5.3 Railways

The proposed infrastructure development concept for the transport sector (Urban Transport, Road Network, Railways, Port, and Logistics) is summarized as shown in Figure 5.1.1 in this chapter. Appendix 1.1 (three sheets of A3 size) is an enlarged version of Figure 5.1.1.

5.3.1 Demand Analysis

Preliminary demand forecast is mentioned in Section 5.1.1: Demand Analysis for Urban Transport.

5.3.2 Development Policy

The following vision and basic policies are generally proposed for the transport sector based on the review of current conditions of the existing transportation infrastructure, preliminary traffic demand forecast, and the development vision of the future urban structure for Greater Yangon. In addition, results of the social survey are also referred to.

Sector Vision	**Realization of An Environment-friendly, Comfortable and Convenient Transport System (High Mobility and Reliable Transportation System Led by Modernized Urban Railway, and Contribution to Promote Planned New Urban Development)**
Basic Policy	1) Development of A Functional Road Network as Urban Backbones (incl. Logistic Routes) 2) Increase People's Mobility through the Effective Public Transport System led by the Urban Mass Rapid Transit (UMRT) 3) Realization of a Safe, Environment-friendly and Comfortable Transport System 4) Development of Appropriate Traffic Demand Management Systems 5) Organizations/Institutions and Capacity Building for Creating and Maintaining A Comprehensive Transport System in the Greater Yangon

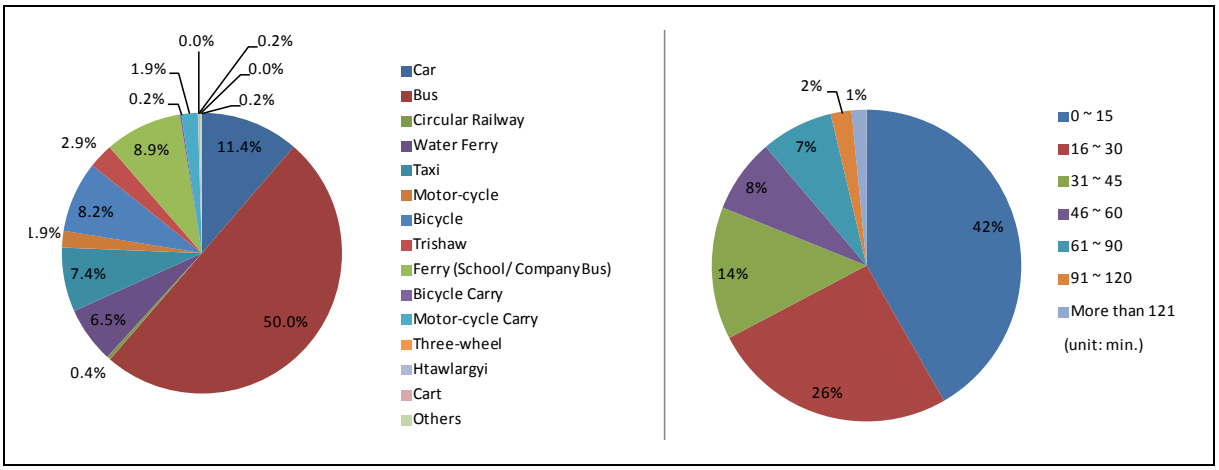
The detailed explanations and background of each basic policy are given as follows:

1) Development of Functional Road Network as Urban Backbones

The details are explained and discussed in Sections 5.1 and 5.2 of this chapter.

2) Increase People's Mobility through Effective Public Transport System Led by the Urban Mass Rapid Transit (UMRT)

