.

Table 2.6.1 Percentage of Poor Population

(unit: %)

	Urban		Rural		Total	
	2005	2010	2005	2010	2005	2010
Ayeyarwady Region	24.4	23.1	30.3	33.9	29.3	32.2
Myanmar Total	21.5	15.7	35.8	29.2	32.1	25.6

Note: Poverty lines were set as MMK 162,136 per adult equivalent per year in 2005 and MMK 376,151 in 2010.
Source: Integrated Household Living Conditions Survey in Myanmar (2009-2010), UNDP

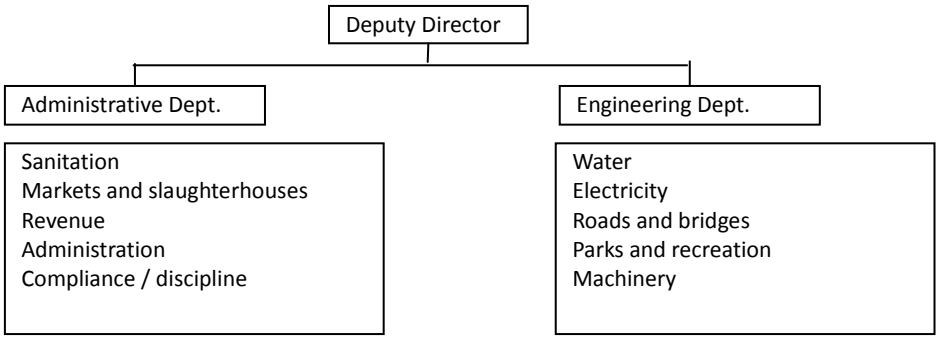
2.7 Institutional Conditions

2.7.1 Regional DUHD Office

- As a regional branch of DUHD, Pathein office has total of 12 staff taking responsibility of housing development project for staff and officer housing and public housing (for poor), with 13 vacancies, as the newly established organization since April 2015.
- Pathein DUHD office has three computers, but neither CAD nor GIS; thus, DUHD can only play limited role in the actual planning stage of the housing at moment.

2.7.2 Development Affairs Organization, a.k.a. City Development Committee

- In Pathein, urban development is planned and served under the Department of Development Affairs of the Ayeyarwady Regional Government. The Department of Development Affairs is a fully independent organization of subnational governance system, and directly belongs to the regional government. It is the only department to have its own bureaucracy and allowed to prepare a local development plan independently functioning from the Union Government.
- Under the Department of Development Affairs, the regional Development Affair Organization (DAO), also referenced as city or township development committees, summarizes the proposed day-to-day administrative plan from township level DAOs and directly reports to the Department of Development Affairs. This is the general planning process on spending funds from the Union Government such as grants, loans, and some funds.



Source: JICA Study Team, based on "Municipal Governance in Myanmar, An Overview of Development Affairs Organizations" (Arnold M., Aung Y T., Kempel S., et al, July 2015)

Figure 2.7.1 General Structure of DAO

- In Pathein, the township DAO consists of one administration and one engineering department under the deputy director, with 155 staffs. In the engineering department, there are 50 staffs, among which 12 are engineers. The head of the administration department is an admin officer and the head of the engineering department is an executive engineer. The admin officer is senior to the executive engineer.

2.8 Relevant Plans and Projects

2.8.1 Existing and Past Plans

Conceptual Plan by MOC

- The Government of Myanmar laid down a policy on urban and regional development. It urged regional/state governments to make long-term urban development plans for their region that consider comprehensive points including society, economy, environment, and infrastructures. To follow the policy, Ayeyarwady Region requested MOC to support the preparation of the plan. The MOC made the urban development plan of Pathein urban area in January 2014, which consists of the current situation of the city including urban infrastructures and social status, and proposed urban development project including new urban area development and housing redevelopment project. Figure 2.8.1 shows the proposed project location for Pathein in the MOC plan. Although the plan includes some future development projects, it does not include future development vision, future structure plan, and land use plan.

Source: Pathein Urban Development Conceptual Plan, MOC

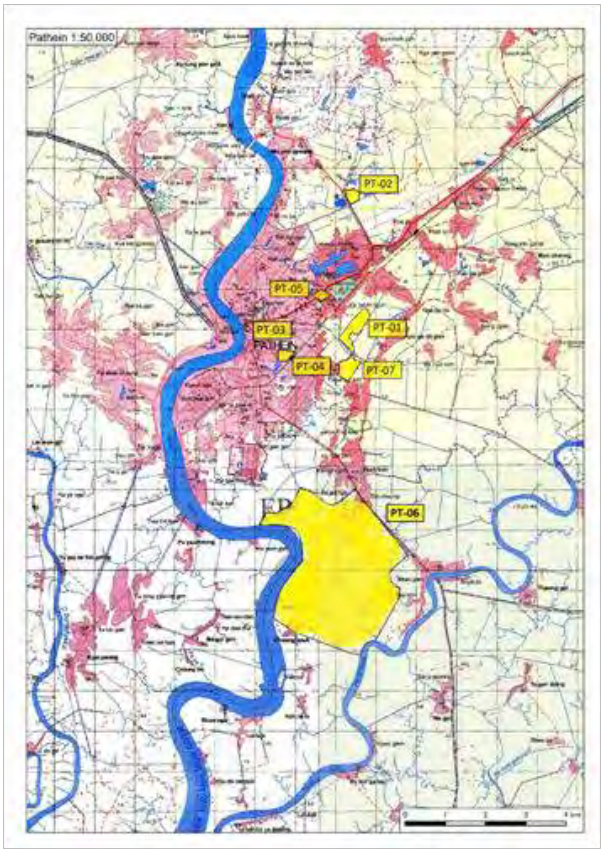
Figure 2.8.1 Proposed Project Location for Pathein in the MOC Plan

Pathein Town Plan by Pathein Township Development Committee

- Pathein Township Development Committee made the town plan in February 2012 according to the Township Development Committees Law and direction of the regional minister in Ayeyarwady Regional Government. The plan consists of current condition of the city and proposed development project including upgrade of urban infrastructures. Although the plan can be used to introduce current conditions of Pathein urban area, it is not used as future comprehensive development plan.

2.8.2 Ongoing and Planned Projects

- Pathein has some ongoing housing supply projects conducted by the public sector. On the other hand, DIG, a domestic developer, has been conducting large-scale project, namely, “Mya Kyun Tar Housing Project (PT-01)”, which will aim to transfer city center function eastwards through change of traffic mode from inland water to road. Figure 2.8.2 and Table 2.8.1 summarize the location and outline of the projects.



Note: The numbers in the map correspond with Table 2.8.1.
Source: JICA Study Team

Figure 2.8.2 Location of Major Development Projects in Pathein Planning Area

Table 2.8.1 List of Major Development Projects in Pathein Planning Area

No.	Name	Development Facility	Developer	Status
PT-01	Mya Kyun Tar Housing Project	Housing development	Delta Industrial Group (DIG)	Under Construction
PT-02	Platinum Pathein Condominium	Luxury housing with residential villas and condominium towers	H & Co Real Estate Holding Ltd (Private Company from Singapore and Myanmar)	Under Construction
PT-03	Ocean Super Center (Pathein)	Shopping mall	City Mart Holding Co., Ltd	Under Construction
PT-04	Pyidawtar Housing Redevelopment Project	Staff housing	DUHD	Under Construction
PT-05	DUHD	Housing development	DUHD	Under Construction
PT-06	Pathein Industrial City	Industrial zone and commercial	Ayeyarwady Development Public Co., Ltd	Under Construction
PT-07	Low Cost Housing Project	Housing development	DUHD	Proposal

Source: JICA Study Team

3 Development Visions and Socio-economic Framework

3.1 Development Visions and Strategies

3.1.1 Development Visions

Necessity

- Development visions are the ideal future images of each city which can be attained through addressing problems and issues, catering to the citizens' needs, and integrating foresight of the stakeholders and experts regarding urban planning, and other disciplines. Without setting clear development visions, it would be difficult to implement an integrated urban development plan efficiently. Consequently, the administration would come to a deadlock, as there are a number of concerned sectors playing important roles in developing, improving, and managing a large city.

Definition of Development Visions

- For the planning, the study formulates the development vision and the strategies for the vision. The following are the definitions of the development vision in the master plan:

  a) **Development Vision**: Development direction and development concept of the city which is realized under the execution of the master plan. Development vision consists of "statement of vision", "key drivers of the vision", and "strategies for the vision".
  b) **Statement of Vision**: The statement of the vision expresses the image of the future city. It summarizes related key drivers and strategies.
  c) **Key Drivers of the Vision (Pillars)**: Statement of the vision consists of several related key drivers. These key drivers correspond to major sector development field of the city and they are expected to become strengtheners and opportunities which conducts realization of the vision.
  d) **Strategies for the Vision**: Strategies are development measures to be taken for the realization of the vision. These consist of measures such as:
     - Enhancement of current strength of the city,
     - Improvement on weakness of the city which hinders progress of urban development and its favorable environment, and
     - Integration of existing development programs and introduction of new urban functions which give added value to current urban resources.

Formulation Process

- For the formulation of the development vision, the study refers to the following planning resources and takes the following process:

  a) **Development Visions and Targets in the Existing Planning Document**: The development visions and targets have been formulated and they are described in the related planning documents such as the development plan of the city and the region. Some visions are stated in related national development plans and sector development plans.
  b) **Results of Analysis on the Current Conditions and Issues**: The result of current conditions of the city is useful to identify remarkable development fields to be respected for the urbanization, environmental improvement, and industrial promotion of the city. These results, which are described in Chapter 2, are informed through the workshops and seminars held in Pathein.
  c) **Discussions Among Stakeholders**: In the workshops and seminars in Pathein, the current conditions of the city are explained with its major development resources, ongoing activities, and planning issues. After sharing the necessary planning information and recognizing the issues, the development vision was discussed among stakeholders of city development and attendees of the seminar and workshops. By discussing the order of

priority of development subjects and their relationships, the prior key drivers of the vision are summarized.

d) **Formulation of Development Vision**: By summarizing the key drivers of the vision, the statement of the development vision was determined. And the realization processes of the development vision are examined as the strategies for the vision.

Resources and Challenges of Pathein

- In view of the spatial features of the city, urban development, infrastructure services, and economic development, the following matters are raised as resources of Pathein to be applied for the future development:

< Resources >

a) Strong agricultural/fishery/dairy production base: rich resources
b) Connectivity to Yangon and other cities through road and riverine routes
c) Abundant and cheaper labor force
d) Sign of more garment factories investing in the future
e) Agro-related industries such as rice mills
f) Rich cultural and historical tourism resources
g) Proximity to famous Ngwe Sang and Chaung Thar beaches
h) Some higher education institutions
i) Housing development under construction

- From the above mentioned view, the following matters are raised as challenges of Pathein to be resolved and improved for the future development:

< Challenges >

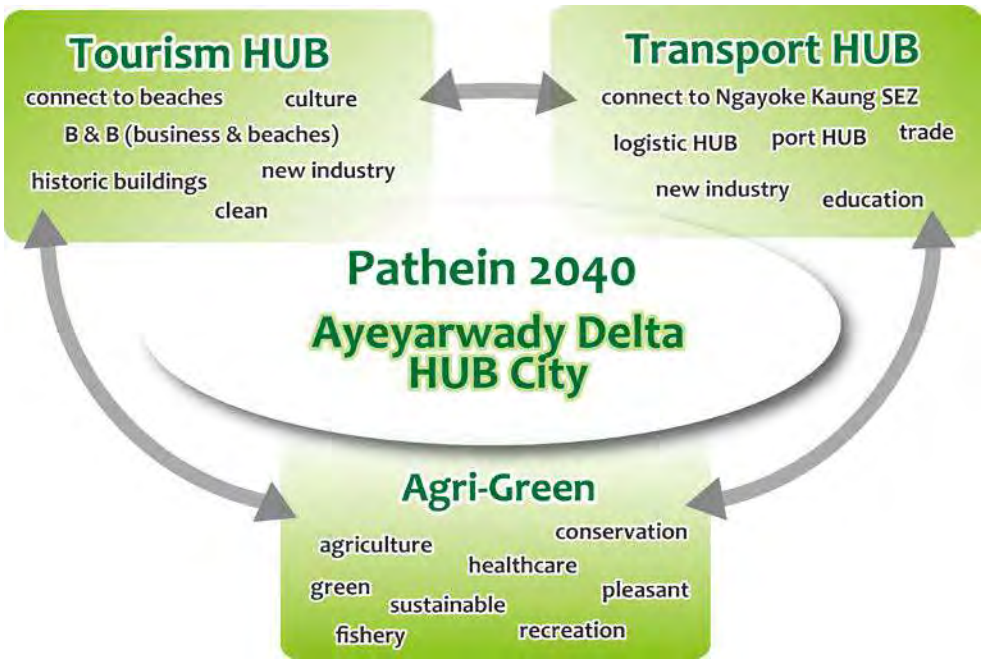
a) Underdevelopment of electric power and infrastructure for production and logistics
b) Lack of capacity of local industries in technology, human resources, finance, and information
c) Lack of workforce even at the basic level; drain of human resources to Yangon
d) Less foreign investments compared with Yangon
e) Long distance to international airport for export
f) Poor quality of hotels; "transit" city to the beaches

Development Vision for Pathein 2040

- The abovementioned features of the city (resources and challenges) are grouped into four themes through the discussions with stakeholders and attendees of the workshop in March 2016 and seminar in May 2016.

a) Tourism HUB
b) Transport HUB
c) Agri-Green

- Then, the development vision of Pathein was established as “Ayeyarwady Delta Hub City”. It intends that by 2040, Pathein will be known as the key hub city in Ayeyarwady delta area, which acts as a business and logistics center for the regions’ economy with a developing role as a hub for tourism. Figure 3.1.1 describes the development vision for Pathein 2040.



Source: JICA Study Team

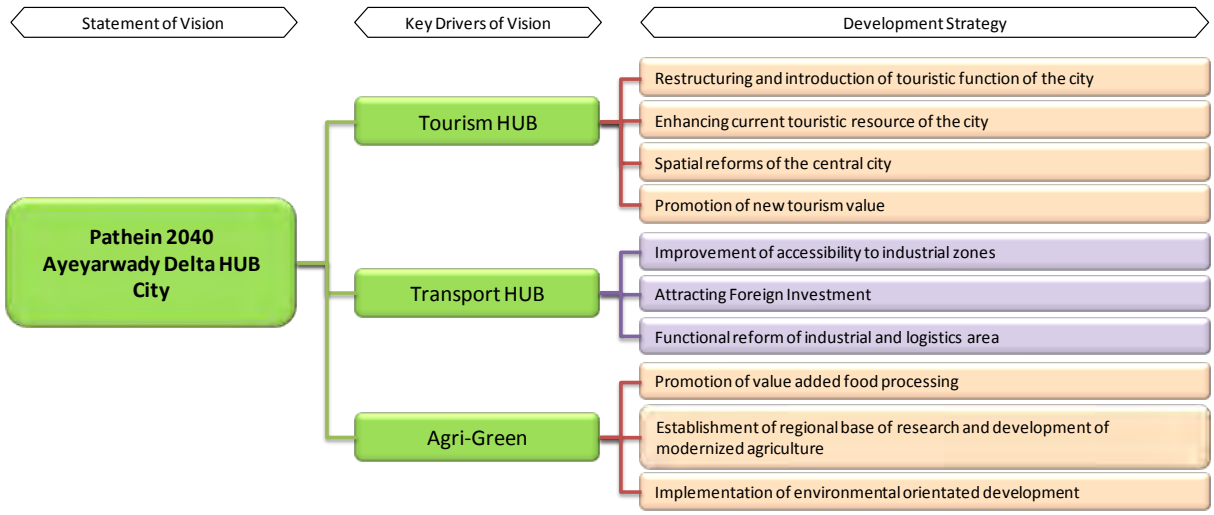
Figure 3.1.1 Development Vision for Pathein 2040

3.1.2 Development Strategy

- Strategies are development measures to be taken for the realization of the vision. These consist of measures such as:

  a) Enhancement of current strength of the city,
  b) Improvement on weakness of the city which hinders progress of urban development and its favorable environment, and
  c) Integration of existing development programs and introduction of new urban functions which give added value to current urban resources.

- Figure 3.1.2 shows the strategies to be considered and introduced for each key driver of the development vision.



Source: JICA Study Team

Figure 3.1.2 Development Strategy in Linkage with the Development Vision

Tourism Hub

- Aside from being the gateway into the region, the city of Pathein has an important role to be a tourism hub city. Utilizing the advantageous location, the city as a tourism gateway can provide "beach plus" experience to tourists and business people. Utilizing the opportunity and potential in the regional context, the city is expected to offer visitors a complementary attraction to the world-class beach resorts to the west, and a tourist infrastructure that also caters to national and international business.

    - **Restructuring and Introduction of Touristic Function of the City:** Inheriting the position as transport hub of water and land transport of the region, the city of Pathein has close relationship with present touristic activities. The following things are pointed as advantages of the touristic industry of the city. By enhancing the potential of these touristic elements, introducing new touristic roles into the city, and integrating these resources, continuous spatial and functional linkage with touristic activities will be generated and it will create new value in the touristic industry of the city.

        a) Gateway function of the city to the beach resort cities in the west coast of Myanmar
        b) Cultural and religious heritages, townscapes, and landscapes of the city

    - **Enhancing Current Touristic Resource of the City:** The central area of Pathein has many cultural and historical heritages for spiritual relaxation. Enhancement of the current historical value in city landscape and townscapes and making spatial linkages between these elements will offer continuous touristic experiences to visitors. For realization of these subjects, it is necessary to formulate corresponding spatial plans and to regulate construction activities in the surrounding area of the heritages.

    - **Spatial Reforms of the Central City:** Restoration and spatial improvement around the historical buildings and monuments are mentioned as a first step for enhancing their individual touristic values. Then, continuous spatial linkage with touristic activities will form a spatial network. These linkages will attract visitors with interest and conduct further discovery of the city. The following are suggested for this subject:

        a) Restoration and spatial improvement around the historical buildings and monuments; and
        b) Execution of landscape improvement works (the river front area and market place) such as harmonized spatial improvement with surroundings, and integration with open spaces, street furniture, gardening, and touristic signs.

    - **Promotion of New Tourism Value:** Pathein City is positioned in an advantageous location as a tourism gateway to famous beaches on the west coast of the township. This can be utilized to create a new value of tourism, or an additional value to beach tourists. For example, it would be appealing to travelers who seek valuable experience in their holidays to offer combination of "physical relaxation" at the beach resort and "spiritual relaxation" in Pathein City where many cultural and historical heritages are placed. Also, business persons can be a potential target, by offering them a "business and beach" package which they can spend in business facilities for conference or exhibition in the city on Fridays and stay in the beach resort during the weekend. New CBD Urban Development Project and Tourism Hub Development Project proposed by JICA Study Team as key projects (discussed in 6.2) will help thrust this strategy.

Transport Hub:

- As the regional center of water transport gateway in historical context and central function of regional land transport network, Pathein has an important role to be a transport hub city. According to current industrial features of the city, it is expected that the city will continue to

develop its role as a transport hub for Ayeyarwady Region, benefitting from its location on key east-west and north-south transport networks. And it is expected to provide modern and efficient business and logistics services for the agricultural and textile economy of the wider region. The following measures are proposed in order to achieve the above development goals:

- **Improvement of Accessibility to Industrial Zones:** After the construction of Yangon-Pathein Highway, the urban space of Pathein has shifted along the arterial road and its spatial structure will be generated in conjunction with the new established land transport network. Corresponding to the change of mode of transport, new access roads from the highway need to be constructed. Utilizing and upgrading the current inter-district roads, the construction of the southeast bypass road will create easier access to the industrial areas and accelerate production activities.

- **Attracting Foreign Investment:** It would be reasonable to consider concentrating on labor intensive manufacturing industry at the initial stage by utilizing abundant labor force in the city and neighboring area. Currently, accumulation of garment factories has started to be seen in the city and is likely to become a nucleus industry for exporting. Food processing is also a potential industry to seek for the consumer market in other regions in Myanmar and foreign countries. Logistics infrastructure including related facilities as well as transport infrastructure is obviously an important factor when such investments are considered. There may be a possibility that industries such as information technology (IT)/business process outsourcing (BPO) or customer center services will be developed in the future if the telecommunication infrastructure is sufficiently developed. The key projects proposed by JICA Study Team include New Port Construction and Warehouses Relocation Project and Access-controlled Highway Project (discussed in 6.2).

- **Functional Reform of Industrial and Logistics Area:** In the long run, the industrial sectors, products, and function of the city of Pathein will be changed. By integrating product, transport, and distribution functions with other related functions such as education, research, and development, new industrial field will be introduced into the city. Corresponding to these changes in the future, the development plan has to consider preparation of basis of industry for the new age. These infrastructures should not only include industrial infrastructure but also social infrastructure with close linkage with urban facilities. For example, educational facilities and vocational schools will help provide human resources who can correspond to expected industrial field in the future.

Agri- Green

- Pathein's remarkable uniqueness is its strong base of agriculture and fishery, and moderate distance to Yangon urban market. Utilizing this strong edge, the city of Pathein is expected to modernize agriculture to improve quality and diversify the industry. Enhancement of these strong points to be an agro-green city will be realized by harmonizing its urban space with its surrounding sensitive and valuable agricultural product field and integrating for development of new industrial field. Through these measures, the city can offer residents, businesses, and visitors a high quality urban lifestyle including a city center that prioritizes people over vehicles and new neighborhoods with integrated social infrastructure like education and healthcare.

  - **Promotion of Value-Added Food Processing:** Food processing will continue to be an important industry in Pathein. Utilizing its geographical advantage, the city can target consumers in Yangon and the surrounding areas by providing value-added food products. As people's living standard increases, their dietary life is expected to be changed gradually, which will potentially create new markets. For example, high quality dairy products may have chances to attract middle and upper class people in Yangon and the surrounding areas.

  - **Establishment of Regional Base of Research and Development of Modernized Agriculture:** Making the most use of the region's advantage as "the Barn of Myanmar",

Pathein could aim to become a central point of research and development (R&D) of modernized agriculture. In order to strengthen competitiveness of the agriculture sector for domestic as well as export market, it is necessary to increase productivity as well as improve quality by promoting mechanization and introducing appropriate technologies and fertilizers. Research institutions such as university can play a key role in these R&D activities.

- **Implementation of Environmental Orientated Development (enhancement of green open spaces in the center):** Plenty of green spaces in the central city area provide good living and working environment for residents. This spatial uniqueness of the city represents environmental and development philosophy of the city and it could suggest new direction of city development in the rural area in Myanmar. By realizing new urban development concept such as low density urbanization, compact city development, and symbiosis of nature and human, exclusive value of living environment will be generated and it will attract migrants, investors for industry, and tourists to the city.

3.2 Socio-economic Framework

3.2.1 Demographic Framework

- The future population of Pathein City for the next 25 years was forecasted in line with the population growth projections of the Union and regions/states that were made by the JICA Study Team prior to examining the growth scenario of the city population. Considering the estimates of the city population, assumptions were made on future urban population ratios of Ayeyarwady Region and future shares of Pathein Township in the increased urban population of the region in the forecast year, while taking into account the past figures presented in 1983 and 2014 census reports. The assumptions are elaborated as follows:
  - The urban population rate of Ayeyarwady Region is assumed to gradually increase to 15.9% in 2040 from 14.4% in 2015.
  - Pathein Towhship's share in the total urban population of the region is assumed to reach 21.5% in 2040 from 19.8% in 2015. Its share in the total rural population of the region is assumed to keep the same level at 2.2% from 2015 to 2040.
- Based on the assumptions, the city population is forecasted to reach 237,000 in 2040 at a growth rate of 1.15% (2015-2040) per annum. Since this study's target area for Pathein includes the seven village tracts located to the east of Pathein City, the combined population of the city and the tracts are calculated as shown at the bottom of Table 3.2.1. The target population is forecasted to reach **273,000 in 2040 from 211,000 in 2015, showing an increase of 62,000 persons**. This corresponds to the average annual growth rate of 1.03% during 2015-2040. Figure 3.2.1 shows the forecasted population until 2040.

Table 3.2.1 Population Estimates of Pathein Township and Target Area from 2015 to 2040

	(1983)	(2014)	2015	2020	2025	2030	2035	2040	Annual Growth Rate (2015-40)
Ayeyarwady Region									
Total Population (thousand)	4,994	6,185	6,240	6,488	6,630	6,720	6,822	6,923	0.42%
Urban Population (thousand)	742	873	899	954	994	1,028	1,064	1,101	0.81%
Rural Population (thousand)	4,252	5,312	5,341	5,534	5,635	5,692	5,758	5,822	0.35%
Urban Population Rate	15%	14%	14%	15%	15%	15%	16%	16%	
Rural Population Rate	85%	86%	86%	85%	85%	85%	84%	84%	
Pathein Township									
Total Population (thousand)		287	295	313	327	339	352	365	0.92%
Urban Population (thousand)		170	178	192	203	214	226	237	1.15%
Rural Population (thousand)		117	118	122	124	125	127	128	0.35%
(seven villages included in the study)		33	33	34	35	35	36	36	0.35%
Share in Urban Population of Region		19%	20%	20%	20%	21%	21%	22%	
Share in Rural Population of Region		2%	2%	2%	2%	2%	2%	2%	
(seven villages Share in Rural Pop of Region)		1%	1%	1%	1%	1%	1%	1%	
Urban Population + Seven Villages		**203**	**211**	**226**	**238**	**249**	**261**	**273**	**1.03%**

Source: JICA Study Team

Source: JICA Study Team

Figure 3.2.1 Population Forecast of Target Area (Pathein City + Seven Village Tracts)

- The MOC's conceptual plan for Pathein City developed in 2014 forecasts the population growth for 20 years at an annual growth rate of 1.6%. In view of the fact that the past population growth of Pathein City and Ayeyarwady Region both showed slow pace of 0.53% and 0.69% per annum, respectively from 1983 to 2014, the JICA Study Team considers that the forecasted growth rate of 1.03% would be within the justifiable range of future population scenario for the target area.

3.2.2 Economic Framework

- The future economic growth of the target area for the next 25 years was forecasted in line with the economic growth projections of the Union and regions/states that were made by JICA Study Team prior to examining the growth scenario of the city economy. The average annual growth rates of the Union's GDP and Ayeyawardy Region's GRP during this period were estimated to be 7.1% and 5.6% respectively by the JICA Study Team, considering the existing projections made by the Myanmar government and international organizations. The GRP of the target area was forecasted based on the urban/rural ratio of productivity per person in employment aged ten years or over, and the population scenarios already forecasted by the JICA Study Team. The urban/rural productivity ratio was calculated to be 1.75:1.00 from the GDP of Myanmar by industry in

2014/15 and corresponding urban and rural populations. An assumption was made on the ratio held constant for the next 25 years by considering that apart from expected increases in productivity of manufacturing and service sectors, productivity of agricultural sector will also be increased because of the progress of mechanization and the use of proper fertilizers, which will have a certain effect to push rural productivity.

- Reflecting on the proportion of calculated productivity index of the target area to that of Ayeyarwady Region, the GRP of the target area was computed as shown in Table 3.2.2. **The GRP is forecasted to grow by 4.5 times and reach MMK 1,435 billion in 2040** from MMK 316 billion in 2015 at constant prices. **The GRP per capita is forecasted to grow by 3.5 times reaching over MMK 5 million in 2040** from MMK 1.5 million.

Table 3.2.2 GRP of Target Area from 2015 to 2040

Item	2015	2020	2030	2040	Average Annual Growth Rate
Ayeyarwady Region: GRP (MMK in billions)	6,334	8,190	12,788	24,690	5.6%
Pathein Township/Urban + Seven Villages: GRP (MMK in billions)	316	420	699	1,435	6.2%
Pathein Township/Urban + Seven Villages: Population (thousands)	211	226	249	273	1.0%
Pathein Township/Urban + Seven Villages: GRP per capita (MMK in millions)	1.50	1.86	2.81	5.26	5.2%
Ayeyarwady Region: GRP Index (A)	6,914	7,203	7,491	7,748	
Pathein TS/Urban + Seven Villages: GRP Index (B)	344	370	410	450	
(B)/(A)	5.0%	5.1%	5.5%	5.8%	

Note: The GRP figures forecasted are based on 2010/11 prices.
Source: JICA Study Team

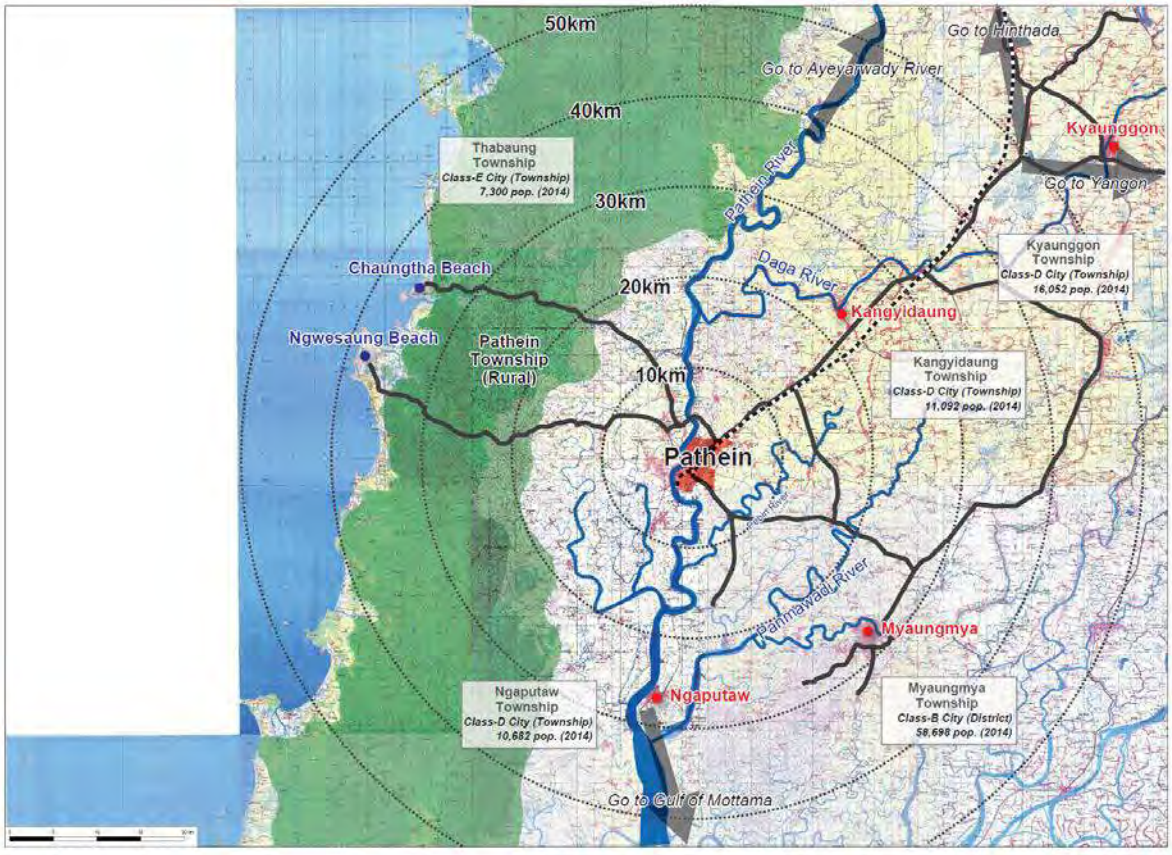
4 Urban Development Policy

4.1 Spatial Plan

4.1.1 Overview of Planning Conditions

- Considering the future spatial plan of Pathein, the relationship with its surrounding areas, such as Kangyidaung, Kyaunggon, Myaungmya, and Ngaputaw, must also be taken into account during planning work.
- Since the main transportation transfer from inland water to road, access road from/to Yangon has been more important currently. Additionally, due to popularity of Ngwesaung Beach and Chaungtha Beach to both domestic and foreign tourists, Pathein has future development potential as a tourism hub. It takes one and half hour from Pathein to these beaches.
- In the above context, it seems that the future urban area tends to expand eastward of the existing urban area rather than southwards or westwards.
- On the other hand, large-scale development project located south of Pathein's existing urban area was proposed by a local developer, namely "Pathein Industrial City Project".

Figure 4.1.1 shows the overview of planning conditions of Pathein.



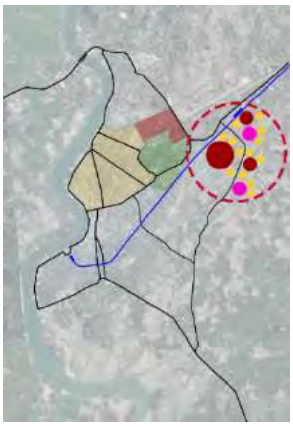
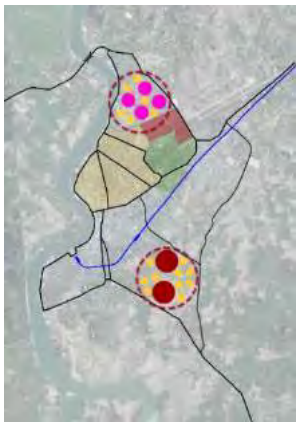
Source: JICA Study Team

Figure 4.1.1 Overview of Planning Conditions of Pathein

4.1.2 Options of Urban Development Structure

- The projected city growth needs to be addressed spatially in terms of space as well as regeneration of the core area for further expansion of the city. After discussions with various stakeholders, three options were suggested for the future growth of Pathein City. The city growth would comprise of industries and workplaces (represented in maroon), tourist centers (represented in pink), and residential development (represented in yellow) as seen in Table 4.1.1.
- There can be three options for the future development of Pathein. The first option focuses on creating a large suburb, while other options look at having a gateway to the city and development of multiple satellites.
- As Option 3, satellite of two or three core development concept, seemed preferable among all options according to the result of a series of meetings with the stakeholders, the spatial plan was made basically in line with the direction of Option 3. On the other hand, some good points of the other two options were also adopted partly in the spatial planning work.

Table 4.1.1 Three Options of Urban Development Structure in Pathein

Option	Option 1	Option 2	Option 3
Concept	Suburb	Gateway	Satellite
No. of Core	1	1	2
Direction	South	Northeast	North and South
Image Map			
Key Features	• Creating a new suburban area. • Development of a suburb to the city which will have compact clusters of industrial, tourism, and residential development. • The suburb will be connected to the existing city center through public transport like trams and BRT. • New infrastructure have to be created for servicing the suburb.	• Creating a new city center in the northeastern part of the city. • Creating a new city center in the vicinity of the new railway station. The city center would be a compact pocket of industrial, tourism related functions, and supportive residential development. • The existing industrial area would complement and support the new development. • Infrastructure can be shared with the existing industrial area.	• Creating a balanced-compact development. • Development of multiple pockets. • Development of a tourist stopover zone towards the northeast on the way to Ngwe Saung. • The warehouses on Strand Road towards the Northwest, would be relocated towards the southwest near the jetty. • The remaining industrial and residential development would be located in a compact cluster towards the southeast of the city.

Source: JICA Study Team

4.1.3 Spatial Plan

- In light of the past trends and considerations of logistics function and some large-scale development projects, the urbanization of Pathein is likely to extend outward, especially eastwards in connection with Yangon through the national road, rather than other directions. On the other hand, connectivity with the two beaches located west is also enhanced in the field of tourism development as the future trend.

- The CBD, which is the center of Pathein including the traditional market and Shwe Moke Htaw Pagoda, has limited potential for future expansion of its central business function due to absence of surplus land for new development, complicated land ownership, and less accessibility outwards such as Yangon. New CBD should have stronger connectivity with Yangon and other cities by means of facilities of road and railway rather than that of inland water after change of traffic mode. To be the regional growth center of Ayeyarwady Delta, development of a new CBD, which leads the business and economic activities of the region with better function of hub with Yangon and tourist beaches, is necessary. Transferring the central station to east, creating new CBD with new central station, and regenerating the old station site are recommendable.

- Population increase of Pathein (urban and seven villages located east side of the Pathein River) by 2040 is 62,000. Setting 100 person/ha as appropriate population density of a new town, the required land for a new town development mainly for residential function would be 6.2 km^2 (1,531 acres) as shown in Table 4.1.2. The required lands have been allocated in the spatial plan shown in Table 4.1.3 and Figure 4.1.2.

Table 4.1.2 Required Land for Future Population Increase of Pathein

Items	Population of 2015	Population of 2040	Population Increase	Density of New Town (person/ha)	Required L and (ha)	Required L and (km^2)	Required L and (acre)
Pathein	211,000	273,000	62,000	100	620	6.2	1,531

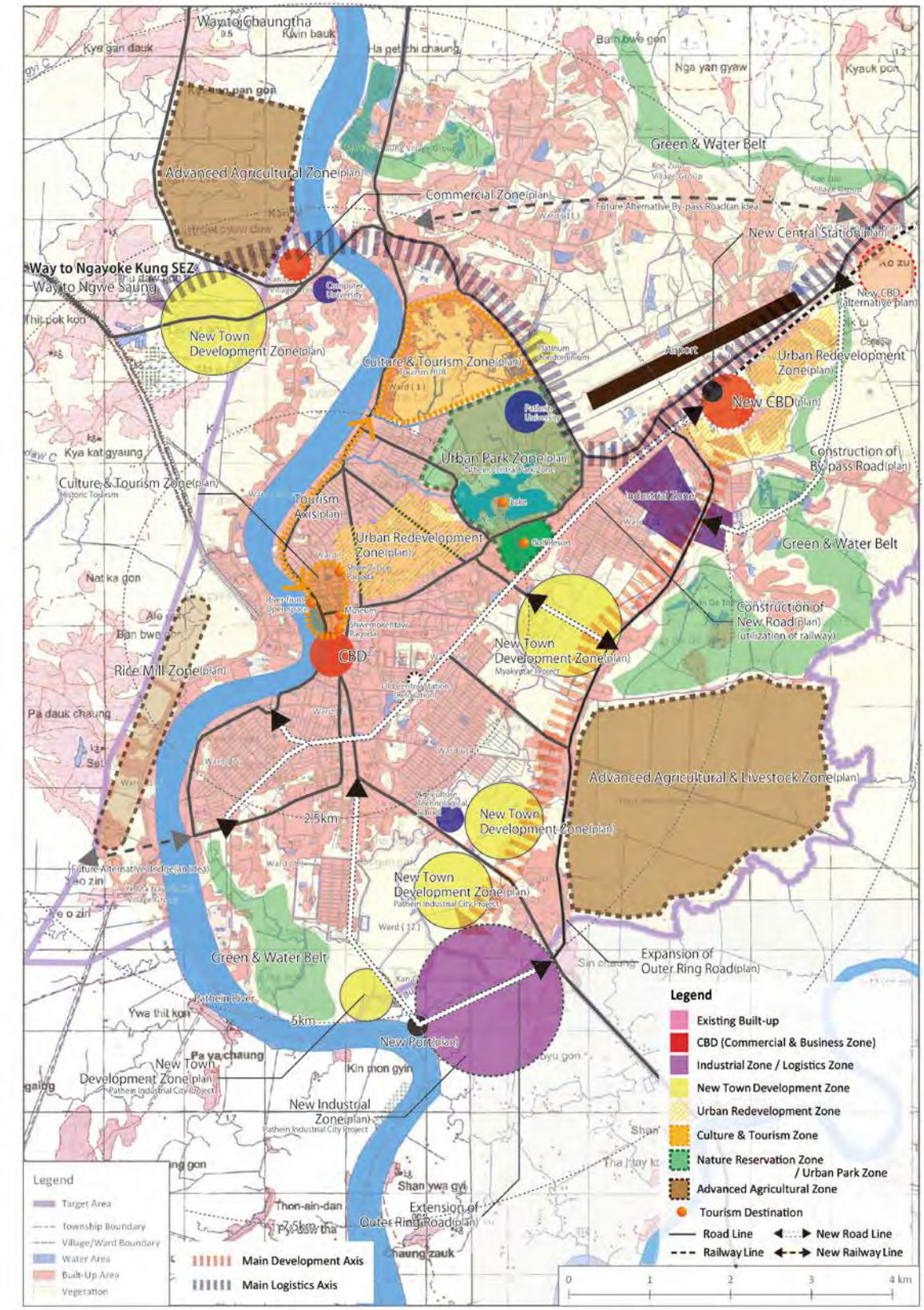
Source: JICA Study Team

Table 4.1.3 Proposed Zones and Contents in the Spatial Plan of Pathein

Items / Zones	Characteristics of Zone	Proposals in the Spatial Plan
Existing Built-up (Residential and Mixed-use)	Current urbanized areas that are covered by buildings mainly for residential, commercial, and mixed-use.	All area would be upgraded gradually in its environment, infrastructure, and social service especially at west old town.
CBD (Commercial and Business)	Current center of commercial and business area leading economic activities of Pathein. It includes a traditional market.	Although existing CBD function must be kept in the future, it is likely more for tourism and traditional culture attracting foreign tourists.
Industrial Zone Logistics Zone	Industrial and logistic function must be in good connection with other focal cities and beaches by roads, railways, and inland water.	Currently, an industrial zone exists and several factories are operating. In the zone, industrial activities should be encouraged by inviting more factories in the short-term.
Urban Redevelopment Zone	In existing built-up, low density residential areas in the city center seem to exist without access to proper infrastructure.	An area between the CBD area and lakes area shall be promoted as higher density to accommodate more residents with proper road system and infrastructure.
New CBD (Commercial and Business Zone)	To accelerate economic growth, development of highly functioning commercial and business area is necessary.	A new CBD is proposed, located 5 km east from the current CBD transferring the central station in it. The place has better connectivity with Yangon and two resort beaches.
New Industrial Zone New Logistics Zone	To be a tourism and logistics hub, expansion of industrial and logistic function is important.	A new industrial zone located south of the city named Pathein Industrial City Project, was proposed and currently under

		construction by a local developer. These locations have better accessibility through inland water.
New Town Development Zone (Residential and Mixed-use)	The new town functions not only as residential but also for commercial and business as mixed-use.	Development of a new town with an area of 6.2 km^2 in total is necessary in the future. Currently, a new town development named Myakyutar Project is ongoing in the center of city. Some more development shall be required south of the city or west of the Pathein River.
Culture and Tourism Zone	To encourage tourism development as tourism hub, promoting culture and tourism zone is recommendable to conserve and utilize historic and nature resources. Improvement of accessibility is also necessary.	Main culture and tourism zones were proposed, namely, tourism hub zone and historic tourism zone. Tourism hub zone is intended to promote business linkage with the two resort beaches.
Urban Park Zone Green and Water Belt Zone	To upgrade urban environment, both urban parks inside the city and green and water belts surrounding the city are necessary.	The area consisting of two lakes, golf resort, and the campus of Pathein University must be conserved and utilized as urban park zone of Pathein as green core of the city. The Pathein River and surrounding paddy fields can function as appropriate green and water belts.
Advanced Agricultural Zone	In the advanced agricultural zone, urban development activities are basically prohibited to avoid urban sprawl and to keep the city more compact and efficient.	Two advanced agricultural areas of northwest and southeast are recommendable for realizing agri-green city as a key driver.

Source: JICA Study Team



Source: JICA Study Team

Figure 4.1.2 Proposed Spatial Plan of Pathein

4.2 Urban Development Policy

- To achieve the development visions and strategies for 2040, development by sectors which are (1) Commercial, Business, & Industry, (2) Housing, (3) Landscape and Tourism, and (4) Environment, must be a basement as well as infrastructure development and social service improvement. Schematic relationship of the visions (three key drivers) and sectors are as shown in Table 4.2.1.

Table 4.2.1 Schematic Relationship of Visions and Sectors

Sectors / Key Drivers	Commercial, Business, & Industry	Housing	Landscape & Tourism	Environment
Tourism HUB	++		++	+
Transport HUB	++		+	
Agri-Green		+	+	++

Note: ++ Strong Relation, + Relation
Source: JICA Study Team

4.2.1 Commercial, Business, and Industry

- Table 4.2.2 shows the development policy of commercial, business, and industry in Pathein City, especially for achieving a future city to be tourism hub and transport hub. In order to execute these policies, spatial control is common and principle measures must be taken by the local and central government for the realization of urban development policies and projects. These control measures are expected to be executed based on the law, by-laws, and other legal frameworks. Concrete measures are described in Chapter 7.1.2 of this report.

Table 4.2.2 Development Policy of Commercial, Business, and Industry in Pathein

Commercial, Business, and Industry Policy	1) Construction of industrial zone along the outer bypass 2) Creation of new touristic zone in the north of the city 3) Improvement of touristic environment in the city center 4) Construction of a new CBD and redistribution of urban function 5) Development of remote area

Source: JICA Study Team

- **1) Construction of Industrial Zone along the Outer Bypass:** Existing industrial areas in the north (Myat Toe) and south (Pauk Gone) constitute two industrial poles of the city. Connecting these two areas, the outer bypass is expected to be constructed and offer traffic circulation without passing the inner city. Corresponding to new construction of industrial arterial road of the city, the following development and improvement measures are expected to be executed:

  a) Spatial and functional expansion of industrial areas,
  b) Housing and related industrial development along the outer bypass (Myat Toe – Payargyi Gone - Pauk Gone), and
  c) Supporting business and commercial development for industrial areas.

- **2) Creation of New Touristic Zone in the North of the City:** A large number of tourists pass through Pathein everyday on their way to the beach. This tourist potential can be utilized to boost economic activity and trigger further development of the city. The following functions and measures are considered for creation of tourist and cultural zones in the north of the city (Taegyi Gone and Thit Nyo Gone) which are located in important transportation node connecting the Pathein Road and road to Ngwesaung Beach and Chaung Thar Beach:

a) Creation of tourist facilities (hotels and restaurants);
b) Tourist transport hub (bus terminal, tourist centers, and information center);
c) Development of cultural and leisure activities (museums, convention centers, and exhibition pavilion); and
d) Development of riverfront edge and relocation of existing warehouses.

- **3) Improvement of Touristic Environment in the Center:** The current central area of the city has unique landscape characteristics as a regional water transport hub city. In accordance with the progress of industrial and commercial development in the city and its periphery area, some of the business and commercial functions are expected to move to these new development areas. In relation to this industrial relocation, restructuring of the function of the current central business district is prospected.

- In order to attract more tourists into the city and utilize commercial, historical, and cultural resources for the touristic industry, improvement of urban space and formulation of spatial linkage among these resources need to be executed. For the reform of landscape and urban environment, the following matters are considered to be carried out in accordance with the spatial plan of the city:

a) Construction of public spaces in the central touristic area (river side area and open spaces along the major touristic route);
b) Spatial improvement of central commercial, market, and traditional production area;
c) Landscape improvement around historical, cultural, and religious monuments;
d) Pedestrian way with roadside tree which forms touristic network by connecting abovementioned resources.

- **4) Construction of a New CBD and Redistribution of Urban Function:** A new CBD is expected to be introduced in order to introduce new commercial and business functions at present. These functions are expected to be installed in the location which ensures close relation with surrounding cities in the region and current central areas of the city spatially and functionally. The entrance of the city from the Pathein Road is considered a suitable area for development of a new CBD in the vicinity of the proposed railway station. The following functions are expected to be introduced in the area:

a) Offices and business centers,
b) Commercial buildings and malls,
c) Service facilities (e.g., hotels), and
d) Passenger transport facilities (construction of linkage with new constructed railway is proposed for the long-term development).

- **5) Development of Remote Area:** The construction of a satellite town in the west of the Pathein River aims to introduce leading agricultural technologies industry and formulation of workers living environment. These functions are planned to be constructed around the west of the Pathein suspension bridge (near Pathein Computer University) or around the west jetty of the Pathein River (around the Shwe Wetluu Pagoda). The development intends to create new industrial spaces that are specialized for research and development functions. The following functions are expected to be introduced in the area:

a) Research and development facility,
b) Educational facilities (university and research institutes related to industrial technologies),
c) Production facilities,
d) Residential facilities for researchers and workers, and
e) Commercial and business facilities which support workers' daily life.

4.2.2 Housing

- In accordance with the population growth, increase of migrant workers for the new industrial areas, and change of living styles, corresponding housings are expected to be supplied in conformity to the city plan with respect on the key driver of Agri-green. Typical housing demands and issues for the realization of the development vision of Pathein City are concluded as shown in Table 4.2.3.

Table 4.2.3 Development Policy of Housing in Pathein

Housing Policy	1) Continuity of current housing developments 2) Improvement of planned residential development area 3) Improvement of the inner urban area 4) Housing development around industrial areas and along the outer bypass road for workers

Source: JICA Study Team

- **1) Continuity of Current Housing Developments:** Ongoing residential developments in the southeast of Koethein Ward, Kimnalin Kyun Ward, and Myat Toe Ward offer satisfactory housing sites and adequately constructed housings. These areas are located near the industrial areas in the north and central area of the city and are expected to be residential areas of workers of these working places. Utilization of prepared residential site by guiding its appropriate development will realize low cost housing supply including provision of apartment type affordable and social housing development.

- **2) Improvement of Planned Residential Development Area:** Residential areas in Ohmar Darni Ward and Yaekyi are developed with grid pattern planned streets, but their width and spatial capacity are insufficient. There are not enough infrastructure facilities and many housing lots are not reclaimed land. These areas are expected to function as important residential areas of the city, and improvement and construction of infrastructure are expected for these areas. In order to improve their spatial condition, it is necessary to reorganize their living environment by application of urban redevelopment project scheme and land adjustment project schemes. These planning method aims to reorganize residential zones and secure public spaces (roads and social facilities) by reconstruction of current low houses to middle-rise new apartment houses. For its realization, participatory involvement of current residents, public sector (local governments), and private developer is indispensable. Assistance on its planning and project coordination needs to be continuously offered for its realization.

- **3) Improvement of the Inner Urban Area:** Flat or two-storey buildings are constructed in residential areas in Yodayar Gone Ward and Laeti Ward. Current living condition is excellent due to its low development density. But improvement on infrastructure (road, pavement, and drainage) is necessary to be executed for their upgrading. Application of urban redevelopment scheme to these areas could be considered in order to secure quality of infrastructure and public spaces if housing demand in the central area rises in the future.

- **4) Housing Development Around Industrial Areas and along the Outer Bypass Road for Workers:** Migration of workers is expected for the industrial areas to be extended and developed. In order to promote industrial investment to these areas and to avoid deteriorated living conditions, housing supply for these workers is considered in relation with these developments. These housing areas need to be located near the working site and commercial and social facilities. Generally, housing developers are interested in housings for medium income class, but they are not interested in housing business for low income workers because of their unprofitable business prospect. Guidance and requirement of social housings by public entities need to be introduced for realization of the balanced development and housing supply.

- These housings are necessary to be supplied around the industrial areas in Pauk Gone Ward and along the outer bypass road. Medium-rise apartment type residential buildings with social public facilities need to be planned for these areas.

4.2.3 Landscape and Tourism

- Pathein planning area aims to play an important role as tourism hub city, the key driver. The following are pointed out as strong advantages on the touristic industry of the city. Utilizing the opportunity and potential in the regional context, the city is expected to offer visitors a complementary attraction to the world-class beach resorts to the west, and a tourist infrastructure that also caters for national and international business. Under such development concept, the following policies in Table 4.2.4 are highly recommended to be considered.

    a) Gateway function of the city to the beach resort cities in the west coast of Myanmar, and
    b) Cultural and religious heritages, townscapes, and landscapes of the city.

Table 4.2.4 Development Policy of Landscape and Tourism in Pathein

Landscape and Tourism Policy	1) Enhancing current touristic resource of the city 2) Promotion of new tourism value 3) Tourism zone development

Source: JICA Study Team

- **1) Promotion of New Tourism Value:** Pathein planning area is positioned in an advantageous location as a tourism gateway to famous beaches on the west coast of Myanmar. This can be utilized to create a new value of tourism, or an additional value to beach tourists. For example, it would be appealing to travelers who seek valuable experience in their holidays to offer combination of “physical relaxation” at the beach resort and “spiritual relaxation” in the Pathein planning area where many cultural and historical heritages are placed. Also, business persons can be a potential target, by offering them a “business and beach” package where they can use business facilities for conference or exhibition in the city on Fridays and stay in the beach resort during the weekend.

- **2) Enhancing Current Touristic Resource of the City:** The central area of Pathein has many cultural and historical heritages for spiritual relaxation. For example, many historical and unique pagodas are located around the center. Enhancement of the current historical value in the city landscape and townscapes and making the spatial linkages between these elements will offer continuous touristic experiences to visitors. For realization of these subjects, it is necessary to formulate corresponding spatial plans and to regulate construction activities in the surrounding area of the heritages.

- **3) Tourism Zone Development:** One of the current biggest bottlenecks for tourism promotion of Pathein is the lack of tourist infrastructures including hotel and restaurant. It may discourage visitors to stay in the city and promote them to pass to the beach. It deteriorates tourist’s satisfaction and lose the precious chance to earn revenue from them. Tourism zones with a variety of tourism functions where tourist can stay for some quality time should be developed. The area surrounding the center of the city, Pathein River, and lakeside is recommended because it has advantage of proximity to the road to the beach and many activities in the center of the city and river/lakeside.

4.2.4 Environment

- To develop Pathein as tourism hub and agri-green city by 2040, the environmental concerns to be addressed in its development policy are a) nature conservation, b) pollution control, c) living conditions, and d) natural hazard. Table 4.2.5 shows the environmental policies in Pathein.

Table 4.2.5 Environmental Policies in Pathein

Environmental Policies	1) Careful control of the urban sprawl 2) Pollution precaution 3) Building livable urban settlement 4) Flooding preparedness

Source: JICA Study Team

- **1) Careful Control of the Urban Sprawl:** It is recommendable to plot a "green belt" strategically around the general city boundary, to avoid the uncontrolled urban sprawl in the future. This "green belt" would suggest the end of the city area. Especially, in the south of the city where the Pathein River gradually turns from west to east by shaping an arc, it is highly recommendable to designate a patch of land as a part of "green belt" as a buffer zone around the branch of the Pathein River, as it could help mitigate the impact of occasional flooding caused by backflowing from the Pathein River.

- **2) Pollution Precaution:** Since many of the new industrial developments are proposed close to the existing residence areas, it is highly recommendable to take precocious action to mitigate future pollution problems. For this purpose, mandating monitoring of air and water quality, and installing wastewater facility in new industrial development are useful measures to raise awareness among people and industry.

- **3) Building Livable Urban Settlement:** Since many newly proposed town developments are plotted close to each other, in order to avoid possible increase in density and stress on infrastructure and urban services, it is recommendable to ensure clean water access, planting street trees, and safety street for any new town development to provide present living environment to city residence at the planning stage. Also, it is beneficial to enhance recreational function of the existing park area around the lake not only for residence but also for encouraging more tourists to stay in the city.

- **4) Flooding Preparedness:** Pathein experiences occasional flooding annually. There are several areas in the city prone to flooding as identified by the municipal authority. One anti-flooding measure is to upgrade the river front in the northwest part of the city along the Pathein River. Upgrading works involve a pedestrian friendly walking promenade which would serve for increasing the amenity of the area to both residence and visitors other than for flood protection.

5 Infrastructure Development and Social Service Policy

- Not only to achieve the development visions and strategies for 2040 but to realize a livable city for all citizens, infrastructure and social service improvement is fundamental. Policies by sectors were set as follows;

5.1 Road and Transportation

5.1.1 Demand Analysis

Road Transport

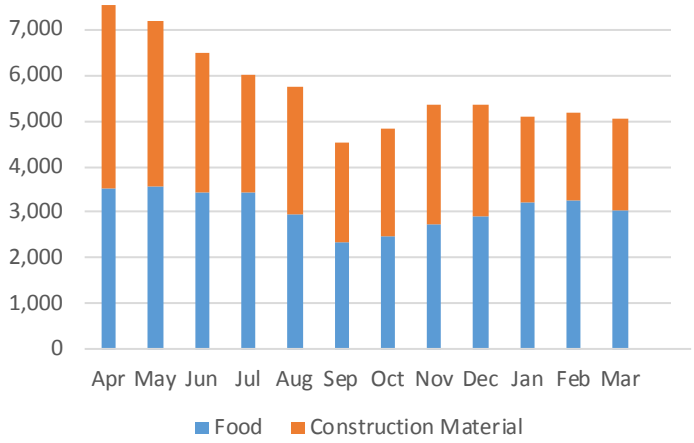
- Any holistic traffic engineering survey, such as person trip survey, to capture the people's mobility is not yet conducted in Pathein and quantitative demand analysis could not be conducted. A comprehensive traffic survey should be conducted immediately since it is essential for urban planning and transportation planning to obtain accurate data to capture the mobility of people and goods.
- At present, the only available information to estimate the overall traffic volume is the number of registered vehicles. In Myanmar, most vehicles are registered in Yangon and Mandalay.
- Moreover, the registered plates of these vehicles have not been properly updated but vehicles are used outside the city of registration. Therefore, it is often difficult to make a correlation between the number of registered cars and actual traffic volume.
- Figure 5.1.1 shows the traffic count by vehicles' registered plates in Pathein. In Pathein, majority of the vehicles on the roads are registered in Yangon (80%). The vehicle registration system in Myanmar shall be improved at the national level.

Source: Traffic Count Survey by the JICA Study Team

Figure 5.1.1 Observation of Registered Plates in Pathein City

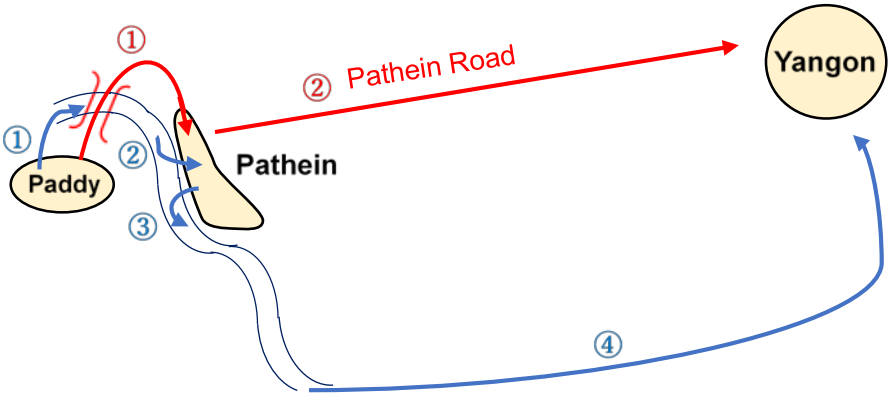
- Traffic survey data is not available and quantitative demand analysis could not be conducted. According to the visual observation, there is no congestion on the road network in Pathein even during morning/evening peak hours. Cargo handling activities on the road, i.e., loading and unloading on the road, induce traffic blockade on Strand Road and streets around the market near Strand Road.
- The urban area (15 wards) of the city is 46 km^2 only and the area is the same as the circle with a radius of 3.8 km. The large-sized public transportation might not be necessary even in the future. Considering the narrow streets in the urban area, small-sized vehicles and paratransit cars will be suitable for the public transportation of the city.
- The toll levy is collected on the national road between Pathein and Yangon (Pathein Road) and the traffic volume is counted at the toll collection gate. In general, there is no congestion on Pathein Road. The average daily traffic volume on Pathein Road is approximately 5,000 passenger car unit (pcu)/day only and the two-lane capacity of the road is still adequate for the current demand. It is noted that Pathein Road serves as a community road for villagers along the road. High-speed through traffic like large size trucks and buses induces serious traffic risk to socially vulnerable such as pedestrian and school kids.

- The development of Pathein Industrial Zone has commenced but there is no congestion at the existing truck and bus terminal.
- The cargo and passenger handling volume in Pathein is 5,693 ton/month and 40,258 pax/month only as shown in Figure 5.1.2; and congestion at the port is not observed. Recently, the transportation of rice products is shifting to land transportation as shown in Figure 5.1.3, since the road network in the region was improved. The islands in the delta are connected by bridges.



Source: DMA, Pathein Office

Figure 5.1.2 Cargo Handling Volume in Pathein Port (2015/2016)



Source: JICA Study Team

Figure 5.1.3 Current and Previous Cargo Transportation

5.1.2 Development Policy

- This study has preliminarily analyzed the current conditions, issues, and demand of transportation. Based on the results of the analysis, development policies shown in Table 5.1.1 are proposed to back up the urban development plan proposed in this study.

Table 5.1.1 Development Policies of Road and Transportation in Pathein

Road and Transportation Policies	1) Provision of urban development axis 2) Provision of logistic/industrial development axis 3) Provision of public transportation

Source: JICA Study Team

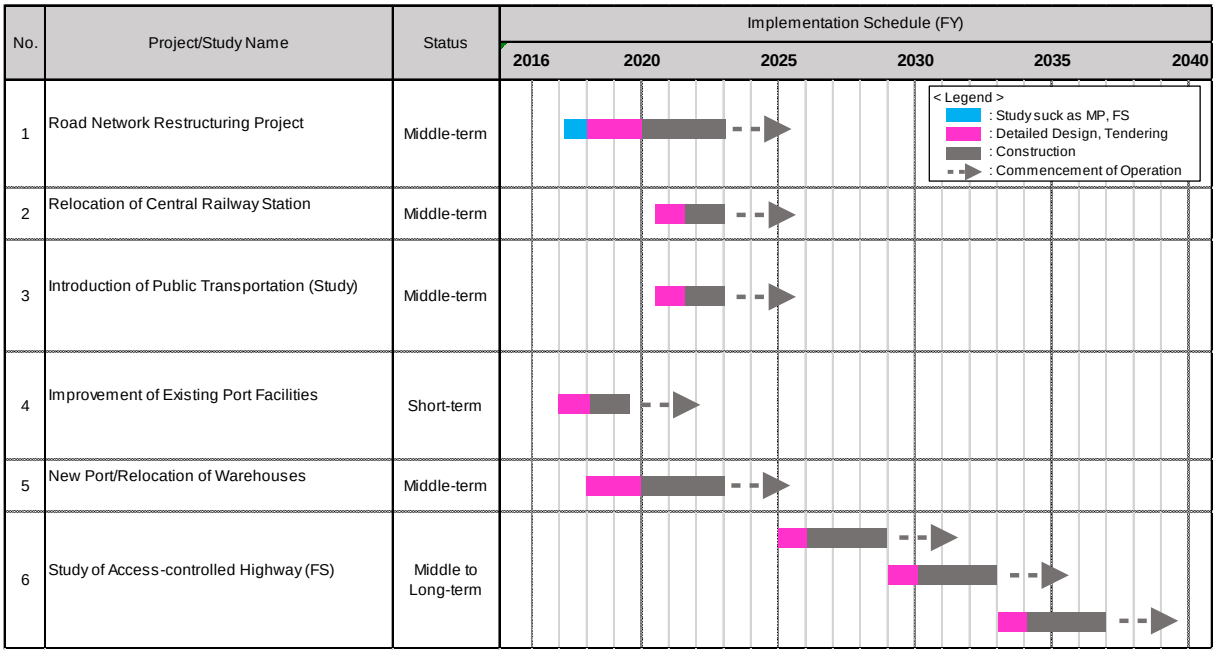
- **1) Provision of Urban Development Axis:** The road network shall be upgraded and strengthened to back up and accelerate the proposed urban development of Pathein. The existing road network of Pathein consists of narrow streets. Wider arterial roads shall be developed for the urban backbone network. The old railway track from Pathein Railway Station to the river has not been used and the land of the track might be used as the right of way (ROW) of the proposed new road. The pedestrian facility shall also be improved. Based on the proposed restructuring of the railway track, the existing central railway station located in the built-up area shall be relocated to the proposed new CBD.

- **2) Provision of Logistic/Industrial Development Axis:** Construction of the industrial zones is undertaken based on the competitive labor force in the delta region. Port operations with the current manual handling will be saturated in the future. Mechanization of cargo handling such as containerization will be necessary to back up the development of the industrial zones. The logistic road network shall be developed as outskirt roads of Pathein City. It is proposed to relocate the existing truck terminal to the proposed logistic road. The newly relocated truck terminal shall be located adjacent to the railway track to serve as multi-modal logistic terminal in the future.

- **3) Provision of Public Transportation:** Sidecar bicycle and motorbike taxi are the major public transportations in Pathein based on the low demand and current narrow road network. Currently, large demand of public transportation is not expected. Since industrial zones are being developed, the demand of public transportation will increase in the future. The new public transportation such as small/medium size bus could be introduced on the proposed new road network mentioned above.

5.1.3 Implementation Schedule

- The proposed implementation schedule of the transportation infrastructure development is shown in Figure 5.1.4.



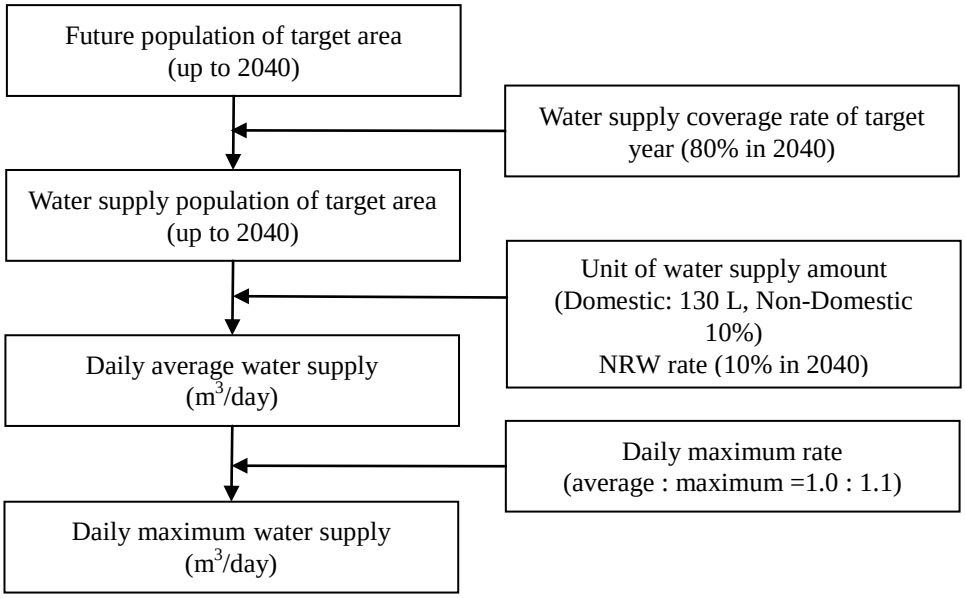
Source: JICA Study Team

Figure 5.1.4: Implementation Schedule (Road and Transportation)

5.2 Water Supply

5.2.1 Demand Analysis

- The flow of water demand forecast in the target year for Pathein City (urban + seven village tracts) is shown in Figure 5.2.1. The future population in the target year shall be based on the future population value from this study.



Source: JICA Study Team

Figure 5.2.1: Flow of Water Demand Forecast for Pathein

- Designed water supply population was obtained by multiplying the future population by the water supply coverage rate of the target year. Although water supply coverage rate is different according to the status of use of wells, from the position of a public health or a living environment, it should target the highest possible level. In this study, the water supply coverage rate was set at 80% by referring to the interview with Pathein CDC. The forecast of designed water supply population for every target year is shown in Table 5.2.1.

Table 5.2.1 Served Population of Water Supply in Pathein City Up to 2040

Year	2015	2020	2025	2030	2035	2040
Urban area population (thousands)	178	192	203	214	226	237
Seven villages population (thousands)	33	34	35	35	36	36
Total population (thousands)	211	226	238	249	261	273
Service coverage rate (%)	0%	10%	30%	52%	70%	80%
Served population (thousands)	0	23	71	129	183	218

Source: JICA Study Team

- In this study, each specification and demand of water supply are presumed with reference to the report by JICA for water supply development in other cities (Mandalay, Yangon) and the interview with Pathein CDC. As a result, the water supply demand in the target area of Pathein is forecasted to be about 35,000 m^3/day in 2040. Some new water source is needed, and the Pathein River is a candidate surface water source. The forecasted water supply demand of Pathein for each target year is shown in Table 5.2.2 and Figure 5.2.2. Also, the specifications used for the calculation of water supply demand are shown below:

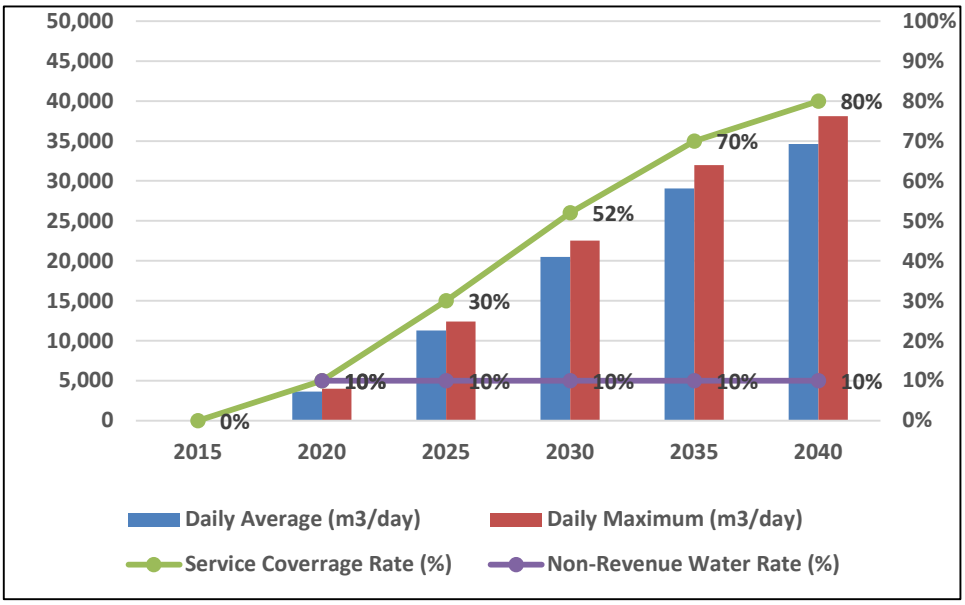
  a) Water demand per unit for domestic use: 130 liters per person per day (L/p/d)

b) Non-domestic use rate: 10% of domestic use
c) Non-revenue water rate: 10% of total demand volume
d) Daily maximum rate: 1.1 times as daily average

Table 5.2.2 Demand of Water Supply in Pathein City Up to 2040

Year	2015	2020	2025	2030	2035	2040
Served population (thousands)	0	23	71	129	183	218
Domestic use (l/c/d)	130	130	130	130	130	130
Non-domestic use rate (%)	10%	10%	10%	10%	10%	10%
Non-revenue water rate (%)	-	10%	10%	10%	10%	10%
Daily maximum rate	1.1	1.1	1.1	1.1	1.1	1.1
Demand for water supply Daily average (m^3/day)	0	3,654	11,281	20,497	29,077	34,638
Demand for water supply Daily maximum (m^3/day)	0	4,019	12,409	22,547	31,985	38,102

Source: JICA Study Team



Source: JICA Study Team

Figure 5.2.2 Demand of Water Supply in Pathein City Up to 2040

5.2.2 Development Policy

- Development of all kinds of infrastructures will support achievement of the four development visions shown by "Pathein 2040 - Ayeyarwady Delta Hub City". The development policies of water supply set up aiming at sector vision "Prompt Development of Water Supply System with Safety and Stability" and based on the analysis of current water supply system in Pathein are shown in Table 5.2.3.

Table 5.2.3 Development Policies of Water Supply in Pathein

Water Supply Policies	1) Review of the water supply master plan in Pathein City 2) Phased development of water supply facilities 3) Capacity development for management ability of water supply system

Source: JICA Study Team

- **1) Review of the Water Supply Master Plan in Pathein City:** According to the water supply project planning (August 2012), Pathein CDC has planned four water treatment plants (WTPs)

along the Pathein River. However, it may be merged into a big WTP at the north side, because the location of water intake at the river upstream has good water quality.

- **2) Phased Development of Water Supply Facilities:** Pathein CDC shall construct a WTP from the water source of the Pathein River. Water distribution pipes shall be installed mainly for urban area enhancing the water supply system in creating distribution loops. They may use vehicle type water-purifying facilities for supplying safe drinking water for a short term until WTP starts operating. The target extension of the service coverage for Pathein City (urban + seven village tracts) in 2040 is 80%.
- **3) Capacity Development for Management Ability of Water Supply System:** Pathein CDC's staff shall acquire management ability on water supply system. To save water from leakage, specialized staff shall do leak detection using modern equipment and monitoring systems.
- The development goal and performance indicators for quantitatively evaluating the effect of the water supply project in Pathein are shown in Table 5.2.4.

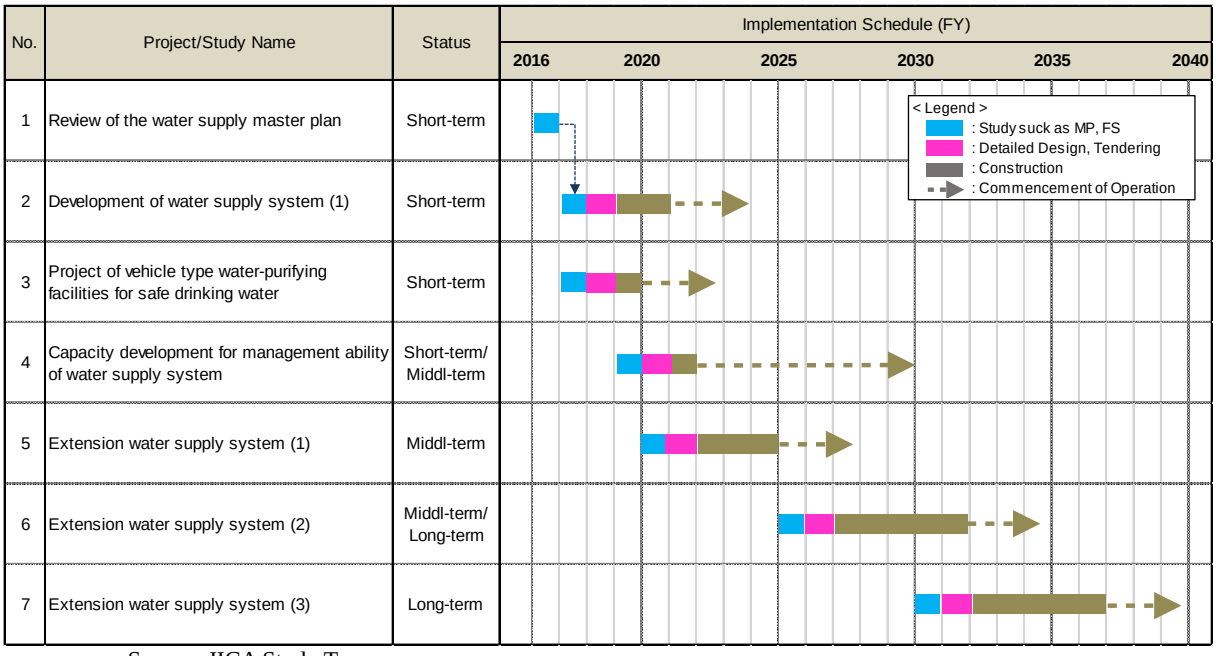
Table 5.2.4 Development Goals and Performance Indicators of Water Supply in Pathein

Development Goals		Performance Indicators (PI)
Customer Service Levels	Service quantity	24/7
	Extension of the service coverage	80% for urban + seven village
Water Quantity	Development surface water production	by 2020 (Pathein River)
	Rehabilitation of public tube-wells	100% by 2020
	Save of non-revenue water (NRW)	NRW 10% by 2040
Water Quality	Install disinfection system at WTP	by 2020

Source: JICA Study Team

5.2.3 Implementation Schedule

- The proposed implementation schedule of the water supply infrastructure development is shown in Figure 5.2.3.



Source: JICA Study Team

Figure 5.2.3 Implementation Schedule for Pathein (Water Supply)

5.3 Sewerage

5.3.1 Demand Analysis

- To decrease the risk of waterborne infectious diseases and groundwater contamination, a new WWTP with appropriate treatment process such as conventional activated sludge process will be required urgently. For the sewerage system of Pathein, comprehensive master plan will be required due to the lack of strategy for sewerage development at present. Then, in this plan, the sewerage demand shall be presumed through the following concept:

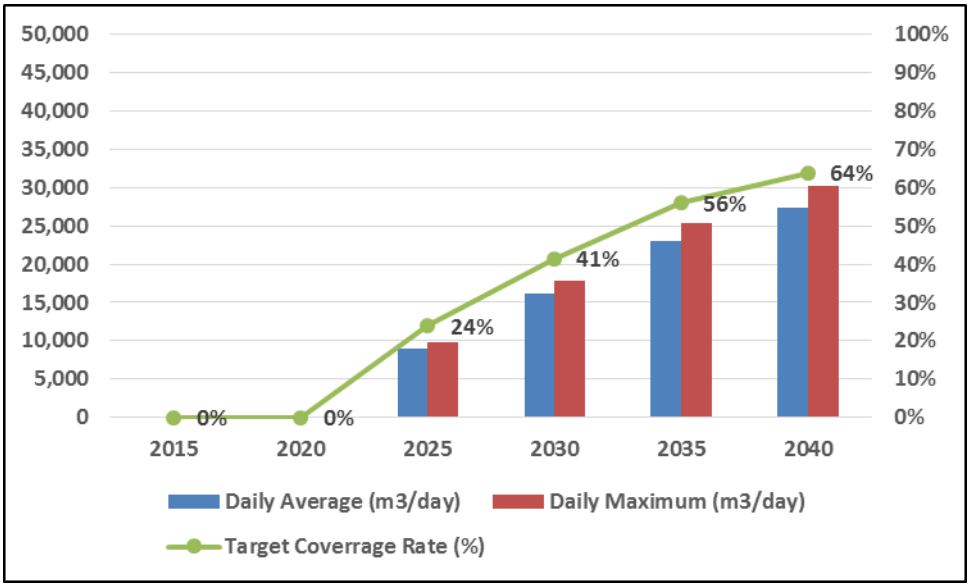
  a) Target of the sewerage system: Urban area (rural area will have individual sewage system)
  b) Domestic sewage demand: Presumed to be the same volume as water supply
  c) Industrial wastewater: Not included (industrial area will have individual sewage system)
  d) Volume of infiltration and inflow: 10% of domestic sewage

- The demand of sewerage in the urban area of Pathein was forecasted to be about 27,000 m^3/day in 2040. For preserving the sanitary water environment in the urban area, development of "efficient and advanced sewage treatment system" is required based on the increase of sewage discharge. The forecasted demand of sewerage for each target year in the urban area of Pathein is shown in Table 5.3.1 and Figure 5.3.1.

Table 5.3.1 Demand of Sewerage in Pathein (Urban Area) Up to 2040

Year	2015	2020	2025	2030	2035	2040
Target coverage rate (%)	0%	0%	24%	41%	56%	64%
Covered population (thousands)	0	0	57	103	146	174
Domestic sewage (l/c/d)	130	130	130	130	130	130
Non-domestic sewage rate (%)	10%	10%	10%	10%	10%	10%
Infiltration and inflow rate (%)	10%	10%	10%	10%	10%	10%
Daily maximum rate	1.1	1.1	1.1	1.1	1.1	1.1
Demand for sewerage Daily average (m^3/day)	0	0	8,935	16,233	23,029	27,433
Demand for sewerage Daily maximum (m^3/day)	0	0	9,829	17,856	25,332	30,176

Source: JICA Study Team



Source: JICA Study Team

Figure 5.3.1 Demand of Sewerage in Pathein (Urban Area) Up to 2040

5.3.2 Development Policy

- Currently, the water quality of the river and lake in Pathein is deteriorating because of many houses or factories discharging sewage. Therefore, to recover the healthful water environment, development of sewerage is required as soon as possible. Aiming at the sector vision of "Realization of Comfortable Life and Healthful Water Environment" and referring to the interview with MCDC, the development policies of sewerage based on the analysis of current situation of Pathein are shown in Table 5.3.2.

Table 5.3.2 Development Policies of Sewerage in Pathein

Sewerage Policies	1) Improve the water environment in public water areas 2) Improve the sanitary living environment 3) Use the flushing-clean toilet 4) Develop the beautiful city with wealthy water and green

Source: JICA Study Team

- 1) **Improve the Water Environment in Public Water Areas:** To recover the healthful water environment, a sewerage system shall be developed urgently. According to other sewerage project in Yangon or Mandalay, the discharge standards of WWTP were proposed by phased approach (BOD: short term 60 mg/L and long term 20 mg/L). Based on this situation, the target discharge standards from WWTP will be required limiting BOD to 20 mg/L. In the long term, it would be desirable to encourage the reuse of wastewater. Also, it shall be integrated with the treatment of sludge collected from septic tanks.

- 2) **Improve the Sanitary Living Environment:** The south areas particularly had lower levels of surface water pollution due to the absence of waterborne sanitation and the proliferation of latrines discharging to the groundwater. Various wastewater such as wastewater from kitchens and baths, flushed toilet water, and the like shall be purified in the sewerage system.

- 3) **Use the Flushing-clean Toilet:** To improve poor sanitary conditions and public health, Pathein CDC shall promote replacing pit latrines with flush toilets and septic tanks for households.

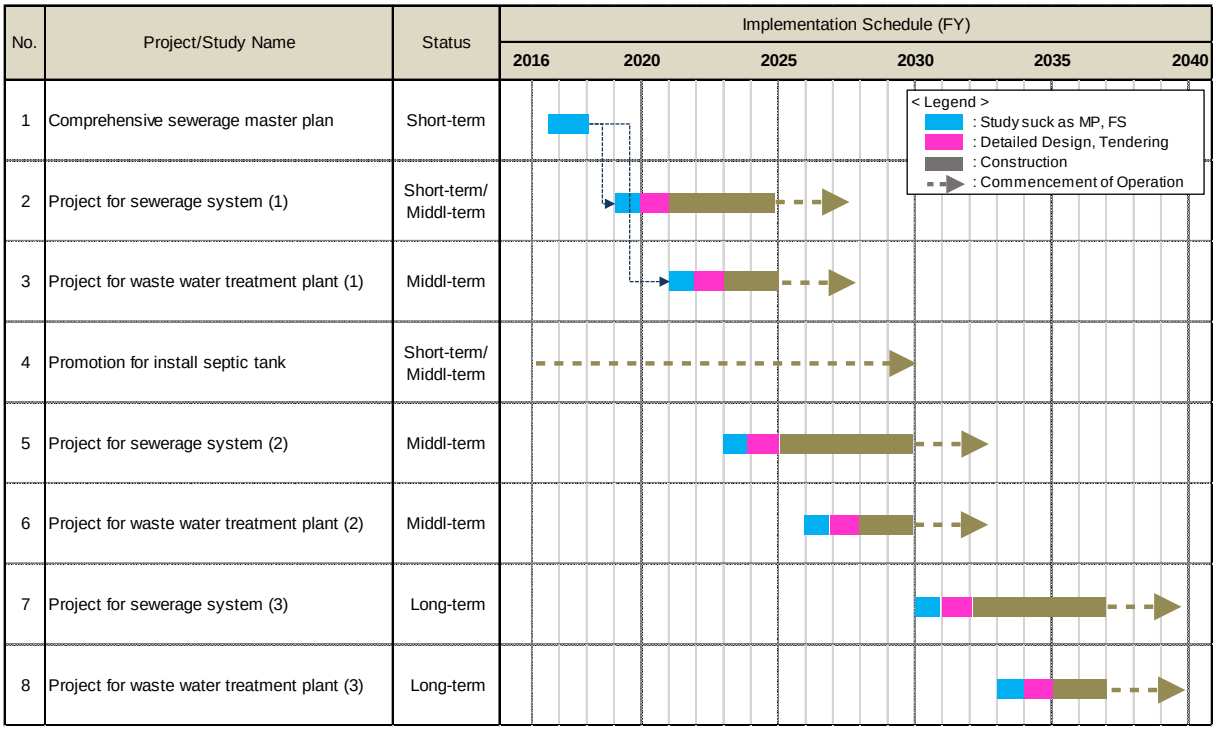
- 4) **Develop the Beautiful City with Wealthy Water and Green:** Pathein CDC promotes preservation of pure water and rich green and improvement of living environment through cooperation with urban development. The clean water through sewerage system and returning living things make up wealthy water and green environment.

- At first, sewerage planning is needed such as: (1) field survey of the topography, geology, and water quality, (2) study of basic specifications like target area, collected population, and sewage quality, and (3) consideration of sewerage type selection, collected zone, capacity and location of WWTP, and main pipe route. The development goals of sewerage of Pathein are as follows:

  a) Make a sewerage master plan with efficient and economical development,
  b) Consider a low cost sewerage project technique and mobile development based on the actual condition of the area,
  c) Develop a sewerage system with 80% of urban area being serviced by 2040,
  d) Promote installation of septic tank at every house until development of sewerage,
  e) Put the proper operation and maintenance of septic tank into practice,
  f) Promote connection with sewerage and collect a suitable charge for use, and
  g) Aim for financially sound sewerage project.

5.3.3 Implementation Schedule

- The proposed implementation schedule of the sewerage infrastructure development is shown in Figure 5.3.2.



Source: JICA Study Team

Figure 5.3.2 Implementation Schedule for Pathein (Sewerage)

5.4 Drainage

5.4.1 Demand Analysis

- There are a total of nine creeks in the town that are used for drainage in Pathein City. The capacity of the existing drainage and channel in the city is not enough during heavy rains. So, low-lying areas in the city are sometimes flooded every year. The issues of the existing drainage are as follows:

  a) Flooding does happen in some specific low-lying areas at the northwest of the city and around creeks at southern area;
  b) Some drainage canals have accumulated soil sediments and many plants are growing at the bottom that inhibits flow;
  c) There are few gates, banks, and pumps which prevent flooding in the low-lying areas.

5.4.2 Development Policy

- About the protection against large-scale flooding, a wide scope project including a river project is required. As development policy of drainage in mainly urban area, drainage facilities meeting the five-year rainfall intensity shall be improved.

- Aiming at the sector vision of "Reduce Flood Damage for Urban Safety Management" and referring to the interview with Pathein CDC, the development policies of drainage set up based on the analysis of the current situation of Pathein are shown in Table 5.4.1.

Table 5.4.1 Development Policies of Drainage in Pathein

Drainage Policies	1) To reduce the frequency of flooding in the urban area 2) The existing drainage should be used as much as possible but shall be upgraded and extended

Source: JICA Study Team

- 1) **To Reduce the Frequency of Flooding in the Urban Area:** To improve the drainage facilities, an indicator termed rainfall return period is set up as the planning target. Based on consideration of actual condition and cost benefit, five-year return period shall be used for the long-term target. Reducing the flooding of two-year return period for a short-term target shall be carried out by relatively modest investments.

- 2) **The Existing Drainage Should be Used as much as Possible but Shall be Upgraded and Extended:** Drainage of the internal runoff should be enabled by improvements (cleaning and dredging) of the drainage canals and extensions of the relevant pumping stations.

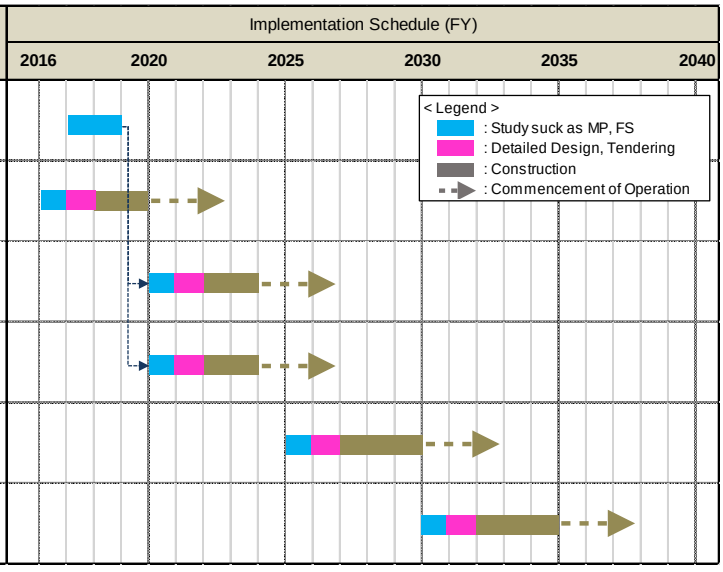
- In case of drainage planning, the target area and design conditions are considered first, and it is necessary to study the improvement, and utilize it effectively after calculating the capacity of the existing drainage. The development goals of drainage in Pathein are as follows:

  a) Make a drainage master plan by utilizing the existing facilities effectively,
  b) Improvement of urban drainage facilities causing inundation,
  c) Some drainage should be enabled by improvement (dredging and covered concrete) of the bottom, and
  d) Installation of the main pumping stations and gates.

5.4.3 Implementation Schedule

- The proposed implementation schedule of the drainage infrastructure development is shown in Figure 5.4.1.

No.	Project/Study Name	Status
1	Comprehensive storm water drainage master plan	Short-term
2	Project for dredging and improving of the existing drainage canals (1)	Short-term
3	Project for improvement of urban drainage facilities (1)	Middl-term
4	Project for installation of the mainly pumping stations and gates	Middl-term
5	Project for dredging and improving of the existing drainage canals (2)	Middl-term
6	Project for improvement of urban drainage facilities (2)	Long-term



Source: JICA Study Team

Figure 5.4.1 Implementation Schedule for Pathein (Drainage)

5.5 Solid Waste

5.5.1 Demand Analysis

- The Nan Thar Kone final disposal site is about 5 acres wide and operated by Pathein CDC. The existing dumpsite is improperly operated: no leachate confinement nor treatment, no biogas confinement nor treatment, and no soil cover on the waste. Actually, according to an interview with Pathein CDC, the remaining life/capacity of the existing dumpsites is as short as two years.

- Considering present collected garbage, the demand of solid waste is roughly calculated by unit volume (0.56 t/thousand-p/d) of another project. As a result, the demand of solid waste in urban

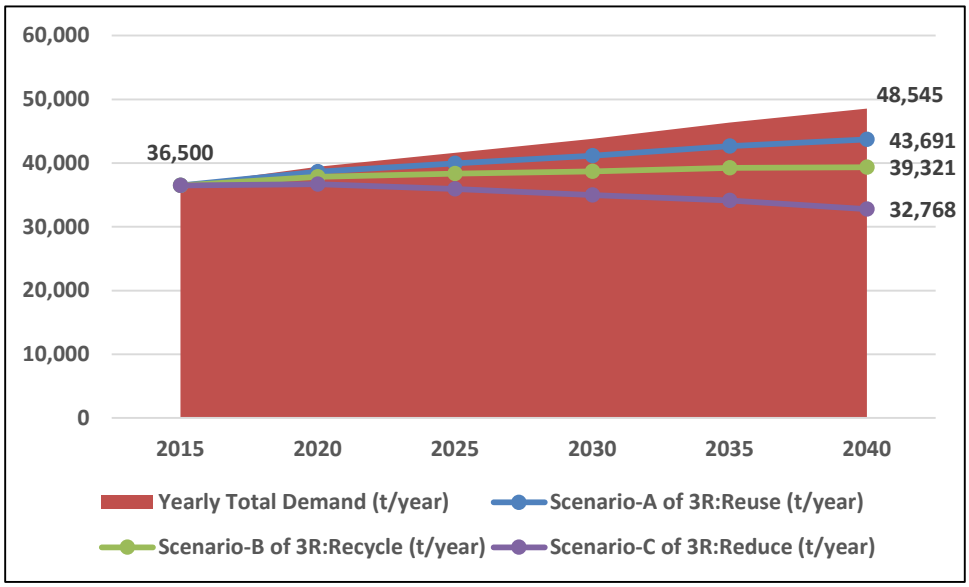
area of Pathein was forecasted to be about 49,000 ton/year in 2040. The 3R Policies (reduce, reuse, and recycle) is required to reduce solid wastes that continuously increase. Therefore, the scenarios of 3R are assumed as shown below. The forecasted demand of solid waste for each target year based on the scenario of the 3R policies in the urban area of Pathein is shown in Table 5.5.1 and Figure 5.5.1.

a) Scenario-A: 10% reduction by reusing available material from waste
   Reuse (10% by 2040)
b) Scenario-B: in addition, 10% reduction by recycling organic material
   Reuse (10%) + Recycle (10% by 2040)
c) Scenario-C: moreover, 15% reduction by incineration of waste
   Reuse (10%) + Recycle (10%) + Reduce (15% by 2040)

Table 5.5.1 Demand of Solid Waste in Pathein (Urban Area) Up to 2040

Year		2015	2020	2025	2030	2035	2040
Urban population (thousands)		178	192	203	214	226	237
Unit volume (t/thousand-p/day)		0.56	0.56	0.56	0.56	0.56	0.56
Demand of solid waste (t/day)		100	108	114	120	127	133
Yearly total demand (t/year)		36,500	39,420	41,610	43,800	46,355	48,545
Scenario-A of 3R:	Reuse rate (%)	0%	2%	4%	6%	8%	10%
	Reuse (t/year)	36,500	38,632	39,946	41,172	42,647	43,691
Scenario-B of 3R:	Recycle rate (%)	0%	2%	4%	6%	8%	10%
	Recycle (t/year)	36,500	37,859	38,348	38,702	39,235	39,321
Scenario-C of 3R:	Reduce rate (%)	0%	3%	6%	9%	12%	15%
	Reduce (t/year)	36,500	36,700	35,951	34,996	34,117	32,768

Source: JICA Study Team



Source: JICA Study Team

Figure 5.5.1 Demand of Solid Waste in Pathein (Urban Area) Up to 2040

5.5.2 Development Policy

- To solve the issue on solid waste and for comfortable and beautiful urban development, a comprehensive action of 3R by united local government and citizen is needed. Aiming at the sector vision of "Beautiful City Movement with a Sound Material-Cycle Society" and referring to the interview with MCDC, the development policies of solid waste based on the analysis of the current situation of Pathein are shown in Table 5.5.2.