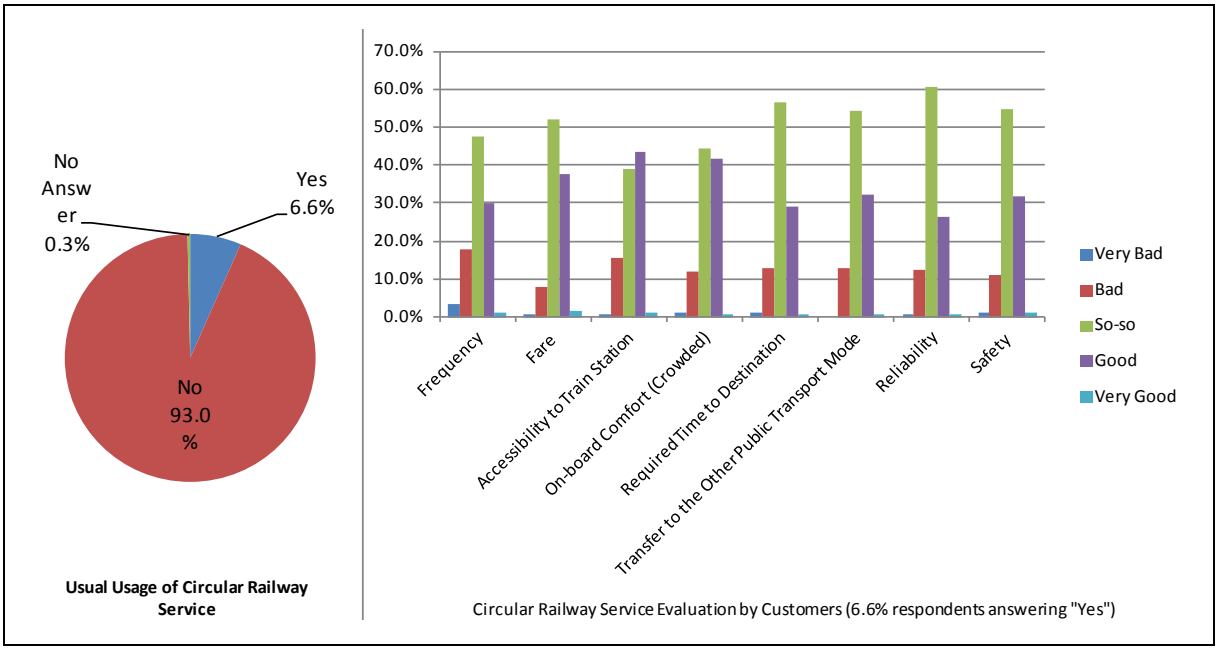
According to the interim report of HIS, the current share of railway transport in the total traffic demand is only 0.4%, while road transport is approximately 90%, which includes buses at 50% as shown in the left side of Figure 5.3.1. It is assumed that one of the reasons for the low modal share of railways is the short travel time from origins to destinations as the travel time of 68% is less than 30 minutes as shown in the right side of Figure 5.3.1. It means that the modal share rate will change when the distance becomes longer due to city expansion and longer travel time is required in the future.



Source: JICA Study Team based on the HIS Interim Report

Figure 5.3.1: Current Modal Share Rate and Travel Time

The left figure below shows the usual usage rate of railways. According to the figure, only 6.6% of the commuters use railways although it passed in the service level evaluation among users based on the right figure below.

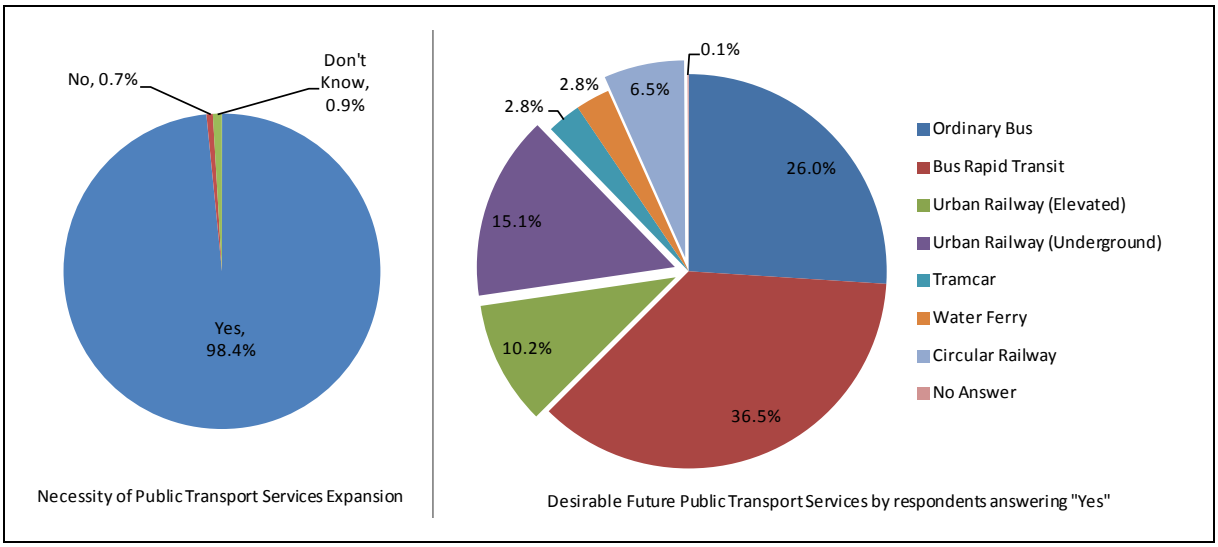


Source: JICA Study Team based on the HIS Interim Report

Figure 5.3.2: Usual Usage Rate and Service Level Evaluation of Yangon Circular Railway

As shown in the two figures above, the current railway is facing an intense battle in terms of modal share. However, the following two figures show that the citizens are expecting developments in the railway infrastructure as future urban transportation mode.