Table 5.5.2 Development Policies of Solid Waste in Pathein

Solid Waste Policies	1) Realization of solid waste management with stability and safety for long term 2) Promote 3R (reduce, reuse, and recycle) 3) Build a sound material cycle society 4) Reduce environmental impact by proper disposal of hazardous wastes

Source: JICA Study Team

- 1) **Renewal of Solid Waste Management with Safety:** Waste management encompasses management of all processes and resources in compliance with health codes and environmental regulations.

- 2) **Promote 3R (Reduce, Reuse, and Recycle):**

  a) **Reduce**: The first and most effective component of the waste management hierarchy is reducing the waste created. Consumers are encouraged to reduce their waste by purchasing in bulk, buying items with less packaging, and switching to reusable instead of single-use items.
  b) **Reuse**: Much of this waste can immediately be reused to minimize the strain on the environment and municipal waste management. For example, consumers can refill a purchased bottle of water with water from home to minimize the number of plastic bottles being discarded.
  c) **Recycle**: When waste is eventually discarded, segregating items for recycling from other waste is important. The recyclables include glass, newspaper, aluminum, batteries, cardboard, and many other materials.

- 3) **Build a Sound Material-Cycle Society:** The 3R policy is a basic action for a sound material-cycle society; and all of the local government, citizens, and companies should have a positive attitude about 3R. Pathein CDC shall promote it through public relations, forum, personnel training project, campaigns, and events.

- 4) **Reduce Environmental Impact by Proper Disposal of Hazardous Wastes:** Hazardous wastes should not be dumped into a landfill like other wastes. It needs to be disposed of responsibly to prevent hazards to human and environmental health.

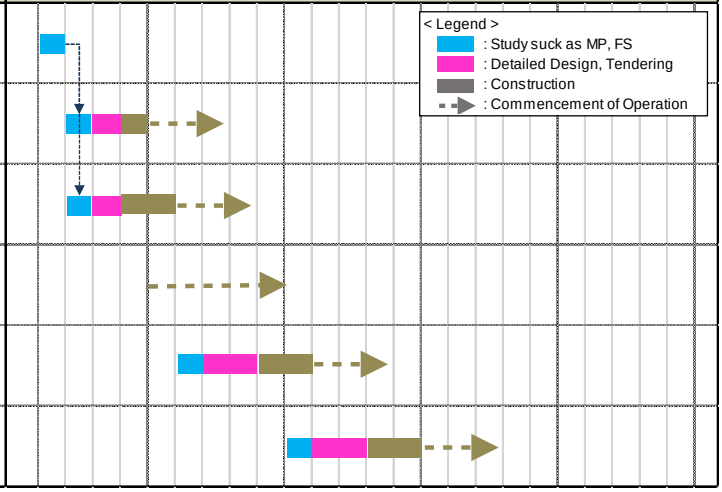
- The development goals of solid waste in Pathein are as follows:

  a) Make a comprehensive strategic planning for collection and reuse of available material in the source of waste,
  b) Provide a recycle system for various material by separate collection,
  c) Construct an incineration plant for solid waste reduction and some management facilities,
  d) Develop new final disposal site with proper reclamation and treatment method.

5.5.3 Implementation Schedule

- The proposed implementation schedule of the solid waste infrastructure development is shown in Figure 5.5.2.

No.	Project/Study Name	Status	Implementation Schedule (FY)
			2016 2020 2025 2030 2035 2040
1	Comprehensive strategic planning of reusing of solid waste and Promotion of the project	Short-term	
2	Construction of the recycling system by separate collection of organic waste	Short-term	
3	Construction of the final disposal site by a proper reclamation and treatment method	Short-term	
4	Project for capacity development of solid waste management	Middl-term	
5	Proper collection of hazardous wastes, and construction of treatment facilities	Middl-term	
6	Construction of incineration facilities for decreasing solid waste	Middl-term	



Source: JICA Study Team

Figure 5.5.2 Implementation Schedule for Pathein (Solid Waste)

5.6 Electricity

5.6.1 Demand Analysis

- While estimating the power consumption and/or peak demand of Pathein target area, frequent suspension of power supply associated with equipment failure and/or shortage of power supply, amount of scheduled load shedding, and distribution loss shall be taken into account. Unfortunately, a well-maintained trend of detailed database was not available in Myanmar's power systems which makes it very difficult to make good estimation of the demand and peak demand forecast even using conventional theorems. Thus, making a strong, detailed, real time, errorless, and digitalized database is truly essential for appropriate planning and design of a superior power system and electrical infrastructure equipment. Installation of SCADA system with centralized/regional control provision would be the first step to start a digitalized database.

- The yearly peak demand trend of Pathein District until 2014 is shown in Table 5.6.1. The peak demand is the maximum value of power demand during a given period. In general, the average power consumption per hour is employed.

Table 5.6.1 Peak Demand Growth Trend of Pathein District

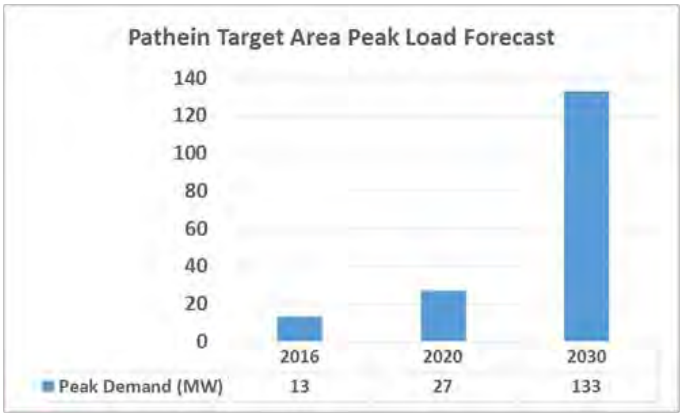
Year	Peak Demand (MW)	Demand Growth Rate
2012	23.2	-
2013	26.4	13.8%
2014	31.9	20.8%

Source: Final Report of 'Preparatory Survey on Distribution System Improvement Project in Main Cities' by JICA

Since the peak demand growth trend data of the target area is not available, the JICA Study Team has decided to consider the trend data of Pathein District for approximation. Although the past trend is usually considered the basis for forecasting the peak power demand, it becomes uncertain in cases where abnormal growth rate of the past few years continues in the future. In the short term, the compound annual growth rate (CAGR) of the past trend may be considered to estimate the peak demand forecast. The CAGR of peak demand in this case is 17.3%, while Pathein ESE assumes that the peak demand growth rate forecast of the target area is 20% for short term. Now, due to the limited statistical data and unavailability of any concrete future development plan, the demand forecast estimations using conventional methods would not be able to receive any

concrete result. Thus, along with database creation, a concrete urban power and electrical infrastructure development master plan shall be formulated.

- However, the demand forecast for the target area made by the JICA Study Team considered 20% growth in the short term and 17.3% in the medium term based on the 66 kV transformers' peak load (13 MW) data dated 7 May 2016. The forecast result till 2030 is shown in Figure 5.6.1. The CAGR of this forecast is 18.07%. With the current data, long-term forecast would not be wise.



Source: JICA Study Team

Figure 5.6.1 Peak Demand For Pathein Township

- In order to get a more precise result in the future, many other modern approaches using weather forecast and artificial intelligence could be used depending on the available data.

5.6.2 Development Policy

- Based on the current condition, issues, and demand forecast analysis, development policies shown in Table 5.6.2 shall be imposed to back up the urban development plan proposed in this study.

Table 5.6.2 Development Policies of Electricity in Pathein

Electricity Policies	1) Distribution loss reduction 2) Developing digital database 3) Comprehensive urban energy and electric power system development plan 4) Upgrading and strengthening of 66 kV substation network 5) Involvement of ESE and/or MOEPE in urban planning

Source: JICA Study Team

- **1) Distribution Loss Reduction:** Currently, the distribution loss in Pathein Township is around 17% according to the ESE. Projects targeting distribution loss reduction shall be taken.

- **2) Developing Digital Database:** Any electricity-related plan and/or design is basically based on detailed data analysis. Making an efficient, detailed, real-time, errorless, and digitalized database of Pathein itself would solve many problems in the power system as well as give Pathein Township a superior power system and electrical infrastructures such as smart cities in the future. Installation of supervisory control and data acquisition (SCADA) system with centralized/regional control provision would be the first step to start a digitalized database.

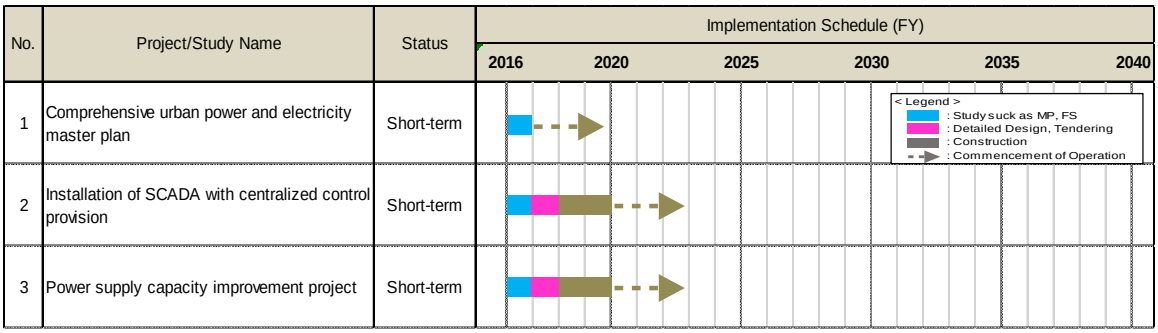
- **3) Comprehensive Urban Energy and Electric Power System Development Plan:** Although Myanmar has formulated an electricity master plan, developing a comprehensive study on energy and power infrastructure of a city like Pathein shall ensure the synchronization of future development plan and urban electricity master plan.

- **4) Upgrading and Strengthening of 66 kV Substation:** In Pathein Township, the electricity supply depends on the capacity of the 66 kV substation. The 66kV substation facilities shall be upgraded on emergency basis.

- **5) Involvement of ESE and/or MOEPE in Urban Planning:** The JICA Study Team's estimation of peak demand forecast and the ESE's peak demand forecast are different. One of the reasons behind this difference is that ESE is not updated about the information of future urban development plans like development ratio made by the other bodies of Myanmar government. Thus, direct involvement of ESE and/or MOEPE while formulating these development plans and/or development committee is recommended.

5.6.3 Implementation Schedule

- The proposed implementation schedule of the electrical infrastructure development is shown in Figure 5.6.2.



Source: JICA Study Team

Figure 5.6.2 Implementation Schedule (Electricity)

5.7 Social Service

- Benefits from achievements of the master plan including economic growth and improvement of environmental condition should be shared with all the people in the community. This means not only increasing the incomes of the poor, but also addressing the needs of disadvantaged and excluded groups. In addition, the development should allow them to fully participate and contribute in the process of growth. To achieve inclusive development, it is key to provide equal opportunity and accessibility to social services for all the people which include all classification in any income groups. To secure the provision of social service, the following development policies should be aimed for:

Table 5.7.1 Development Policies of Social Service in Pathein

Social Service Policies	1) Provision of equal opportunity of education and employment for all people 2) Provision of healthy and secured living environment for all people 3) Provision of social safety net for all people

Source: JICA Study Team

- **1) Provision of Equal Opportunity of Education and Employment for All People**: Education helps provide children with opportunities to fulfill their potential and is critical to all aspects of social development. However, access to education is limited particularly for low income groups and minorities. Attendance rates of primary schools (primary school age) in Mandalay City is 74-80%, although Myanmar's constitution guarantees access to free and compulsory primary education to all children. In addition, attendance rates of the following basic education schools, middle, and high school, decrease gradually with increase of their age. Those are mainly caused by economic difficulties, poor access mode to schools, and gap of number of schools. Measures to reduce this should be taken. Regarding employment, labor market and employment opportunities have many gaps concerning those classified as vulnerable groups such as people with lower education levels, poor, and persons with disabilities. New graduates from universities also have difficulties finding immediate employment. Those hidden demands of vulnerable groups and new

entrants to the labor market should be clarified and matched with appropriate jobs. The following recommended supports should be considered to provide equal opportunity of education and employment:

- Preparation of school allocation plan according to the estimated future population and number of students;
- Develop regulations that lead to greater complementarities between private and public schools;
- Upgrading teacher quality with pre-service and in-service teacher training programs;
- Improvement of infrastructures for educational institutions such as laboratory and library;
- Operation of school bus service and launching mobile school program in remote areas;
- Spread of scholarship program for children with economic difficulties;
- Enhancement of job matching network with various employment opportunities, target of which includes students that graduated from higher education facilities; and
- Provision of vocational training which targets special job seekers including those who left schools earlier, person with disabilities, poverty groups, and females.

- **2) Provision of Accessibility to Healthy Life for All People**: Quality of life is closely related to health condition. In addition, good health condition gives a positive impact on productivity and amount of labor force. On the contrary, health problem may increase the risk of poverty through lost earnings and increased health expenditures. However, health facilities by type are currently not equally distributed in Pathein planning area. The gap of service level should be balanced by establishing necessary health facilities with appropriate assignment of qualified health workers. The following recommendations should be considered to enhance the health status of the community:
  - Improve supply and access of health care services for all areas considering number, type, and transportation;
  - Establish appropriate and sustainable health financing scheme;
  - Training of health provider (in-service and on-the-job) and appropriate assignment of qualified health workers;
  - Launch program for promotion of public health such as education and information about the spread of diseases;
  - Introduce health insurance system particularly for the urban poor community; and
  - Community support system for elderly people to provide health care, social care, and protection in their daily activities.
- **3) Provision of Social Safety Net for All People**: Participation of socially vulnerable groups to the growth process of the city will contribute in realizing an inclusive development. Actually, there are people who are in socially vulnerable groups which have poverty, low level education, and disabilities. For example, according to data from UNDP, 32% of Ayeyarwady residents are in poverty and most of them originally belong to such situation and it is hard to get out of poverty cycle. On the other hand, anyone has the potential to fall into socially vulnerable group because of accidents including recession, serious injury or disease, debilitation due to getting older, and becoming a single or no-parent family. It is quite important to provide social support for them to

get opportunity to have secured livelihood. The following recommendations should be considered to support socially vulnerable people's lives:

- Survey on the existing condition of socially vulnerable groups including poor, orphans, and people with disabilities regarding living condition, education, employment, and health for appropriate support;
- Provision of affordable housings for low income household;
- Promotion of human development programs such as skill-enhancement training and vocational training;
- Financial support including scholarship and grant for orphans and children with disabilities; and
- Promotion of universal design (barrier-free) in public facilities, public transportation, and footpath.

6 A Roadmap of Key Projects

6.1 Development Aspects

- The plan assumes three development aspects with targets. The following describe concrete projects and activities for each development aspect.

Execution of Industrial Development and Development of Related Infrastructures

- The plan focuses on the completion of current ongoing projects and preparation/construction of the principal industrial facilities for the development aspect. It intends to accommodate migrant persons for new industries and to prepare basis of urban infrastructures for the following development. The following are planned to be executed in the development aspect:

    - Logistics and industrial function improvement (refer to key project of no.6, 7, 8 & 9 in the next page)
    - Arterial roads network development (no.3, & 4)
    - Public transportation improvement (no.4, & 5)
    - Basic infrastructure development (no.10, 11, 12, & 13)
    - Industrial zone development (along the outer bypass)
    - Ordinal housing supply (necessary to construct principal infrastructure networks)

Improvement of Urban Environment and Strengthening of Touristic Function

- The improvement of current urban areas is planned in the development aspect, after completion of construction of basic infrastructure services and ensuring their basic supply. Upgrading the spatial quality in the central area where many cultural and commercial facilities are located and newly introduced visitors' facilities in the touristic hub area in the north will lead touristic and economic development of the city with its symbolical appearances. Some new housing developments are planned to start after thorough examination of spatial planning and business plans.

    - Tourism hub function improvement (no.2)
    - Improvement of residential environment by urban redevelopment and land readjustment
    - Informal settlements formalization

Creation of New Function of the City

- After examination and formulation of planning and business schemes, the developments for new town areas and new CBD areas are planned to start. Because of their extensive development areas, their developments need to progress by stages. The development plans need to be reviewed and modified according to the demand for housings and business facilities if necessary.

    - Commercial and business area development (no.1)
    - Remote area development (west of Pathein River)

6.2 Key Projects

- To achieve the development vision and realize the spatial plan written in the previous section, 13 key projects, which are focal actions to be commenced in the short term (two from urban development sector and 11 from infrastructure development sector), are selected and described in detail in this section. Some projects could be commenced in the middle term because discussion and preparation works are recommendable to be started as soon as possible. Table 6.2.1 summarizes them and the following section describes each project.

Table 6.2.1 Key Projects

Sector	Project Name	Vision (Key Drivers)		
		Tourism HUB	Logistic HUB	Agri-green
Urban Development	1. New CBD Development Project	++	+	
	2. Tourism Hub Development Project	++		+
Infrastructure Development	3. Road Network Restructuring Project	++	++	
	4. Central Railway Relocation Station		++	
	5. Public Transportation Introduction Project		+	+
	6. Port Facilities Improvement Project		++	
	7. New Port Construction and Warehouses Relocation Project		++	
	8. Pathein Airport Improvement Project	+	++	
	9. Access-controlled Highway Project (Study)	++	++	
	10. Water Supply Development Project	+	+	+
	11. Drainage Improvement Project	+	+	+
	12. Solid Waste Management Project	+	+	+
	13. Power Supply Capacity Improvement Project	+	+	+

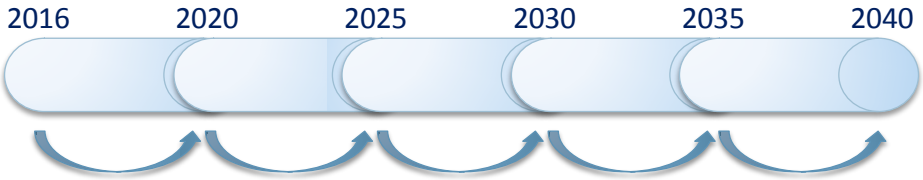
Note: ++ Strong Relation, + Relation
Source: JICA Study Team

Table 6.2.2 Implementation Schedule and Rough Cost Estimation of Key Projects

No.	Project Name	Implementation Schedule	Rough Cost Estimation (million USD)	Status*	Implemented by
1	New CBD Development Project		61	-	-
2	Tourism Hub Development Project		230	-	-
3	Road Network Restructuring Project		15	-	-
4	Central Railway Relocation Station		10	-	-
5	Public Transportation Introduction Project		0	-	-
6	Port Facilities Improvement Project		10	-	-
7	New Port Construction and Warehouses Relocation Project		—	-	-
8	Pathein Airport Improvement Project		10	-	-
9	Access-controlled Highway Project (Study)		—	-	-
10	Water Supply Development Project		6	-	-
11	Drainage Improvement Project		1	-	-
12	Solid Waste Management Project		5	-	-
13	Power Supply Capacity Improvement Project		3	-	-

Note: * " - " in the status column means the project is in proposal stage and its implementation body is not yet determined.
Source JICA Study Team

- It is recommendable that the key projects are planned every five years through the monitoring regard on progress of conducting projects and change of circumstances. According to drafted "Urban and Regional Development Plan", a master plan shall be formulated every 5 – 10 years under the conceptual plan. In this context, re-planning of key projects shall be one of the works in master planning.



Source: JICA Study Team

Figure 6.2.1 Image of Planning Cycle for Key Projects

1. New CBD Development Project

Table 6.2.3 New CBD Development Project

Current Status and Issues	Vacant land is currently available for development of a new CBD in the vicinity of the proposed railway station. The concept is to create a walkable CBD next to the railway station. The edges of the CBD would be iconic office towers while the inner buildings would be smaller offices. A green shaded pedestrian spine would connect the entire length of the CBD and the railway station through a plaza on the upper level.
Purpose	The purpose is to develop a new CBD for the city and maximize business and commerce activities in the city.
Main Scope	- Development of offices, business centers, and malls near the existing industrial zone - Development of hotels - Development of leisure center - Development of a central activity zone for the residents

Source: JICA Study Team

Source: JICA Study Team

Figure 6.2.2 Images of the New CBD Development Project

2. Tourism Hub Development Project

Table 6.2.4 Tourism Hub Development Project

Current Status and Issues	A large number of tourists pass through Pathein everyday on their way to Ngwe Saung Beach. This tourist potential can be developed upon creation of a tourism zone in the northwestern part of the city. This hub will boost the economic growth of the city and create employment opportunities for the residents.
Purpose	To create a tourist and cultural zone that will boost the economic activity in Pathein and trigger further development.
Main Scope	- Creating tourist facilities - Developing cultural activities - Developing the Strand Road and riverfront edge - Relocation of existing warehouses - Creating leisure activities for citizens

Source: JICA Study Team

Source: JICA Study Team

Figure 6.2.3 Images of the Tourism Hub Development Project

3. Road Network Restructuring Project

Table 6.2.5 Road Network Restructuring Project

Current Status and Issues	- There is no congestion on the main roads of the city except parts of Strand Road and narrow secondary streets around the market. - Most of the arterial roads in the city have very narrow carriageway without sufficient road shoulder. Additional arterial axis roads will be required to back up the proposed urban and logistic/industrial area. - There is an abandoned (unused) old railway track and part of the track was replaced.
Purpose	Restructuring of the road network to suit the proposed urban spatial plan.
Main Scope	- Upgrading of the outer skirts road from “Pathein Industrial City” to the “Pathein Industrial Zone” - Construction of the new alignment to bypass the proposed CBD area - Provision of the additional urban arterial road on the abandoned railway corridor - Improvement of the existing arterial roads - Pedestrian facilities on the road network

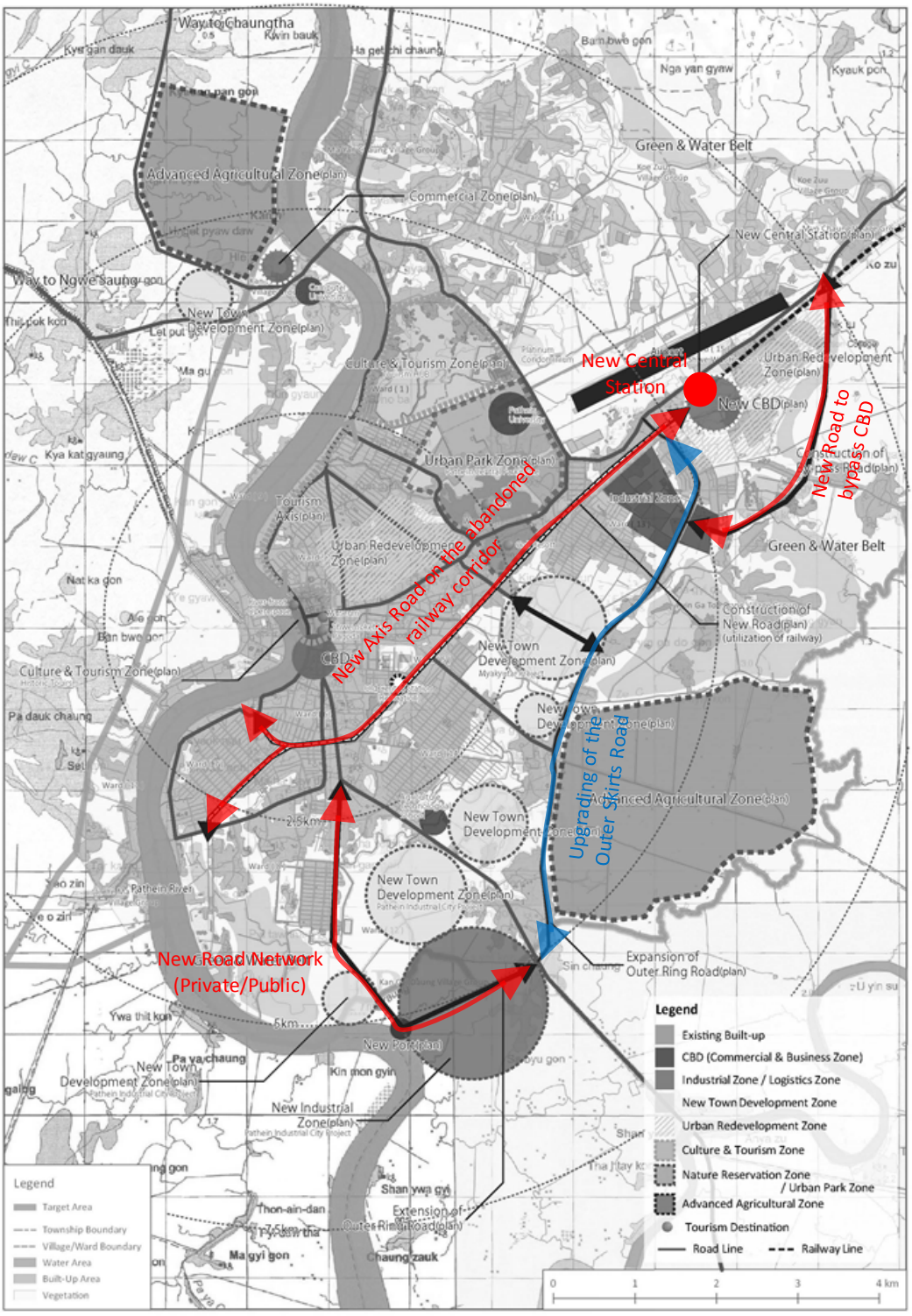
Source: JICA Study Team

4. Central Railway Relocation Station

Table 6.2.6 Outline of Relocation of Central Railway Station

Current Status and Issues	- The existing old railway track from the central station to the Ayeyarwady River has not been used. The central station is located in the densely built-up area. Access roads are quite narrow and there is no space for further station development. - Additional arterial axis roads will be required to back up the proposed urban and logistic/industrial area.
Purpose	- Relocation of the central station to the proposed CBD to improve convenience of railway users. - Provision of ROW for the axis road instead of the abandoned railway track.
Main Scope	- Relocation of the central station to the proposed new CBD - Demolition of the abandoned railway track in order to provide ROW for the road construction - Transit facility for other public transport system such as buses and taxi

Source: JICA Study Team



Source: JICA Study Team

Figure 6.2.4 Image of the Road Network Restructuring and Railway Station Relocation

5. Public Transportation Introduction Project

Table 6.2.7 Public Transportation Introduction Project

Current Status and Issues	- Lack of public transport - Narrow streets in the city center - Construction of new industrial areas
Purpose	Provision of public transport for industrial workers and tourists
Main Scope	- Mode selection study (paratransit type vehicles will be suitable for narrow streets and current demand) - Less or no emission vehicles might be preferable - Construction of bus stops - Provision of sidewalk with at least 1.5 m width

Source: JICA Study Team

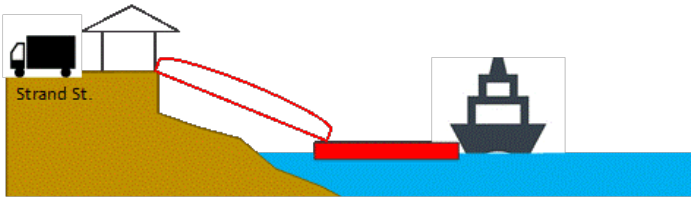
6. Port Facilities Improvement Project

Table 6.2.8 Port Facilities Improvement Project

Current Status and Issues	Old port infrastructure is still being used in jetties. No parking space is provided for loading/unloading around jetties; and traffic congestion is induced by cargo handling works on Strand Road.
Purpose	Ease traffic congestion on Strand Road
Main Scope	Construction of parking space for cargo handling activity

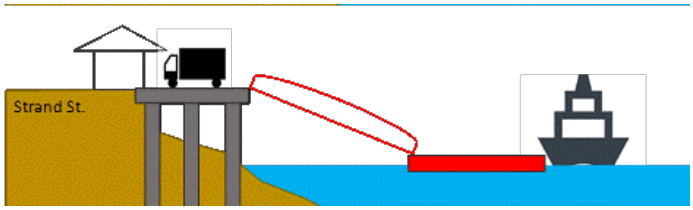
Source: JICA Study Team

(Cargo Handling on Strand Road)



(Current)

(Existing Jetty)



(Improved Image)

Source: JICA Study Team

Figure 6.2.5 Images of the Port Facilities Improvement Project

7. New Port Construction and Warehouses Relocation Project

Table 6.2.9 New Port Construction and Warehouses Relocation Project

Current Status and Issues	- Port facilities such as jetties, warehouses, and port-related offices are located in the current CBD area. - New industrial area named “Pathein Industrial City” in the southern area of the city is under development.
Purpose	Relocation of the port facilities to the southern area based on the proposed urban spatial plan
Main Scope	- Construction of the new port in the south - Relocation of warehouses to the southern area around the new port/industrial area

Source: JICA Study Team

(Existing Warehouses on Strand Road)

(New Port proposed by Pathein Industrial City)

Source: JICA Study Team

Figure 6.2.6 Images of the New Port Construction and Warehouses Relocation Project

8. Pathein Airport Improvement Project

Table 6.2.10 Pathein Airport Improvement Project

Current Status and Issues	- Cancelation of international pre-flight service - Budget constraint and damaged airport infrastructure
Purpose	Proper maintenance and repair of airport infrastructure
Main Scope	- Overlaying of the runway - Replacement/improvement of damaged/old facilities

Source: JICA Study Team

9. Access-controlled Highway Project (Study)

Table 6.2.11 Access-controlled Highway Project (Study)

Current Status and Issues	- Pathein Road is a “community road” and also a “logistic road”, and induces safety risk to vulnerable villagers along the road. - There are several deep port plans and tourism development plan in and around Pathein City, and the logistic/tourism axis will be required.
Purpose	- Improvement of traffic safety on the existing two-lane road between Pathein and Yangon - Provision of high-standard axis road to accelerate the development of the delta area
Main Scope	Feasibility study for the access-controlled highway between Pathein and Yangon

Source: JICA Study Team

Source: JICA Study Team

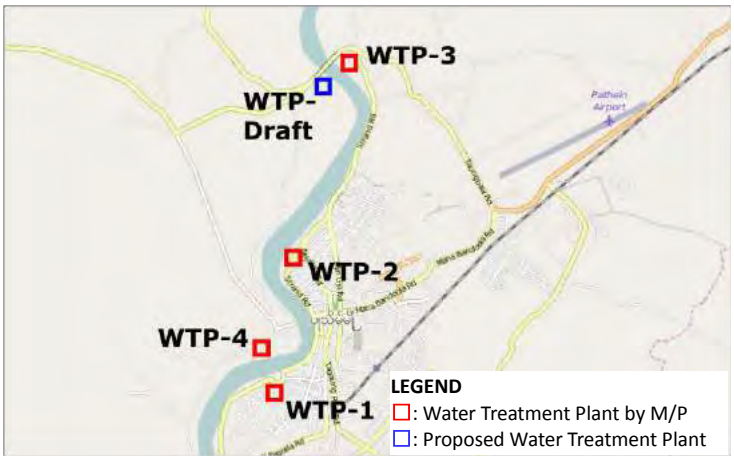
Figure 6.2.7 "High-speed Through Traffic" in Villages along Pathein Road

10. Water Supply Development Project

Table 6.2.12 Water Supply Development Project

Current Status and Issues	There is no modern water supply service in Pathein City although many households have their own dug-wells; but the water quality of most of these wells is not good and not suitable for drinking purpose.
Purpose	Development project of water supply system in central urban area
Main Scope	- Water treatment plant with Pathein River as the water source - Water reservoir, distributing pump, and pipe network

Source: JICA Study Team



Source: JICA Study Team

Figure 6.2.8 Image of Water Supply Development Project

11. Drainage Improvement Project

Table 6.2.13 Drainage Improvement Project

Current Status and Issues	There are nine creeks that are used for drainage in Pathein City. The capacity of the existing drainage and channel in the city is not enough for heavy rains. Some creeks have accumulated soil sediments, and many plants are growing at the bottom that inhibit flow.
Purpose	Improvement of the bottom of creeks will increase flow capacity.
Main Scope	- Cleaning and dredging on the bottom of creek - Improving the creeks by concrete/bloc or masonry structure

Source: JICA Study Team

Source: JICA Study Team

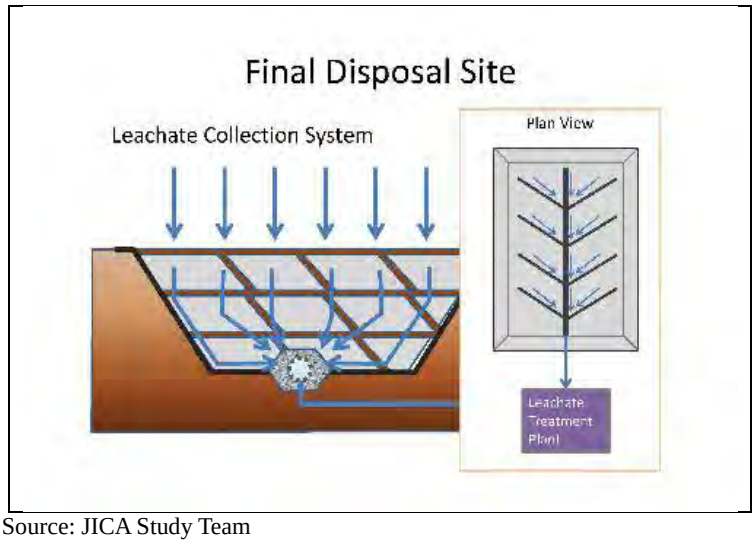
Figure 6.2.9 Images of the Drainage Improvement Project

12. Solid Waste Management Project

Table 6.2.14 Solid Waste Management Project

Current Status and Issues	The existing dump site will reach full capacity in the near future. Solid waste management facilities are severely old.
Purpose	Creating a clean city with a sound material-cycle through 3R (reduce, reuse, and recycle) policy and its execution.
Main Scope	- Improve the capacity of maintenance equipment. - Set up 3R policy and execute a training program for solid waste management.

Source: JICA Study Team



Source: JICA Study Team

Figure 6.2.10 Image of the Solid Waste Management Project

13. Power Supply Capacity Improvement Project

Table 6.2.15 Outline of Power Supply Capacity Improvement Project

Current Status and Issues	Current overall capacity of some 66 kV transformers are almost full during peak demand. And these transformers will be overloaded during peak hours by 2017.
Purpose	Ensuring the supply reliability of electric power
Main Scope	- Installation and rehabilitation of 66 kV substations and/or - Upgrading 66 kV substations to 132 kV substations with higher loading capacity - Enable well-planned cascade connections to ensure N-1 contingency condition

Source: JICA Study Team

Source: JICA Study Team

Figure 6.2.11 Image of the Power Supply Capacity Improvement Project

6.3 Future Image of Pathein 2040

- A bird's eye view of future urban image of Pathein was drawn using computer graphics. The view from northwest is the culture and tourism zone in front and the new CBD at the back.

Source: JICA Study Team

Figure 6.3.1 Bird's Eye View of Future Urban Image of Pathein

7 Project Implementation and Urban Management

7.1 Urban Development Management

7.1.1 General View of Urban Development Management by Official

- The spatial control and principal measures to be taken by the local and central government for the realization of urban development policies and projects are common. These control measures are expected to be executed based on the law, by-laws, and other legal frameworks.

- The following are spatial control zones which are expected to be introduced for the realization of planning items:

  a) Boundary of urbanization area: These are areas which can be used for future development. The area is composed of urbanization area, urbanization control area, and development restricted area.
  b) Zoning of land use: The land use determines permitted activities on land and buildings. The planning indexes, such as floor area ratio (FAR), building coverage ratio (BCR), open space ratio, and maximum height of building, are in many cases prescribed in relation with land use zoning. It also relates the development capacity of each area.
  c) Boundary of specific urban development project: In order to secure the land for future infrastructure facilities and urban development for public purpose, their areas are designated in advance and construction activities in these areas will be restricted.

- In enforcing the abovementioned control measures, detailed contents of planning items should be examined in the following detailed planning study. Currently, the legal spatial control measures are not yet formulated and under preparation in Myanmar. The contents of planning items should be adjusted to the formulation of legal systems which will be set in the future.

7.1.2 Application of Urban Development Management in Pathein

Area Classifications

- To realize the spatial plan of Pathein for 2040, the development activities by private and public sectors should be guided and promoted properly. This shall also contribute to avoid uncontrollable urban sprawl that will make Pathein a compact city. In this context, Pathein City shall be classified into four areas. Further examination for formulation of the detailed plan is as follows:

  1) **Urbanized area** is the current built-up area (e.g., CBDs, residential, and industrial zones). Public sector shall improve urban environment and infrastructure continuously. Some areas shall be target of urban redevelopment.
  2) **Urbanization promotion area** is suitable for future urban development by 2040. Public sector shall develop key infrastructure and social service in cooperation with private sector by means of PPP scheme. The areas shall be reserved for development of new towns, CBDs, and industrial and logistics zones.
  3) **Urbanization control area** is where development activities shall be controlled properly but not prohibited. Public sector shall not have positive responsibility for development of infrastructure and social service. Private sector who is interested in a project activity must develop by itself. The areas shall be also utilized for urban parks, tourism, and/or green, and water belt.
  4) **Urbanization restricted area** is where development activities must be prohibited strictly. The areas shall be reserved for nature reservation and high valued agriculture development.

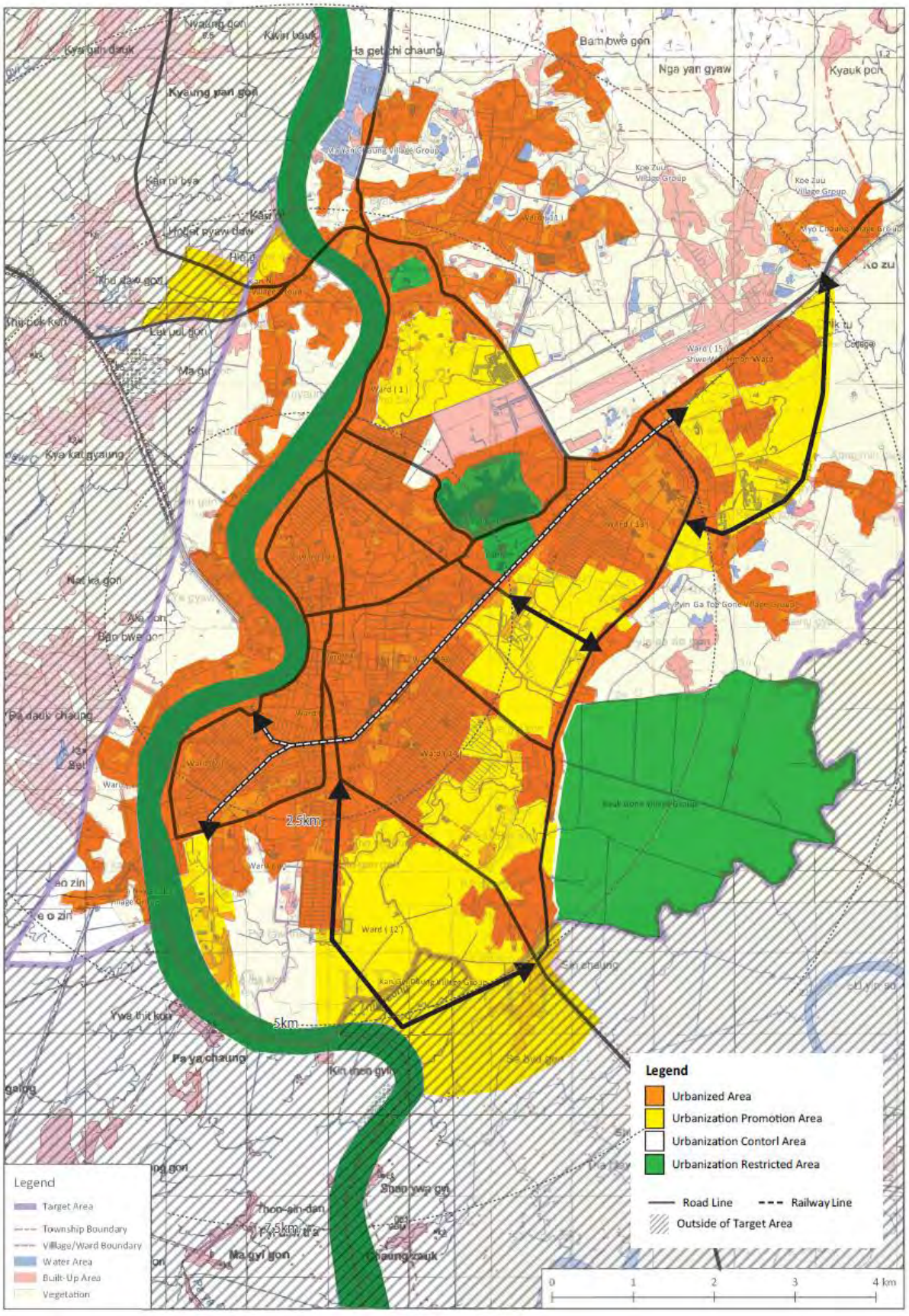
- Four types of classified areas mentioned above shall correspond to zones which are proposed in the spatial plan in the previous session as shown in Table 7.1.1.

Table 7.1.1 Matrix of the Area Classification and the Spatial Plan

Classified Areas / Zones	Urbanized Area	Urbanization Promotion Area	Urbanization Control Area	Urbanization Restricted Area
Existing Built-up (Residential and Mixed-use)	■			
CBD (Commercial and Business)	■			
Industrial Zone Logistics Zone	■			
Urban Redevelopment Zone	■			
New CBD (Commercial and Business Zone)	■	■		
New Industrial Zone New Logistics Zone		■		
New Town Development Zone (Residential and Mixed-use)		■		
Culture and Tourism Zone	■	■	■	■
Urban Park Zone Green and Water Belt Zone	■	■	■	
Nature Reservation Zone Advanced Agricultural Zone			■	■

Note: Colored (gray) cells mean classified area in which each zone is located.
Source: JICA Study Team

- Under the proposed area classification framework, zoning regulation must be discussed by the local and union government to control land and building use, FAR (floor area ratio), BCR (building coverage ratio), or building height to encourage proper urban development with necessary infrastructure and social service. The zoning regulation system is expected to be introduced as earlier stage as possible.



Source: JICA Study Team

Figure 7.1.1 Proposed Area Classification of Pathein

Zoning of Land Use

- Based on the land use principle in this study, detailed boundary of land use area should be designated in the further examination for formulation of detailed plan. Legal system needs to be enacted in parallel for effective control. These land use zonings and regulations need to be adjusted to the regulations under preparation and planned to be enacted by MOC in the near future. The following categories are supposed for land use planning:

  a) Low density residential area (detached housing area),
  b) Middle density residential area (apartment housings),
  c) High density residential area (high rise housings; it is not recommended for Maylamyine),
  d) Commercial and business area,
  e) Mixed use area (residence with small scale shops),
  f) Semi-industrial area (light and no polluted industries, with housings if necessary),
  g) Industrial area, and
  h) Green park and open space.

Boundary of Specific Urban Development Project

- The precise boundary should be examined in the following study for the detailed plan. The following are candidate areas which need to be designated for the area:

  a) Development areas for new industrial areas, housing development areas, and new CBD areas;
  b) Urban redevelopment area and land readjustment area for upgrading the current residential area;
  c) Road site (including widening); and
  d) Sites for major infrastructure facilities such as water supply, wastewater treatment, electricity, and transport.

7.2 Capacity Development

- Officers have some concerns on the readiness of City Development Organization to implement all the planned development project during the study period. One officer expressed:

  "Pathein lacks the ability to manage urban planning and development projects, as Pathein does not have the city management structure similar with Yangon or Mandalay."

- However, considering the size of the city, it may be too early to conclude that Pathein has similar independent city management institution at this stage. Rather, the discussion about readiness or ability to manage many large-scale civil work and/or development project has something to do with communication among related governmental offices and lack of human resource on urban management. Taking into account the above argument, below are discussions on capacity development from institutional point and urban management point.

7.2.1 Capacity Development in Coordination Function of GAD

- As reported in prior studies conducted by UNDP and non-profit organizations (NPOs) on Myanmar's local governance structure, the horizontal coordination system within the local governance structure is weak in Ayeyarwady Region. This point found remaining weakness in Pathein during the study, too. For high pitch development, multi-angled assessment would be required for Pathein to be a "clean modernized city" by 2040. It is necessary to strengthen the horizontal communication on urban planning and coordinating function in the key local governance structure such as GAD. GAD has key role in local development affairs, having seats in four key committees of the subnational government: Township Management Committee (TMC), Township Development Support Committee (TDSC), Township Development Affairs

Committee (TDAC) (in some articles, this committee is translated as Township Municipal Committee (TMuC)), and Farmland Management Body (FMB).

- Capacity development in GAD as a key coordinator on information sharing, decision making process, and prioritizing fund allocation and development issues can be achieved by specialized program under the support of international organization or bilateral cooperation to strengthen systematic approach and process for such tasks of GAD.

7.2.2 Capacity Development in Urban Management

- Currently, Pathein urban development management by DAO or CTC is only focused on daily urban infrastructure management and maintenance, due to the lack of human resources and funds. For incoming large-scale urban development, TDO is likely not capable in providing necessary guidance and supervision to such projects. However, it is not only the case of Pathein DAO but also in many other cities. Even the private sector in Myanmar is facing the same problems, as they have not experienced this type of development in the past.

- To secure successful results of new development, it is only possible to accumulate experiences of such large-scale project year after year with local staff. To start with, it is recommendable to implement projects under the international cooperation by hiring globally experienced consultants to supervise projects, together with a training course for officers by consultants. For receiving international cooperation, Pathein City or Ayeyarwady Regional Government need to work together with the Union government to seek international support for its development.

7.3 Project Implementation

- In order to implement the development programs described in Chapters 4, 5, and 6, and to realize balanced development as a whole, provision of support and intervention for the project by public entities are necessary for adequate implementation. For this purpose, the central government and local government are expected to take a role in the following implementation schemes:

  a) Project implementation by the government;
  b) Subsidization for implementation; and
  c) Project coordination by the government.

- For the project implementation for Pathein, the following measures are recommended to be taken by the government.

7.3.1 Project Implementation by the Government

- The following are considered as projects which will be implemented under governments' initiative. Especially, it is necessary to consider government's initiative for the implementation of unprofitable development projects.

  a) Construction of basic infrastructure facilities,
  b) Unprofitable development project (e.g., construction of social housing and affordable housings) and housings around industrial areas for workers, and
  c) Improvement of touristic environment in the center of the city.

7.3.2 Subsidization for Implementation

- Subsidization is effective for promotion of small-scale urban development activities not conducted by large-scale investors. For the development of Pathein, the following development activities are recommended to be subsidized for their implementation:

  a) Upgrading of individual buildings for disaster prevention (e.g., construction of fireproof building),

b) Small-scale urban redevelopment project and land readjustment project (spatial improvement by introduction of collective housings), and
c) Improvement of planned residential development area.

7.3.3 Project Coordination by Government

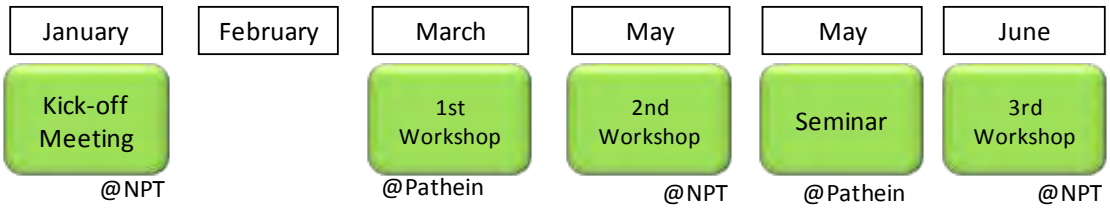
- Generally, private investors are interested with large-scale development with profitable business program, and its development tends to progress individually without effective control. Governments' involvement in project coordination is expected for appropriate project realization and its management. It is necessary to coordinate individual development project under public entities by planning, licensing, and construction in order to secure its suitability as public orientated development, especially for the following development projects:

a) Housing development along the outer bypass road,
b) Construction of industrial zone along the outer bypass,
c) Creation of new touristic zone in the north of the city,
d) Construction of new CBD and redistribution of urban function,
e) Development of remote area, and
f) Improvement of the inner urban area.

APPENDIX-A: PLANNING PROCESS

- The plan was formulated with public involvement during the planning process. There are two types of meetings as follows:
  - Workshop Meeting: to discuss with the counterpart (C/P) and related organizations; and
  - Seminar: to collect opinions of various stakeholders such as representatives of local communities.

The planning process is shown in Figure A.1.



Source: JICA Study Team

Figure A.1: Public Involvement in the Planning Process

A.1 Kick-off Meeting

- The kick-off meeting was held on 19 January 2016 (Tuesday) in Nay Pyi Taw, chaired by Director General of DUHD, and participated by MOC, relevant ministries, and representatives from the target three cities. Through the discussions after the opening remarks and explanation of the project outline, all participating organizations basically agreed on the methodology and contents of the study. Table A.1 shows the summary of result of the kick-off meeting and some pictures from the meeting are shown in Figure A.2.

Table A.1 Summary of Result of the Kick-off Meeting

Title of the Meeting	Kick-off Meeting
Date and Time	19 January 2016 (Tuesday) 13:00-14:15
Venue	Nay Pyi Taw (Meeting Room of MOC)
Chairperson	Director General, DUHD
Total Number of Participants	39 participants
Participating Organizations	MOC, DUHD, General Administration Department (GAD), Mandalay City Development Committee (MCDC), JICA
Agenda	1. Opening Remarks (Chairperson) 2. Explanation of the Study Outline (JICA Study Team) 3. Discussion

Source: JICA Study Team

Introduction

Presentation of the Study Outline

Source: JICA Study Team

Figure A.2: Pictures from the Kick-off Meeting

A.2 1st Workshop Meeting

- The 1st workshop meeting was held on 25 March 2016 (Friday) in Pathein (Pathein Hotel), chaired by Deputy Director of URDD and participated by MOC, relevant organizations, and the JICA Study Team. Table A.2 shows the summary of result of the 1st workshop meeting and some pictures from the workshop are shown in Figure A.3.

Table A.2 Summary of Result of the 1st Workshop in Pathein

Title of Meeting	Urban Development Planning 1st Workshop in Pathein
Date and Time	25 March 2016 (Friday), 13:00-17:30
Venue	Pathein Hotel, Pathein City
Chairperson	Deputy Director of URDD, MOC
Total Number of Participants	21 participants
Participating Organizations	DUHD, GAD, Forest, Ministry of Information (MOI), Township Development Committee (TDC), Environmental Conservation Department (ECD), Department of Rural Development (DRD), Planning Department
Agenda	1. Opening 2. Session 1: Review of Current Status 3. Session 2: Planning Framework 4. Session 3: Spatial Planning 5. Closing

Source: JICA Study Team

Group Discussion

Group Photo during the Pathein Workshop

Source: JICA Study Team

Figure A.3 Pictures of the 1st Workshop in Pathein

A.3 2nd Workshop Meeting

- The 2nd workshop meeting was held on 3 May 2016 (Tuesday) in Nay Pyi Taw, chaired by Deputy Director General of DUHD and participated by MOC, relevant organizations, and the JICA Study Team. Table A.3 shows the summary of result of the 2nd workshop meeting and some pictures from the workshop are shown in Figure A.4.

Table A.3 Summary of Result of the 2nd Workshop in Nay Pyi Taw

Title of the Meeting	Urban Development Planning Workshop
Date and Time	3 May 2016 (Tuesday), 13:00-17:30
Venue	Office 40, Ministry of Construction, Meeting Room
Chairperson	Deputy Director General, DUHD
Total Number of Participants	40 participants
Participated Organizations	DUHD, DAN, DH, Ministry of Religious Affair and Culture (MORAC), Ministry of Transport and Communications (MOTC), Planning Department, GAD, TDC, MCDC, Myanmar Engineering Society (MES), ECD, DALMS
Agenda	1. Review of Current Status 2. Planning Framework 3. Spatial Planning

Source: JICA Study Team

Discussions

Discussions

Source: JICA Study Team

Figure A.4 Pictures of the 2nd Workshop

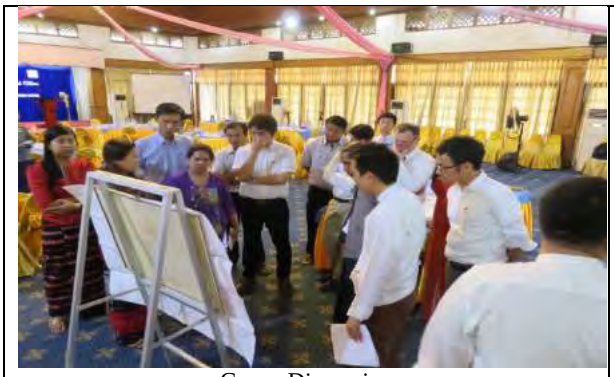
A.4 Seminar

- The seminar meeting was held on 13 May 2016 (Friday) in Pathein (Pathein Hotel), chaired by Deputy Director of URDD and participated by MOC, relevant organizations, JICA, and the JICA Study Team.

Table A.4 Summary of Result of the Seminar in Pathein

Title of the Meeting	Urban Development Planning Seminar
Date and Time	13 May 2016 (Friday), 13:00-17:30
Venue	Pathein Hotel
Chairperson	Deputy Director, URDD
Total Number of Participants	48 participants
Participated Organizations	DUHD, GAD, TDC, DOC, DTAA, DMH, DISI, Planning Department, Forest Department, Ayeyarwady Region Chamber of Commerce and Industry (ARCCI), University, Companies, Merchants, Hotels
Agenda	1. Planning Framework and Development Vision 2. Socio-economic Framework 3. Industrial Development 4. Urban Development Policy 5. Infrastructure

Source: JICA Study Team



Group Discussion

Group Photo during the Pathein Seminar

Source: JICA Study Team

Figure A.5 Pictures of the Seminar

A.5 3rd Workshop Meeting

- The 3rd workshop meeting was held on 16 June 2016 (Thursday) in Nay Pyi Taw, chaired by Director General of DUHD and participated by MOC, relevant organizations, and the JICA Study Team.

Table A.5: Summary of Result of the 3rd Workshop in Nay Pyi Taw

Title of the Meeting	Urban Development Planning Workshop
Date and Time	16 June 2016 (Thursday), 13:00-17:30
Venue	Office 40, Ministry of Construction, Meeting Room
Chairperson	Director General, DUHD
Total Number of Participants	40 participants
Participated Organizations	DUHD, MORAC, MOTC, Myanmar National Police Force (MNPF), Ministry of Hotels and Tourism (MOHT), ECD, GAD, MCDC, TDC, The Asia Foundation
Agenda	1. Study Outline, Progress and Planning Framework 2. Vision and Strategies 3. Spatial Plan 4. Prioritized Projects 5. Urban Development Management

Source: JICA Study Team

Discussion

Group Photo

Source: JICA Study Team

Figure A.6: Pictures of the 3rd Workshop

APPENDIX-B: POSTER

Urban Development Plan for Mawlamyine 2040

Urban Development Plan for Mawlamyine 2040

1 Introduction and Planning Framework

1.1 Background of the Plan

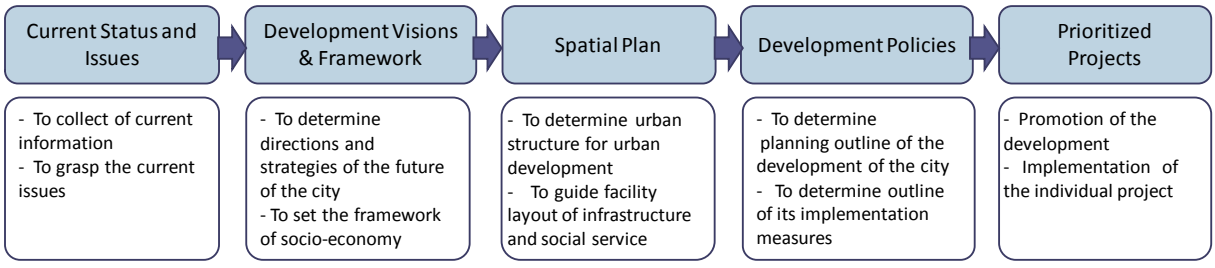
- Due to the promotion of economic deregulation after shifting the policy to emphasize reforms on international relations and economy since 2011, Myanmar has been more powerful as a new investment frontier in Asia as well as worldwide. Myanmar's gross domestic product (GDP) per capita is estimated to reach the level of middle-income countries by 2030 in case economic reforms and foreign direct investments continue steadily.
- The Government of Myanmar formulated the "National Comprehensive Development Plan (NCDP)" in 2014 through the Ministry of National Planning and Economic Development, which indicates the development policies of the whole country and presents the guidelines of comprehensive development of all sectors and strategic national development goals.
- In parallel, the Ministry of Construction (MOC) has been making the "Urban and Regional Development Planning Law" to be enacted soon in 2016 in order to support the formulation of urban development plans within the country systematically and to enforce management system in implementing the plans for local authorities.
- To accelerate economic development in the whole country, Mawlamyine shall be definitely required to have important role as regional center of Mon State and gateway city of the Association of Southeast Asian Nations (ASEAN) countries. To promote the required roles, it is urgent to clarify the future development vision, formulate the urban development plan of Mawlamyine, and share the plan with the citizens.

1.2 Objectives of the Plan

- The primary objectives of the urban development plan of Mawlamyine 2040 are as follows:

  To present development visions and strategies with spatial and structure plan by 2040,
  To present urban and infrastructure development policies for the realization of the development visions, and
  To propose a roadmap of key projects.

- The main items and flow of the urban development plan are shown in Figure 1.2.1.

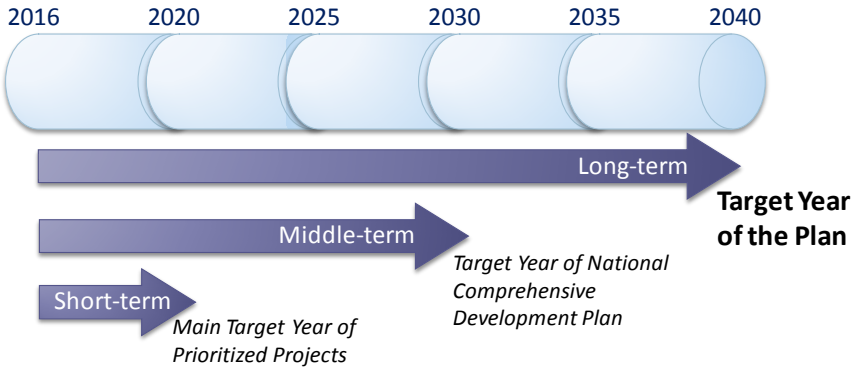


Source: JICA Study Team

Figure 1.2.1 Main Items and Flow of the Urban Development Plan

1.3 Target Year

- The target year of the plan is set at 2040. Benchmarks are also set at 2030 as middle-term and at 2020 as short-term as shown in Figure 1.3.1.

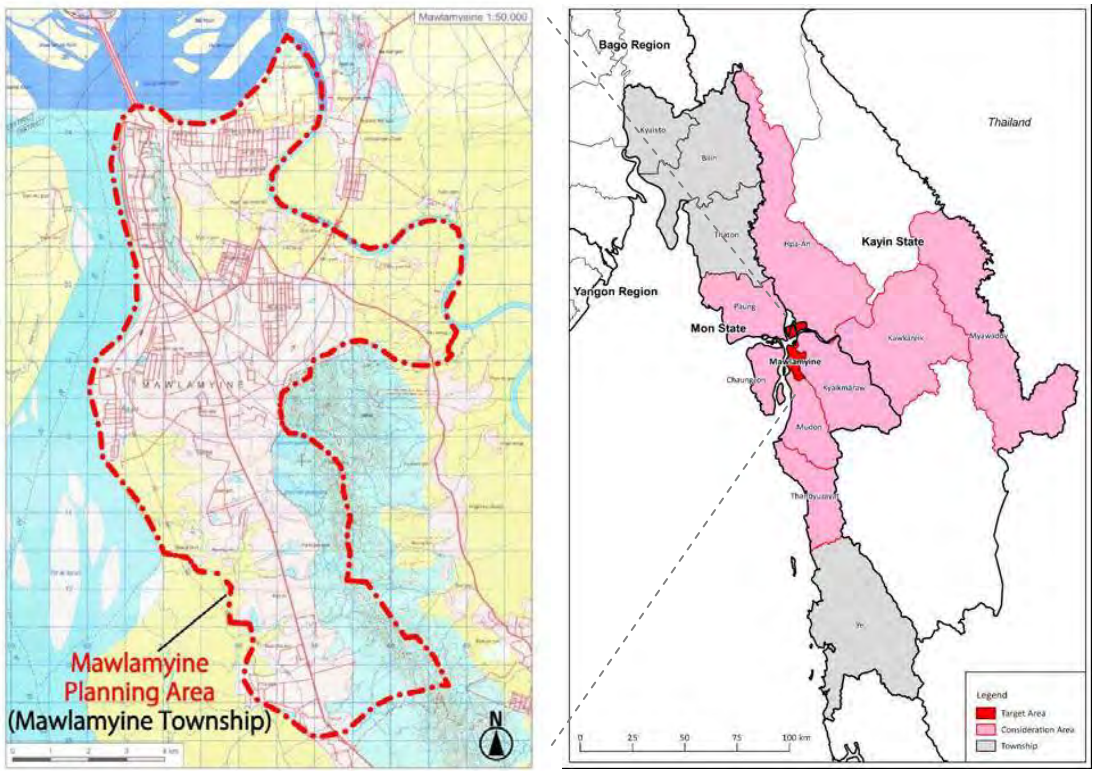


Source: JICA Study Team

Figure 1.3.1 Target Year of the Urban Development Plan

1.4 Target Area

- Mawlamyine is located in the south-east area of Myanmar, which is about 200 km south-east of Yangon. Mawlamyine Township is about 219 km^2, which stretches 11 km east and west and 18 km north and south.
- The planning area of Mawlamyine (hereafter referred as "Mawlamyine Planning Area") is the whole Mawlamyine Township area that belong to Malwamyine District, Mon State. Figure 1.4.1 shows the boundary map of the target area.
- Taking a broad view (large-scale view) is also necessary to identify the individual city in linkage with its surrounding cities from various viewpoints especially of its geographical feature, and transportation and logistics function. The broad view including the surrounding areas, namely:



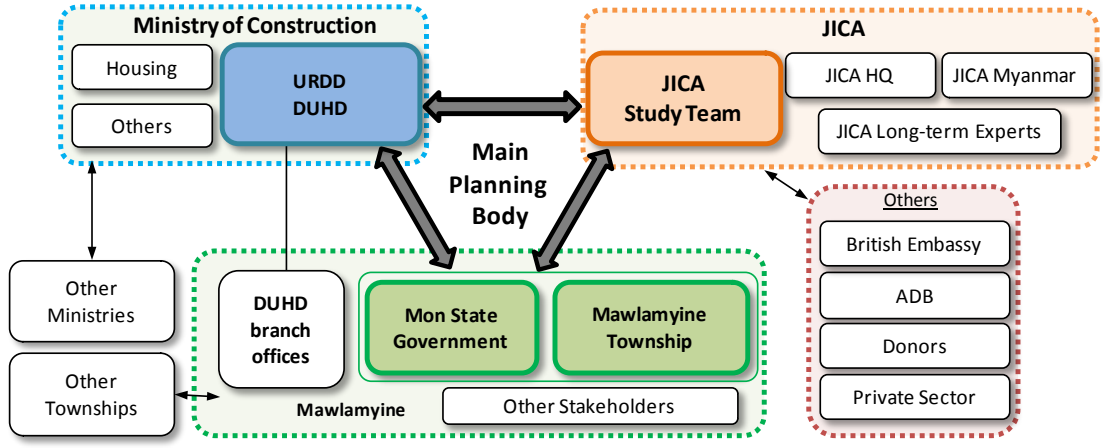
Source: JICA Study Team

Figure 1.4.1 Planning Area of Mawlamyine

Mudon Township and Thanbyuzayat Township in the south, Kawkareik Township and Myawaddy Township in the east, Hpa-An Township and Paung Township in the north, and Chaungzon Township in the west, is considered.

1.5 Planning Organizations and Process

- The urban development plan of Mawlamyine was made possible by close cooperation of Mon State Government, Mawlamyine Township, Urban Regional Development Division (URDD) (Department of Urban and Housing Development: DUHD) of Ministry of Construction, and the Japan International Cooperation Agency (JICA) Study Team based on the existing conceptual plans.
- Additionally, stakeholders participated in the planning works through discussions in a series of workshop meetings. Necessary information inputs from relevant ministries and opinions from stakeholders were also collected for appropriate planning process. Figure 1.5.1 shows the planning organization.

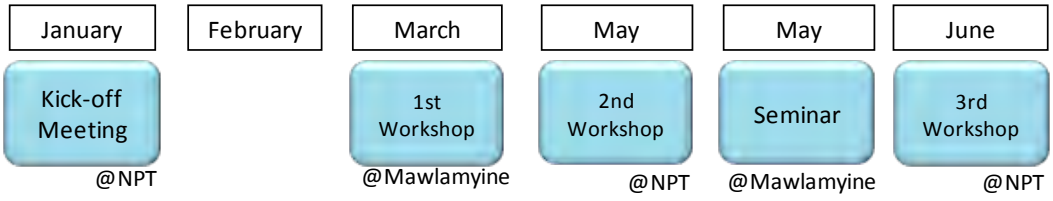


Source: JICA Study Team

Figure 1.5.1 Planning Organizations

- The plan was formulated with public involvement in its planning process. There are two types of meetings as follows:
  - Workshop Meeting: to discuss with the counterpart (C/P) and related organizations; and
  - Seminar: to collect opinions of various stakeholders such as representatives of local communities.

The planning process is shown in Figure 1.5.2.



Source: JICA Study Team

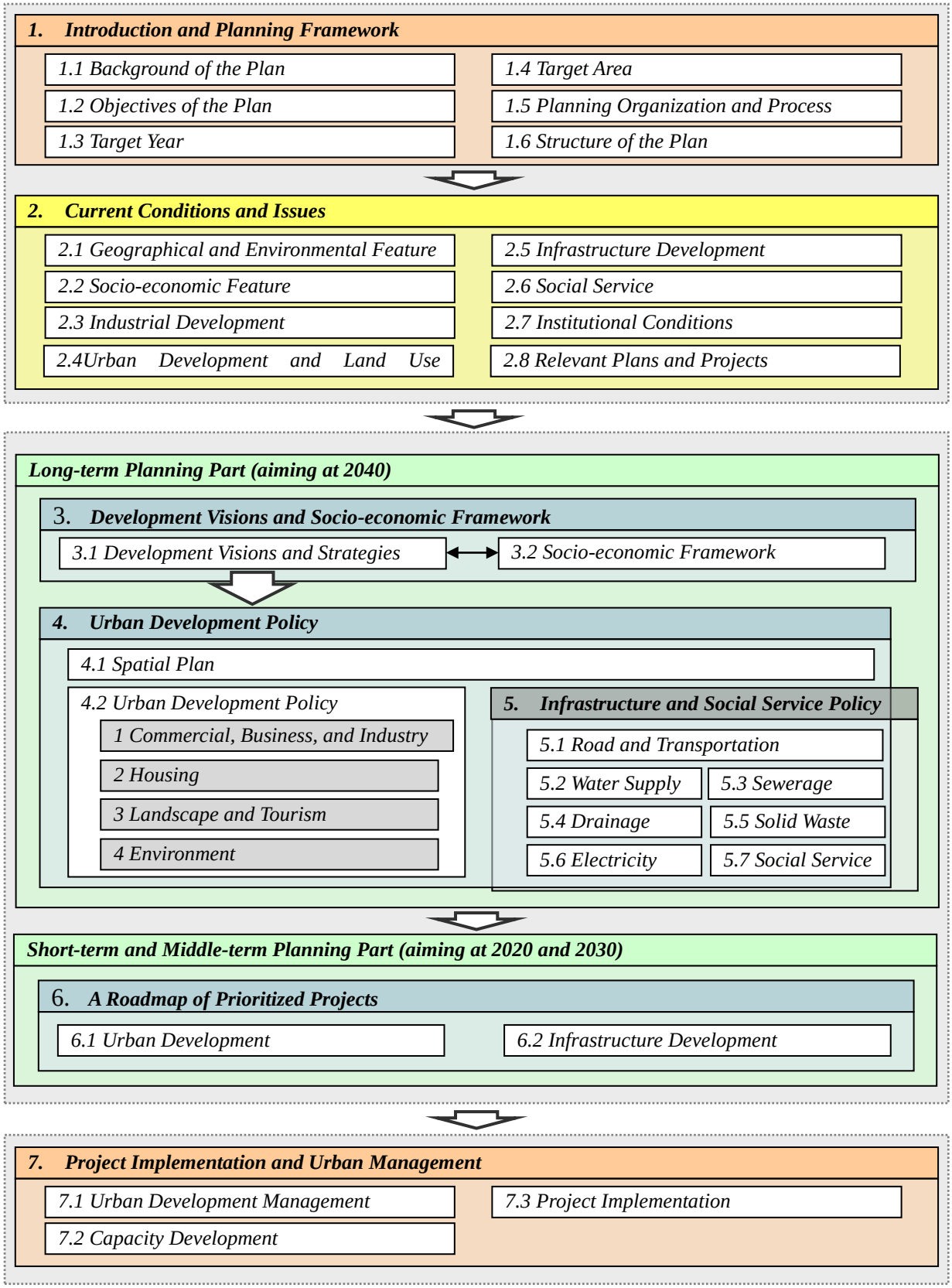
Figure 1.5.2 Public Involvement in the Planning Process

1.6 Approval of the Plan

- According to the drafted "Urban and Regional Development Planning Law" examined by MOC, the city conceptual plan is defined to be formulated by MOC (union ministry) and submitted to the national urban and housing development central committee. In line with this regulation, this plan shall be approved at the national level with consensus of the regional government.

1.7 Structure of the Plan

- Referring to the existing conceptual plans and considering general requirement of an urban development plan, the structure and basic contents of the plan are framed as shown in Figure 1.7.1. The plan shall have seven chapters. The main body of the plan shall consist mainly of two parts (long-term and short/middle-term) in order to satisfy the requirements for both of sharing future image and encouraging actions.



Source: JICA Study Team

Figure 1.7.1 Structure of the Urban Development Plan

2 Current Conditions and Issues

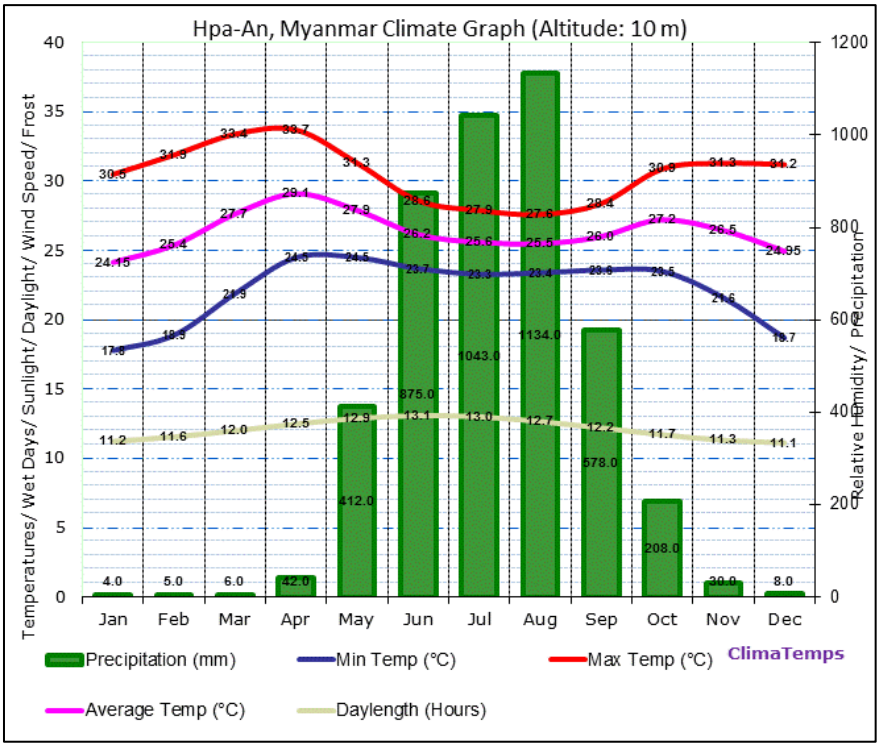
2.1 Geographical and Environmental Feature

2.1.1 Geography

- Mawlamyine is located in the southeast area of Myanmar, which is about 200 km southeast of Yangon, with its geographic coordinates at 16°29'N, 97°37'E. This regional capital city of Mon State sits in the Thanlwin delta but flanked by low hills from east to west. The Ataran River is in the east; and the Thanlwin River, the Gulf of Mottama, and the Andaman Sea in the west.
- Mawlamyine Township is about 219 km^2, which stretches 11 km east and west, and 18 km north and south. The township belongs to Mawlamyine District in Mon State, which shares border with Bago Region, Kayin State, and Tanintharyi Region.

2.1.2 Climate

- Mawlamyine experiences a tropical climate with lower humidity than most parts of Southeast Asia. It has a tropical monsoonal climate with a dry season, a heavy monsoon for the rest of year, and no cold season according to the Köppen climate classification system. Its temperature averages between 25.6 °C in January, the coolest month and 29.4 °C in April, the hottest month. The rainy season is between June and October although the greatest rainfalls usually occur in July and August. The average annual rainfall in Mawlmayine is 190 inches. Figure 2.1.1 shows the climate and temperature of Hpa-An, which is 60 km north of Mawlamyine with its geographic coordinates at 16°45'N, 97°40'E (whereas Malwmayine is 16°29'N, 97°37'E) as a “reference” case. Mawlamyine tends to have more rainfalls than Hpa-An during the monsoon season, but has very similar average temperature.



Source: http://www.hpaan.climatemps.com/

Figure 2.1.1 Reference Climate and Temperature of Nearby City Hpa-An

2.1.3 Natural Disaster

- The 2013 Global Climate Risk Index identified Myanmar as one of the countries which is most affected by severe weather disasters from 1992 to 2011 due to Myanmar's location, topography, climate, and geology. The major natural disasters in Myanmar are forest fire, landslides, earthquake, floods, drought, cyclones, and storm surges. Among these more than 70% of the disasters accounted for man-made forest fire, then flooding ranking second at 11%.

- Since Mawlamyine sits on the mouth of the Thanlwin River, Mawlamyine has natural protection from tsunami or high rise of seawater triggered by tropical cyclones, being sheltered by Bilugyun (Blue) Island from outer ocean. Thus, Mawlamyine is less prone to cyclones or storm surges.

- There are no active faults nor tectonic lineaments running across Mawlamyine, thus this city with cultural heritages is historically free from earthquake risks.

- However, Mawlamyine is susceptible to flooding. Especially, its low land in the northeast of the city annually suffers from flood damages after intensive rainfalls every once or twice a year during the monsoon season. This is caused by the combination of topographic and drainage system problems.

2.2 Socioeconomic Feature

- Mawlamyine City is the urban area of Mawlamyine Township, which is one of the six townships in Mawlamyine District. There are only two districts in Mon State and Mawlamyine District has the larger population. Among the population of 289,000 in Mawlamyine Township, 254,000 people are urban dwellers, which shows a quite high rate of urban population. This plan targets the whole area of Mawlamyine Township including both urban and rural populations. Table 2.2.1 shows the population of Mawlamyine District by township in 2014.

Table 2.2.1 Population of Mawlamyine District by Township in 2014

State/ District/Township	Population (in thousands)			Urban Population
	Total	Urban	Rural	
Mon State	2,054	572	1,482	27.8%
Mawlamyine District	1,232	434	798	35.2%
Mawlamyine	289	254	36	87.9%
Kyaikemaraw	196	11	185	5.6%
Chaungzon	122	8	114	6.6%
Thanbyuzayat	171	57	113	33.3%
Mudon	191	53	138	27.7%
Ye	152	34	118	22.4%
Lamine (ST)	88	14	75	15.9%
Khawzar (ST)	23	4	19	17.4%

Note: ST = Sub Township
Source: The 2014 Myanmar Population and Housing Census

- Table 2.2.2 illustrates the gross regional product (GRP) of Mawlamyine Township and its sectoral compositions from 2010/11 to 2014/15 at current prices. Although the overall compositions have been relatively stable, there has been a gradual decline seen in the share of the agricultural sector. In the service sector, whose share in the entire economy was 59% in 2014-15, communications have especially shown an increase from 1.8% in 2010-2011 to 7.8% in 2014-15.

Table 2.2.2 Gross Regional Product (GRP) of Mawlamyine Township by Sector: 2010/11-2014/15
(At current prices; MMK in millions)

Sectors	2010-2011		2011-2012		2012-2013		2013-2014		2014-2015	
	Value	% com-position	Value	% com-position	Value	% com-position	Value	% com-position	Value	% com-position
AGRICULTURE	**24,183**	**10.2%**	**24,024**	**8.6%**	**25,638**	**8.0%**	**27,345**	**7.3%**	**31,156**	**7.2%**
Agriculture	12,377	5.2%	11,810	4.2%	12,490	3.9%	12,944	3.5%	15,112	3.5%
Livestock and Fishery	11,503	4.9%	12,055	4.3%	12,909	4.1%	14,260	3.8%	15,848	3.6%
Forestry	302	0.1%	159	0.1%	239	0.1%	141	0.0%	195	0.0%
INDUSTRY	**76,948**	**32.6%**	**92,531**	**33.1%**	**106,361**	**33.4%**	**125,005**	**33.4%**	**148,226**	**34.0%**
Mining	737	0.3%	1,121	0.4%	1,190	0.4%	1,282	0.3%	1,305	0.3%
Processing and Manufacturing	37,075	15.7%	44,565	15.9%	54,203	17.0%	67,460	18.0%	79,051	18.2%
Electric Power	3,397	1.4%	4,281	1.5%	4,933	1.5%	5,689	1.5%	6,339	1.5%
Construction	35,739	15.1%	42,565	15.2%	46,036	14.4%	50,575	13.5%	61,530	14.1%
SERVICES	**134,945**	**57.2%**	**163,338**	**58.4%**	**186,721**	**58.6%**	**221,727**	**59.3%**	**256,143**	**58.8%**
Transportation	82,909	35.1%	105,454	37.7%	114,195	35.8%	126,455	33.8%	134,665	30.9%
Communications	4,319	1.8%	4,680	1.7%	10,956	3.4%	21,103	5.6%	33,978	7.8%
Financial Institutions	424	0.2%	538	0.2%	739	0.2%	750	0.2%	851	0.2%
Social and Administrative Services	4,986	2.1%	5,051	1.8%	7,143	2.2%	12,456	3.3%	16,026	3.7%
Rental and Other Services	5,674	2.4%	6,127	2.2%	7,475	2.3%	7,953	2.1%	9,783	2.2%
Trade	36,634	15.5%	41,490	14.8%	46,214	14.5%	53,010	14.2%	60,841	14.0%
GROSS REGIONAL PRODUCT	**236,076**	**100.0%**	**279,894**	**100.0%**	**318,720**	**100.0%**	**374,077**	**100.0%**	**435,524**	**100.0%**

Source: Ministry of National Planning and Economic Development

- Table 2.2.3 shows that 63% of the total labor force aged ten years and older of Mawlamyine Township is engaged in the service sector. This proportion is much higher than that of the Union and Mon State. On the other hand, the township has a much smaller portion of people working in the agricultural sector (12%), compared with the Union and the Ayeyawady Region. About 18% of the total labor force is employed in the industry sector.

Table 2.2.3 Employment Population Aged 10 Years and Older by Sector in 2014

		Agriculture	Industry	Service	Not stated/ Not Applicable	Total
Population						
Union	Persons	11,026,852	2,626,966	6,070,683	1,336,030	21,060,531
Mon State	Persons	338,065	98,246	245,068	46,404	727,783
Mawlamyine Township	Persons	12,571	19,501	68,016	7,741	107,829
Percentage Share						
Union	%	52%	12%	29%	6%	100%
Mon State	%	46%	13%	34%	6%	100%
Mawlamyine Township	%	12%	18%	63%	7%	100%

Source: The 2014 Myanmar Population and Housing Census; Data from the Ministry of Immigration and Population

2.3 Industrial Development

2.3.1 Industrial Activities

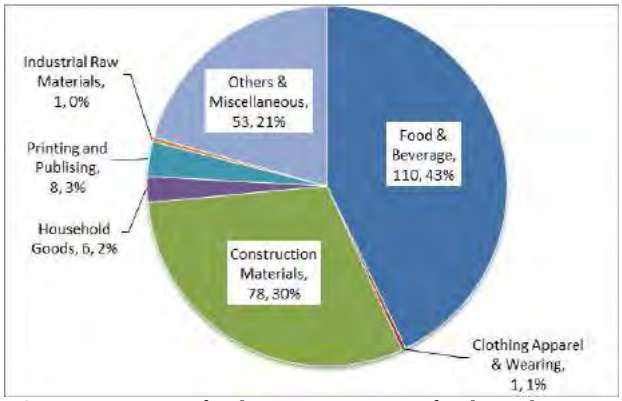
- The city of Mawlamyine is the capital of Mon State. It is the gateway to Southeast Myanmar, and also connected to Myawaddy, the eastern border with Thailand, by GMS East-West Economic Corridor (EWEC). Agricultural sector is the main source of economic activities of the state such as rice, oil palm, fruits and vegetables, and rubber. Some fruits grown in Maylamyine such as pomelo are known as the best in the country. Fishery products are also major components of the economy. By utilizing the road connections, Mawlamyine is also playing a role as the export base of these products to Thailand. Apart from natural gas which is Myanmar's biggest export item to Thailand, many of the other main export products from Myanmar to Thailand such as live animals, vegetables, wood and wood articles, and fish products are also produced in Mon State and transported through the border.

- According to "Myanmar Industry Directory 2015-16", there were a total of 2,155 registered industries in Mon State, corresponding to 5.0% of the total number in Myanmar. More than 80% of them were small industries. Table 2.3.1 and Figure 2.3.1 show the number of industries in Mawlamyine Township by size and by sub-sector in 2015-16, respectively. Major types of industries are "food and beverage" (43% of the total number of industries), "construction materials" (30%), and "others and miscellaneous" (21%), in descending order.

Table 2.3.1 Number of Industries by Size in Mawlamyine Township in 2015-16

Size of Industries	Number of Industries	Number of Employees
Large	43	483
Medium	32	228
Small	182	654
Total	257	1,365

Source: Ministry of Industry, Directorate of Industrial Supervision and Inspection, Mon State Office



Source: Ministry of Industry, Directorate of Industrial Supervision and Inspection, Mon State Office

Figure 2.3.1 Number of Industries by Sub-sector in Mawlamyine Township in 2015-16

- In Mon State, there is one industrial zone established under the supervision of the Mon State government in the mid-1990s as seen in Table 2.3.2, namely Maylamyine Industrial Zone. According to a study conducted by JETRO Yangon, a total of 86 factories were in the zone in 2013 for businesses such as food and beverages, mineral and petroleum products, and daily commodities. The industrial zone is located in Kyaik Mayaw Township, just outside of the northeast part of Mawlamyine City, along Zartha Pyin Road linking further to Hpa-An, Kayine State, after crossing a narrow suspension bridge over the Ataran River from the city center. The location causes a huge accessibility problem since the bridge makes large vehicles such as container trucks impossible to pass; and also since it is for small scale industries in the industrial zone, they have to pay tolls every time they cross the bridge to reach the city even for their small business. Underdevelopment of infrastructure such as electricity and water is also reported.

Table 2.3.2 Industrial Zones in Mon State

Industrial Zone	Location	Year of Establishment	Area (acre)	No. of factories*
Mawlamyine Industrial Zone	Kyaikemayaw Township, Mawlamyine District	1995	171.04	86

Note: * as of February 2013
Source: Myanmar Industry Directory 2015-16; JETRO (Yangon), 2013

- In response to this situation, development of a new industrial zone, Kyauktan Industrial Zone is currently promoted by private funds under a directive of the Mon State government. The area covering 254 acres is located in the southwest of the city of Mawlamyine. Construction of the new zone started in 2014 and the official opening ceremony took place in March 2016 with ten businesses having started their operations. The industrial zone is expected to contain a variety of businesses such as zinc, ready-mix cement, food and beverages, textiles, gold purification, ice factories, and shoe production.

- Another recent development of industrial sector is an investment of USD 400 million in construction of a cement factory by Pacific Link Cement, which is a joint venture between local company and Siam Cement Group (SCG) of Thailand. The factory, located in Kyaik Maraw

Township of Mawlamyine District, is expected to start operation in the middle of 2016. It plans to produce 1.8 million tons of cement per year, employing more than 1,000 workers.

- In the trading sector, there are many markets in Mawlamyine reflecting the position of the city as a trading hub in the State. They include Zigyi Market, Zeigyi Upper Market, Myaingyadanar Market, Thanlwin Market, and many others. A variety of goods such as rice and cereal crops, vegetables, fruits, flowers, fishery products, clothes and other daily goods are traded by merchants and residents; and many of them are transported by river ferry to other places including Bilu and other islands on the Thanlwin River from the jetty.

- In the tourism sector, Mawlamyine is blessed with many resources to attract tourists. For example, famous historical places such as Kyaik Tan Lan Pagoda, Nwa Le Bo Pagoda, Seidon Mibaya Monastery, Pa Auk Taw Ya Monastery, and St. Matthews Church are scattered in and around the city. Also, among the number of islands located in the Thanlwin River to the west of the city, some of them are visited by some tourists. The Bilu Island is known as a place of cottage industry where various handicrafts such as bamboo hats and hand-made rubber bands are produced. The Gaung Say Island also called Shampoo Island is a historical island, and the whole land is recognized as holy area.

2.3.2 Foreign Investment

- For comparison purposes, Table 2.3.3 shows the total investment amounts of permitted enterprises under the Foreign Investment Law in Mon State as well as the Union in total. In 2014-2015, six enterprises were permitted in Mon State with the investment of USD 326 million, out of the total of 211 enterprises with USD 8.011 billion permitted in Myanmar.

Table 2.3.3 Total Investment of Permitted Enterprises under the Foreign Investment Law in Mon State

(USD in millions)

Region	2010-2011		2011-2012		2012-2013		2013-2014		2014-2015	
	No. of Enterprises	Foreign Investment	No. of Enterprises	Foreign Investment	No. of Enterprises	Foreign Investment	No. of Enterprises	Foreign Investment	No. of Enterprises	Foreign Investment
UNION TOTAL	**24**	**19,999 ***	**13**	**4,644 ***	**94**	**1,419 ***	**123**	**4,107 ***	**211**	**8,011 ***
Mon State	2	2,945	-	-	-	-	1	375	6	326

Note: * Increased in investment value.
Source: Ministry of National Planning and Economic Development (MNPED) Central Statistical Organization, "Myanmar Data CD-ROM 2015", February 2016. (Originally from Directorate of Investment and Company Administration)

- According to the Directorate of Investment and Company Administration (DICA) website, a total of six enterprises (including both foreign and domestic companies) were permitted by Myanmar Investment Commission in 2015 to invest in Mon State. Among them, two investments are expected to be made into food and beverage and construction materials in Mawlamyine Township as shown in Table 2.3.4.

Table 2.3.4 List of Enterprises Permitted by Myanmar Investment Commission in 2015 for Mawlamyine Township

Name of Company	Location	Type of Investment Business	Form of Investment	Date of Issue
Mandalay Golden Friends Mining Company Limited	Mawlamyine Township, Mon State	High Qualified Alcoholic Beverage Local Distribution	Myanmar Citizens Investment	27-2-2015
NC & MaGa Co.,Ltd.	Mawlamyine Township, Kyauktan Industrial Area	Manufacturing and Marketing of Concrete Pole and Pile	Joint Venture	3-4-2015

Source: Directorate of Investment and Company Administration (DICA) Website

2.3.3 Orientation of Development

- The Second Five-Year Development Plan of Mon State (FY 2016-17 to FY 2020-21) aims to generate development of the region through the following measures:

  - Producing and trading high quality rice,
  - Improving rubber base production, and
  - Undertaking technical and logistic work to utilize opportunities from linkages to the economic corridor.

  The target five-year average growth rate is 8.9%, and the percentage composition of industrial sectors is planned to be 30%, 29%, and 41% for agriculture, industry, and service sectors in 2020-21, respectively.

- The JICA Study Team was not able to obtain the Second Five-Year Development Plan of Mawlamyiane Township, since it is still in the approval process within the Myanmar government. Instead, below are major work items for development of the industrial sector stated in the Mon State Plan of 2016-2017. These would imply the broad needs and challenges faced by Mawlamyine City as well.

  a) Micro and medium businesses will be strengthened by technical support.
  b) Communication between the government and business people has to be improved.
  c) Increasing provision of infrastructure such as energy, raw materials, capital goods, and techniques to develop the industry.
  d) Effective implementation of administration procedure and reducing rules and regulations.
  e) Prescribing laws on standard specification, copyright, and competition policy to improve quality of industrial products.
  f) Developing skilled labors.
  g) Producing new types of products utilizing own natural resources and uplifting them for high value.

2.4 Urban Development and Land Use

2.4.1 Urban and Housing

- The current urban area of Mawlamyine is composed of the following different characteristic zones. Their features and issues of urban space and buildings are described as follows:

Central Urban Area

The central urban area of Mawlamyine shown in Figure 2.4.1 is located between the east bank of the Thanlwin River and Yankin Hill. Many commercial buildings and trade buildings which have two to three storeys stand along the Strand Road and Lower Main Road and forms the central commercial area of the city. There are middle rise buildings with five to eight floors but they are exceptionally used such as hotel. The administrative buildings and public buildings stand along the Baho Street and Upper Main Road, which are located in the hinterland of the abovementioned commercial areas along the Thanlwin River. Flat and 2-3-storey detached housings are typical residential buildings in the area. In addition to that, middle rise apartment buildings with four to five storeys are observed in the area, but not many. The current environment of urban space is relatively good and its

Source: JICA Study Team

Figure 2.4.1 Photo of Central Urban Area

density of development are low, so specific problems in the area are not observed and remarkable.