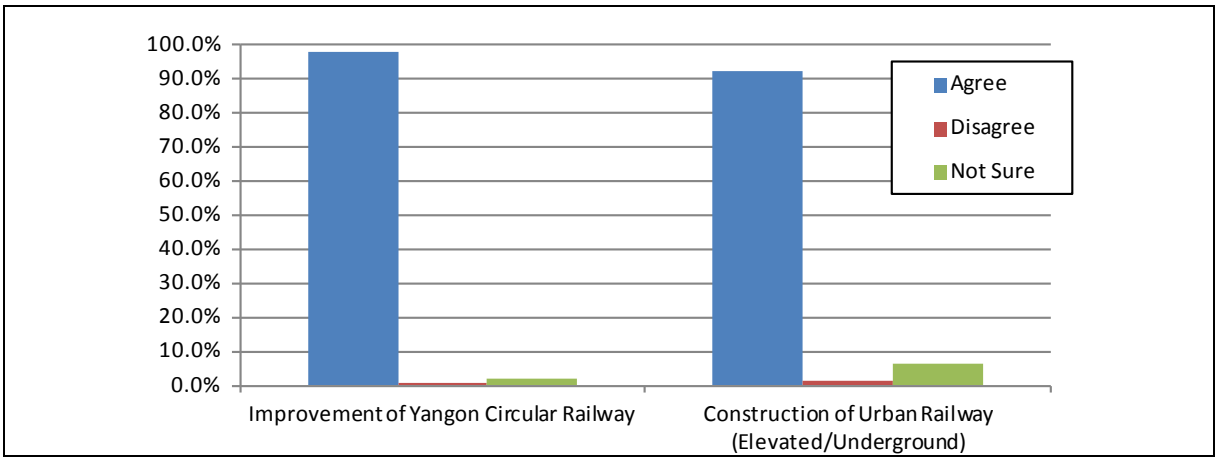
According to Figure 5.3.3, most citizens recognize the need to improve and expand public transport services, and approximately 32% of them expect to see the development of railway services.



Source: JICA Study Team based on HIS Interim Report

Figure 5.3.3: Desired Future Transport Services

In addition, Figure 5.3.4 shows 97.7% and 92.0% of the citizens agree with the "improvement of Yangon Circular Railway" and "construction of urban railway", respectively, as transport improvement measures.



Source: JICA Study Team based on HIS Interim Report

Figure 5.3.4: Evaluation of Future Transport Measures

From the reasons stated above, "Increase in people's mobility through the effective public transport system led by the urban mass rapid transit (UMRT)" is mentioned as one of the development policies.

In implementing railway infrastructure development, modernization of the existing railway line is prioritized instead of constructing a new line in order to reduce the initial development cost.

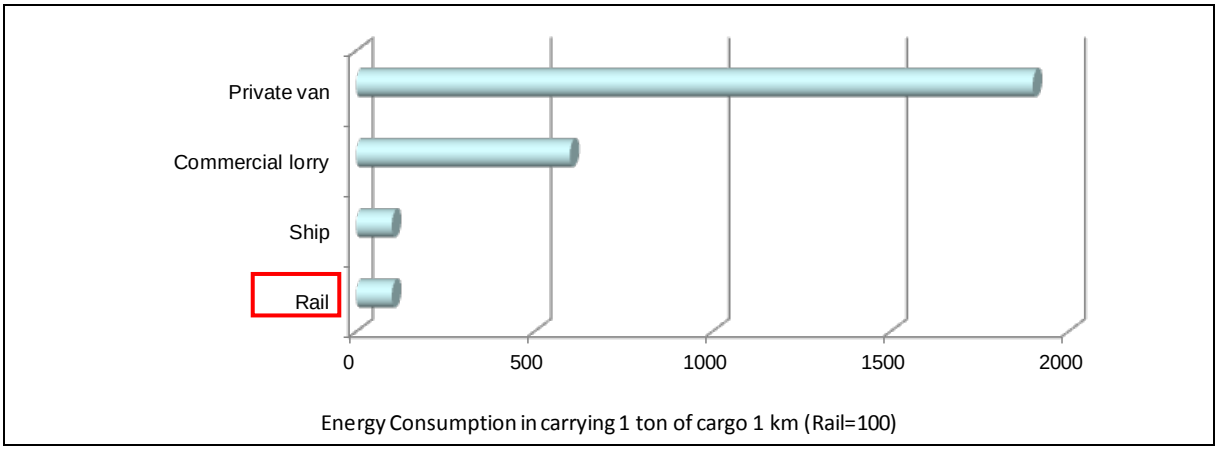
3) Pursuit of Safety, Environment-Friendly, and Comfortable Transportation System

Yangon City is a beautiful city with lakes and plenty of green areas, and these will remain in the proposed urban development plan. In order to preserve such a beautiful city in the future, it is required to install a public transport system that is safe, has low environmental burden,

has high energy efficiency, and has low CO_2 emission. The figures below show that railways have outstanding advantages in these aspects.

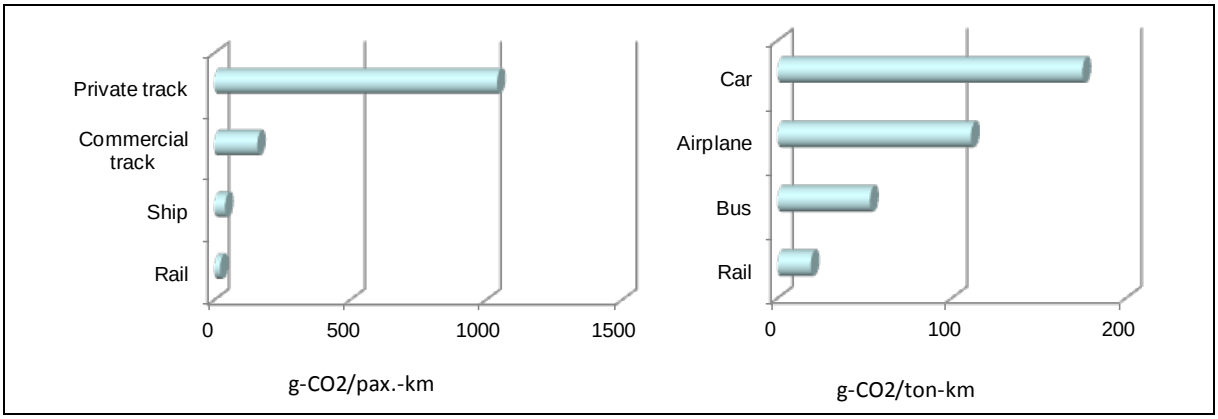
Source: Ministry of Land, Infrastructure and Transport, Japan

Figure 5.3.5: Risk of Death by Transportation Mode



Source: Ministry of Land, Infrastructure and Transport, Japan

Figure 5.3.6: Energy Consumption Rate by Transportation Mode



Source: Ministry of Land, Infrastructure and Transport, Japan

Figure 5.3.7: CO_2 Emission Rate by Transportation Mode

4) Development of Appropriate Traffic Demand Management System

According to the demand analysis, the Planning Area will generate approximately 13 million trips/day by 2040. Of these trips, railway transport would undertake approximately 4 million trips/day or 30% of the total. In order to deal with the large number of trips, it is essential to establish a modernized urban public transport network which consists of a urban mass rapid transit (UMRT) - like heavy railway and UMRT line as the main axes, and a medium-capacity transit like monorail, automated guideway transit (AGT) as feeder transport. Moreover, there is also a need to introduce the appropriate transportation demand management (TDM) system for the effective coordination and connectivity among public transport modes.

In addition, it is also important to consider TDM in the collaboration between urban development layout and urban transport. According to the city development vision shown in Chapter 3, the development layout plan is established in consideration of some policies including i) decentralized city with subcenters, ii) close placement of residential areas and work places, and iii) urban layout in collaboration with urban mass rapid transit network. These policies will contribute to the establishment of an appropriate TDM system

5) Organizations/Institutions and Capacity Building for Creating and Maintaining the Comprehensive Transportation System in Greater Yangon

Regarding railway operation/management, it is quite important to know which organization will manage and how will it handle the railway operations. In this context, the current railway system in Yangon has the following issues:

1) Privatization of Yangon Circular Railway and the Suburban Lines

As mentioned in Section 2.3.3, MR is trying to proceed with the privatization of the Yangon Circular Railway and the suburban lines. However, there are still many issues to be solved in the privatization process, and it is quite unclear whether this will be realized successfully and when will it be carried out.

2) Budget Allocation System

Accordin3ation/division in charge of Yangon area (Division 7 in Lower Myanmar Administration) and which has control over the budget has no allocation of its own, because the authority for budget allocation is given only to MR headquarters. Consequently, this causes an obstruction in establishing Division 7's own development/maintenance plan.

In order to solve these issues, the "organizations/institutions and capacity building for creating and maintaining the comprehensive transportation system in Greater Yangon" is essential.

5.3.3 Development Goals and Target Effect Indicators

For the purpose of the evaluation of future urban railway network development and to confirm its outcomes, the development goals and target effect indicators of railways in 2040 are shown below.