Expansion Area towards East of the City

- In Kyeik Ma Nae area in the northeast of the city, there are expanded urban areas along the East-West arterial road towards the Ataran River and Kyeik Ma Yaw area beyond the river. This area is occupied with flat and 2-storey housings and commercial buildings for daily living goods and services. The area is formed with regular grid shape housing lots. Main streets in the area are paved, but other small roads are not paved and drainage problem is observed. The living condition is not seriously bad, but the following are pointed out as issues to be improved:

Source: JICA Study Team

Figure 2.4.2 Photo of Expansion Area towards East of the City

  - Many narrow unpaved roads exist and limited arterial road capacity provokes traffic congestion around the market place,
  - High density residential area with small-scale wooden buildings are formed in some areas in the west, and
  - Some of the developed area has inundation problem and needs to be improved for housing.

Expansion towards Southeast between the New Railway Station and the Airport

There are planned residential areas in Zayar Myine area and Myine Than Yar area shown in Figure 2.4.3, which are located in the southeast of the city. Most of the buildings in these areas are detached one or two storeyed houses. Compared with the abovementioned housing areas in Kyeik Ma Nae, the housing lots in these areas are larger, their density is lower, and their urban environment is better. These areas are located in high ground and are not affected by inundation damage. There are few problems in their living condition.

Source: JICA Study Team

Figure 2.4.3 Photo of a Residential Area in Zayar Myine

South of Central City

- There are planned housing development areas in Thirimyine, Mupon, and Kyauktan areas, which are located in the south of the city, shown in Figure 2.4.4.

- Thirimyine and Mupon areas are located in the east of the old Mawlamyine Railway Station and the Upper Main Road. These residential areas are composed of one or two storey buildings for residential and mixed use with commercial facilities. The buildings formed a good living environment, but vacant houses and housing sites are observed in the area (supposed to be effect of relocation of the railway station).

Source: JICA Study Team

Figure 2.4.4 Photo of South Area of Central City

The roads in the district are wide enough for motor vehicle traffic. Most of the inner district roads are equipped with drainage canals, but they are not paved except for main streets.

- Kyauktan area is located in the south of the old Mawlamyine Railway Station and its housing area are surrounded by the Upper Main Road, which connects to the new bridge to Bilu Island in the north, the Thanlwin River in the west, the railway track in the east, and the new industrial area in the south. In these areas, housing sites with regular grid pattern roads for detached housing are prepared and provided. But buildings in the area are wooden rural style housings, which are similar to those in agricultural village and paddy field. The road width in these areas is not enough for traffic of automobiles, so the residents depend on bike, bicycle, and light vehicles for their movement. From these views, the areas have issues to be improved as a present-day residential area.

East of the Ataran River

- There is a housing and industrial development area on the east bank of the Ataran River, in the Kyeik Ma Yaw area, along the inter city road to Hpa-A as shown in Figure 2.4.5. The residential area is developed well with appropriate development density, wide road width, and enough open spaces. But difficulty on water supply obstructs the progress of development in the area.

Source: JICA Study Team

Figure 2.4.5 Photo of East Area of the Ataran River

2.4.2 Land Use and Regulations

Land Use

- A land use pattern was developed based on the analysis of satellite imagery of 2015 covering only urban area, and using imagery of 2012 for other area. Looking at the land use, built-up shares 44.6% of Mawlamyine planning area (township area) as shown in Table 2.4.1 and Figure 2.4.6, especially in the urban area.

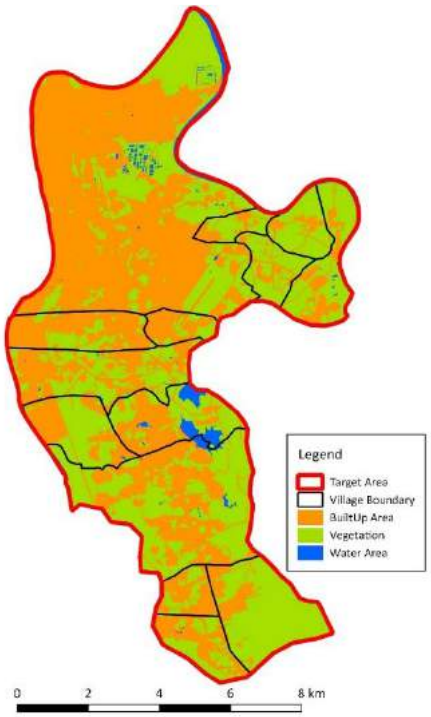
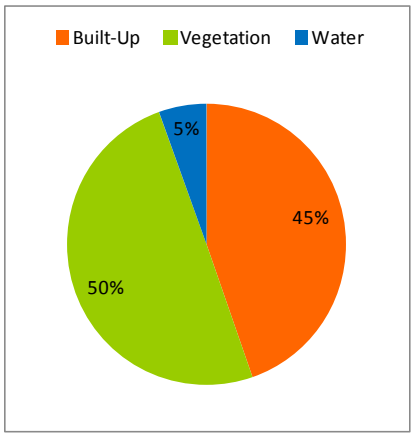


Table 2.4.1 Current Land Use (General) of Mawlamyine Planning Area

Type	Built-Up	Vegetation	Water	Total
Area (ha)	4,185	4,671	519	9,375
Share	(44.6%)	(49.8%)	(5.6%)	(100.0%)

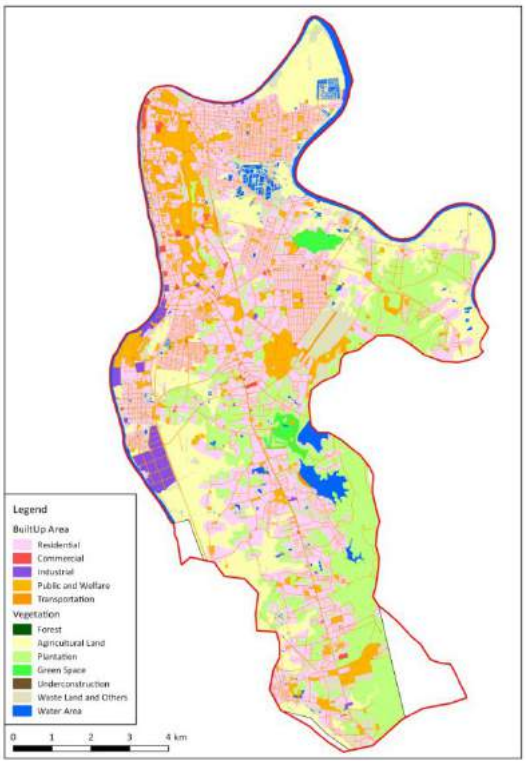
Source: JICA Study Team



Source: JICA Study Team

Figure 2.4.6 Current Land Use (General) of Mawlamyine Planning Area

- Based on the analysis of satellite imagery of 2015, land use was sub-categorized into 15 types targeting the Mawlamyine planning area (371 ha is blank from the whole planning area) as shown in Figure 2.4.7 and Table 2.4.2.



Source: JICA Study Team

Figure 2.4.7 Current Land Use (Detail) of Mawlamyine Planning Area

Table 2.4.2 Current Land Use (Detail) of Mawlamyine Planning Area

Type		Area (ha)	Share
Built-Up	Residential	2,892	32%
	Commercial	43	0%
	Industrial	132	1%
	Public	778	9%
	Transit	340	4%
Vegetation	Forest	0	0%
	Agriculture	1,573	17%
	Plantation	1,707	19%
	Green space	106	1%
	U. construct	0	0%
	Others	914	10%
Water	River	4,300	48%
	Channel	274	3%
	Lake	7	0%
	Pond	159	2%
Total		9,004	100%

Source: JICA Study Team

Building Regulation

- According to the interview survey, Mawlamyine does not have any specific regulations related to building and land use.

2.4.3 History, Landscape, and Tourism

History of the City

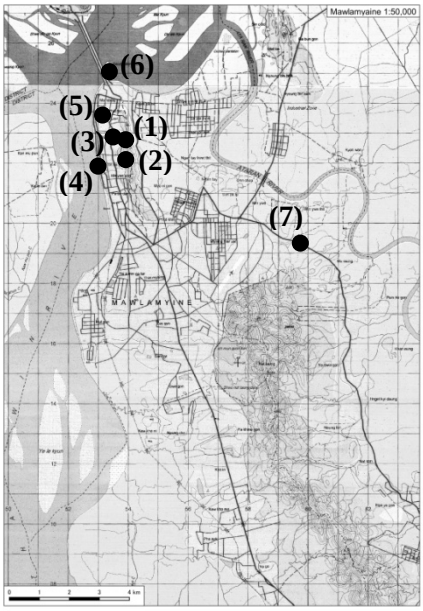
- Mawlamyine was established in 1573. The Ataran River is in the east while Chaung Sone Town and the Thanlwin River are in the west of the city. Mawlamyine became a famous city because of the tourist attractions like the ancient pagodas and historical culture, Taung Wine Pagodas, ancient colony buildings, churches, the Thanlwin River, Gaung Say Kyun, and Bilu Kyun.

Tourism and Landscape

- The townscape of Mawlamyine is prominently characterized as a beautiful natural landscape made of Yankin Hill and the Thanlwin River. As the former capital of the British colonial, a lot of historical buildings remained in the city, which have big potential for tourism development in the future. Figure 2.4.8 summarizes the characteristics of Mawlamyine City.

Kyaik Tan Lan Pagoda (1)
On the Yankin Hill, there is a pagoda and monastery as landmark of the city.

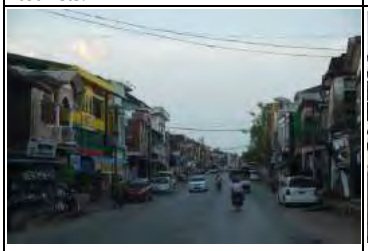
View from Yankin Hill (2)
On top of the hill, there is a panoramic view of the city and the river.



Location of the Places in the Pictures

Historical Church (3)
Many historical buildings built in the British colonial period can attract tourists.

River and Boulevard (4)
The Thanlwin River and a boulevard along it provide an open atmosphere.



City Center Townscape (5)
In the city center, relatively low rise buildings can be seen.

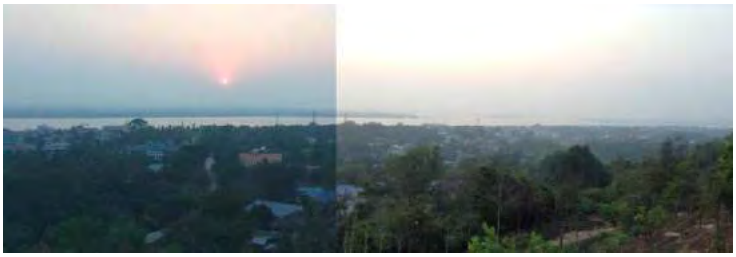
Thanlwin Bridge (6)
The bridge, which opened in 2006, is the longest road and rail bridge in Myanmar.

Rubber Plantations (7)
Huge area of rubber plantations surrounds the city of Mawlamyine.

Source: JICA Study Team

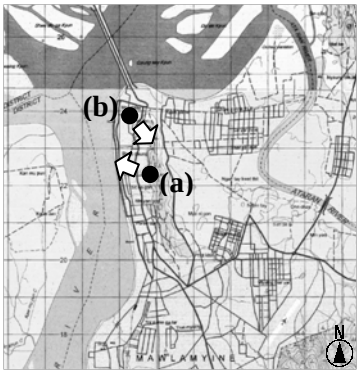
Figure 2.4.8 Characteristics of Mawlamyine

- Beautiful landscape surrounded by green towards the center of Mawlamyine where a lot of historical buildings are located can be overlooked from a viewpoint of Yankin Hill. It also provides a good view of the sunset with the Thanlwin River. There is no high-rise buildings that distort the view from the hill.
- The pagodas and monasteries on Yankin Hill can be seen from many points in the center of Mawlanyine. The perspective to pagodas and monasteries contains religious implications to people in Mawlamyine. Figure 2.4.9 shows the views from and towards the Yankin Hill.



(a) Panoramic View from Yankin Hill Towards West

(b) View Towards Yankin Hill



Point and Direction
of the Views (a) and (b)

Source: JICA Study Team (The pictures were taken in March 2016.)

Figure 2.4.9 View From and Towards Yankin Hill

2.5 Infrastructure

2.5.1 Transport and Road

- On-road Cargo Handling: Traffic congestion is observed during peak hours of cargo handling on Strand Road. Provision of cargo handling space could solve this issue.
- Public Transport: Generally, traffic congestion is not found in the city except on Strand Road mentioned above. Large-sized bus is not allowed to operate for short-trip traffic in the city. It is easy to catch small-sized taxi (motorbike or light truck type) everywhere in the city.
- Bus Terminal: Mawlamyine Bus Terminal will become saturated and the expansion is planned already.
- Truck Terminal: Zeigyo Truck Terminal is located in the built-up area and the relocation of the terminal might be considered. A possible candidate for the relocation might be the new industrial area in Kyauktan which is located further south from Zeigyo.
- New Bridge: The access road for Thanlwin (Chaung Sone) Bridge in Mawlamyine City is quite narrow.
- Abandoned Track: Since the completion of new railway track, the section towards the old station has not been used for passengers.
- International Freight: The international freight was not in service. It will be necessary to confirm the role of the airport and development priorities of the airport.
- Domestic Freight: The domestic freight is in service only once a week. It will be necessary to confirm the role of the airport and development priorities of the airport.

2.5.2 Water Supply

- Mawlamyine Township area is supplied piped water up to 22 out of 40 quarters from four intakes of water source. Currently, the water demand is nearly twice compared with the water supply volume.
- Many people need to rely on other water sources such as tube well, dug well, hand pump, and brick reservoir. The population connected to the MCDC's water supply system remains as low as 18% of the total population and total number of taps is only 8,500. The promotion of tap water connected to the houses is urgently needed in Mawlamyine City
- Regarding the current situation on quality of raw water from the river system (Ataran-1 and Ataran-2), appropriate purification process and chlorination disinfection are not applied throughout the system. This indicates a risk to health, if the raw water contains coliform. Figure 2.5.1 shows images of private tube well and Ataran-2 pump station.
- According to MCDC, 75% of the citizens purchase bottled water for drinking purpose but the remaining 25% are the poor citizens who cannot purchase bottled water and are drinking untreated or unsanitary water after boiling.
- Depending on the growth of demand, human resource capacity development is needed for operating water supply system and managing administration.

Source: JICA Study Team

Figure 2.5.1 Private Tube Well and Ataran-2 Pump Station

2.5.3 Sewerage

- There is no public waste water treatment plant (WWTP) to collect and treat domestic wastewater in Mawlamyine City. A domestic wastewater is discharged without appropriate treatment to street drainage, and finally flows into rivers and ponds. Also there are many households which cannot use toilet on clean sanitary conditions. These mainly cause water pollution. Figure 2.5.2 shows images of dirty creek and river.

Source: JICA Study Team

Figure 2.5.2 Dirty Creek and River in Mawlamyine City

- Although the water injection type toilet without a septic tank has become extensively popular, the toilet of this type should be changed with proper septic tank or connected to sewerage system. Furthermore, there are no modern night soil treatment plants in Mawlamyine City, and excreta or excess sludge removed from a pit toilet or a septic tank is thrown into the existing final dumping site without stabilization pond system.
- Project of sewerage system and sanitary night soil treatment plant are strongly required in Mawlamyine City. However, these projects require long time and large funds.

2.5.4 Drainage

- The capacity of the existing drainage and channel in Mawlamyine City is not enough against heavy rains. So, low-lying areas in the city are sometimes flooded every year. There are not enough gates, banks, and pumps which prevent flooding in the low-lying areas.

- Some hydrological surveys on existing drainage shall be required and a meteorological observation shall be collected for improvement of the drainage system.
- Soil sediments and garbage have accumulated on many drainage or canals. Some illegal buildings are on a canal. A small culvert at a road crossing is a bottleneck of the flow. Figure 2.5.3 shows images of existing drainage and channel.

Source: JICA Study Team

Figure 2.5.3 Existing Drainage and Channel in Mawlamyine City

2.5.5 Solid Waste

- The final disposal sites are simple dumping sites without any pollution control facility (no landfill liner and no drainage of leachate). The issue of illegal industrial waste dumping and open burning of fields was long done there. As a result, the harmful acts caused pollution to the environment. The improper solid waste management will pose high risk on health and high impact on the environment. Solid waste is collected by MCDC's truck and dumped to the final disposal site shown in Figure 2.5.4.

Source: JICA Study Team

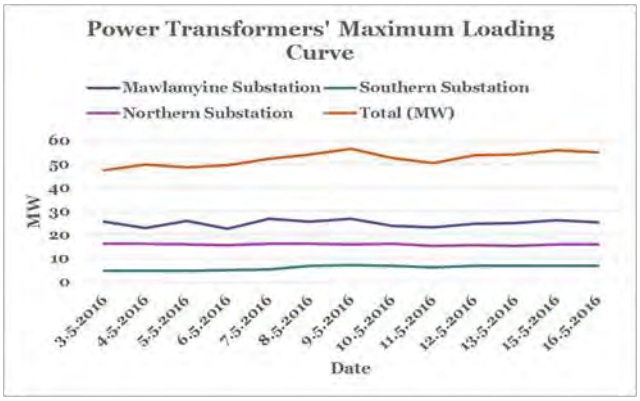
Figure 2.5.4 Existing Final Disposal Site in Mawlamyine

- Collected solid waste is rapidly increasing in Mawlamyine City, then the capacity of the final disposal sites will be decreased. So, MCDC shall start the 3R policy (recycle, reuse, and reduce) for environmental efforts.

2.5.6 Electricity

- In Mawlamyine, at the transmission level, the voltages are 230 kV and 66 kV. The input of the only primary substation in Mawlamyine (230/66/11 kV, 50 MVA x 2) comes from Thaton Power Substation with a 230 kV transmission line. The 230 kV main bus of the primary substation is also connected to the Mawlamyine combined cycle independent power producer (IPP). From the 66 kV main bus on the secondary side of the Mawlamyine primary substation, one feeder named Mawlamyine Feeder serves Mawlamyine Township. The Mawlamyine Feeder supplies the target area of this project by three 66 kV substations. Figure 2.5.5 shows the list and maximum loading curve on specific dates of these substations. According to the Ministry of Electric Power and Energy (MOEPE), these transformers are running on full load during peak season.

Substation Name	Rated Voltage (kV)	Transformer's Rated Capacity (MVA)
Mawlamyine 66kV	66/11	10
	66/33	30
Southern	66/11	10
Northern	66/11	20



Source: JICA Study Team based on MOEPE Data

Figure 2.5.5 Maximum Loading Curve of the 66 kV Power Transformer in Mawlamyine Township

- There is one combined cycle IPP in Mawlamyine Township directly connected to the 230 kV primary substation. The existence of Myanma Oil and Gas Enterprise (MOGE) gas pipeline connected to Yadana-Zawdika Natural Gas Pipeline which goes through Mawlamyine, provides the potential to build another new power plant in the target area.

- Based on the latest available loading data and the MOEPE's load forecast, loading capacity of the power transformers has been assessed and is shown in Table 2.5.1. As seen from the assessment, all the power transformers are already running on almost full load during peak hours and will be overloaded during peak season by the year 2017.

Table 2.5.1 Preliminary Capacity Assessment of 66 kV Power Transformers in Mawlamyine Township

Substation	Voltage kV	Transformer Rating MVA	Allowable Load (p.f=0.8) MW	May 16, 2016 (maximum)		2017 Demand Forecast (+15%)			2018 Demand Forecast (+15%)		
				MW	% Loading (p.f=0.8)	MW	% Loading (p.f=0.8)	Remaining Capacity (MW)	MW	% Loading (p.f=0.8)	Remaining Capacity (MW)
Mawlamyine	66/33/11	40	32	26.8	84	30.82	96.3	1.18	35.4	110.8	-3.44
Southern	66/11	10	8	7.11	89	8.1765	102.2	-0.18	9.4	117.5	-1.40
Northern	66/11	20	16	16.4	103	18.86	117.9	-2.86	21.7	135.6	-5.69

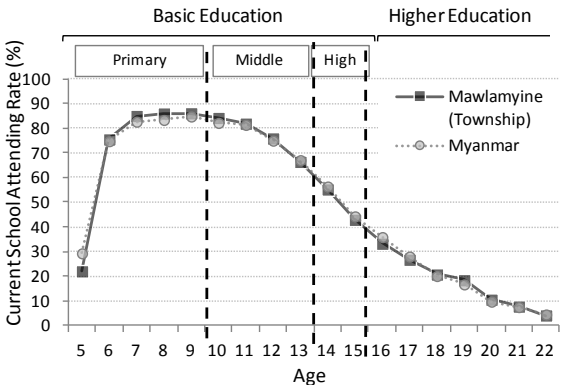
Source: JICA Study Team based on the MOEPE data

- According to MOEPE, current distribution loss in Mawlamyine is around 25% to 30%, which is a large value.

2.6 Social Service

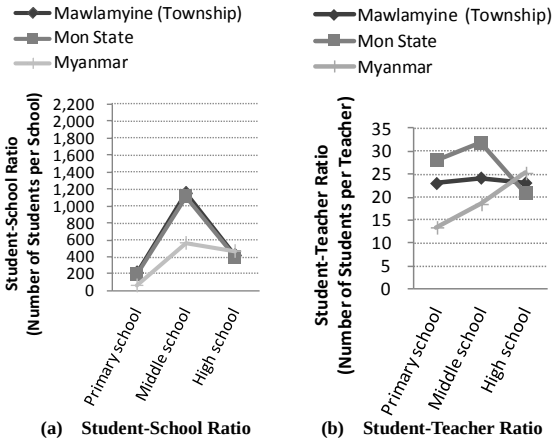
2.6.1 Education

- The literacy rate in Mawlamyine Township is more than 95% and it is higher than its surrounding area and whole Myanmar, which indicates that basic education prevails more widely in the city.
- School attendance in Mawlamyine Township decreases gradually after the completion of the primary education cycle as shown in Figure 2.5.1 and the similar trend is shown for the whole Myanmar. Two of the main reasons of the gradual decrease of school attendance are economic difficulty of the household to send their children to school, where they cannot pay for the opportunity cost, and the another is schools are located too far from home causing the children to commute.
- Preparation of facilities for primary and middle school education in Mawlamyine Township is at lower level than that of the whole Myanmar. In particular, the number of students per middle school in Mawlamyine Township is especially higher, which is beyond 1,100 as shown in Figure 2.6.2. And there is a tendency that the facilities will be insufficient in new urbanized areas with increasing number of housing and children.
- Provision of a sufficient number of teachers is one of the indicators to measure the quality of education. The ratios of student-teacher of primary and middle school in Mawlamyine Township are 10 and 6 points higher than the ratio of the whole Myanmar, respectively. Figure 2.6.2 shows the comparison of student-school ratio and student-teacher ratio among Mawlanyine Township, Mon State, and the whole Myanmar.
- In terms of the population ratio whose highest level of education completed is under primary school in Mawlamyine Township is 22-25% lower than the surrounding areas and the whole Myanmar as shown in Figure 2.6.2. However, the population ratio whose highest level of education completed is more than the university or college in Mawlamyine Township resulted higher values than the surrounding areas. It suggests that highly educated people are more concentrated in the city compared with the surrounding areas.



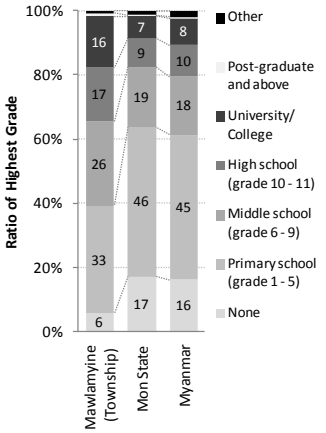
Note: The above relation between age and school does not reflect the students who have repeated the school years.
Source: JICA Study Team based on the 2014 Myanmar Population and Housing Census

Figure 2.5.1 School Attendance Rate



Source: JICA Study Team based on the 2014 Myanmar Population and Housing Census

Figure 2.6.2 Student-School Ratio and Student-Teacher Ratio

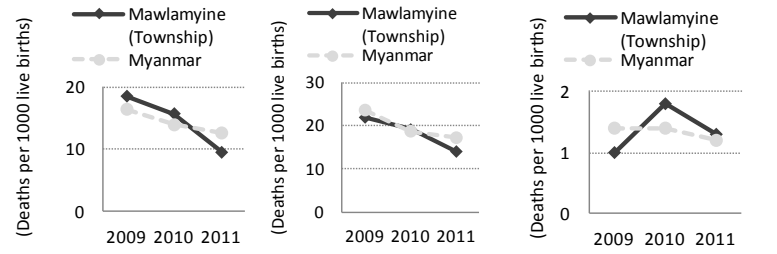


Source: JICA Study Team based on the 2014 Myanmar Population and Housing Census

Figure 2.6.3 Composition of Population who are 25 Years and Over by Highest Level of Education

2.6.2 Health

- Basic health indicators of infant mortality rate, under-five mortality rate, and maternal mortality rate in Mawlamyine Township have improved in recent years as shown in Figure 2.6.4. The health indicators are mostly same or better than the whole Myanmar.



(a) Infant Mortality Rate **(b) Under-five Mortality Rate** **(c) Maternal Mortality Rate**

Source: JICA Study Team based on the data from Township Health Profile 2011, Ministry of Health, Myanmar

Figure 2.6.4 Basic Health Indicators of Mawlamyine Township

- There are 10 hospitals, 139 clinics, 3 urban health centers, 2 sub-urban health centers, 3 rural health centers and 13 sub-rural health centers in Mawlamyine Township. In addition to Mawlamyine General Hospital, which is the state hospital of Mon State with 500 beds, there are big private hospitals like Yadanarmon Hospital and Zarni Bwar Hospital. Most of the hospitals are located in urban areas, while rural areas are mainly covered by small clinics and rural/sub-rural health centers.

(a) Mawlamyine General Hospital

(b) Yadanarmon Hospital

Source: JICA Study Team

Figure 2.6.5 Hospitals in Mawlamyine Township

2.6.3 Poverty

- The United Nations Development Programme (UNDP) implemented integrated household living conditions surveys in the whole Myanmar area in 2005 and 2010. Table 2.6.1 shows the percentage of the population who are poor in Mon State and the whole Myanmar. Ratios of poor population in both urban and rural area decreased from 2005 to 2010.

Table 2.6.1 Percentage of Poor Population

(unit: %)

	Urban		Rural		Total	
	2005	2010	2005	2010	2005	2010
Mon State	22.5	17.8	21.3	16	21.5	16.3
Myanmar Total	21.5	15.7	35.8	29.2	32.1	25.6

Note: Poverty lines were set as MMK 162,136 per adult equivalent per year in 2005 and MMK 376,151 in 2010.
Source: Integrated Household Living Conditions Survey in Myanmar (2009-2010), UNDP

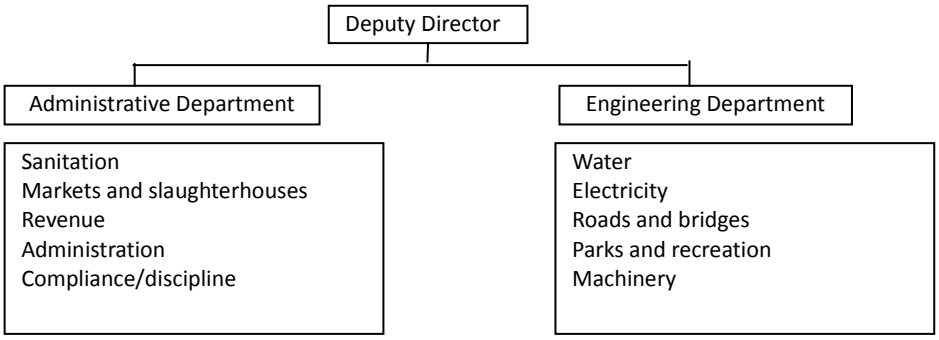
2.7 Institutional Conditions

2.7.1 Regional DUHD Office

- As one of the 14 regional branches of DUHD, Mawlamyine Office has a total of 17 staffs taking responsibility of the housing development project for staff and officers and public housing (for poor), with eight vacancies, as it is the newly established organization since April 2015.
- Mawlamyine DUHD Office has three computers and one colored printer, but no CAD nor GIS; thus, DUHD can play some limited role in the actual planning stage of housing at the moment.

2.7.2 Township Development Organization (a.k.a. City Development Committee)

- In Mawlamyine, urban management is planned and served under the Department of Development Affairs of the Mon State government. As described in other chapters, the Department of Development Affairs is a fully independent organization of subnational governance system, and directly belongs to the regional government. It is the only department to have its own bureaucracy and allowed to prepare a local development plan independently, functioning from the Union government.
- Under the Department of Development Affairs, the regional Development Affair Organization (DAO), also referenced as city or township development committees, summarizes the proposed day-to-day administrative plan from township level DAOs and directly reports to the Department of Development Affairs. This is the general planning process on spending funds from the Union government such as grants, loans, and some funds. Figure 2.7.1 shows the general structure of a DAO.



Source: JICA Study Team, based on "Municipal Governance in Myanmar, An Overview of Development Affairs Organizations" (Arnold M., Aung Y T., Kempel S., et al, July 2015)

Figure 2.7.1 General Structure of DAO

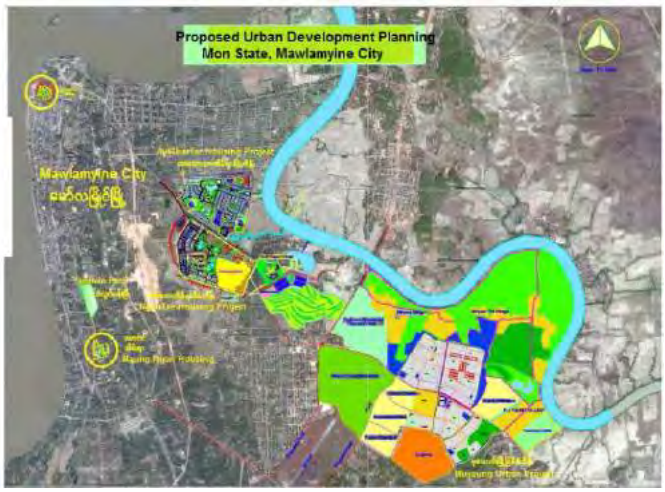
- For mid-term planning, it is prepared by the regional office of the Department of Planning under the Ministry of National Planning and Economic Development (MNPED) with "bottom up" planning system, supported by the Township Management Committee (TMC), in consultation with (and seeking the consensus of) the Township Development Support Committee (TDSC), Township Management Committee (TMC), and the Township Farmland Management Committee (TFMC). Normally, the TMC function is served by the Township Planning and Implementation Committee (TPIC); however, in Mawlamyine and many other cities in Mon State, TPIC is observed largely to be inactive. Another unique feature in Mon State in township management is TDSC having some executive duties in practice, although TDSC has an advisory function on paper.

2.8 Relevant Plans and Projects

2.8.1 Existing and Past Plans

Conceptual Plan by MOC

- The Government of Myanmar laid down a policy on urban and regional development. It urged regional/state government to make long-term plans for urban development for their region, which is considered from comprehensive points including society, economy, environment, and infrastructures. To follow the policy, Mon State requested MOC to support the preparation of the plan. The MOC made urban development plans of Mawlamyine City in 2013, which consists of the current situation of the city including urban infrastructures and social status, and proposed urban development project including new urban area development and housing redevelopment project. Figure 2.8.2 shows the proposed project location for Mawlamyine in MOC plan. Although the plan includes some future development projects, it does not include future development vision, future structure plan, and land use plan.



Source: Mawlamyine Urban Development Conceptual Plan, MOC

Figure 2.8.1 Proposed Project Location for Mawlamyine in MOC Plan

Mawlamyine Town Plan by Mawlamyine Township Development Committee

- Mawlamyine town plan was made by Mawlamyine Township Development Committee in January 2016. The plan consists of current situation of the city including infrastructure and social status, and proposed development projects. Although the plan can be used to introduce current conditions of Mawlamyine, it is not used as future comprehensive development plan.

2.8.2 Ongoing and Planning Projects

- In Mawlamyine Planning Area, some housing supply projects are ongoing, being conducted by the public sector. In addition, “Kyauktan Industrial Zone (MLM-04)” will be an important project to promote industrial and logistic function in Mawlamyine. Details on the major development projects on Mawlamyine planning area are shown in Figure 2.8.2 and Table 2.8.1.

Note: The numbers in the map correspond with .Table 2.8.1
Source: JICA Study Team

Figure 2.8.2 Location of Major Development Projects in Mawlamyine Planning Area

Table 2.8.1 List of Major Development Projects in Mawlamyine Planning Area

No.	Name	Development Facility	Developer	Status
MLM-01	Ocean Super Center (Mawlamyine)	Shopping Mall	City Mart Holding Co.,Ltd	Completed
MLM-02	Thanlwin Bridge (Chaung Zone)	Bridge	Joint Venture of the Government of Myanmar and the Government of Japan	Under Construction
MLM-03	Maung Ngan Staff Housing Redevelopment Project	Staff Housing	DUHD	Under Construction
MLM-04	Kyauktan Industrial Zone	Industrial Zone	The Government of Myanmar and private companies	Under Construction
MLM-05	Proposal of Pyidawtar Staff Housing Redevelopment Project	Staff Housing	DUHD	Proposal
MLM-06	Ngan Tay and Aye Tar Yar Town Expansion Project	Town Expansion	NA	Proposal
MLM-07	Proposed Mu Yaung City Expansion Project	Town Expansion	NA	Proposal

Source: JICA Study Team

3 Development Visions and Socioeconomic Framework

3.1 Development Visions and Strategies

3.1.1 Development Visions

Necessity

- Development visions are the ideal future images of each city which can be attained through addressing problems and issues, catering to the citizens' needs, and integrating foresight of the stakeholders and experts regarding urban planning and other disciplines. Without setting clear development visions, it would be difficult to implement an integrated urban development plan efficiently. Consequently, the administration would come to a deadlock, as there are a number of concerned sectors playing important roles in developing, improving, and managing a large city.

Definition of Development Visions

- For the planning, the study formulates the development vision and the strategies for the vision. The definitions of the development vision in the master plan are described as follows:

    - **Development Vision**: Development direction and development concept of the city are realized under the execution of the master plan. Development vision consists of "Statement of Vision", "Key Drivers of the Vision", and "Strategies for the Vision".
    - **Statement of Vision**: The statement of the vision expresses the image of the future city. It summarizes related key drivers and strategies.
    - **Key Drivers of the Vision (Pillars)**: Statement of the vision consists of several related key drivers. These key drivers correspond to major sector development fields of the city and they are expected to become strengtheners and opportunities which conduct realization of the vision.
    - **Strategies for the Vision**: Strategies are development measures to be taken for the realization of the vision. These consist of measures such as:
        - Enhancement of current strength of the city;
        - Improvement on the weakness of the city, which hinders the progress of urban development and its favorable environment; and
        - Integration of existing development programs and introduction of new urban functions which give added value to current urban resources.

Formulation Process

- For the formulation of the development vision, the study refers to the following planning resources and takes the following process:

    - **Development Visions and Targets in the Existing Planning Document**: The development visions and targets have been formulated and they are described in the related planning documents such as the development plan of the city and the region. Some visions are stated in related national development plans and sector development plans.
    - **Results of Analysis on the Current Conditions and Issues**: The result of the current conditions of the city is useful to identify remarkable development fields with respect to urbanization, environmental improvement, and industrial promotion of the city. These results, which are described in Chapter 2, were obtained through the workshops and seminars which were held in Mawlamyine.
    - **Discussions Among Stakeholders**: In the workshops and seminars in Mawlamyine, the current conditions of the city as well as its major development resources, ongoing activities, and planning issues are explained. After sharing the necessary planning information and recognizing the issues, the development vision was discussed among stakeholders of the city who attended the seminar and workshops. By discussing the order of priority of

development subjects and their relationships, the prior key drivers of the vision are summarized.

- **Formulation of Development Vision**: By summarizing the key drivers of the vision, the statement of the development vision was determined. And the realization processes of the development vision are examined as the strategies for the vision.

Resources and Challenges of Mawlamyine

- From the view of spatial features of the city, urban development, infrastructure services, and economic development, the following matters are raised as resources of Mawlamyine to be applied for future development.

< Resources >

- Strong agricultural and fishery products including rice, specialty fruits, rubber, and palm oil.
- Connectivity to Yangon and other cities in the county, and Thailand through EWEC.
- Possible returnee workers from Thailand or other foreign countries.
- Rich cultural and historical tourism resources; attracting a variety of international tourists.
- Development of accessibility to Bilu Island.

- From the abovementioned viewpoint, the following matters are raised as challenges of Mawlamyine to be resolved and improved for future development.

< Challenges >

- Underdevelopment of electric power and infrastructure for production and logistics.
- Lack of capacity of local industries in technology, human resources, finance, and information.
- Lack of skilled workforce.
- Less foreign investments compared with Yangon especially for other than oil and gas industry.
- Uplifting existing products to higher value.
- Brain drain of qualified human resources to Yangon and abroad.

Development Vision for Mawlamyine 2040

- Abovementioned features of the city (resources and challenges) are grouped into three themes through the discussions with stakeholders and attendants of the workshop in March 2016 and seminar in May 2016.

- Heritage tourism
- Connectivity and industry
- Livable

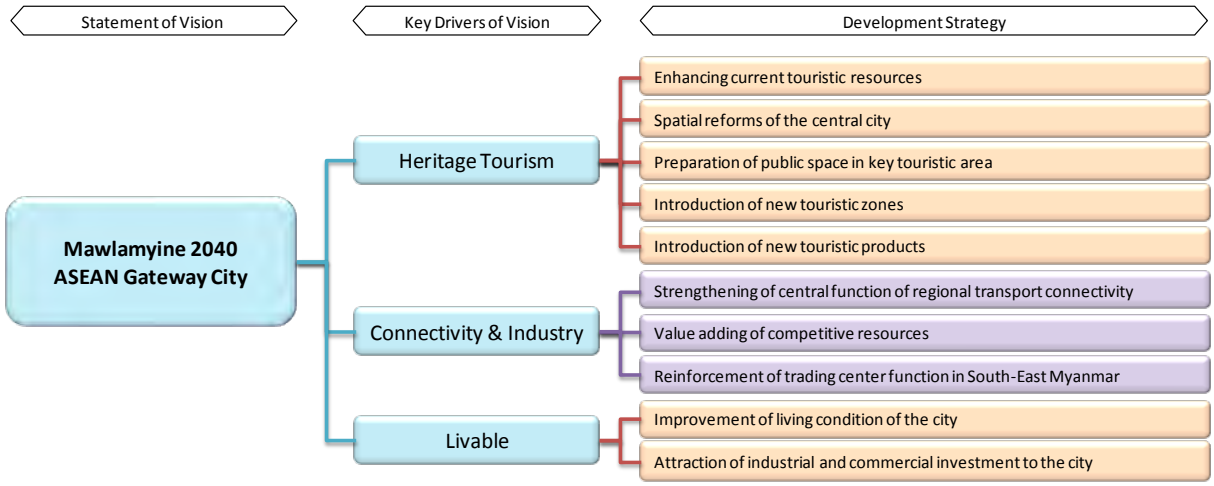
- Then the development vision of Mawlamyine was established as “ASEAN Gateway City”. It intends that by 2040, Mawlamyine will be known as a world-class heritage tourism city with a spectacular waterfront and with a growing and advanced manufacturing zone focused on primary products like rubber in the south of the city. Figure 3.1.1 describes the development vision for Mawlamyine 2040.

Source: JICA Study Team

Figure 3.1.1 Development Vision for Mawlamyine 2040

3.1.2 Development Strategy

- Strategies are development measures to be taken for the realization of the vision. These consist of measures such as:
  - Enhancement of current strength of the city,
  - Improvement on weakness of the city which hinders progress of urban development and its favorable environment, and
  - Integration of existing development programs and introduction of new urban functions which gives added value to the current urban resources.
- Figure 3.1.2 shows the strategies to be considered and introduced for each pillar of development vision.



Source: JICA Study Team

Figure 3.1.2 Development Strategy in Linkage with Development Vision

Heritage Tourism

- Mawlamyine attracts tourists with a lot of heritages such as pagodas on the hill, heritage buildings that remained as a historical town of the British colonial period, and their characteristic landscapes such as panoramic view from the hill and townscapes along riverside commercial zone. Mawlamyine can be said to have big potential in tourism sector for the future, but these assets are not utilized enough. Utilizing these cultural resources in harmonization with urban environment of the city, the city is expected to attract increasing numbers of international visitors, drawn by the historic and cultural buildings but also the spectacular waterfront setting.

    - **Enhancing Current Touristic Resources:** The central area of Mawlamyine has many touristic and cultural elements. Their surroundings are kept in good condition without significant damages by unregulated development around these heritages. Enhancement of the current historical value in city landscape and townscapes and making the spatial linkages between these elements will offer continuous touristic experiences to visitors. For realization of these subjects, it is necessary to formulate corresponding spatial plans and to regulate construction activities in surrounding area of the heritages.

    - **Spatial Reforms of the Central City**: Restoration and spatial improvement around the historical buildings and monuments are mentioned as a first step for enhancing the respective touristic values. Then continuous spatial linkage with touristic activities will form a spatial network. These linkages will attract visitors with interest and conduct further discovery of the city. The following are suggested for this subject:

        - Restoration of the building: restoration of the appearance of buildings and its uses; and
        - Landscape improvement around the monuments: harmonized spatial improvement with surroundings. Integration with open spaces, street furniture, gardening, and touristic signs.

    - **Preparation of Public Space in Key Touristic Area**: Pedestrian ways along the river and between touristic elements and public open spaces for scenic spot.

    - **Introduction of New Touristic Zones:** The city of Mawlamyine has an advantage for its location in the international and regional context. The city is located near Thailand, the neighboring country, and famous tourist spot like Kyaikhtiyo. The city accommodates tourists from/to these countries and places, and it has the potential to attract them by its own touristic values of the city. Adding to the current touristic resources, installation of new touristic facilities and activities are recommended in order to make the best use of this opportunity. The following matters are suggested to be considered:

        - Development of new touristic zone in the periphery of the central city area,
        - Development in Bilu Island with new touristic environment, and
        - Introduction of new touristic activities such as convention and sports.

    - **Introduction of New Touristic Products:** It is necessary to diversify tourism products by linking every resource of the city to a valuable experience of tourists. For instance, developing Bilu Island (Bilugyun) as a base for artisanal products and other islands in the Thanlwin River for recreation will become additional attractions to tourists who are based in the city. Mon State's specialty fruits and other special food can be promoted more in hotels and restaurants targeting tourists.

Connectivity and Industry

- Since Mawlamyine is located at the west gateway of the Greater Mekong Sub-region (GMS) west-east economic corridor, to play an important role as the logistic hub is expected. Because its location is at the mouth of the Thanlwin River, water transportation has been developed. On the

other hand, new industrial zone located in the south of the city can be a trigger for industrial development with new bridge on Bilu Island to be constructed soon.

- Rubber plantation and related industries are well-known in and around Mawlyamine. The city is expected to develop skills and manufacturing capability based on the processing and advanced manufacturing of these locally produced raw materials. By advancing such industries as well as other existing industries, higher-value products are expected to grow as leading industry of the region in short-term.

    - **Strengthening of Central Function of Regional Transport Connectivity**: At first, it is necessary to improve current logistic circulation corresponding to the future development plan of Mawlamyine. Following linkages are necessary to be developed and improved. By strengthening spatial linkage and traffic connections, business connections among local industries, neighboring cities, and foreign firms in new development area is expected.

        - Improvement of the outer ring road and enhancement of link with surrounding cities.
        - Formulation of integrated linkage between road and railway traffic.
        - Replacement of traffic terminal.
        - Enrichment of transport function by construction of new logistic zone.

    - **Value Adding of Competitive Resources**: It is important to take advantage of the city and the state's existing resources in sectors such as agriculture, forestry, and fishery in order to consider its direction of industrial development. For example, developing higher-value products such as quality rice and rubber products, as well as processing raw products such as fish, fruits, and vegetables should be explored. In addition, related industries derived from these resources also have chances to be promoted. In Mawlamyine City, a joint-venture with Japanese forestry companies has recently started operation of a factory to produce furniture materials made from old rubber trees of the state.

    - **Reinforcement of Trading Center Function in Southeast Myanmar:** Reinforcing the city's function as trading center is considered to be an effective mean of developing additional values to its own resources. The "trading center" has two roles: a) the center of dealing with physical products to collect and dispatch by making use of transport connections; and b) the center of information that will help access to the needs of external market and motivate further efforts to improve the industry. Myanmar's first central rubber market, which is reportedly planned to be established in Mawlamyine, can play such important roles to step into the path to upgrade the industry.

Livable

- Health care, pollution control, disaster mitigation, and infrastructure development must be prioritized properly in the city development plan for it to be a livable city. The city of Mawlamyine aims to be attractive to live in as well as to visit, including a city center that prioritizes people over vehicles and new neighborhoods with integrated social infrastructure like education and healthcare. Current city area with fair infrastructure services tends to be limited only to west side of Yankin Hill. In order to carry out this planning theme, improvement of infrastructures and reorganization of urban spaces in the outskirt of the central area need to be executed in order to realize a livable city as a whole. And public spaces which are integrated with green and water should also be created more.

    - **Improvement of Living Condition of the City:** The living condition of several districts in the periphery of the city is poor because of insufficient infrastructure. These districts are occupied with small-scale wooden building and shops, and their development density is higher than that of the central areas of the city. The living environment of these areas is not so good at responding to the present function of the city. The environment of these areas is not suitable to natural disasters. As countermeasure for this situation, execution of

improvement of living condition; reduction of risks of water flood, sanitation, and fire in dense residential area should be planned in these areas by application of urban redevelopment planning and/or land readjustment.

- **Attraction of Industrial and Commercial Investment to the City:** The city of Mawlamyine is facing international, regional, and city competition of attracting industrial investment. In order to fascinate investors for their industrial investment, stable provision of workers and their living condition are important factors as well as industrial environment. Upgrading the current living environment and construction of residential facilities are measures for securing skilled labors and persons in managerial position for industrial activities. As a result of applying these measures, stable provision of human resources for industrial activities will be realized by attracting investors and migrants into the city.

3.2 Socioeconomic Framework

3.2.1 Demographic Framework

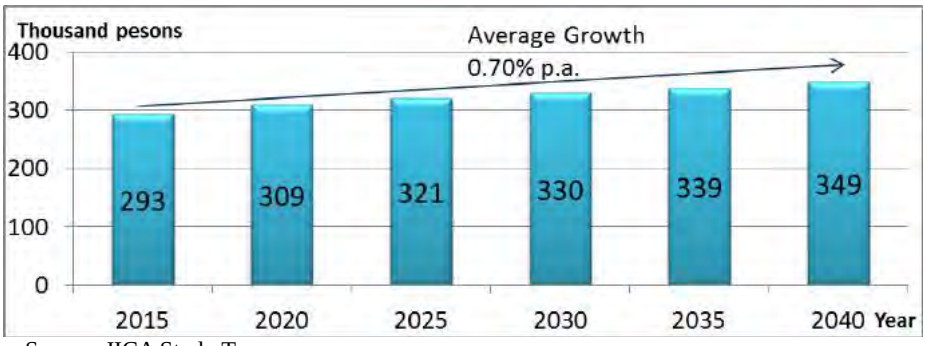
- The future population of Mawlamyine City for the next 25 years was forecasted in line with the population growth projections of the union and regions/states that were made by the JICA Study Team prior to examining the growth scenario of the city population. In considering the estimates of the city population, assumptions were made on future urban population ratios of Mon State and future shares of Mawlamyine Township in the increased urban population of the state in the forecast year, while taking into account the past figures presented in the 1983 and 2014 census reports. The assumptions are elaborated as follows:
  - Urban population rate of Mon State is assumed to slightly increase to 29% in 2040 from 28% in 2015.
  - Mawlamyine Towhship's share in the total urban population of the state is assumed to reach 47.0% in 2040 from 44.4% in 2015. Its share in the total rural population of the state is assumed to slightly decrease to 2.2% in 2040 from 2.4% in 2015.
- Based on the assumptions, the population of Maylamyine Township is forecasted to reach **349,000 in 2040 from 293,000 in 2015, showing an increase of 56,000 persons.** This corresponds to an average annual growth rate of 0.70% during 2015-2040. Table 3.2.1 and Figure 3.2.1 show the forecasted population until 2040.

Table 3.2.1 Population Estimates of Mawlamyine Township and Target Area from 2015 to 2040

	(1983)	(2014)	2015	2020	2025	2030	2035	2040	Annual Growth Rate (2015-2040)
Mon State									
Total Population (in thousands)	1,680	2,054	2,072	2,155	2,202	2,232	2,266	2,299	0.42%
Urban Population (in thousands)	473	572	580	608	625	638	653	667	0.56%
Rural Population (in thousands)	1,207	1,482	1,492	1,547	1,576	1,593	1,613	1,632	0.36%
Urban Population Rate	28.2%	27.9%	28.0%	28.2%	28.4%	28.6%	28.8%	29.0%	
Rural Population Rate	72%	72%	72.0%	71.8%	71.6%	71.4%	71.2%	71.0%	
Mawlamyine Township									
Total Population (in thousands)		**289**	**293**	**309**	**321**	**330**	**339**	**349**	**0.70%**
Urban Population (in thousands)		254	258	273	284	294	303	313	0.79%
Rural Population (in		36	36	37	37	37	35	36	0.01%

thousands)									
Share in Urban Population of State		44.3%	44.4%	44.9%	45.4%	46.0%	46.5%	47.0%	
Share in Rural Population of State		2.4%	2.4%	2.4%	2.3%	2.3%	2.2%	2.2%	

Source: JICA Study Team



Source: JICA Study Team

Figure 3.2.1 Population Forecast of Mawlamyine Township

- MOC's Conceptual Plan for Mawlamyine City forecasts the population growth for a 10-year time from 2012 to 2022 at an average rate of 2.0% annually, although the conceptual plan shows at the same time that the annual growth rate for the preceding 15 years (1997 to 2012) was only 0.6% on average. UN HABITAT's Demographic Study of Mawlamyine (July 2015) have projected annual growth rates of population until 2040 in a close range to the above forecasted by the JICA Study Team (UN HABITAT: 0.68% for slow scenario and 0.71% for moderate scenario).

3.2.2 Economic Framework

- The future economic growth of the target area for the next 25 years was forecasted in line with the economic growth projections of the union and regions/states that were made by the JICA Study Team prior to examining the growth scenario of the city economy. The average annual growth rates of the Union's GDP and Mon State's GRP during this period were estimated to be 7.1% and 7.3% respectively by the JICA Study Team, considering the existing projections made by the Myanmar government and international organizations. The GRP of the target area was forecasted based on the urban/rural ratio of productivity per person in employment aged ten years or over, and the population scenarios already forecasted by the JICA Study Team. The urban/rural productivity ratio was calculated to be 1.75:1.00 from the GDP of Myanmar by industry in 2014/15 and corresponding urban and rural populations. An assumption was made on the ratio holding constant for the next 25 years by considering that apart from expected increases in productivity of manufacturing and service sectors, productivity of agricultural sector will also be increased because of the progress of mechanization and the use of proper fertilizers, which will have a certain effect to push rural productivity.

- Reflecting on the proportion of calculated productivity index of the target area to that of Mon State, GRP of the target area was computed as shown in Table 3.2.2. **The GRP is forecasted to grow by 6.3 times and will reach MMK 3,100 billion in 2040** from MMK 490 billion in 2015 at constant prices. **The GRP per capita is forecasted to grow by 5.3 times arriving at over MMK 8.9 million in 2040** from MMK 1.7 million.

Table 3.2.2 GRP of Mawlamyine Township from 2015 to 2040

Item	2015	2020	2030	2040	Average Annual Growth Rate
Mon State	2,529	3,752	7,695	14,857	7.3%
Mawlamyine Township GRP (MMK in billions)	491	739	1,563	3,101	7.7%
Mawlamyine Township Population (in thousands)	293	309	330	349	0.7%
GRP per capita (MMK in millions)	1.67	2.39	4.73	8.88	6.9%
Mon State: GRP Index (A)	2,507	2,610	2,710	2,799	
Mawlamyine Township: GRP Index (B)	487	514	550	584	
(B)/(A)	19.4%	19.7%	20.3%	20.9%	

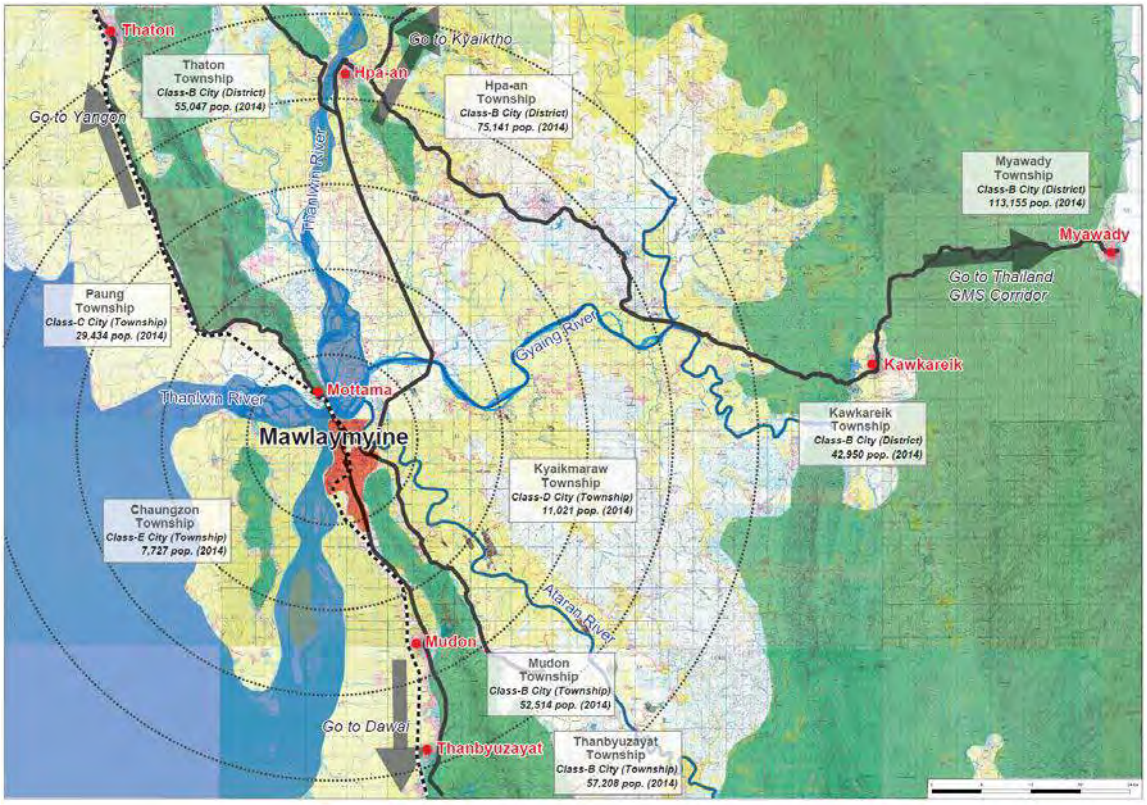
Note: GRP figures forecasted are based on 2010/11 prices.
Source: JICA Study Team

4 Urban Development Policy

4.1 Spatial Plan

4.1.1 Planning Conditions in a Broad View

- Considering the future spatial plan, the relationship with the surrounding areas such as Thaton, Mottama, Hpa-an, Kawkareik, Myawady, Mudon, and Thanbyuzayat, must also be taken into account in its planning work. Mawlamyine is well-known as the west gateway of the Greater Mekong Sub-region (GMS) west-east economic corridor. Due to the ASEAN Economic Community (AEC) commencement, the function of Mawlamyine must drastically change in the future particularly in terms of trade, logistics, and industrial activities. Additionally, the construction of bridge across between the Mawlamyine and Chaungzon townships will give impact on urban expansion.



Source: JICA Study Team

Figure 4.1.1: Planning Conditions in a Broad View of Mawlamyine

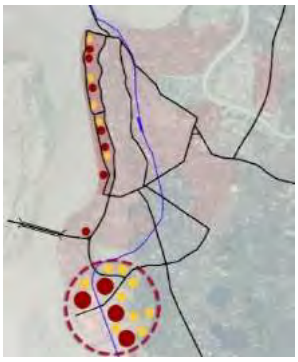
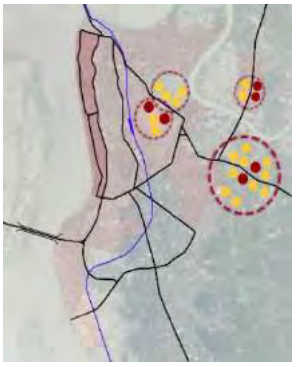
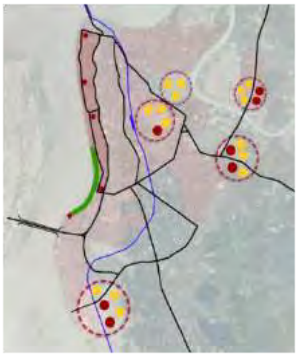
4.1.2 Options of Urban Development Structure

- The projected city growth needs to be addressed spatially in terms of space for further expansion of the city as well as regeneration of the core area. After discussions with various stakeholders, three options were suggested for the future growth of Mawlamyine Township. The city growth would comprise industries and workplaces (represented in maroon), tourist centers (represented in pink), and residential development (represented in yellow) as seen in Table. 4.1.1.

- There can be three options for the future development of Mawlamyine. The first option creates a western axis of development while the second option creates an eastern axis. The third option creates development along both axes.

- As for Option 3, two axes development concept seemed preferable among all options according to the result of a series of meetings with the stakeholders as the spatial plan was made basically in line with the direction of Option 3. On the other hand, some good points of the other two options were also adopted partly in the spatial planning work.

Table 4.1.1: Three Options of Urban Development Structure in Mawmalyine

Option	Option 1	Option 2	Option 3
Concept	One Axis (Western)	One Axis (Eastern)	Two Axes
No. of Core	1	2	3
Direction	Western	Eastern	Two Axes
Image map			
Key Features	• The city develops towards the western side. • A new zone would be created near the existing industries that would take care of the industrial and residential expansion of the city in the vicinity of the new bridge. • This location is better for import and export connectivity with the islands through the bridge. • This option has good connectivity with the existing rail network. • Development within the core city may have an impact on the heritage elements.	• The city develops towards the eastern side. • Multiple pockets of residential and industrial development along the eastern part of the city. • Existing motor workshops on the route to Hpa-An would be redeveloped to create a planned cluster of industries supported by residential components. • Better connectivity with EWEC and Hpa-An industrial network. • Old city developed exclusively for tourism and cultural usage.	• The city develops towards both eastern and western side. • City growth would be distributed equally in multiple pockets of growth both along the western and eastern parts of the city. • This option would prevent creation of a suburb and create a balanced growth. • A riverfront cultural and tourism zone would be developed towards the end of the lower main road. • Heritage buildings of the city will be conserved and will be used for tourism and cultural activities. • The housing pockets as proposed in the conceptual plan by MOC would be retained.

Source: JICA Study Team

4.1.3 Spatial Plan

- In light of the past trends and considerations of logistics function and some large-scale development projects, the urbanization of Mawlamyine is likely to extend outward, especially southwards and west and eastwards in connection with the ASEAN Highway direction of Hpa-An.

By constructing a new bridge, connection with Chaungzon Township shall also accelerate urban development in the future trend.

- The central business district (CBD), which is the center of Mawlamyine including traditional market and jetty port, has limited potential for future expansion of its central business function due to lack of surplus land for new development and complicated land ownership. Preservation of the beautiful panoramic view from Yankin Hill to the Than Lwin River is also considered as a symbol and tourism attraction of the city. To be a national gateway city, development of new CBD and promotion of tourism destination are necessary to lead business and economic activities of Myanmar as well as Mawlamyine. Development of new CBD in the vicinity of the new railway station is recommended.

- Population of Mawlamyine by 2040 will increase to 56,000. Setting 100 persons/ha as appropriate population density of the new town and the required land for new town development mainly for residential function would be 5.6 km^2 (1,383 acre). The required lands have been allocated in the spatial plan.

Table 4.1.2: Required Land for Future Population Increase of Mawlamyine

Items	Population of 2015	Population of 2040	Population Increase	Density of New Town (person/ha)	Required Land (ha)	Required Land (km2)	Required Land (acre)
Mawlamyine	293,000	394,000	56,000	100	560	5.6	1,383

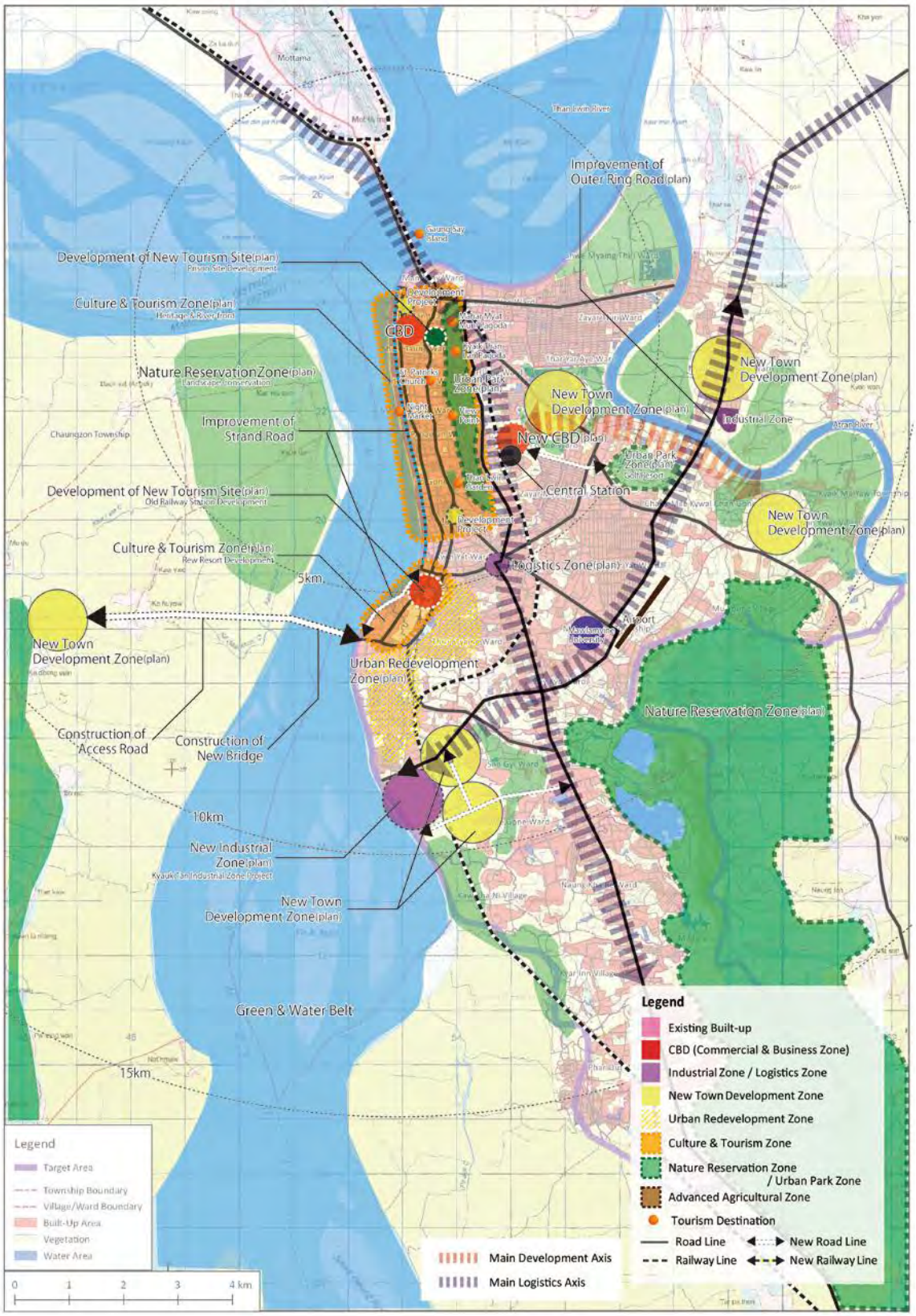
Source: JICA Study Team

Table 4.1.3: Proposed Zones and Contents in the Spatial Plan of Mawlamyine

Items / Zones	Characteristics of Zone	Proposals in the Spatial Plan
Existing Built-up (Residential and Mixed-use)	Current urbanized areas which are covered by buildings mainly for residential, commercial, and mixed-use.	All areas would be upgraded gradually in its environment, infrastructure, and social service. The south area of the city center is likely to be necessary for urban redevelopment.
CBD (Commercial and Business)	Current center of commercial and business area leads economic activities of Mawlamyine. It includes traditional market and jetty ports.	Although existing CBD function must be kept in the future, it is likely more for tourism attracting foreign tourists. Townscape and building height must be controlled.
Industrial Zone Logistics Zone	Industrial and logistic functions must be in good connection with other focal cities and countries by roads, railways, and water as the gateway city of the ASEAN.	Mawlamyine has less industrial function currently other than the industrial zone located at east side of the Atran River. Logistics function is necessary in the future in linkage with other gateway cities.
Urban Redevelopment Zone	In the existing built-up area, low-level residential areas (informal houses) seem to exist without access to proper infrastructure.	An area along the Than Lwin River in the south shall be improved with proper road system and infrastructure.
New CBD (Commercial and Business Zone)	To accelerate economic growth, development of highly functional commercial and business area is necessary.	New CBD is proposed at the central station area, east side of Yankin Hill. In this area, high-rise buildings shall be allowed for better function.
New Industrial Zone New Logistics Zone	To be a connectivity and industry city, expansion of industrial and logistic functions is important.	New industrial zone, Kyauk Tan Industrial Zone, is under construction located in the south of the city by local developer.
New Town Development Zone (Residential and Mixed-use)	New town includes function of not only residential but some commercial and business as mixed-use.	Development of new town with an area of 5.6 km^2 in total is necessary in the future. Several new towns are proposed at the vicinity of industrial zone and new CBD and suburbs such as Chaungzon Township.
Culture and Tourism	To encourage tourism development,	Main two culture and tourism zones were

Zone	promoting culture and tourism zone is recommended to conserve and utilize historic resources and good panoramic view. Improvement of access is also necessary.	proposed, namely: heritage river-front zone and new resort development zone. Since Strand Road along the river has good atmosphere and connection of two proposed zones, improvement of the road as tourist place is recommended as Tourism Axis.
Urban Park Zone Green and Water Belt Zone	To upgrade urban environment, both urban parks inside the city and green and water belts surrounding the city are necessary.	Yankin Hill and panoramic view toward west side (sunset view) must be conserved and utilized as urban park for symbol and key tourism destination of the city. Then, the Lwin River and Atran River are functioned as appropriate green and water belts.
Nature Reservation Zone	In nature reservation zone, development activities are basically prohibited to avoid urban sprawl and to keep the city more compact and efficient.	Mountain in the southeast must be conserved as nature reservation zone of Mawlamyine for water reservation.

Source: JICA Study Team



Source: JICA Study Team

Figure 4.1.2: Proposed Spatial Plan of Mawlamyine Planning Area

4.2 Urban Development Policy

- To achieve the development visions and strategies for 2040, development by sectors which are (1) Commercial, Business, & Industry, (2) Housing, (3) Landscape and Tourism, and (4) Environment, must be a basement as well as infrastructure development and social service improvement. Schematic relationship of the visions (3 key drivers) and sectors are as shown in Table 4.2.1.

Table 4.2.1 Schematic Relationship of Visions and Sectors

Sectors / Key Drivers	Commercial, Business, & Industry	Housing	Landscape & Tourism	Environment
Heritage Tourism	+		++	+
Connectivity & Industry	++		+	
Livable		++	+	++

Note: ++ Strong Relation, + Relation
Source: JICA Study Team

4.2.1 Commercial, Business and Industry

- The following table shows the development policy of commercial, business, and industry in Mawlamyine City, especially for achieving a future city to be connectivity and industry as ASEAN gateway city. In order to execute these policies, spatial control is collective and principal measures for the realization of urban development policies and projects have to be undertaken by the local and central government. These control measures are expected to be executed based on the law, by-laws, and other legal frameworks. Concrete measures are described in Chapter 7.1.2 of this report.

Table 4.2.2: Development Policy of Commercial, Business, and Industry in Mawlamyine

Commercial, Business, and Industry Policy	1) Spatial Improvement of Current Central Area 2) Relocation and Functional Reform of Logistics Zone of the City 3) Redevelopment of Former Railway Station Site (Sub-center Development) 4) Promotion of Industrial Investment to Kyank Industrial Zone 5) Construction of New CBD Area

Source: JICA Study Team

- **1) Spatial Improvement of Current Central Area:** New CBD is expected to be introduced in order to attract more tourists into the city and to utilize natural, historical, and cultural resources for the tourism industry, improvement of urban space and formulation of spatial linkage among these resources need to be executed. For the reform of landscape and urban environment, following matters are considered to be carried out in accordance with spatial plan of the city.
  - Construction of public spaces in the central tourism area (river side area, open spaces along the major tourism route).
  - Pedestrian way with roadside tree, which forms the tourism network.
  - Landscape improvement around historical, cultural, and religious monuments.
  - Public facilities which correspond to new demand of the city (parking, green and park space)
- **2) Relocation and Functional Reform of Logistics Zone of the City**: In order to extend current logistic and transport functions of the city and to realize efficient distribution of cargo

and products in the region, the new logistic and transport hub is planned to be relocated and constructed in the south of the central city along the current arterial road. For the determination of its location, the following matter and function need to be taken into consideration:

- Easy accessibility from current and future arterial road to the site.
- Connection of major regional road to all directions (location near the important mode of current road network).
- Selection of location, which is close to current and future development area.
- Selection of site in the outskirt of the city in order to avoid traffic congestion and accidents.
- Connectivity of other transport mode (railway traffic)

- Considering the abovementioned condition, the plan proposes its site around the intersection of National Road No. 8, Kyaikkami Street, and Taung Wine Road.

- **3) Redevelopment of Former Railway Station Site (Sub-center Development):** The former railway station site is a vacant place now but it is surrounded by commercial buildings, housing units, and service road, which inherit former urban functions when the station was located there, and the site is situated in the important node, which connects downtowns/new developed area, and the city with Bilu Island by a newly constructed bridge.

- By using these infrastructures and exploiting the potential of the land, the land is expected to lead the future function and industry of a new age of the city of Mawlamyine. The following functions are expected to be introduced into the area by urban redevelopment scheme.

  - Commercial development
  - Hotels and tourist infrastructure
  - Strong connectivity to Strand Road

- **4) Promotion of Industrial Investment to Kyank Industrial Zone**: The Kyank Industrial Zone is one of the key drivers of the city, which leads to industrial development and economic growth of the city. For better use of investment in the area, the following measures for improvement of production environment and enhancement of occupancy of industrial facilities in the area are essential:

  - Improvement of infrastructure for production (water supply, sewage treatment facility, and stable electric supply).
  - Improvement of production environment (establishment of close linkage with commercial business facilities, decent accessibility to arterial roads and surrounding cities).
  - Establishment of close relation with employment promotion facilities and related industries (e.g., establishment of vocational school and incubators for new businesses).
  - Improvement of living conditions for staffs and workers of the industrial zone.

- **5) Construction of New CBD Area**: New CBD is expected to be introduced in order to enhance commercial and business functions of the current urban area of the city of Mawlamyine and to boost the economic activity of the city. The creation of a new CBD with offices, hotels, workplaces, and malls are expected to be realized in the location, which ensures close relation with current central business areas of the city spatially and functionally.

- The new station area is considered a suitable area for this development purpose. The following functions are expected to be introduced in the area:

  - Business places, offices, and malls
  - Hotels and tourist infrastructure
  - Cultural and leisure activities for citizens

4.2.2 Housing

- In accordance with population growth, increase of migrant workers based on the demands of industrial areas and change of living styles, corresponding housing units are expected to be supplied in conformity to the city plan. To be livable city, housing development should secure quality and quantity. Typical housing demands and issues for the realization of the development vision of Mawlamyine City are concluded as follows:

Table 4.2.3: Development Policy of Housing in Mawlamyine

Housing Policy	1) Improvement of Current Residential Areas with Reconstruction of Buildings 2) New Town Development around the Station (housing supply by new residential types, apartment building, modern-style building) 3) Housing Supply around Industrial Areas for Workers (introduction of affordable housing units and social housing, need to be supplied for new migrant workers in the industrial areas) 4) New Residential Development in Remote Areas

Source: JICA Study Team

- **1) Improvement of Living Environment of Current Housing Area:** Residential areas in the northeast of the city (Kyeik Ma Nae area) and the south of the city (Zayar Myine area and Myine Than Yar area) are developed with grid pattern planned streets, but their width and spatial capacity are not sufficient. These areas are expected to function as important residential areas of the city and improvement and construction of infrastructure are expected for the areas. In order to improve their spatial condition, it is necessary to reorganize their living environment by application of urban redevelopment project scheme and land adjustment project schemes. This planning method aims to reorganize residential zones and securing public spaces (roads, social facilities) by reconstructing current low houses to middle/high-rise new apartment houses. For its realization, participatory involvement of current residents, public sector (local governments), and private developer is indispensable. Assistance on its planning and project coordination needs to be continuously offered for its realization.

- **2) New Town Development around the Station:** Preparation of modern living facilities with international standard qualities is important for attracting investors from other regions and countries. For the development plan of the city of Maylamyine, these housing projects are expected to be supplied especially for the development in and around CBD. In the areas, brilliant living environment are expected to be planned and prepared in integration with commercial/business spaces and functions. Medium and high-rise apartment type residential buildings are expected to be planned for these areas.

- **3) Housing Supply around Industrial Areas for Workers:** Migration of workers are expected for the new industrial areas to be developed. In order to promote industrial investment to these areas and to avoid deteriorated living conditions, housing supply for these workers are considered in relation with these developments. These housing areas need to be located near the working site and living facilities (commercial and social facilities). Generally, housing developers are interested in housing for medium income class, but they are not interested in housing business for low income workers because of the unprofitable business prospect. Guidance and requirement of social housing by public entities need to be introduced for realization of the balanced development and housing supply. These housing units are necessary to be supplied around the Kyank industrial areas and in the Kyeik Ma Yaw area. Medium-rise apartment type residential buildings with social public facilities need to be planned for these areas.

- **4) New Residential Development in Remote Area:** It is supposed that current urbanized area will extend to the southeast of the city in long term. These areas in the outskirt of the city (Chank Mile Kywal Chan Gone, Kyaik Ma Yaw) are expected to supply houses which

complement the capacity of current residential areas corresponding to the demands in long term. Housing units in these areas are supposed to be developed mainly for detached houses.

4.2.3 Landscape and Tourism

Heritage Tourism

- Mawlamyine attracts tourists due to its heritage sites such as pagodas on the hill, heritage buildings that remained as a historical town of the British colonial period, as well as its unique natural landscape including Yankin Hill and the Thanlwin River. Considering not only the tourist attraction in the area but also the location which is between Thailand and Yangon, Mawlamyine has a big potential in the tourism sector at the international level in the future. However, preservation and utilization of heritage and landscape are not well managed and there is a need for development of tourist zone also to become an international tourist destination. The following policies should be considered to establish an attractive tourism city, heritage tourism as the key driver, utilizing and enhancing the tourism function and landscape of Mawlamyine:

Table 4.2.4: Development Policy of Landscape and Tourism in Mawlamyine

Landscape and Tourism Policy	1) Enhancing Current Tourism Resources 2) Introduction of New Tourism Zones 3) Introduction of New Tourism Products

Source: JICA Study Team

- **1) Enhancing Current Tourism Resources**: The central area of Mawlamyine has many tourism and cultural elements. To enhance the attractiveness of resources, the following policies should be taken:
    - Conservation of landscape and townscapes: Their surroundings are kept in good condition without significant damages by unregulated development around these heritage sites. To enhance the current historical value in city landscape and townscapes, appropriate conservation measures should be implemented. For realization of these subjects, it is necessary to formulate corresponding spatial plans and to regulate construction activities in surrounding areas of the heritage sites.
    - Restoration of the building: restoration of the appearance of buildings and its use
    - Landscape improvement around the monuments: harmonized spatial improvement with surroundings. Integration with open spaces, street furniture, gardening, and tourism signage.
    - Preparation of public space in key tourism areas: pedestrian ways along the river and between tourism elements and public open spaces for scenic spot.
- **2) Introduction of New Tourism Zones:** The city of Mawlamyine has an advantage for its location in an international and regional context. The city is located near Thailand, the neighboring country, and famous tourist spot like Kyaikhtiyo. The city accommodates tourists from/to these countries and places and it has a potential to attract them by its own tourism values. Adding to the current tourism resources, installation of new tourism facilities and activities are recommended in order to make the best use of this opportunity. The following matters are suggested to be considered:
    - Development of new tourist zone near Thanlwin Bridge.
    - Development of new tourist zone in the periphery of the central city area.
      Development in Bilu Island with new tourist environment.
      Introduction of new touristic activities such as convention, sports, etc.
- **3) Introduction of New Tourism Products:** Considering the distance from Yangon which takes six to seven hours by car and the relatively small-scale size of Mawlamyine, it is necessary to

diversify tourism products by linking every resource of the city and the area to attract tourists from distant places. For instance, developing Bilu Island (Bilugyun) as a base for artisanal products and other islands in the Thanlwin River for recreation will become additional attractions to tourists based in the city. Mon State's specialty fruits and other special food can be promoted more in hotels and restaurants targeting tourists.

4.2.4 Environment

- Since Mawlamyine will be developed as livable and heritage tourism city by 2040, there are environmental concerns that need to be addressed in its development policy. There are four main concerns to be taken into consideration: a) nature conservation, b) pollution control, c) living conditions, and d) natural hazard.

Table 4.2.5: Environmental Policy in Mawlamyine

Environmental Policy	1) Creation of Nature Reservation Zone 2) Monitoring Air and Water Quality 3) Ensuring Less Impact on the Environment

Source: JICA Study Team

1) **Creation of Nature Reservation Zone:** Mawlamyine is located conveniently close to its water supply sources such as Kin Moon Chone Reservoir, Shwe Nat Taung Reservoir, and the Ataran River, although it is already facing water supply shortages due to its current population. Since the proximity between water resources and city is so close, it is necessary to protect those water resources from any pollution to keep clean water access to its residents. For water resource protection, it is recommended to designate large area around the Kin Moon Chone and Shwe Nat Taung reservoirs as a "natural conservation zone".

2) **Monitoring Air and Water Quality:** Like many other cities in Myanmar, Mawlamyine does not introduce environmental monitoring system to observe the environmental status of air and water. Although the future development projects are planned horizontally expanding from the existing city center, some environmental impact can be foreseen and it is necessary to introduce monitoring the quality of air and water periodically to ensure the environmental quality for urban residents.

3) **Ensuring Present Living Neighborhood:** Many new town development plans are with modernized large-scale housing compound; thus, it is foreseeable that new town development would have some impact on the environment once people started moving in and living in. Thus, it is necessary to facilitate access to clean water, equip wastewater treatment system before discharging to surface water system, and ensure equal access to urban service than the existing city area.

5 Infrastructure Development and Social Service Policy

- Not only to achieve the development visions and strategies for 2040 but to realize a livable city for all citizens, infrastructure and social service improvement is fundamental. Policies by sectors were set as follows;

5.1 Road and Transportation

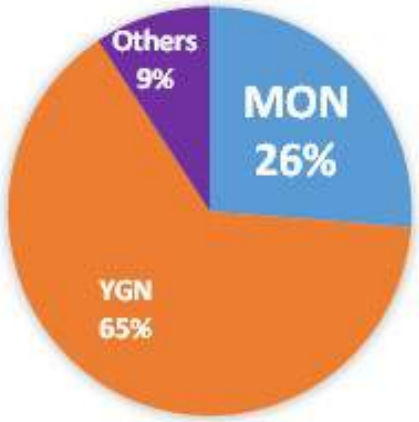
5.1.1 Demand Analysis

- Any holistic traffic engineering surveys such as person trip survey to capture the people's mobility have not yet been conducted in Mawlamyine while the quantitative demand analysis could not be conducted. A comprehensive traffic survey should be conducted immediately since it is essential for urban and transportation planning to obtain accurate data to capture the mobility of people and goods. The access bridge to BiluIsland will be completed in December 2016 and the development plan of the island shall be reflect to the urban and traffic planning of Mawlamyine.

- At present, the only available information to estimate the overall traffic volume is the number of registered vehicles. In Myanmar, most vehicles are registered in Yangon and Mandalay.

  Moreover, the registered plate of these vehicles has not been properly updated but vehicles are still being used outside the registered city. Therefore, it is often difficult to make a correlation between the number of registered cars and actual traffic volume.

- Figure 5.1.1 shows the traffic counting by the vehicles' registered plate in Mawlamyine. In Mawlamyine, majority of the vehicles on the roads are registered in Yangon (65%). The vehicle registration system in Myanmar shall be improved at the national level.



Source: Traffic Count Survey by JICA Study Team

Figure 5.1.1: Observation of Registered Plate in Mawlamyine Township

- Traffic survey data is not available and the quantitative demand analysis could not be conducted. According to the visual observation, there is no congestion on the road network in Mawlamyine even during morning/evening peak hours. Cargo handling activities on the road, loading and unloading on the road, induce traffic blockade on Strand Road and streets around the market near Strand Road are common in the streets of Mawlamyine.

- The area of the Mawlamyine Township is 218 km^2 and the area is the same as the circle with a radius of 8.3 km. A large size public transportation might not be necessary even in the future. Considering the narrow streets in the urban area, small size vehicles and paratransit cars will be suitable for public transportation in the city.

- The toll levy is collected in National Road No. 8 (NH-8) between Mawlamyine (MLM) and Yangon (YGN) and MLM and Tanpyuzayat (TPZ). Traffic volume is counted at the toll collection gate in NH-8. In general, there are no congestion in NH-8. The average daily traffic volume in NH-8 is 5,100 pcu/day (MLM-YGN) and 2,100 pcu/day (MLM-TPZ) only and the 2-lane capacity of NH-8 is still adequate for the current demand. A part of the section between MLM and YGN is going to be widened into 4-lanes. It is noted that NH-8 serves as a community road for villagers along the road. High-speed vehicles such as large size trucks and buses induce serious traffic risk to socially vulnerable persons such as pedestrians and school children.

- The capacity of the existing truck and bus terminals is going to be saturated and the expansion works of Mawlamyine Bus Terminal are under construction. Zeigyo Truck and Bus Terminal is also going to be saturated. The development of a large-scale industrial zone, Kyauk Tan Industrial Zone, is under construction and the demand for a truck terminal will be increased. The existing truck and bus terminals are located in the densely built-up area and will induce traffic congestion in the city.
- The cargo and passenger handling volume in Mawlamyine is 51,600 ton/month and 167,000 pax/month and congestion at the port has not been observed yet.

5.1.2 Development Policy

- This study has preliminarily analyzed the current conditions, issues, and the demand for transportation. Based on the results of the analysis, a development policy was proposed to back-up the urban development plan proposed in this study.

Table 5.1.1: Development Policy of Road and Transportation in Mawlamyine

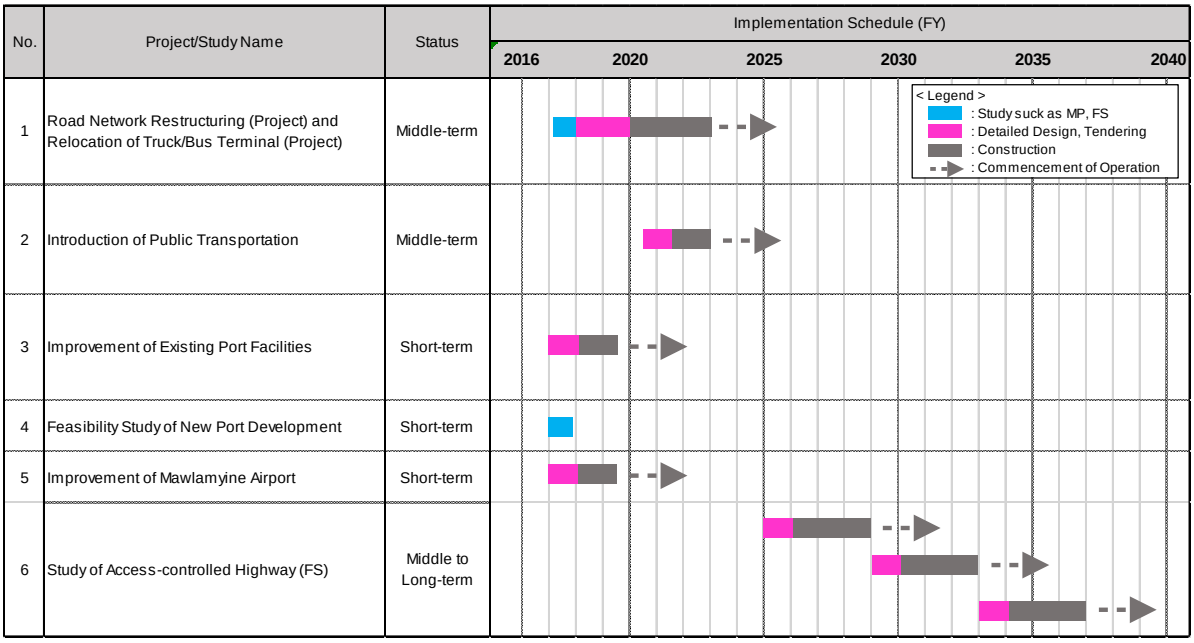
Road and Transportation Policy	1) Provision of Urban Development Axis 2) Provision of Logistic/Industrial Development Axis 3) Provision of Public Transportation

Source: JICA Study Team

- **1) Provision of Urban Development Axis:** The road network shall be upgraded and strengthened to backup and accelerate the proposed urban development of Mawlamyine. The existing road network of Mawlamyine consists of narrow streets and the wider additional arterial roads shall be developed for the urban backbone network. There is an old abandoned railway track in the city and the land of the track might be replaced into the right of way (ROW) of the proposed new road. The pedestrian facility also shall be improved. It is proposed to relocate the existing two bus terminals (Maulamyine BT and Zeigyo BT) to the area around the Mawlamyine Central Railway Station, which will be the core of the proposed new CBD. The relocation of the bus terminals will enhance multi-modal transit and accelerate the station development.
- **2) Provision of Logistic/Industrial Development Axis:** The large-scale industrial zone is being developed in Kyauk Tan area in the south of the city. The corridor between the industrial zone and Myawaddy, border of Thailand, is proposed to be developed as the logistic axis road and the outer skirts road of the city. Also, it is proposed to relocate Zeigyo Truck Terminal to Kyauk Tan area along the corridor near the existing railway track for the multi-modal logistic terminal in the future.
- **3) Provision of Public Transportation:** Side-car bicycle and motorbike-taxi are the major public transportation in Mawlamyine based on the low demand and current narrow road network. Since large-size industrial zones are being developed in Kyauk Tan area, the demand of public transportation will be increased in the future. The public new transportation such as small/medium-sized buses could be introduced on the existing and proposed road network.

5.1.3 Implementation Schedule

- The proposed implementation schedule of the transportation infrastructure development is shown in Figure 5.1.2.



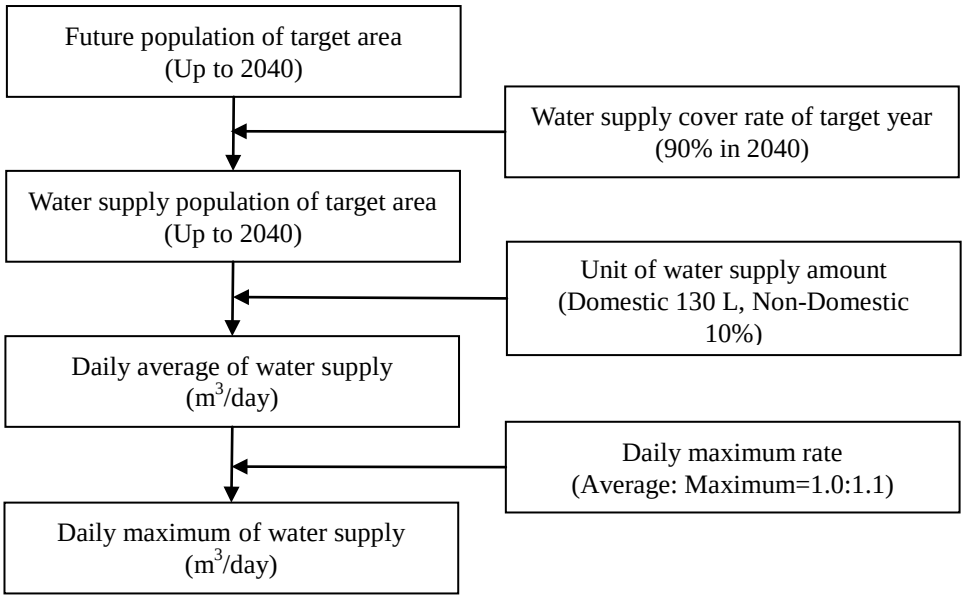
Source: JICA Study Team

Figure 5.1.2: Implementation Schedule (Road and Transportation)

5.2 Water Supply

5.2.1 Demand Analysis

- The flow of water demand forecast on the target year for Mawlamyine Township is shown in Figure 5.2.1. The future population of the target year shall be based on the future population value of this study.



Source: JICA Study Team

Figure 5.2.1: Flow of Water Demand Forecast for Mawlamyine

- Designed water supply population multiplied the future population by the water supply cover rate of the target year. Although water supply cover rate is dependent according to the status of use of wells, from the point-of-view of public health or environment, it should target the highest possible

level. In this study, the water supply cover rate has set 90% by referring to the interview to Mawlamyine CDC. The forecast of designed water supply population for every target year is shown in Table 5.2.1.

Table 5.2.1: Served Population of Water Supply in Mawlamyine Township Up to 2040

Year	2015	2020	2025	2030	2035	2040
Urban Area Population (thousand)	258	273	284	294	303	313
Rural Population (thousand)	36	37	37	37	35	36
Total Population (thousand)	293	309	321	330	338	349
Service Coverage Rate (%)	55%	63%	71%	79%	85%	90%
Served Population (thousand)	161	195	228	261	287	314

Source: JICA Study Team

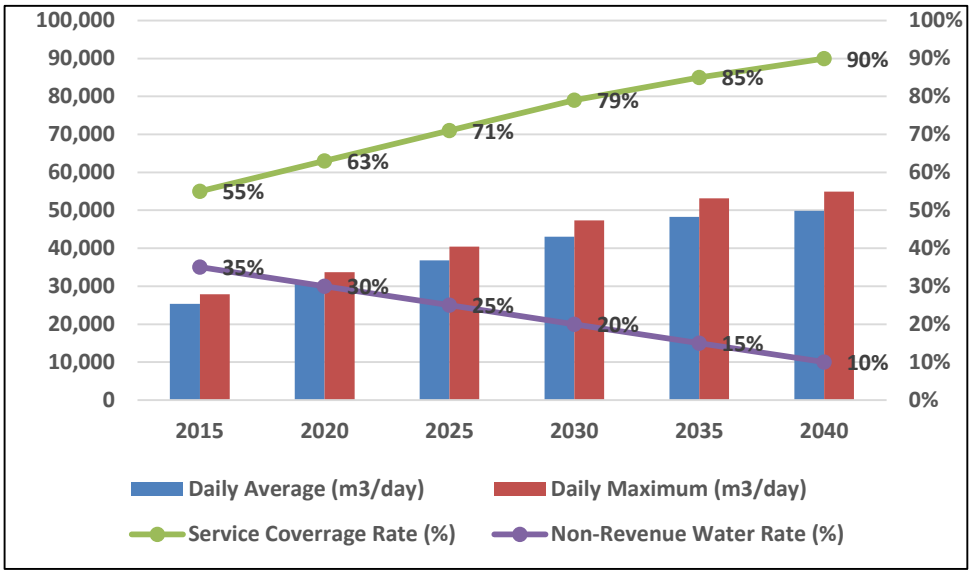
- In this study, each specification and demand of water supply is presumed to refer on the report by JICA on water supply development in other cities (Mandalay and Yangon) and the interview with Mawlamyine Centre for Disease Control (CDC). As a result, the demand for water supply in the target area of Mawlamyine was forecasted to be about 50,000 m^3/day in 2040, so new water sources are needed and the Mawlamyine River is a candidate for surface water. The forecasted demand of water supply for each target year of Mawlamyine is shown in Table 5.2.2 and Figure 5.2.2., and the specifications used for calculation of the demand of water supply are shown below.

a) Water demand per unit for domestic use: 130 liters per person per day (lpsd) in 2040
b) Non-domestic use rate: 10% of domestic use
c) Non-revenue water rate: 10% of total demand volume
d) Daily maximum rate: 1.1 times as daily average

Table 5.2.2: Demand of Water Supply in Mawlamyine Township Up to 2040

Year	2015	2020	2025	2030	2035	2040
Served Population (in thousands)	161	195	228	261	287	314
Domestic Use (lpcd)	93	100	110	120	130	130
Non-Domestic Use Rate (%)	10%	10%	10%	10%	10%	10%
Non-Revenue Water Rate (%)	35%	30%	25%	20%	15%	10%
Daily Maximum Rate	1.1	1.1	1.1	1.1	1.1	1.1
Demand for Water Supply Daily Average (m^3/day)	25,339	30,643	36,784	43,065	48,284	49,891
Demand for Water Supply Daily Maximum (m^3/day)	27,873	33,707	40,462	47,372	53,112	54,880

Source: JICA Study Team



Source: JICA Study Team

Figure 5.2.2: Demand of Water Supply in Mawlamyine Township Up to 2040

5.2.2 Development Policy

- Development of all kinds of infrastructures will support achievement of four development visions shown by "Mawlamyine 2040 - ASEAN Gateway City". The development policy of water supply set-up aiming at the sector vision “Prompt Development of Water Supply System with Safety and Stability” and based on the analysis of current water supply system in Mawlamyine is shown in Table 5.2.3.