Table 5.3.1: Development Goals and Effect Indicators (Railway)

Development Goal	Effect Indicators
a) Improvement of Convenience and Accessibility	Total Route Length (122 km - 350 km)
b) Speed-up Enhancement	Average Operational Speed (15 km/hour - 30 km/hour)
c) Accomplishment of Modal Shift	Modal Share Rate (3% - 30 %)

Source: JICA Study Team

It is noted that the effect indicators are limited to the items which can be actually counted or quantitatively grasped based on the traffic surveys or statistical data in future.

The reasons why these numbers are adopted are as follows:

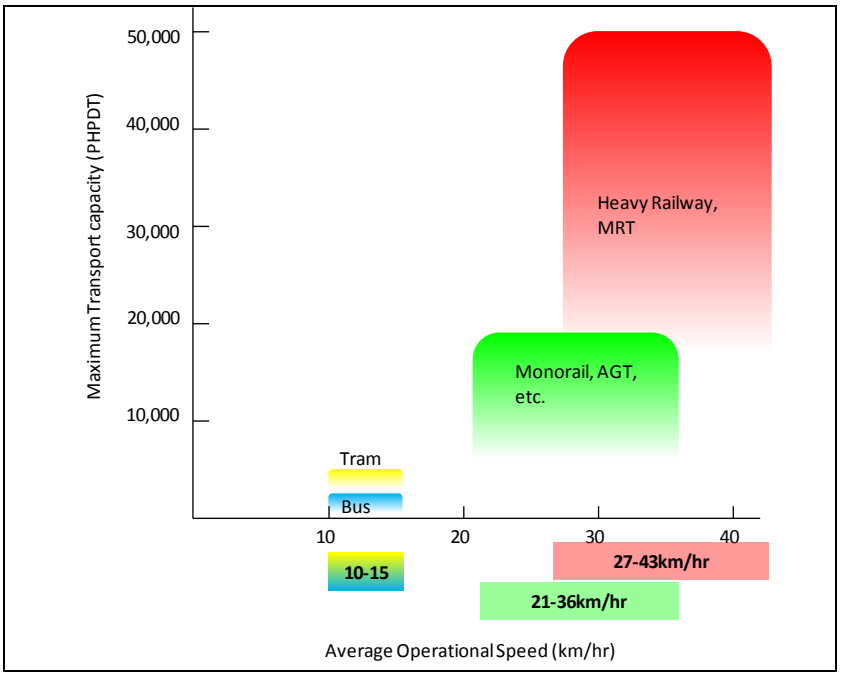
(1) Total Route Length

It is important to establish an urban mass rapid transit network which will act as the “axes” and “trunk network” of the public transport in Yangon metropolitan area.

As mentioned in Section 5.3.4 (1), a 350-km railway network will be appropriate in 2040 in light of the demand forecast results, in reference to the examples of other major cities, and in conformity with the urban development layout plan.

(2) Average Operational Speed

As mentioned in the previous chapter, the current average operational speed of the Yangon Circular Railway is approximately 15 km/hr and it is quite slow for an urban railway. In case of the major megacities in Japan, the average operational speed is 27-43 km/hr as shown in the table below.



Source: Guidance for LRT Development Plan in harmonization with Urban Planning, MLIT of Japan, 2005

Figure 5.3.8: Operational Speed and Maximum Transport Capacity by Mode

From the reasons shown above, the target average operational speed is set at 30 km/hr.

(3) Modal Share Rate

The present modal share of the Yangon Circular Railway is only 3%. On the other hand, the modal share of railways in major developed metropolitan areas is from 9% to 47% as shown in the table below. There is a wide deviation due to the different urban transport conditions. However, in order to deal with the large number of trips in 2040, Greater Yangon should establish mass rapid transport systems such as in Tokyo or Paris. Therefore, the target modal share rate of railways is set at 30%.

Table 5.3.2: Mode Share of Railway Trips in Selected Developed Metropolitan Areas

City	Data Year	Railway Mode Share (All Purpose Trips)	Railway Mode Share (Commuting Trips)
New York Metro	2001	9.1	22.7
New York City	2009	12.0	33.6
Greater London	2006	12.0	31.0
Inner London	2006	14.7	37.0
Paris Metro	2008	20.5	41.4
City of Paris	2008	33.9	64.0
Tokyo Metro	2008	29.4	52.5
Tokyo 23 wards	2008	46.6	74.0

Source: Transport Development in Asian Megacities, 2012

5.3.4 Preliminary Development Plan

(1) Preliminary Development Plan

1) Analysis of Required Network Length in 2040

1) Required Length Based on Demand Forecast and Modal Share Rate

< Calculation from the railway transport density >

The required network length can be calculated from the expected railway transport density which is defined as the “daily average passenger volume” divided by the “total route length”.