Table 5.2.3: Development Policy of Water Supply in Mawlamyine

Water Supply Policy	1) Upgrading of Shwe Nat Taung Dam Water Supply System 2) Upgrading of Kim Mon Chone Dam Water Supply System 3) Upgrading of Attran-1 and Attran-2 River Water Supply System 4) Extension of Water Supply System

Source: JICA Study Team

- **1) Upgrading of Shwe Nat Taung Dam Water Supply System:** Shwe Nat Taung Dam water supply system shall be upgraded as follows:

  a) From RTC Reservoir Tank to Kan Thone Kan Reservoir Tank, shall connect pumping pipeline.
  b) In RTC Reservoir Tank, to collect more water, the tank holding 100,000 gallons of water shall be constructed.
  c) There is no water supply in Thiri Myine Ward now so direct pumping pipeline shall connect there.
  d) Booster pump shall be installed in transmission pipe from Shwe Nat Taung Dam.

- **2) Upgrading of Kim Mon Chone Dam Water Supply System:** Kim Mon Chone Dam water supply system shall be upgraded as follows:

  a) From RTC Reservoir Tank to Kan Thone Kan Reservoir Tank, shall connect pumping pipeline.
  b) Connection of pipe with gravity flow to RTC Reservoir Tank should be done to add more water to Kim Mon Chone Dam.
  c) Near Kan Thone Kan Reservoir Tank, connection of pipe should be done.

d) In Taung Wine Road, to connect Zay Yar Myine Ward and Ngan Tay Village, new pipeline should be installed.

- **3) Upgrading of Attran-1 and Attran-2 River Water Supply Systems:** Upgrading of Attran-1 and Attran-2 river water supply systems shall be upgraded as follows:

a) From river intakes of Attran-1 and Attran-2 to each tank, pumping pipeline, and motor pump should be improved.
b) There is no chemical treatment process in Attran-1 and Attran-2 river water supply systems. It is necessary to establish an appropriate water supply system with purification process to match the World Health Organization (WHO) standards.

- **4) Extension of water supply system:** Water distribution pipes shall be installed for non-served area enhancing the water supply system in creating distribution loops. The new Attran-3 River water supply system shall be constructed according to the urban development plan.

- The development goal and performance indicators for quantitatively evaluating the effect of the water supply project in Mawlamyine are shown in Table 5.2.4.

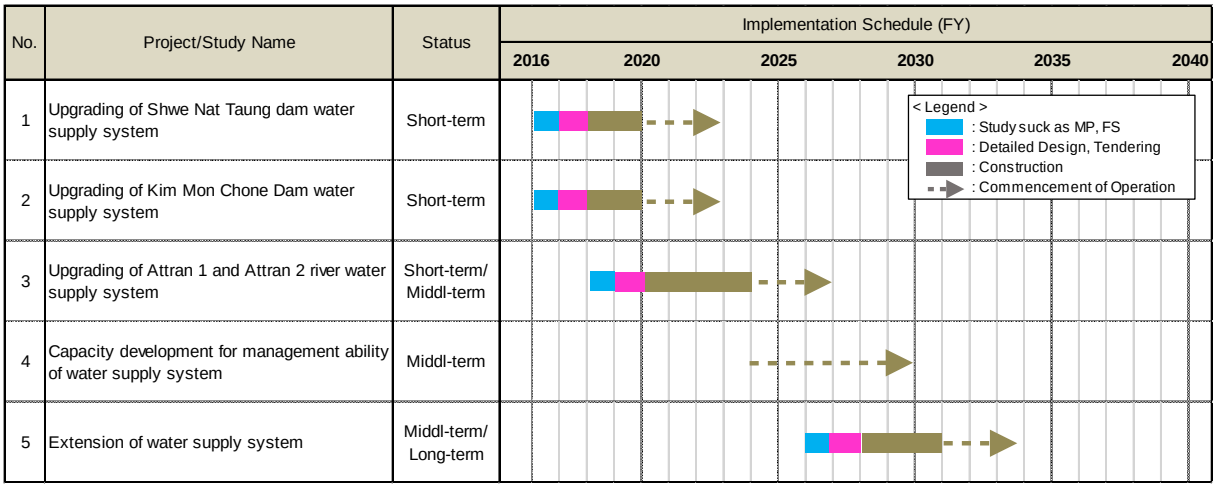
Table 5.2.4: Development Goals and Performance Indicators of Water Supply in Mawlamyine

Development Goals		Performance Indicators (PI)
Customer Service Levels	Service quantity	24/7
	Extension of the service coverage	90% for Urban + Rural
Water Quantity	Development surface water production	by 2030 (Attran-3)
	Rehabilitation of public tube-wells	100% by 2020
	Save of non-revenue water (NRW)	NRW 10% by 2040
Water Quality	Install disinfection system at Attran-1,-2	by 2022

Source: JICA Study Team

5.2.3 Implementation Schedule

- The proposed implementation schedule of the water supply infrastructure development is shown in Figure 5.2.3.



Source: JICA Study Team

Figure 5.2.3: Implementation Schedule for Mawlamyine (Water Supply)

5.3 Sewerage

5.3.1 Demand Analysis

- To decrease the risk of waterborne infectious diseases and groundwater contamination, a new wastewater treatment plant (WWTP), with appropriate treatment process, such as conventional activated sludge process, will be required urgently. For the sewerage system of Mawlamyine, a comprehensive master plan will be required due to lack of strategy for sewerage development at present. Then, in this plan, the sewerage demand shall be presumed by the concept shown in the following:

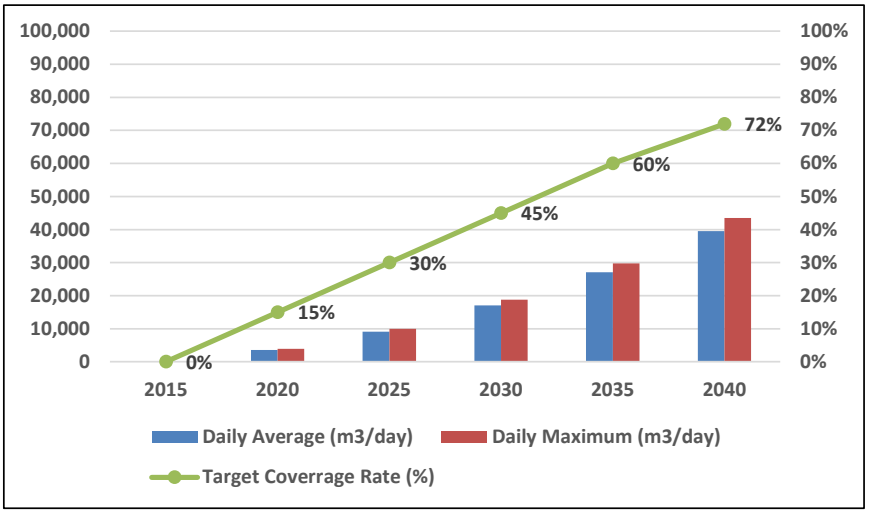
  a) Target of the sewerage system: Urban area (rural area will adopt the individual sewage system)
  b) Domestic sewage demand: Presumably the same volume as water supply
  c) Industrial waste water: Not included (industrial area will adopt the individual sewage system)
  d) Volume of infiltration and inflow: 10% of domestic sewage

- The demand of sewerage in the urban area of Mawlamyine was forecasted to be about 40,000 m^3/day in 2040. For preserving the sanitary water environment in the urban area, the development of "efficiently and advanced sewage treatment system" is required according to the increasing amount of sewage discharge. The forecasted demand of sewerage for each target year in the urban area of Mawlamyine is shown in Table 5.3.1 and Figure 5.3.1.

Table 5.3.1: Demand of Sewerage in Mawlamyine (Urban Area) Up to 2040

Year	2015	2020	2025	2030	2035	2040
Target Coverage Rate (%)	0%	15%	30%	45%	60%	72%
Covered Population (in thousands)	0	29	68	117	172	251
Domestic Sewage (lpcd)	93	100	110	120	130	130
Non-Domestic Sewage Rate (%)	10%	10%	10%	10%	10%	10%
Infiltration and Inflow Rate (%)	10%	10%	10%	10%	10%	10%
Daily Maximum Rate	1.1	1.1	1.1	1.1	1.1	1.1
Demand for Sewerage Daily Average (m^3/day)	0	3,539	9,104	17,054	27,087	39,514
Demand for Sewerage Daily Maximum (m^3/day)	0	3,893	10,014	18,759	29,796	43,465

Source: JICA Study Team



Source: JICA Study Team

Figure 5.3.1: Demand of Sewerage in Mawlamyine (Urban Area) Up to 2040

5.3.2 Development Policy

- Currently, in the river and lake in Mawlamyine, the water quality is deteriorating by discharging sewage from houses and factories. Therefore, to recover healthful water environment, development of sewerage is required as soon as possible. Aiming at the sector vision of "Realization of Comfortable Life and Healthful Water Environment" and referring on the interview with Mawlamyine CDC, the development policy of sewerage set-up based on the analysis of current situation of Mawlamyine as shown in Table 5.3.2.

Table 5.3.2: Development Policy of Sewerage in Mawlamyine

Sewerage Policy	1) Improve the Water Environment in Public Water Areas 2) Improve the Sanitary Living Environment 3) Use the Flushing-clean Toilet 4) Develop the Beautiful City with Wealthy Water and Green

Source: JICA Study Team

- **1) Improve the Water Environment in Public Water Areas:** To recover healthful water environment, a sewerage system should be developed immediately. Referring to other sewerage projects in Yangon or Mandalay, the discharge standards of WWTP was proposed as phased approach (Biochemical oxygen demand (BOD); Short term 60 mg/l, Long term 20 mg/l). Based on this situation, the target discharge standards from WWTP will be required limiting BOD to 20 mg/l. In the long term, it would be desirable to encourage the reuse of wastewater and integrate the treatment of sludge collected from septic tanks.

- **2) Improve the Sanitary Living Environment:** Depending on the diffusion of water supply and advancement in lifestyle, the type and volume of water of wastewater are increasing and are being discharged to drainage or ground around the houses. Various wastewater such as domestic water from kitchen, bathroom, and flush toilet water shall be treated in the sewerage system.

- **3) Use the Flushing-clean Toilet:** To improve poor sanitary conditions and public health, Mawlamyine CDC shall promote replacing a pit latrine to flush toilet and septic tank for households.

- **4) Develop the Beautiful City with Wealthy Water and Green:** Mawlamyine CDC promotes preservation of pure water and rich green and improvement in living environment, cooperating with urban development. The clean water produced by the sewerage system and growth of living things make up wealthy water and green environment.

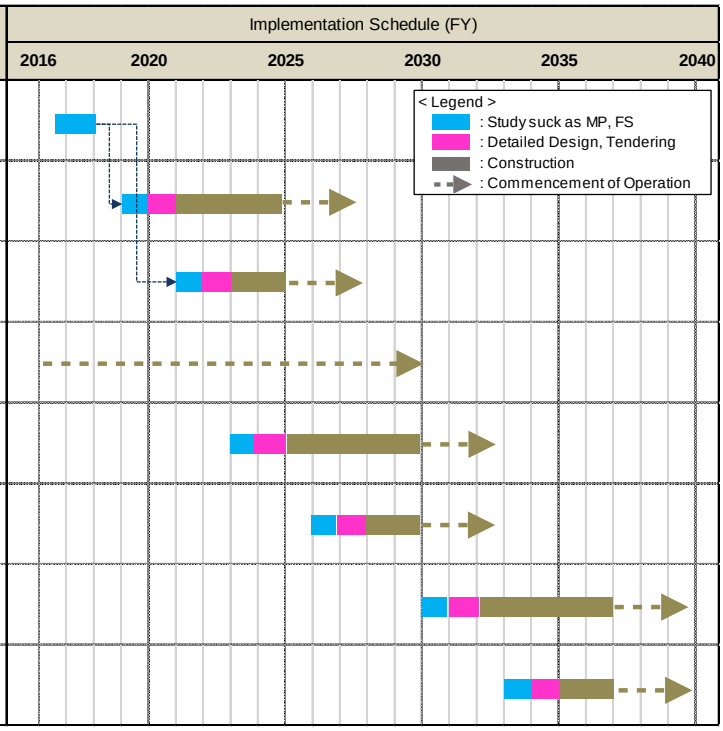
- At first, sewerage planning is needed and the tasks that need to be accomplished are as follows: (1) Field survey of the topography, geology, and water quality; (2) Study of basic specifications like target area, collected population, and sewage quality; and (3) Consider sewerage type selection, collected zone, capacity and location of WWTP, and main pipe route. The development goals of sewerage of Mawlamyine are shown below.

  - Make a sewerage master plan that is efficient and economically viable.
  - Possibility of a project technique of sewerage considering low cost and mobile development according to the actual condition of the area.
  - Develop a target covered area of sewerage system at 80% of water served area in the urban area by 2040.
  - Promote installation of septic tank at every house until development of sewerage.
  - Put proper operation and maintenance of septic tank into practice.
  - Promote connection to sewerage and collect a suitable charge for its usage.
  - Study the financial soundness of the sewerage project.

5.3.3 Implementation Schedule

- The proposed implementation schedule of the sewerage infrastructure development is shown in Figure 5.3.2.

No.	Project/Study Name	Status
1	Comprehensive sewerage master plan	Short-term
2	Project for sewerage system (1)	Short-term/ Middl-term
3	Project for waste water treatment plant (1)	Middl-term
4	Promotion for install septic tank	Short-term/ Middl-term
5	Project for sewerage system (2)	Middl-term
6	Project for waste water treatment plant (2)	Middl-term
7	Project for sewerage system (3)	Long-term
8	Project for waste water treatment plant (3)	Long-term



Source: JICA Study Team

Figure 5.3.2: Implementation Schedule for Mawlamyine (Sewerage)

5.4 Drainage

5.4.1 Demand Analysis

- Stormwater in Mawlamyine Township flows into the Thanlwin River or the Attran River. The area in the east side and near the Attran River have low and flat topography. Hence, these areas basically have drainage problems. Although habitual flood occurs in some areas, people do not seem to consider this as a big problem because flood usually disappears a few hours later. Also, flood depth is normally less than knee high. The issue points of the drainage are shown below.
  - Some drainage canals have accumulated soil sediments, which inhibit the flow .
  - There are not enough gates, banks, and pumps which prevent flooding in the low-lying areas.
  - The increase of rain water runoff rate following urban development is a concern due to expansion of flooding.
- Aiming at the sector vision of "Reduce Flood Damage for Urban Safety Management" and referring to the interview with the Mawlamyine CDC, the development policy of drainage set-up based on the analysis of current situation of Mawlamyine is shown in Table 5.4.1.

Table 5.4.1: Development Policy of Drainage in Mawlamyine

Drainage Policy	1) To Reduce the Frequency of Flooding in Urban Area 2) Existing Drainage Should be Used as much as Possible but shall be Upgraded and Extended

Source: JICA Study Team

- **1) Reduce the Frequency of Flooding on Urban Area:** On improving drainage facilities, an indicator termed as rainfall return period is set-up as the planning target. Based on consideration of actual condition and cost benefit, a five-year return period shall be used for a long-term target. Reducing flooding on a two-year return period for a short-term target shall be carried out by the relatively modest investments.

- **2) Existing Drainage Should be Used as Much as Possible but Shall be Upgraded and Extended:** Drainage of the internal runoff should be enabled by improvements (cleaning and dredging) of the drainage canals and installation of main pumping stations.

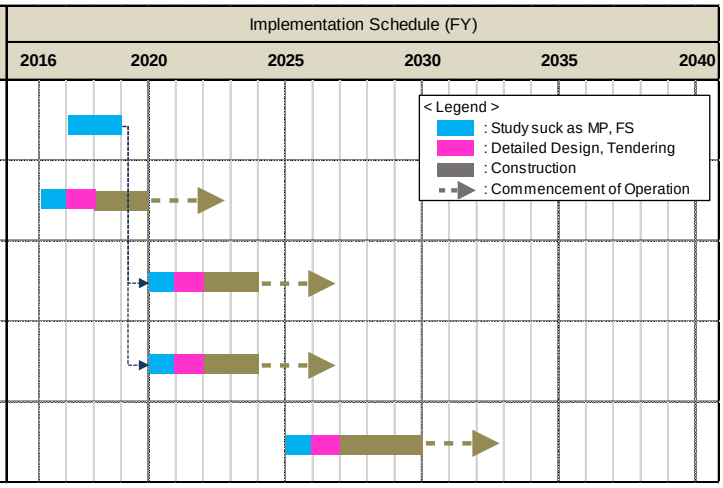
- In case of drainage planning, the target area and design conditions are considered first, and it is necessary to study the improvement, utilizing it effectively, after calculating the capacity of the existing drainage. The development goal of drainage in Mawlamyine is shown below.

    - Make a drainage master plan by utilizing the existing facilities effectively.
    - Improvement of urban drainage facilities causing inundation.
    - Some drainage should be enabled by improvements (dredging and covered concrete) of the bottom.
    - Installation of main pumping stations and gates.

5.4.2 Implementation Schedule

- The proposed implementation schedule of the drainage infrastructure development is shown in Figure 5.4.1.

No.	Project/Study Name	Status
1	Comprehensive storm water drainage master plan	Short-term
2	Project for dredging and improving of the existing drainage canals	Short-term
3	Project for improvement of urban drainage facilities (1)	Middl-term
4	Project for installation of the mainly pumping stations and gates	Middl-term
5	Project for improvement of urban drainage facilities (2)	Middl-term



Source: JICA Study Team

Figure 5.4.1: Implementation Schedule for Mawlamyine (Darinage)

5.5 Solid Waste

5.5.1 Demand Analysis

- The final disposal sites are simple dumping sites operated by the Mawlamyine CDC without any pollution control facility (no landfill liner and no drainage of leachate). Leachate from dumped waste to the sites flows out and permeates into the ground without any treatment. Improper open burning in the site releases dense dangerous smoke and some garbage collector operates at the site, including women and children, without any safety protection (no mask and no gloves). Solid waste collection is rapidly increasing following urban development in Mawlamyine Township. The handling capacity of the final disposal site can only accommodate little amount of waste.

- Considering the present collected garbage, the demand of solid waste management is roughly calculated by unit volume (0.56 t/thousand-p/d) of the other project. As a result, the demand of

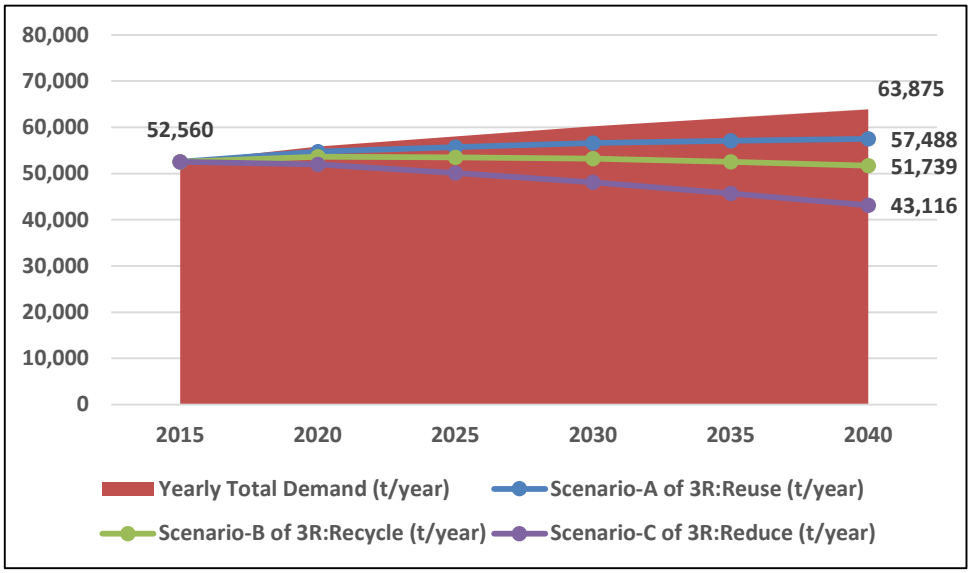
solid waste management in the urban area of Mawlamyine was forecasted to be about 64,000 tons/year in 2040. The 3Rs policy (Reduce, Reuse, and Recycle) is required for reducing solid waste which continues to increase. Therefore, the scenarios of the 3Rs are assumed below. The forecasted demand of solid waste for each target year based on the scenario of the 3Rs policy in the urban area of Mawlamyine is shown in Table 5.5.1 and Figure 5.5.1.

- Scenario-A: reduce 10% by reuse of available material from waste
  Reuse (10% by 2040)
- Scenario-B: in addition, reduce 10% by recycle of organic material
  Reuse (10%) + Recycle (10% by 2040)
- Scenario-C: moreover, reduce 15% by incineration of waste
  Reuse (10%) + Recycle (10%) + Reduce (15% by 2040)

Table 5.5.1: Demand of Solid Waste Management in Mawlamyine (Urban Area) Up to 2040

Year		2015	2020	2025	2030	2035	2040
Urban Population (in thousands)		258	273	284	294	303	313
Unit Volume (t/thousand-p/day)		0.56	0.56	0.56	0.56	0.56	0.56
Demand of Solid Waste Management (t/day)		144	153	159	165	170	175
Yearly Total Demand (t/year)		52,560	55,845	58,035	60,225	62,050	63,875
Scenario-A of 3Rs:	Reuse Rate (%)	0%	2%	4%	6%	8%	10%
	Reuse (t/year)	52,560	54,728	55,714	56,612	57,086	57,488
Scenario-B of 3Rs:	Recycle Rate (%)	0%	2%	4%	6%	8%	10%
	Recycle (t/year)	52,560	53,634	53,485	53,215	52,519	51,739
Scenario-C of 3Rs:	Reduce Rate (%)	0%	3%	6%	9%	12%	15%
	Reduce (t/year)	52,560	51,992	50,142	48,120	45,669	43,116

Source: JICA Study Team



Source: JICA Study Team

Figure 5.5.1: Demand of Solid Waste Management in Mawlamyine (Urban Area) Up to 2040

5.5.2 Development Policy

- For solving the issue of solid waste and for comfortable and beautiful urban development, a comprehensive action of 3Rs by a united local government and citizen is needed. Aiming at the sector vision of "City Beautiful Movement with a Sound Material-Cycle Society" and referring to the interview with Mawlamyine CDC, the development policy of solid waste set-up based on the analysis of current situation of Mawlamyine is shown in Table 5.5.2.

Table 5.5.2: Development Policy of Solid Waste in Mawlamyine

Solid Waste Policy	1) Renewal of Solid Waste Management with Safety 2) Promote 3Rs (Reduce, Reuse, and Recycle) 3) Buildup of Sound Material Cycle Society 4) Reduce Environmental Impact by Disposal of Hazardous Wastes Properly

Source: JICA Study Team

- **1) Renewal of Solid Waste Management with Safety:** Waste management encompasses management of all processes and resources in compliance with health codes and environmental regulations.

- **2) Promote 3Rs (Reduce, Reuse, and Recycle):**

  - **Reduce**: the first and most effective component of the waste hierarchy is reducing the waste created. Consumers are encouraged to reduce their waste by purchasing in bulk, buying items with less packaging, and switching to reusable instead of single-use items.
  - **Reuse**: Much of this waste can immediately be reused to minimize the strain on the environment and municipal waste management. For example, consumers can refill a purchased bottle of water with water from home to minimize the number of plastic bottles being discarded.
  - **Recycle**: when waste is eventually discarded, segregating items for recycling from other waste is important. The recyclable items include glass, newspaper, aluminum, batteries, cardboard, and many other materials.

- **3) Buildup of Sound Material Cycle Society:** 3Rs policy is a basic action for a Sound Material-Cycle Society, and all of the local government units, citizens, and companies should have a positive attitude about 3Rs. Mawlamyine CDC shall promote it through public relations, forum, personnel training project, campaign, event, etc.

- **4) Reduce Environmental Impact by Disposal of Hazardous Wastes Properly:** Hazardous waste should not be dumped into a landfill like any other waste. It needs to be disposed responsibly to prevent hazards to human and environmental health.

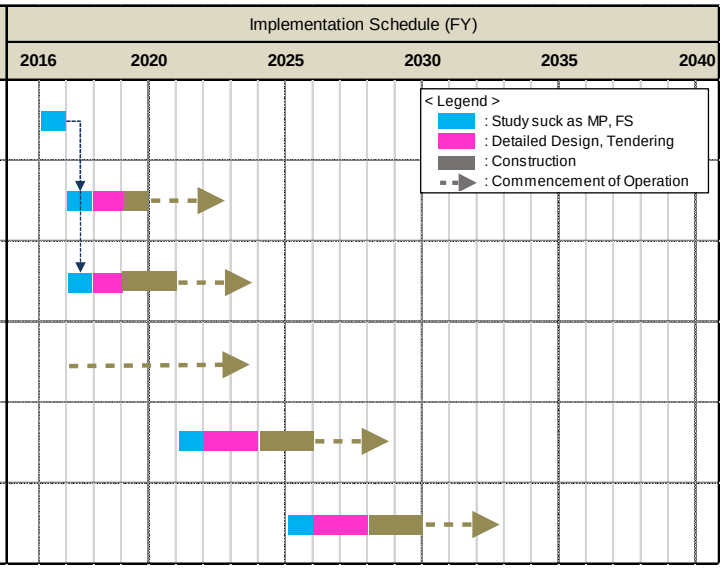
- The development goals of solid waste in Mawlamyine are shown below.

  - Make a comprehensive strategic planning for collection and reuse of available material in the source of waste.
  - Provide a recycle system for various material by having separate collection.
  - Construct an incineration plant for reducing of solid waste and some management facilities.
  - Develop new final disposal site with proper reclamation and treatment method.

5.5.3 Implementation Schedule

- The proposed implementation schedule of the solid waste infrastructure development is shown in Figure 5.5.2.

No.	Project/Study Name	Status
1	Comprehensive strategic planning of reusing of solid waste and Promotion of the project	Short-term
2	Construction of the recycling system by separate collection of organic waste	Short-term
3	Construction of the final disposal site by a proper reclamation and treatment method	Short-term
4	Project for capacity development of solid waste management	Short-term/ Middl-term
5	Proper collection of hazardous wastes, and construction of treatment facilities	Middl-term
6	Construction of incineration facilities for decreasing solid waste	Middl-term



Source: JICA Study Team

Figure 5.5.2: Implementation Schedule for Mawlamyine (Solid Waste)

5.6 Electricity

5.6.1 Demand Analysis

- While estimating the power consumption and/or peak demand of Mawlamyine Township, frequent suspension of power supply associated with equipment failure and/or shortage of power supply, amount of scheduled load shedding, and distribution loss should be taken into account. Unfortunately, a well-maintained trend of detailed database has not yet been available in Myanmar's power systems which makes it very difficult for a good estimation of consumption and peak demand forecast even using the conventional theorems. Thus, making a strong, detailed, real time, errorless, and digitalized database is truly essential for appropriate planning and design of superior power system and electrical infrastructure equipment. Installation of supervisory control and data acquisition (SCADA) system with centralized/regional control provision would be the first step to start a digitalized database.

- The yearly peak-demand trend till 2015 is shown in Table 5.6.1. The peak demand meant the maximum value of the power demand during a given period. In general, the average power consumption per hour is employed.

Table 5.6.1: Peak Demand Growth Trend of Mawlamyine Township

Year	Peak Demand (MW)	Demand Growth Rate
2012	17.70	-
2013	21.10	19.1%
2014	26.10	24.0%
2015	-	-
2016	50.3	-

Source: Prepared by the JICA Study Team based on the final report of the 'Preparatory Survey on Distribution System Improvement Project in Main Cities' by JICA

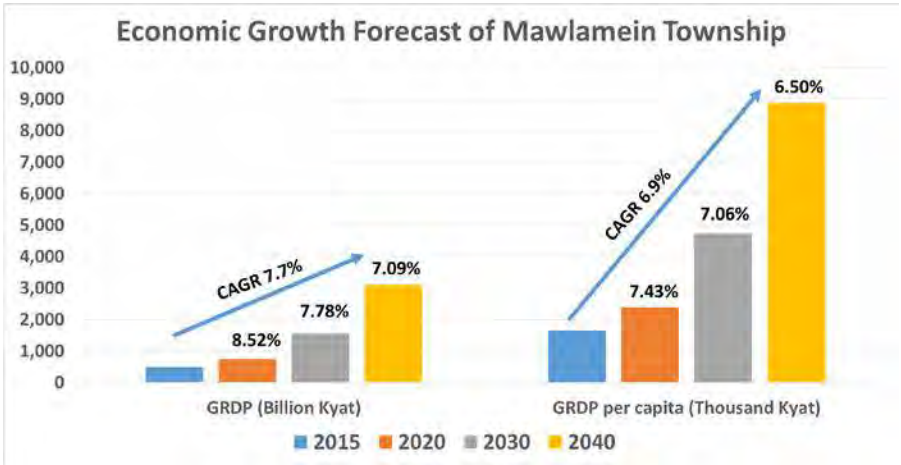
- The table above shows the substations' peak demand only. Amount of scheduled load shedding and distribution loss are not included in the above statistical data. Although the past trend is usually considered to be the base for forecasting power consumption, it becomes uncertain in cases where abnormal growth rate of the past few years continues in the future. Potentially developing areas like Mawlamyine Township, where the scope of development is large, could be considered as identical. In short term, the compound annual growth rate (CAGR) of the past trend may be considered to estimate the peak-demand forecast. The CAGR of peak-demand in this case is 29.84%, while the Electricity Supply Enterprise (ESE) considers the peak demand growth rate

forecast at 15% increment in load. Due to limited statistical data and unavailability of any concrete future development plan, the demand forecast estimations with conventional methods would not be able to receive any concrete result. Thus, along with creating a database, a concrete urban power and electrical infrastructure development master plan should be formulated.

- The conventional and ancient methodology of power-demand forecast is broadly classified into macro and micro methods. Macro method makes an analysis from the viewpoint of the general situation. The power demand and peak power are forecasted by finding and using a certain (i.e., gross rating point (GRP), GRP per capita, etc.) trend or correlation to the power consumption and vice versa. Micro method makes a detailed analysis of demand by categorizing it into constituents, and the total power demand is derived from estimations made for each constituent. The demand forecast using the micro method for Mawlamyine Township is not possible with the current database. However, the peak-demand forecast is made by the JICA Study Team based on macro method and spatial plan as shown below.

- Firstly, the loads are divided into two parts: Public (any loads other than the industrial load) and Industrial (industrial zone, SEZ). The estimation is done from the supply-side point of view. The Industrial load could be estimated based on the land use area (acre or hector), scale of industry, etc. As soon as the urban development plan has concrete definition of the future industrial area, scale of industry and project implementation time schedule available, the forecast would be possible for industrial load (i.e., 1 hector=4 or 5 MW, Phase-1,2,3, etc.) Public load forecast has been done based on GRP and GRP/capita forecast.

- According to the population growth forecast by the JICA Study Team, the average growth rate of Mawlamyine Township's population is calculated as 0.7% per annum until the year 2040. The forecast of GRP (at current price) and GRP per capita (at constant price) made by JICA Study Team is shown in Figure 5.6.1. In this forecast, CAGR of GRP and GRP per capita are 7.7% and 6.9%, respectively and the breakdown of growth rate is shown in Figure 5.6.1.

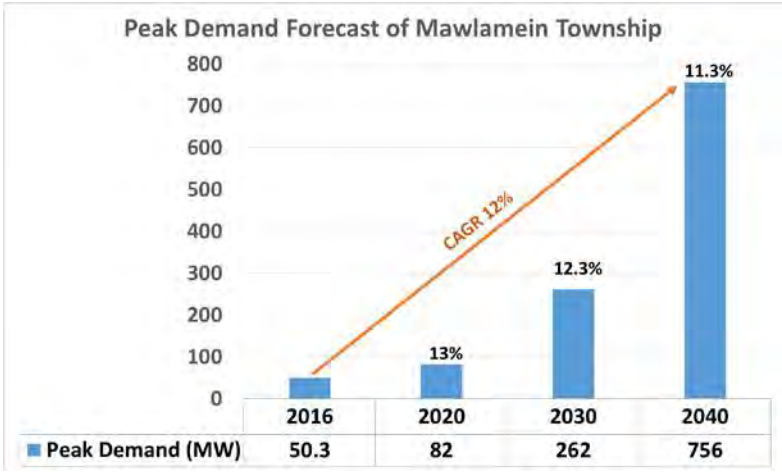


Source: JICA Study Team

Figure 5.6.1: Forecast of GRDP and GRDP per capita of Mawlamyine Township

- The GRP growth trend data (shown in Table 3.2.2 above) shows the values in current price. In order to decide the desired coefficient value, the trend has been converted to constant price. By comparing the GRP growth trend in constant price and the peak demand growth trend (Table 5.6.1) a rough estimation of elasticity value equal to 1.74 has been predicted for the Mawlamyine Township. Since both the GRP growth trends and peak power demand trends are based on limited time period of history and various conditions on data, the elasticity value may have a certain degree of deviation. But for the moment, this is assumed to be the best value of elasticity. The forecasted growth rate of peak power demand is assumed to be equal to 'elasticity value' times of forecasted 'GRP per capita growth rate'. By considering the abovementioned data, the peak

demand growth forecast for public load till 2040 is made and is shown in Figure 5.6.2. The CAGR of this forecast is 12%.



Source: JICA Study Team

Figure 5.6.2: Peak Demand Forecast of Mawlamyine Township

- In order to get a more precise result in the future, many other modern approaches using weather forecast and intelligent algorithm could be used depending on the available data.

5.6.2 Development Policy

- Based on the current condition, issues, and demand forecast analysis, development policy shall be imposed to back-up the urban development plan proposed in this study.

Table 5.6.2: Development Policy of Electricity in Mawlamyine Township

Electricity Policy	1) Distribution Loss Reduction 2) Developing Digital Database 3) Comprehensive Urban Energy and Electric Power System Development Plan 4) Upgrading and Strengthening of Primary Substations Network 5) Involvement of the Mandalay Electricity Supply Corporation (MESC) and/or Ministry of Electrical Power and Energy (MOEPE) in Urban Planning

Source: JICA Study Team

- **1) Distribution Loss Reduction:** Currently, the distribution loss in Mawlamyine Township is around 25% to 30% according to ESE. Projects targeting distribution loss reduction shall be taken.

- **2) Developing Digital Database:** Any electricity-related plan and/or design is basically based on detailed data analysis. Making an efficient, detailed, real-time, errorless, and digitalized database of Mawlamyine itself would solve many problems in the power system as well as make the Mawlamyine Township wide-open to superior power system and electrical infrastructures and become one of the smart cities in the future. Installation of SCADA system with centralized/regional control provision would be the first step to start a digitalized database.

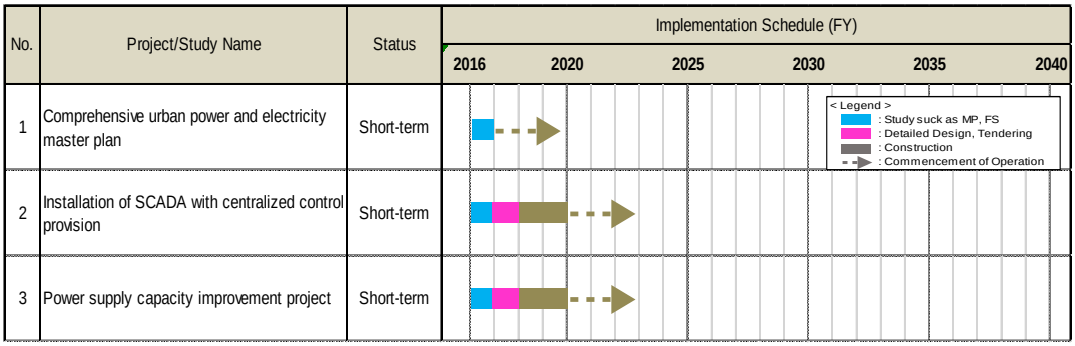
- **3) Comprehensive Urban Energy and Electric Power System Development Plan:** Although Myanmar has formulated an electricity masterplan, developing a comprehensive study on energy and power infrastructure of a city like Mawlamyine shall ensure the synchronization of the future development plan and the urban electricity masterplan.

- **4) Upgrading and Strengthening of 66 kV Primary Substations Network:** In Mawlamyine Township, the electricity supply depends on the capacity of the primary substations. The primary substation facilities shall be upgraded in an emergency basis.

- **5) Involvement of ESE and/or MOEPE in Urban Planning:** The JICA Study Team's estimation of peak demand forecast and the ESE's peak demand forecast are different. One of the reasons behind this difference is that ESE is not updated about the information of future urban development plans, i.e., development ratio, made by the other bodies of the Myanmar government. Thus, direct involvement of ESE and/or MOEPE while formulating these development plans and/or development committee is recommended.

5.6.3 Implementation Schedule

- The proposed implementation schedule of the electrical infrastructure development is shown in Figure 5.6.3.



Source: JICA Study Team

Figure 5.6.3: Implementation Schedule (Electricity)

5.7 Social Service

- Benefits from achievements of the master plan, including economic growth and improvement of environmental condition, should be shared to all the people in the community. This means not only increasing the incomes of the poor, but also addressing the needs of the disadvantaged and excluded groups. In addition, the development should allow them to fully participate and contribute in the process of growth. To achieve inclusive development, the key point is to provide equal opportunity and accessibility to social services for all people which include all classification of income groups. To secure the provision of social service, the following development policy should be aimed for:

Table 5.7.1: Development Policy of Social Service in Mawlamyine

Social Service Policy	1) Provision of Equal Opportunity of Education and Employment for All People 2) Provision of Healthy and Secure Living Environment for All People 3) Provision of Social Safety Net for All People

Source: JICA Study Team

- **1) Provision of Equal Opportunity of Education and Employment for All People**: Education helps provide children with opportunities to fulfill their potential and is critical to all aspects of social development. Access to education is, however, is limited particularly for low income groups and minorities. Attendance rates of primary school (primary school age) in Mawlamyine Planning Area is 75-86%, although the Myanmar's Constitution guarantees access to free and compulsory primary education to all children. In addition, attendance rates in basic education schools, middle, and high school, decrease gradually as people increase in their age. Those are mainly caused by economic difficulties, poor access mode to schools, and gap of number of

schools. Measures to reduce student dropouts should be taken. Regarding employment, labor market and employment opportunities have many gaps concerning those classified as vulnerable groups such as lower education levels, poor, and persons with disabilities. Newly graduates from universities also have difficulties in finding immediate employment. Those hidden demands of vulnerable groups and new entries to the labor market should be clarified and matched with appropriate jobs. The following recommended supports should be considered to provide equal opportunity of education and employment:

- Preparation of school allocation plan according to the estimated future population and number of students,
- Develop regulations that lead to greater complementarities between private and public schools,
- Upgrading teacher quality with pre-service and in-service teacher training programs,
- Improvement of infrastructures for educational institutions such as laboratory and library,
- Operation of school bus service and launching of mobile school program in remote areas,
- Provision of scholarship program for children with economic difficulties,
- Enhancement of job matching network with various employment opportunities, target of which includes students graduated from higher educational facilities, and
- Provision of vocational training which targets special job seekers including those who retired from schools early, person with disabilities, poverty groups, and females.

- **2) Provision of Accessibility to Healthy Life for All People**: Quality of life is closely related to health condition. In addition, good health condition gives a positive impact on productivity and amount of labor force. On the contrary, health problem may increase the risk of poverty through loss of earnings and increase health expenditures. The health facilities by type are, however, not equally distributed in Mawlamyine Planning Area currently. The gap of service level should be balanced by establishing necessary health facilities, which should go together with appropriate assignment of qualified health workers as well. The following recommendations should be considered to enhance the health status of the community:
  - Improve supply and access of health care services for all areas, considering number, type, and transportation,
  - Establish appropriate and sustainable health financing scheme,
  - Training of health provider (in-service and on-the-job) and appropriate assignment of qualified health workers,
  - Launch program for promotion of public health such as education and information about the spread of diseases,
  - Introduce health insurance system particularly for the urban poor community, and
  - Community support system for elderly people to provide health care, social care, and protection in their activities of daily life.

- **3) Provision of Social Safety Net for All People**: Participation of social vulnerable groups to growth process of the city will contribute in realizing inclusive development. Actually, there are people who are in social vulnerable groups which are poor, have low level of education, and with disabilities. For example, 16% of Mon State residents, according to data from the United Nations Development Programme (UNDP), are living in poverty, and most of them originally belong to

this situation and have a hard time to get out of the poverty cycle. On the other hand, anyone has a potential to fall into socially vulnerable groups caused by accidents including recession, serious injury, or disease, debilitation due to old age, and becoming single or growing up with no parent nor family. It is quite important to provide social support for them to get an opportunity to have their own livelihood and to secure their lives. The following recommendations should be considered to support social vulnerable people's lives:

- Survey on the existing condition of social vulnerable groups including poverty, orphans, and disabilities regarding living condition, education, employment, and health for appropriate support,
- Provision of affordable housing for low income household,
- Promotion of human development programs such as skill-enhanced training and vocational training,
- Financial support including scholarship and grant for orphans and children with disabilities, and
- Promotion of universal design (barrier-free) in public facilities, public transportation, and footpath.

6 A Roadmap of Key Projects

6.1 Development Aspects

- The plan assumes three development aspects with its targets. The following describes concrete projects and activities for each development aspect.

Improvement of Urban Environment and Tourism Promotion

- The improvement of current urban areas is planned in the beginning of the development phase after the completion of construction of basic infrastructure services and ensuring their basic supplies. Upgrading of the spatial quality in the central area, where many cultural and religious monuments are located, would lead to tourism and economic development of the city with its symbolical appearances. Improvement of current low quality residential area is important from the view of reduction of disasters. These improvement activities are expected to contribute in attracting investment from other regions and other countries. Some development for new housing development are being planned to start after thorough examination on spatial planning and business plans. The following projects and activities are expected to be executed in this aspect:

    - Tourism promotion and heritage conservation (refer to key project of no.2, 3, & 4 in the next page)
    - Basic infrastructure development (no.11 & 12)

Execution of Urban Redevelopment, and Implementation of Projects for Economic Development

- The plan focuses on preparatory development for migrant residents and construction of principal infrastructure networks in the peripheral areas and new development areas of the city. It intends to accommodate migrant persons for new industries and to prepare the basis of urban infrastructures for development. The following items are being planned to be executed in this aspect:

    - Logistics and industrial function improvement (no.5, 7, 8, 9, & 10)
    - Arterial roads network development (no.5)
    - Public transportation improvement (no.6)
    - Improvement of residential environment by urban redevelopment and land readjustment
    - Informal settlements formalization

Implementation of New CBD Development

- After examination and formulation of planning and business schemes, the developments for new CBD areas and new town areas are being planned to start. Because of their extensive development area, the developments need to be progressed by stages, and the development plans need to be reviewed and modified according to the demand of housing and business facilities, if necessary.

    - Commercial and business area development (no.1)
    - Urban redevelopment around the new bridge and Bilu Island

6.2 Key Projects

- To achieve the development vision and realize the spatial plan written in the previous section, 12 key projects, which are focal actions to be commenced in the short-term (four from urban development sector and the other eight from infrastructure development sector), are selected and described in detail in this section. Some projects could be commenced in the middle term because discussion and preparation works are recommendable to be started as soon as possible. Table 6.2.1 summarizes the key projects and the following section describes each project.