According to the data on railway transport density in Tokyo Metropolitan Area shown in the table below, the average transport density is 15,000 to 30,000 passengers/km-day.

Table 5.3.3: Railway Transport Density in Tokyo Metropolitan Area

Type	Average Transport Density (unit: passengers/km-day)
All private railway companies in Southwest Tokyo Area	18,000 (exactly 18,520)
All private railway companies in Tokyo Area	15,000 (exactly 15,706)
All private railway companies in Osaka Area	9,000 (exactly 8596)

Note: The 30,000 transport density is actually the maximum based on the current high density condition of Tokyo Metro.
Source: Financial Situation of Major Private Railway Companies in Japan (http://hp.vector.co.jp/authors/VA037302/write/sitetu.html)

On the other hand, according to the demand forecast, railway transport should deal with four million trips in 2040 in case of the estimated 30% share. In order to deal with four million trips, it is required to extend the railway network as shown below.

Table 5.3.4: Required Railway Length calculated from Expected Railway Transport Density

	Expected Transport Density (person/km-day)	Required Railway Length (km)	Calculation
Case 1	18,000	220km	=4,000,000/18,000
Case 2	15,000	270km	=4,000,000/15,000
Case 3	9,000	450km	=4,000,000/9,000

Source: JICA Study Team

< Calculation from the maximum capacity of railway transport >

As mentioned above, the railway transport in Yangon should deal with four million trips in 2040. On the other hand, according to the table below, peak hour railway transport capacity indicated as Peak Hour Peak Direction Trips (PHPDT) is assumed at 50,000. In case the

peak ratio (hourly maximum passenger number/daily passenger number) is assumed at 15%, one railway line can deal with 660,000 trips (50,000/0.15 x 2) in both directions. Hence, the total required number of railway line in 2040 is estimated at six lines (4,000,000/660,000). It means that the total required railway length is calculated as 300 km in case the average length per line is assumed at 50 km.

Table 5.3.5: Comparison of Transit Capacity

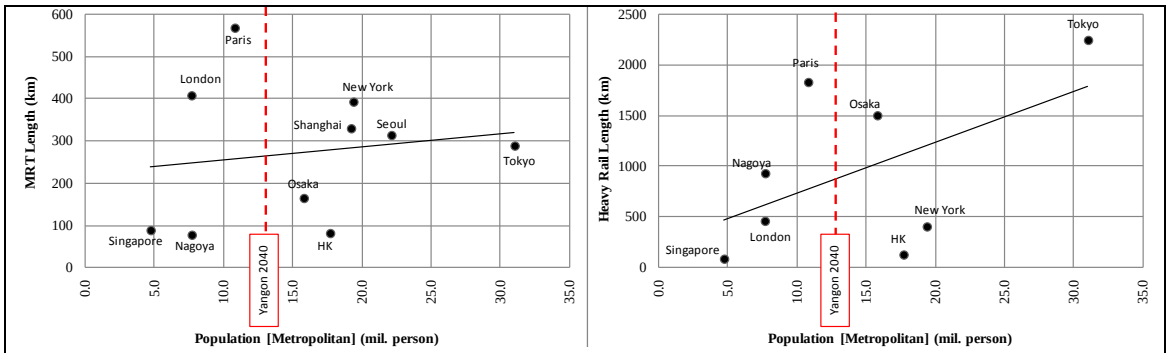
Type of System	Max. Capacity (PHPDT)*
a) Railway/UMRT (underground)	20,250 – 67,500
b) Railway/UMRT (elevated)	Ditto
c) LRT	10,800
d) Monorail (straddle type)	27,000
e) Monorail (suspension type)	18,000
f) AGT	10,800 – 21,600
g) Bus (elevated)	2,700
h) Bus (BRT at grade)	Ditto

Note: PHPDT: Peak Hour Peak Direction Trips
Source: Project Formation Study on Medium Transit System for Bangkok Metropolitan Area and Surrounding Areas, 2006

2) Example of Other Major Cities

The actual lengths of some railway networks in the world's major cities are studied in order to confirm the accuracy of the abovementioned calculation results.