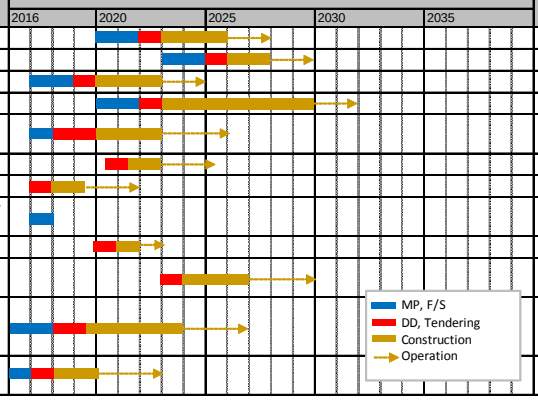
Table 6.2.1: A List of Key Projects

Sector	Project Name	Vision (Key Drivers)		
		Heritage Tourism	Connectivity & Industry	Livable
Urban Development	1. New CBD Development Project		++	+
	2. New Tourism Site Development Project	++		
	3. Strand Road Improvement Project	++		+
	4. Heritage Redevelopment Project	++		+
Infrastructure Development	5. Road Network Restructuring and Truck/Bus Terminals Relocation Project		++	
	6. Public Transportation Introduction Project		++	+
	7. Port Facilities Improvement Project		++	
	8. New Port Development Project (Feasibility Study)		++	
	9. Mawlamyine Airport Improvement Project		++	
	10. Access-controlled Highway Project (Study)		++	
	11. Third Greater Mekong Subregion Corridor Towns Development Project (Water Supply and Solid Waste Management)	+	+	++
	12. Power Supply Capacity Improvement Project	+	+	++

Note: ++ Strong Relation, + Relation
Source: JICA Study Team

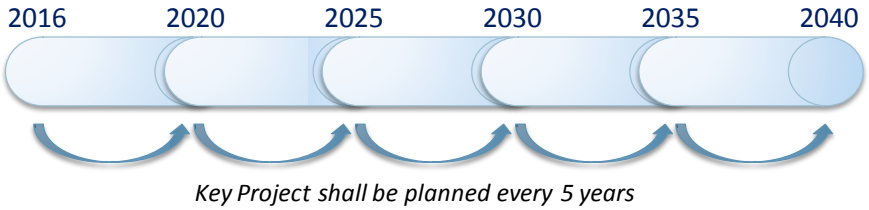
Table 6.2.2: Implementation Schedule and Rough Cost Estimation of Key Projects

No.	Project Name	Implementation Schedule	Rough Cost Estimation (million USD)	Status*	Implemented by
1	New CBD Development Project		77	-	-
2	New Tourism Site Development Project		45	-	-
3	Strand Road Improvement Project		10	-	-
4	Heritage Redevelopment Project		14	-	-
5	Road Network Restructuring and Truck/Bus Terminals Relocation Project		15	-	-
6	Public Transportation Introduction Project		15	-	-
7	Port Facilities Improvement Project		10	-	-
8	New Port Development Project (Feasibility Study)		1	-	-
9	Mawlamyine Airport Improvement Project		10	-	-
10	Access-controlled Highway Project (Study)		1	-	-
11	Third Greater Mekong Subregion Corridor Towns Development Project (water supply and solid waste management)		105	Ongoing (F/S started)	City Development Committee supported by ADB
12	Power Supply Capacity Improvement Project		3	-	-



Note: * " - " in the status column means the project is in proposal stage and its implementation body is not yet determined.
Source JICA Study Team

- It is recommendable that the key projects are planned every five years through the monitoring regard on progress of conducting projects and change of circumstances. According to drafted "Urban and Regional Development Plan", a master plan shall be formulated every 5 – 10 years under the conceptual plan. In this context, re-planning of key projects shall be one of the works in master planning.



Source: JICA Study Team

Figure 6.2.1: Image of Planning Cycle for Key Projects

1. New CBD Development Project

Table 6.2.3: New CBD Development Project

Current Status and Issues	Vacant land is currently available in the vicinity of the existing railway station. This land can be used to create a new modern CBD for the city. The new CBD would be completely walkable and pedestrian friendly. The buildings in key locations would be iconic hotel blocks and office towers.
Purpose	Creation of a new CBD with offices, hotels, workplaces, and malls to boost the economic activity of the city.
Main Scope	・ Creating business places, offices, and malls. ・ Creating hotels and tourist infrastructure. ・ Creating cultural and leisure activities for citizens.

Source: JICA Study Team

Source: JICA Study Team

Figure 6.2.2: Images of New CBD Development Project

2. New Tourism Site Development Project

Table 6.2.4: New Tourism Site Development Project

Current Status and Issues	The old railway station area is unused and has a potential to be developed as a commercial and tourist area owing to its prime location and connectivity. The project can be developed in two phases: Phase 1 would be the development of the station core area. Phase 2 can be the extension of the CBD in the surrounding area. The redevelopment would comprise mostly of commercial usage with some hotels, restaurants, and cafes. A small railway museum can also be proposed to conserve the historic engines and the railway track.
Purpose	Redevelopment of the old railway station site to a new sub-centre.
Main Scope	・ Commercial development. ・ Tourist facilities. ・ Strengthening of connectivity to Strand Road.

Source: JICA Study Team

Source: JICA Study Team

Figure 6.2.3: Images of New Tourism Site Development Project

3. Strand Road Improvement Project

Table 6.2.5: Strand Road Improvement Project

Current Status and Issues	Strand Road has immense potential to be developed as a major tourist zone. Currently, there are not enough tourist facilities in the area and a lot of buildings on the Strand Road are in a dilapidated condition. Some of the interventions required are: to provide additional tourist facilities, development of the public realm, adding open street cafes, adequate lighting and landscaping, provision of jogging tracks, and commercial development to activate the area.
Purpose	Tourist and cultural development of the Strand Road.
Main Scope	・ Development of hotels. ・ Development of open cafes and restaurants. ・ Development of waterfront promenade and greens. ・ Development of the public realm.

Source: JICA Study Team

Source: JICA Study Team

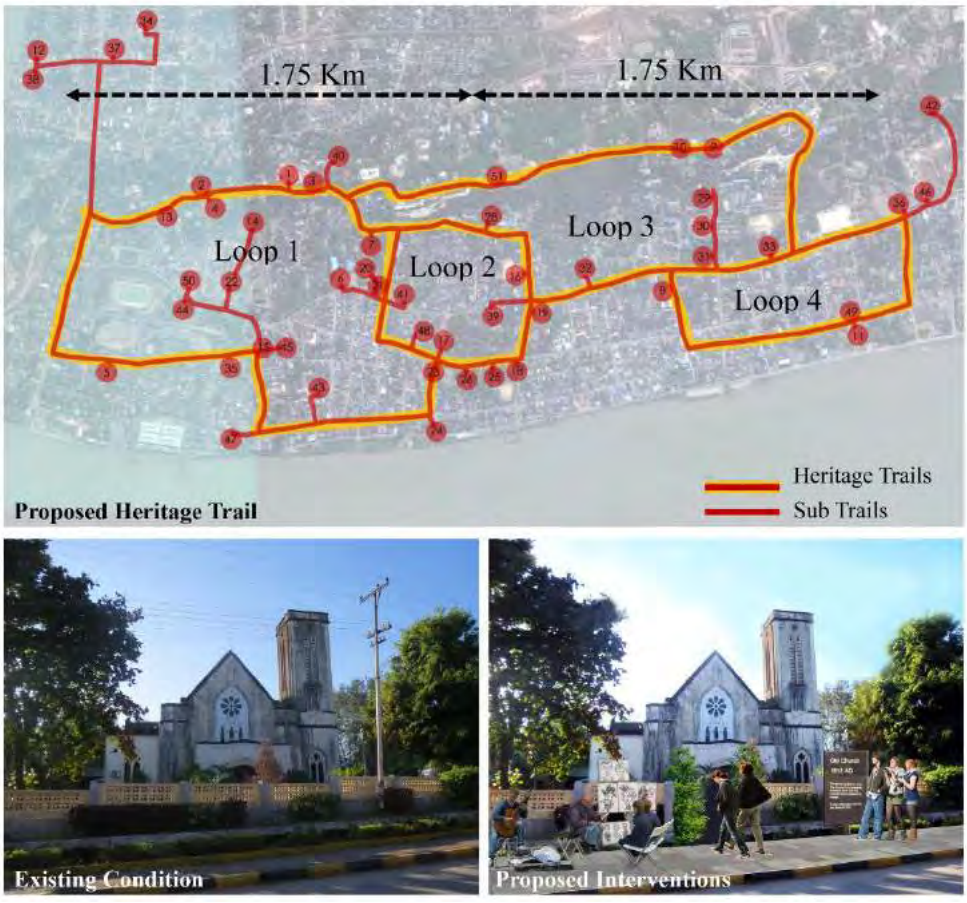
Figure 6.2.4: Images of Strand Road Improvement Project

4. Heritage Redevelopment Project

Table 6.2.6: Heritage Redevelopment Project

Current Status and Issues	Many buildings in Mawlamyine are over 100-150 years old. These buildings are currently being used for administrative uses and their heritage value is underutilized. There are no identified tourist circuits. There is a scope to develop the area around such buildings in order to facilitate heritage conservation and boost tourism. Some of the interventions required are removal of overhead electric lines, adding tourist information boards, adding informal tourist activities, increase accessibility, redevelopment of pavements, and conservation and restoration of the buildings.
Purpose	Conservation of heritage buildings and exploiting the tourist potential of Mawlamyine.
Main Scope	・ Heritage redevelopment of buildings. ・ Development of heritage trails that connects various buildings of heritage value. ・ Development of tourist facilities around such buildings. ・ Signage and infrastructure development. ・ Creating awareness and linkages to such buildings.

Source: JICA Study Team



Source: JICA Study Team

Figure 6.2.5: Images of Heritage Redevelopment Project

5. Road Network Restructuring and Truck/Bus Terminals Relocation Project

Table 6.2.7: Road Network Restructuring and Truck/Bus Terminals Relocation Project

Current Status and Issue	・ Narrow arterial roads (mainly two-lanes) in the city ・ Abandoned railway track ・ Truck terminal in built-up areas ・ Bus terminals are not connected with the railway station
Purpose	Restructuring of the road network and relocation of truck/bus terminals to suit with the proposed urban special plan.
Main Scope	・ Improvement of road network by outer skirts roads. ・ Construction of new road on the abandoned railway track and improve accessibility to the new bridge. ・ Integration of two bus terminals and the central railway station. ・ Relocation of the Zeigyo Truck Terminal.

Source: JICA Study Team

Source: JICA Study Team

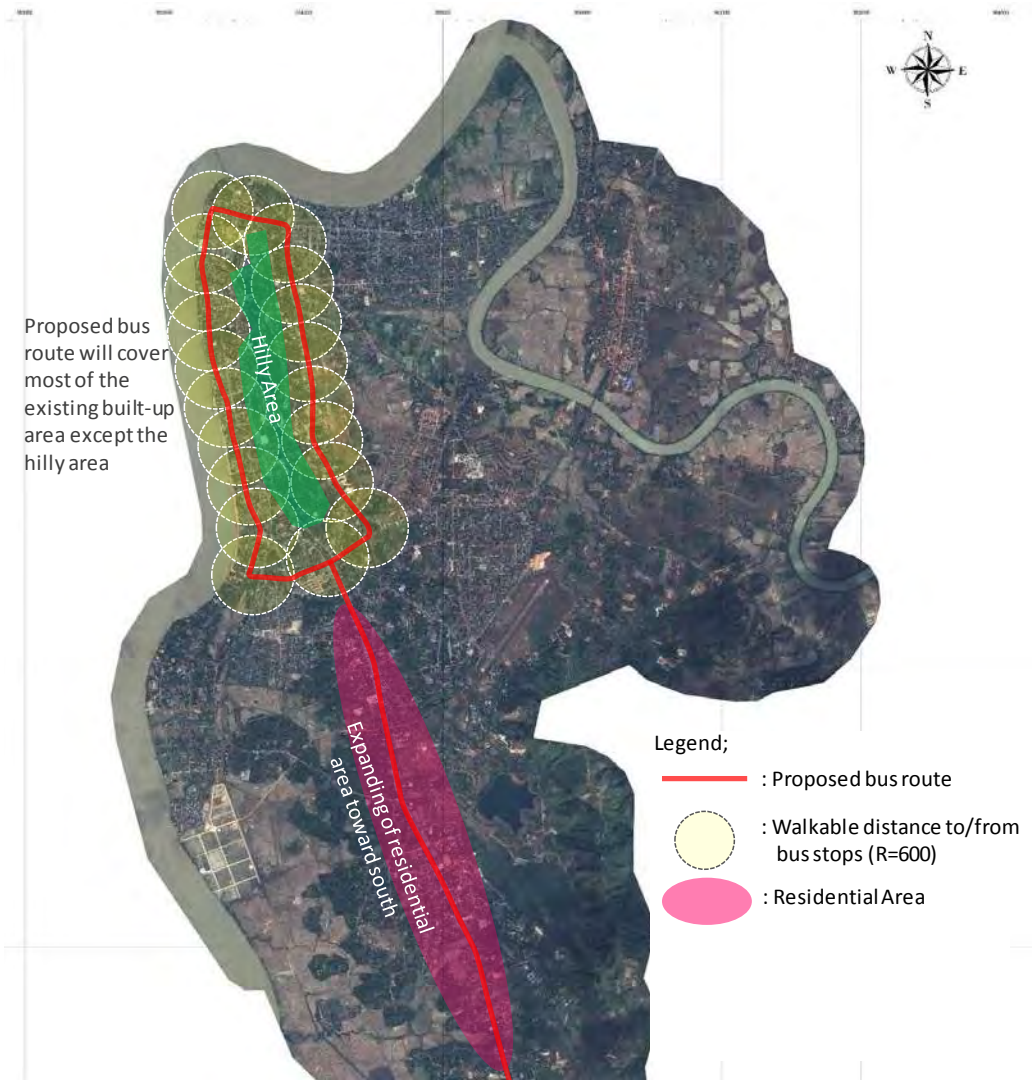
Figure 6.2.6: Image of Road Network Restructuring and Truck/Bus Terminals Relocation Project

6. Public Transportation Introduction Project

Table 6.2.8: Public Transportation Introduction Project

Current Status and Issue	・ Lack of public transportation system ・ Expanding of the urban area toward south ・ Less pedestrian sidewalk
Purpose	Modal shift to public transportation and reduce future traffic congestion Upgrading of non-motorized transport (NMT) facility for citizens and tourists
Main Scope	・ Bus service facilities between CBD and the residential area along NH-8 ・ Minimum widening of the existing roads for introduction of public transportation (space for bus stop, etc.) ・ Construction of sidewalk at least more than 1.5 m in width

Source: JICA Study Team



Source: JICA Study Team

Figure 6.2.7: Image of Public Transportation Introduction Project

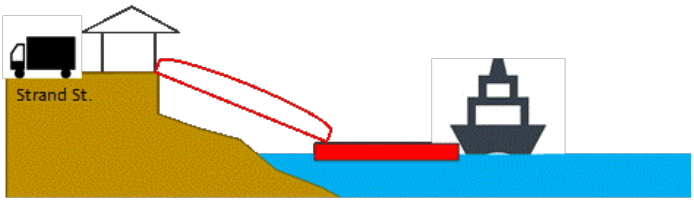
7. Port Facilities Improvement Project

Table 6.2.9: Port Facilities Improvement Project

Current Status and Issue	Old port infrastructure is still being used in jetties. No parking space is provided for loading/unloading around jetties and traffic congestion is induced by cargo handling works on Strand Road.
Purpose	Ease traffic congestion on Strand Road.
Main Scope	Construction of parking space for cargo handling activity.

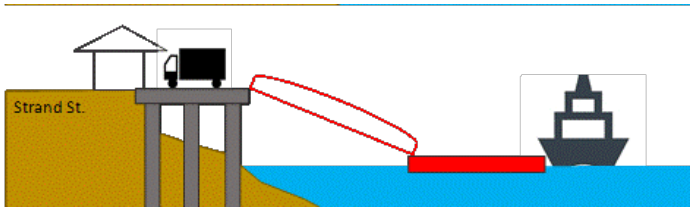
Source: JICA Study Team

(Cargo handling on Strand Road)



(Current)

(Thaton Jetty)



(Improved Image)

Source: JICA Study Team

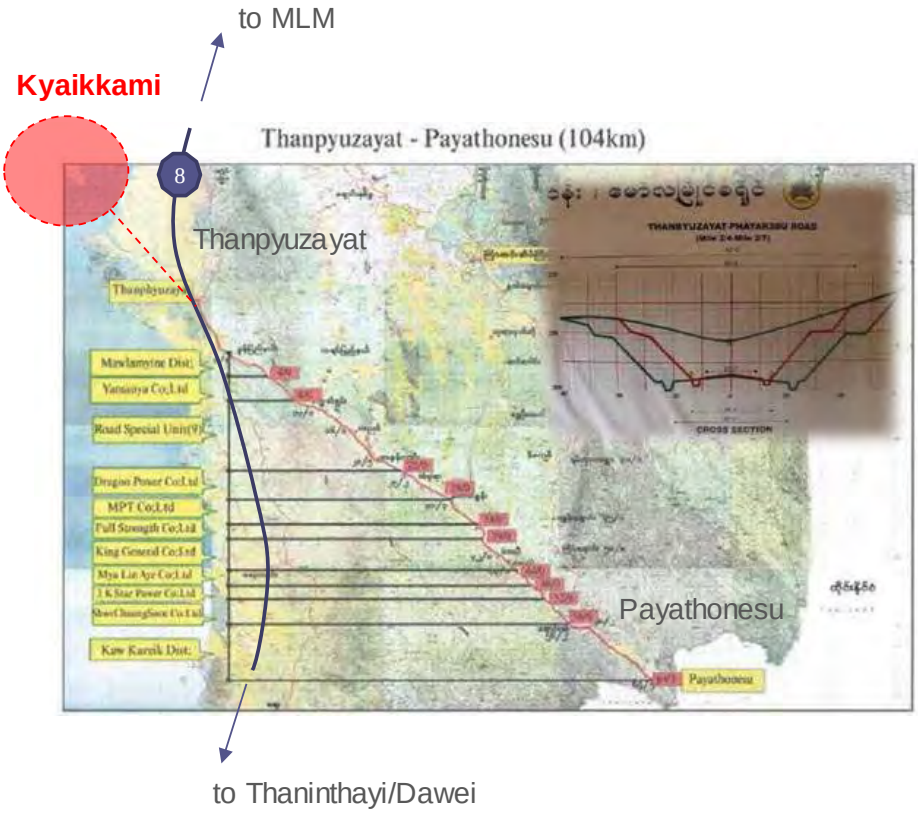
Figure 6.2.8: Image of Port Facilities Improvement Project

8. New Port Development Project (Feasibility Study)

Table 6.2.10: New Port Development Project

Current Status and Issue	・ Shallow depth of the Thanlwin River (approximately 4.5 m) ・ Necessity of hub port in the region to support national and regional development ・ New road to Thailand (Thanpyuzayat–Payathonesu) under construction
Purpose	Confirmation of feasibility of the new port
Main Scope	・ Construction of a new port in the region with 12 m depth (Kyaikkami will be a candidate location in the region.) ・ Construction of the access road to the proposed new port

Source: JICA Study Team



Source: JICA Study Team

Figure 6.2.9: Thanpyuzayat-Payathonesu Road and Kyaikkami

9. Mawlamyine Airport Improvement Project

Table 6.2.11: Mawlamyine Airport Improvement Project

Current Status and Issue	・ Cancelation of international pre-flight service in 2015 ・ Budget constraint and damaged airport infrastructure
Purpose	Proper maintenance and repair of airport infrastructure
Main Scope	・ Overlaying of the runway ・ Replacement/improvement of damaged/old facilities

Source: JICA Study Team

10. Access-controlled Highway Project (Study)

Table 6.2.12: Access-controlled Highway Project (Study)

Current Status and Issue	Existing highway, NH-8, serves as a “community road” and also a “logistic road” and might induce safety risk to vulnerable villagers along the road. There are several road construction projects between Myanmar and Thailand and the logistic axis to Yangon shall be upgraded.
Purpose	Improvement of traffic safety on the existing two-lane road between Mawlamyine and Yangon. Provision of high-standard logistic axis road to accelerate regional and national development.
Main Scope	Feasibility study for the access-controlled highway between Mawlamyine and Yangon.

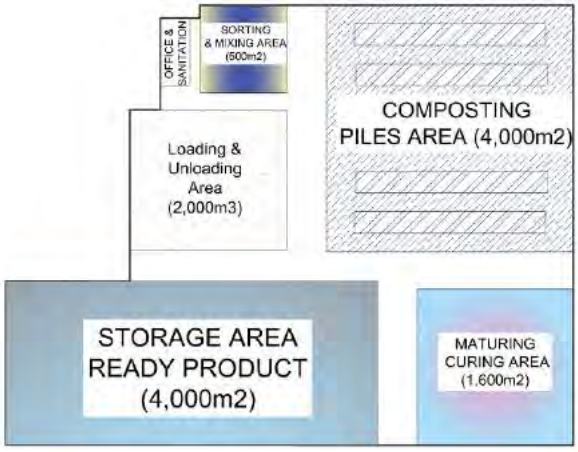
Source: JICA Study Team

11. Third Greater Mekong Subregion Corridor Towns Development Project (Water Supply and Solid Waste Management)

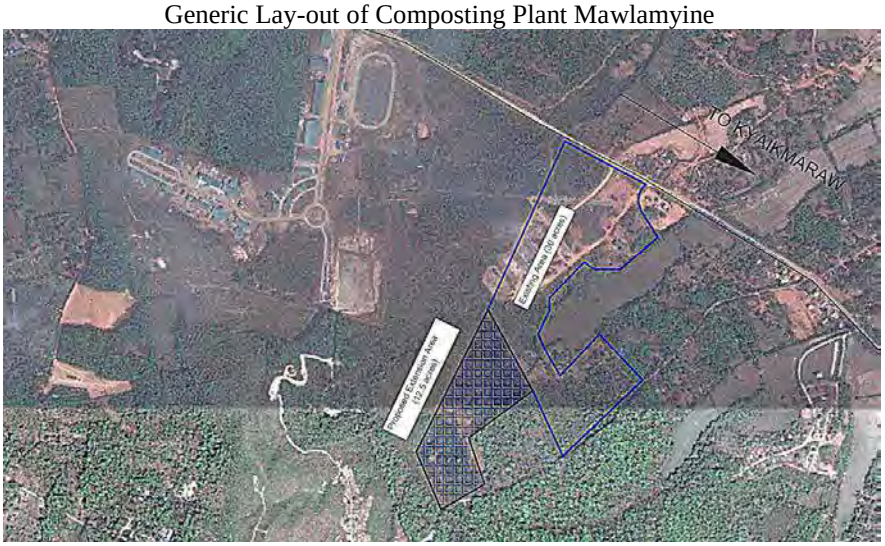
Table 6.2.13: Third Greater Mekong Subregion Corridor Towns Development Project (Water Supply and Solid Waste Management)

Current Status and Issues	**1. Water Supply** Need to extend/improve all networks, increase amounts/qualities of water produced and to reduce levels of NRW. In concert with these, operational and financial management needs to be improved, whether this is within government or the private sector. For Mawlamyine there is a real risk to current systems from expected future climate change. In addition, proposals for dams on existing supply rivers provide a high level of uncertainty as to the location of any new surface water intakes. But an area of the country which receives an average of 5 meters of rain per annum should not really have a problem in developing an appropriate and safe supply of potable water. **2. Solid Waste Management** The Mawlamyine (MTDC) provides solid waste collection services to 23 of the 28 wards (covering about 90% of the total population). It has only 7 waste vehicles for and manages to collect waste twice a week. The town produces about 142 ton/day and about 50% of waste is collected and dumped at the designated dump site. Hazardous waste is not separately collected but mixed with household waste. There is a clear risk of contamination of these water resources by leachate from the dump site. The illegal burning of waste takes place at the dump site to reduce waste volumes.
Purpose	**1. Capacity Building Program (included Water Supply)** The Mon State Capacity Building Program (MS-CBP) should be composed of training sessions, on-the-job training, workshops and also specific studies and small pilot projects. **2. Solid Waste Management** The 3Rs of "Reduce, Reuse and Recycling" formulate the most preferred options, because the main goal of solid waste management is reducing and eliminating adverse impacts of waste materials on human health and environment.
Main Scope	**1. Capacity Building Program (included Water Supply)** ・ Capacity Strengthening for Project Implementation ・ Technical Strengthening in house technical knowledge and practice ・ Strengthening O&M of urban services by involving the private sector ・ Strengthening Urban (and Spatial) Planning **2. Solid Waste Management** ・ Collection Improvement ・ Recycling + Hospital Waste Incinerator ・ New Controlled Landfill (Cell No.1: 3.0ha) ・ Compost Plant

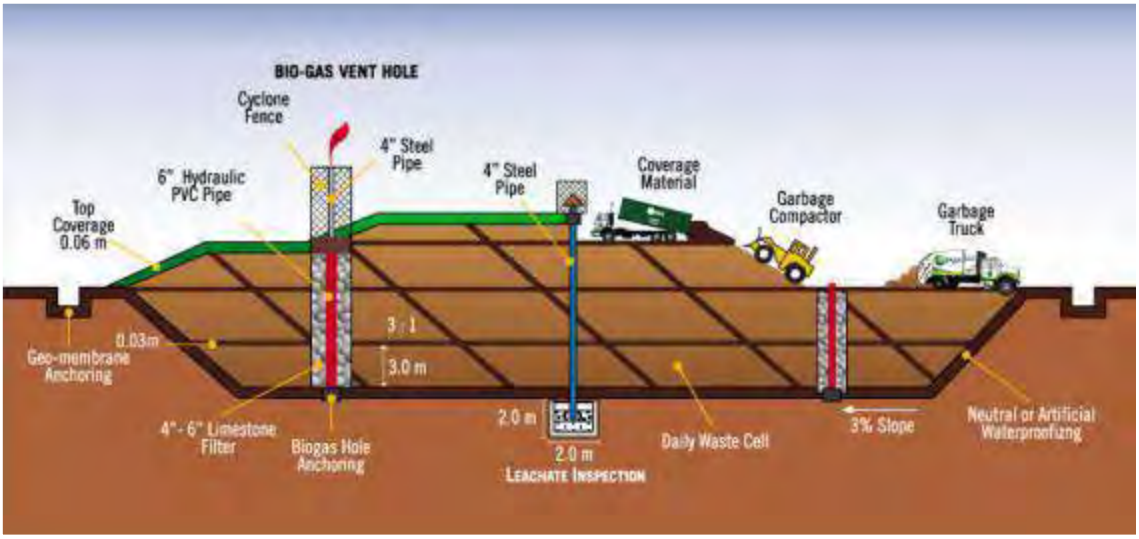
Source: Preparing Third GMS Corridor Towns Development "MON STATE REPORT (Dec 2015)" by ADB



Generic Lay-out of Composting Plant Mawlamyine



Mawlamyine Proposed Landfill and Existing Dump Site



Principles for Construction of Controlled Landfill

Source: Preparing Third GMS Corridor Towns Development "MON STATE REPORT (Dec 2015)" by ADB

Figure 6.2.10: Image of Solid Waste Management Project

13. Power Supply Capacity Improvement Project

Table 6.2.14: Power Supply Capacity Improvement Project

Current Status and Issues	Currently, the overall capacity of primary substations are almost full during peak demand and existing primary transformers will be overloaded during the peak season by the year of 2017.
Purpose	Ensuring the supply reliability of electric power.
Main Scope	・ Installation and rehabilitation of 66 kV substations and/or ・ Upgrading 66 kV substations to 132 kV substations with higher loading capacity. ・ Enable well-planned cascade connections to ensure N-1 contingency condition.

Source: JICA Study Team

Source: JICA Study Team

Figure 6.2.11: Image of Power Supply Capacity Improvement Project

6.3 Future Image of Mawlamyine 2040

- A bird's-eye view of future urban image of Mawlamyine was drawn in clan-based graph drawing. The view from west is the river-front area, Yankin Hill at the middle, and new the CBD behind.

Source: JICA Study Team

Figure 6.3.1: Bird's-eye View of Future Urban Image of Mawlamyine

7 Project Implementation and Urban Management

7.1 Urban Development Management

7.1.1 General View of Urban Development Management by Official

- The spatial control is common and principal measures should be taken by the local and central government for the realization of urban development policies and projects. These control measures are expected to be executed based on the law, by-laws, and other legal frameworks.
- The following shows spatial control zones which are expected to be introduced for the realization of planning items:
    - Boundary of urbanization area: Determines the areas which can be used and developed for future development. The area is composed of urbanization area, urbanization control area, and development restricted area.
    - Zoning of land use: The land use determines permitted activities of land and buildings. The planning index, such as the floor area ratio (FAR), building coverage ratio (BCR), open space ratio, and maximum height of building, are prescribed in relation with land use zoning in many cases. It also relates development capacity of each area.
    - Boundary of specific urban development project: In order to secure the land for future infrastructure facilities and urban development for public purpose, areas are designated in advance, and construction activities in these areas will be restricted.
- For the enforcement of the abovementioned control measures, detailed contents of planning items should be examined in the following detailed plan study. Currently, the legal spatial control measures have not been formulated and under preparation in Myanmar. The contents of planning items should be adjusted to the formulation of legal systems, which will be set in the future.

7.1.2 Application of Urban Development Management in Mawlamyine

Area Classifications

- To realize the spatial plan of Mawlamyine for 2040, the development activities by private and public entities should be guided and promoted properly. This shall also contribute to avoid uncontrollable urban sprawl in Mawlamyine which can be a compact city. In this context, Mawlamyine Township shall be classified into four areas in further examination for the formulation of detailed plan as follows:

    1) **Urbanized Area**: which is currently a built-up area (e.g., CBDs, residents, and industrial zones). Public sector shall improve urban environment and infrastructure continuously. Some areas shall be targets of urban redevelopment.
    2) **Urbanization Promotion Area:** which is suitable for future urban development by 2040. Public sector shall develop key infrastructure and social service in cooperation with private sector by means of PPP scheme. The areas shall be reserved for development of new towns, CBDs, industrial, and logistics zones.
    3) **Urbanization Control Area**: in which development activities shall be controlled properly but not prohibited. Public sector shall not have positive responsibility for development of infrastructure and social service. Private sector who is interested in a project activity must develop by itself. The areas shall be also utilized for urban parks, tourism, and/or green and water belt.
    4) **Urbanization Restricted Area:** in which development activities must be prohibited strictly. The areas shall be reserved for nature conservation and high-valued agriculture development.

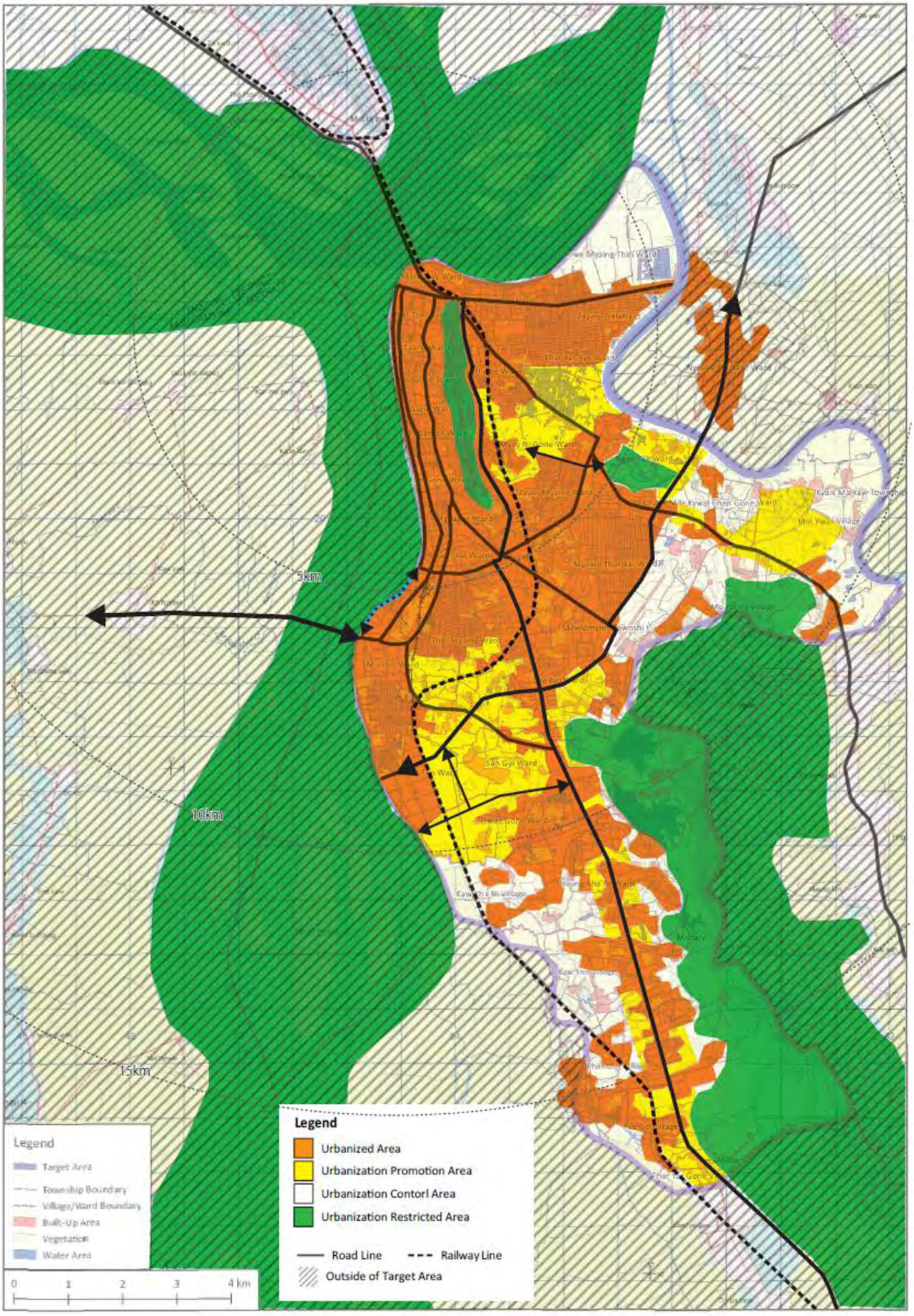
- Four types of classified areas mentioned above shall correspond to zones which are proposed in the spatial plan in the previous session as shown in Table 7.1.1 below.

Table 7.1.1: Matrix of the Area Classification and the Spatial Plan

Classified Areas / Zones	Urbanized Area	Urbanization Promotion Area	Urbanization Control Area	Urbanization Restricted Area
Existing Built-up (Residential and Mixed-use)	■			
CBD (Commercial and Business)	■			
Industrial Zone Logistics Zone	■			
Urban Redevelopment Zone	■			
New CBD (Commercial and Business Zone)	■	■		
New Industrial Zone New Logistics Zone		■		
New Town Development Zone (Residential and Mixed-use)		■		
Culture and Tourism Zone	■	■	■	■
Urban Park Zone Green and Water Belt Zone	■	■	■	
Nature Reservation Zone Advanced Agricultural Zone			■	■

Note: Colored (gray) cell means classified area in which each zone is located
Source: JICA Study Team

- Under the proposed area classification framework, zoning regulation must be discussed by the local and union government to control land and building use, FAR (floor area ratio), BCR (building coverage ratio), or building height to encourage proper urban development with necessary infrastructure and social service. The zoning regulation system is expected to be introduced as earlier stage as possible.



Source: JICA Study Team

Figure 7.1.1: Proposal of Area Classification of Mawlamyine

Zoning of Land Use

- Based on the principal land use by this study, detailed boundary of land use area should be designated for further examination in the formulation of a detailed plan; and a legal system needs to be enacted in parallel for effective control. The following categories are for land use planning. These land use zonings and their regulations need to be adjusted to the regulations, which is under preparation and planned to be enacted in the near future by the Ministry of Commerce (MOC).

    - Low density residential area (detached housing area)
    - Middle density residential area (apartment housing)
    - High density residential area (high rise housing, it is not recommended to Maylamyine)
    - Commercial and business area
    - Mixed-use area (residential with small-scale shops)
    - Semi-industrial area (light and no polluted industries, with housing, if necessary)
    - Industrial area
    - Green, park, open space

Boundary of Specific Urban Development Project:

- The following are candidate areas which need to be designated for the area and their precise boundary should be examined in the following study for the detailed plan:

    - Development of areas for new logistic and transport hub areas, housing development areas, and new CBD areas;
    - Urban redevelopment area and land readjustment area for the upgrading of current residential area;
    - Road site (including widening); and
    - Sites for major infrastructure facilities such as water supply, waste water treatment, electricity, and transport.

7.2 Capacity Development

- Mawlamyine has experienced receiving groups of specialists and academe for economic, social, and environmental studies of the city and of the region. There are many ongoing regional economic development researches and feasibility studies by non-government organizations (NGOs) such as the Asian Development Bank, as Mawlamyine's location is a strategic city for international trade between Myanmar and Thailand. Due to this geographic position of the city, it is expected that Mawlamyine will continue receiving international specialists for regional development and for its economic projects and urban development projects in the future as well. Thus, one of the areas where capacity development is urgently required for Mawlamyine is the area which requires deeper interaction with the people by international specialists, while the other area requires urban management service for densely populated and for expansion of the city.

7.2.1 Capacity Development in Urban Management

- As mentioned, Mawlamyine receives many international visitors and feasibility studies in diverse social concerns and many subjects of studies are related to or influential on its urban development. Thus, it is crucial for Mawlamyine City, as well as the Department of Development Affairs of Mon State government, to be involved in communications and study processes. Although being a part of the discussion process or results of the study may not be strong enough to strengthen the capacity within the Mons State government nor Mawlamyine City Development Organization to become independent to draw and plan a comprehensive development plan for the city. Having direct communication enriches the experience and amount of information from such interaction with international experts in urban management and economic development among local officers. Through such experience, it is expected to have increased quality in municipal governance as well as urban management as an eventual result.

7.2.2 Capacity Development in Project Implementation

- Mawlamyine is expected to expand to the east and to the south of the city as the city grows for the next two decades. This is an inevitable direction as the current urban area is already dense and further densification would cause negative impact on the people's living standard. Mawlamyine will experience higher density urban management and expansion of urban service area at the same time. The Mawlamyine City Development Organization needs to prepare to meet this future demand of city service and urban management at the same time. For this purpose, it is necessary to set up a systematic and well considered urban planning within the Township Development Organization in advance. Such training program may be conducted locally under the support of international NGOs as well as bilateral support from other countries such as Japan.

7.3 Project Implementation

- In order to implement the development programs, which are described in Chapters 4, 5, and 6, and to realize balanced development as a whole, provision of support and intervention for the project and by public entities are necessary for their adequate implementation. For this purpose, the central government and local government are expected to take a role in the following implementation schemes:
    - Project implementation by the government
    - Subsidization for implementation
    - Project coordination by the government
- For the project implementation for Mawlamyine, the following measures are recommended to be taken by the government:

7.3.1 Project Implementation by Government

- The following are considered as the project is implemented by the governments' initiative. Particularly, it is necessary to consider government's initiative for the implementation of unprofitable development project.
    - Construction of basic infrastructure facilities
    - Unprofitable development project (social housing around the industrial area)
    - Reform of landscape and urban spaces

7.3.2 Subsidization for Implementation

- Subsidization is effective for promotion of small-scale urban development activities, which is not conducted by large-scale investors. For the development of Mawlamyine, the following development activities are recommended to be subsidized for their implementation:
    - Upgrading of individual buildings for disaster prevention
    - Small-scale urban redevelopment project and land readjustment project for environmental improvement

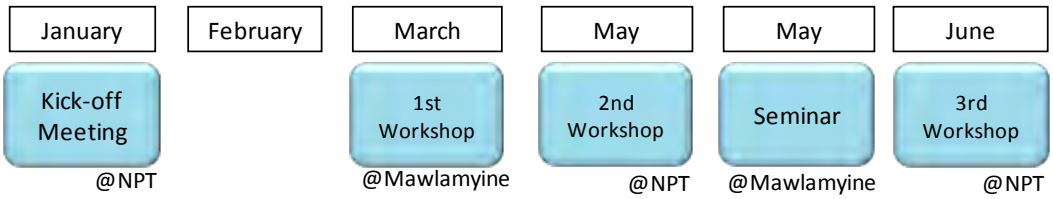
7.3.3 Project Coordination by the Government

- Generally, large-scale development with profitable business program catches the interest of private investors and its development tends to be individually progressed without effective control. Government involvement in project coordination is expected for appropriate project realization and its management. Especially for the following development projects, it is necessary to coordinate individual development project under public entities by planning, licensing, and construction in order to secure its suitability as public-orientated development.
    - New CBD development project
    - Construction of logistics and transportation hub zone
    - Housing construction and supply in remote area

APPENDIX-A: PLANNING PROCESS

- The plan was formulated with public involvement in its planning process. There are two types of meetings as follows:
  - Workshop Meeting: to discuss with the counterpart (C/P) and related organizations; and
  - Seminar: to collect opinions of various stakeholders such as representatives of local communities.

The planning process is shown in Figure A.1.



Source: JICA Study Team

Figure A.1 Public Involvement in the Planning Process

A.1 Kick-Off Meeting

- The kick-off meeting was held on 19 January 2016 (Tuesday) in Nay Pyi Taw, chaired by Director General of DUHD and participated by MOC, relevant ministries, and representatives from the three target cities. Through the discussions after the opening remarks and explanation of the project outline, all participating organizations basically agreed on the methodology and contents of the study. Table A.1 shows the summary of result of the kick-off meeting and some pictures from the meeting are shown in Figure A.2.

Table A.1 Summary of Result of the Kick-off Meeting

Title of the Meeting	Kick-off Meeting
Date and Time	19 January 2016 (Tuesday) 13:00-14:15
Venue	Nay Pyi Taw (meeting room of MOC)
Chairperson	Director General, DUHD
Total Number of Participants	39 participants
Participated Organizations	MOC, DUHD, General Administration Department (GAD), Mandalay City Development Committee (MCDC), JICA
Agenda	1. Opening Remarks (Chairperson) 2. Explanation of the Study Outline (JICA Study Team) 3. Discussion

Source: JICA Study Team

Introduction | Presentation

Source: JICA Study Team

Figure A.2 Pictures from the Kick-off Meeting

A.2 1st Workshop Meeting

- The 1st workshop meeting was held on 22 March 2016 (Tuesday) in Mawlayaine (Shwe Myint Mo Tun Hotel) chaired by Deputy Director of URDD and participated by MOC, relevant organizations, and the JICA Study Team. Table A.2 shows the summary of result of the 1st workshop meeting and some pictures from the workshop are shown in Figure A.3.

Table A.2 Summary of Result of the 1st Workshop Meeting

Title of the Meeting	Urban Development Planning Workshop
Date and Time	22 March 2016 (Tuesday) 13:00 – 17:30
Venue	Shwe Myint Mo Tun Hotel, Mawlamyine City
Chairperson	Deputy Director, URDD, MOC
Total Number of Participants	27 participants
Participated Organizations	Forest, DUHD, GAD, Health, Department of Rural Development (DRD), Department of Meteorology and Hydrology (DMH), Directorate of Industrial Supervision and Inspection (DISI), SDA, Planning Department, Environmental Conservation Department (ECD), Archaeology Department, Education, Township Development Committee (TDC)
Agenda	1. Opening 2. Session 1: Review on Current Status 3. Session 2: Planning Framework 4. Session 3: Spatial Planning 5. Closing

Source: JICA Study Team

Group Discussion

Group Photo at the Mawlamyine Workshop

Source: JICA Study Team

Figure A.3 Pictures from the 1st Workshop

A.3 2nd Workshop Meeting

- The 2nd workshop meeting was held on 3 May 2016 (Tuesday) in Nay Pyi Taw, chaired by Deputy Director General of DUHD and participated by MOC, relevant organizations, and the JICA Study Team. Table A.3 shows the summary of result of the 2nd workshop meeting and some pictures from the workshop are shown in Figure A.4.

Table A.3 Summary of Result of the 2nd Workshop

Title of the Meeting	Urban Development Planning Workshop
Date and Time	3 May 2016 (Tuesday) at 13:00 – 17:30
Venue	Office 40, Ministry of Construction, Meeting Room
Chairperson	Deputy Director General, DUHD
Total Number of Participants	40 participants
Participated Organizations	DUHD, DAN, DH, Ministry of Religious Affair and Culture (MORAC), Ministry of Transport and Communications (MOTC), Planning Department, GAD, TDC, MCDC, Myanmar Engineering Society (MES), ECD, DALMS
Agenda	1. Review on Current Status 2. Planning Framework 3. Spatial Planning

Source: JICA Study Team


Discussions


Discussions

Source: JICA Study Team

Figure A.4 Pictures from the 2nd Workshop

A.4 Seminar

- The seminar meeting was held on 18 May 2016 (Wednesday) in Mawlamyine (Ngwe Moe Hotel), chaired by Deputy Director of URDD and participated by MOC, relevant organizations, JICA, and the JICA Study Team. Table A.4 shows the summary of result of the seminar and some pictures from the seminar are shown in Figure A.5.

Table A.4 Summary of Result of the Seminar

Title of the Meeting	Urban Development Planning Seminar
Date and Time	18 May 2016 (Wednesday) at 13:00 – 17:30
Venue	Ngwe Moe Hotel
Chairperson	Deputy Director, URDD
Total Number of Participants	54 participants
Participated Organizations	DUHD, DRD, GAD, TDC, DAN, DMH, MOSBA, Planning Department, LF, Central Statistical Organization (CSO), DISI, DAAS, Finance Department, ECD, Hotels, Asian Development Bank (ADB), TU, United Nations High Commissioner for Refugees (UNHCR)
Agenda	1. Planning Framework and Development vision 2. Socio-economic Framework 3. Industrial Development 4. Urban Development Policy 5. Infrastructure

Source: JICA Study Team


Group Discussion


Group Photo

Source: JICA Study Team

Figure A.5 Pictures from the Seminar

A.5 3rd Workshop Meeting

- The 3rd workshop meeting was held on 16 June 2016 (Thursday) in Nay Pyi Taw, chaired by Director General of DUHD and participated by MOC, relevant organizations, and the JICA Study Team. Table A.5 shows the summary of result of the 3rd workshop meeting and some pictures from the workshop are shown in Figure A.6.

Table A.5 Summary of Result of the 3rd Workshop

Title of the Meeting	Urban Development Planning Workshop
Date and Time	16 June 2016 (Thursday) at 13:00 – 17:30
Venue	Office 40, Ministry of Construction, Meeting Room
Chairperson	Director General, DUHD
Total Number of Participants	40 participants
Participated Organizations	DUHD, MORAC, MOTC, Myanmar National Police Force (MNPF), Ministry of Hotels and Tourism (MOHT), ECD, GAD, MCDC, TDC, The Asia Foundation
Agenda	1. Study Outline, Progress and Planning Framework 2. Vision and Strategies 3. Spatial Plan 4. Prioritized Projects 5. Urban Development Management

Source: JICA Study Team

Discussion

Group Photo

Source: JICA Study Team

Figure A.6 Pictures from the 3rd Workshop

APPENDIX-B: POSTER