The relation between population and railway network length of major metropolitan areas in the world is shown in Figure 5.3.9 below. The figure shows that some metropolitan areas with nearly 13 million populations like Yangon in 2040 have 90 km to 500 km length of UMRT network and 480 km to 1,800 km length of heavy railway network, although there is a large dispersion among the sampled cities. However, these lengths are considered to be too long and unsuitable for Yangon judging from the difference in metropolitan land areas. Most of the metropolitan areas in the figure except London, Hong Kong, and Singapore have wider urban areas of about 2 to 12 times than that of Yangon with 1,500 km^2, and this explains the longer length of the railway network there. On the other hand, London metropolitan area covers an area of 1,596 km^2 and Hong Kong metropolitan area with 1,428 km^2, which are almost equivalent to Yangon metropolitan area, with 408 km and 82 km lengths of UMRT network and 462 km and 130 km lengths of heavy railway network respectively. The result shows that the calculation results for Yangon as shown in Table 5.3.5 above are appropriate and realistic.



(a) Population – MRT Length (b) Population – Heavy Railway Length

Note: Heavy Railway means normal railway including MRT.
Source: JICA Study Team based on the Transport Development in Asian Megacities, Basic Study for Mid-term Infrastructure Development in Republic of Indonesia (JICA), Wikipedia (World Megacity's Population, http://ja.wikipedia.org/wiki/%E4%B8%96%E7%95%8C%E3%81%AE%E9%83%BD%E5%B8%82%E5%9C%8F%E4%BA%BA%E5%8F%A3%E3%81%AE%E9%A0%86%E4%BD%8D), World Subway Data (http://www.jametro.or.jp/world/index.html), Toshi to Romen Kokyo Kotsu (City and Road Surface Public Transport)

Figure 5.3.9: Relationship between Metropolitan Population and Railway Network Lengths

3) Conclusion

Based on the above analyses, the required railway network length for the Planning Area in 2040 will be between 220 km and 450 km.

2) Alternative Network Length Study

As mentioned above, the analysis results for the required railway network length showed a wide range between 220 km and 450 km. Therefore, alternative network length study should be conducted in order to assess the most appropriate length in consideration of the concepts and layouts of the urban function, accessibility to stations, etc. Three alternatives are set as follows:

i) Alternative 1: 220 km length network (as minimum case)

ii) Alternative 2: 350 km length network

iii) Alternative 3: 450 km length network (as maximum case)

Table 5.3.6 below shows the comparison of each alternative in view of its appropriateness in terms of urban function layout, accessibility to stations, and cost aspect. As shown in the layouts in the table, the features of each alternative are as follows:

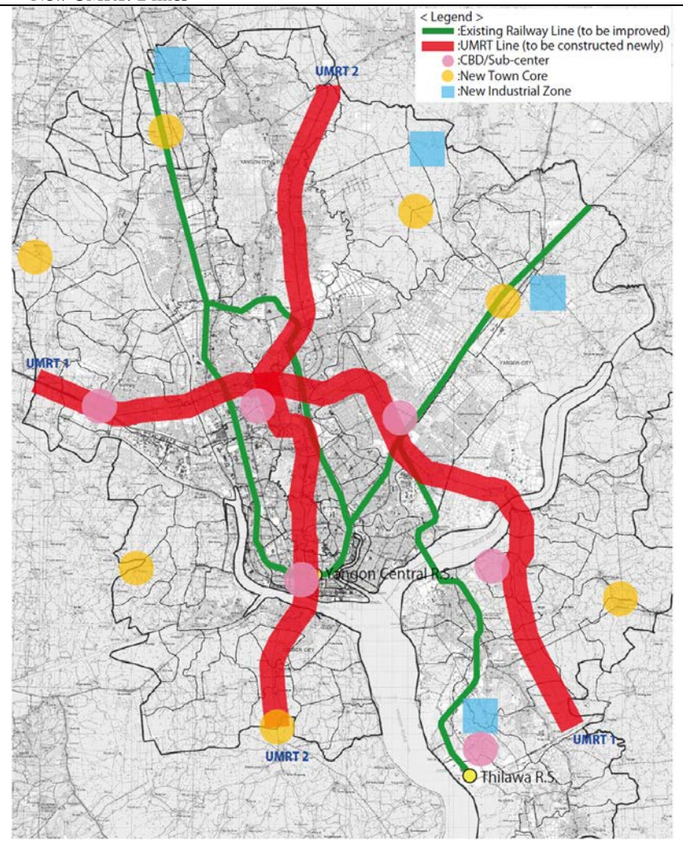
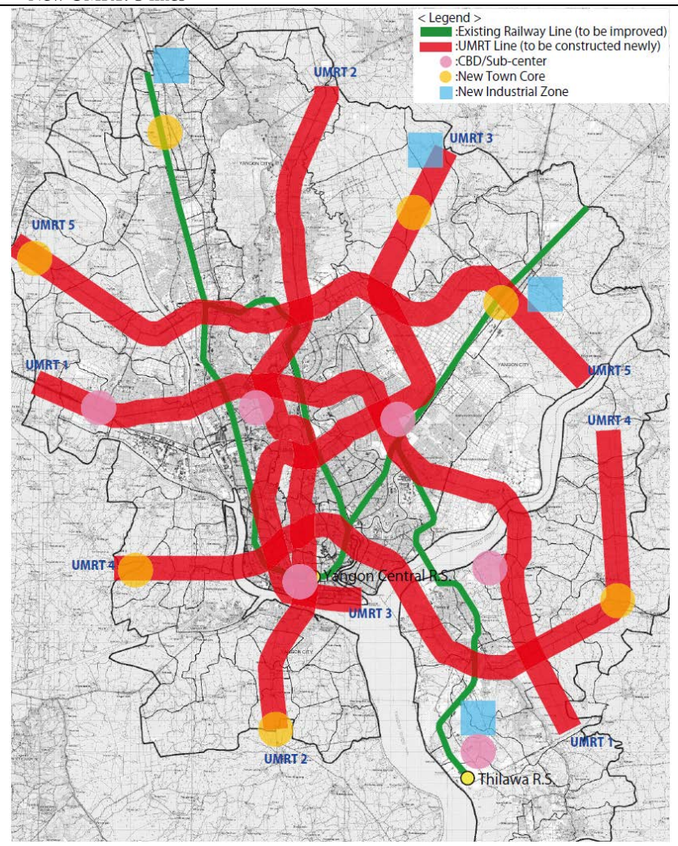
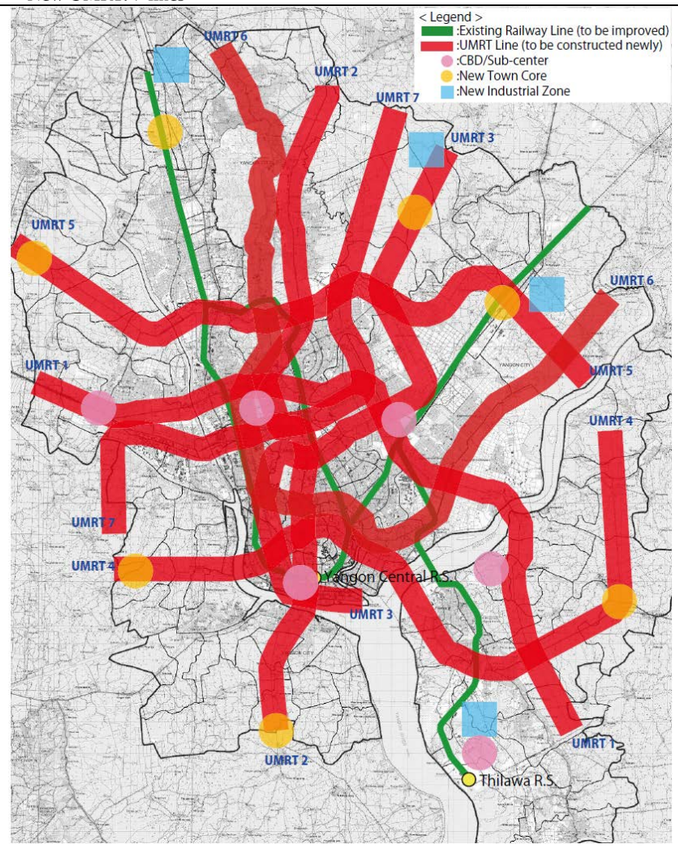
- The network of Alternative 2 covers all future urban function areas appropriately and suits the future urban development plan. On the other hand, the network of Alternative 1 does not cover a lot of future urban function areas, while the network of Alternative 3 tends to cover too much area including some non-urban function areas.
- The network of Alternative 2 can provide all the citizens with good access to any station within 5 km. However, in the network of Alternative 1, people may have to travel a longer distance between houses and nearby stations. The network of Alternative 3 seems to be costly due to the excess in the number of stations, although it can provide convenient access to stations.

It is noted that described routes for each UMRT line shown in the railway network layout below are drawn by the following reasons.

- The route for UMRT 1 is planned in order to link with 5 Sub-centers which are located on east-west direction and developed by 2025.
- The routes for UMRT 2, 3, 4, and 5 are planned in order to link CBD/Sub-centers with New Town Cores/New Industrial Zones radially.

In addition, it is noted that the figures of the railway network layout below are draft conceptual plan to show the necessity of the development of these corridors and the detailed route alignments will be studied in the sector master plan study.

Table 5.3.6: Comparison of Alternative Network

	Alternative 1	Alternative 2	Alternative 3
Network Length	**220 km** (exactly 220.4 km) - Improved Existing Line: 122.1 km - New UMRT: 98.3 km	**350 km** (exactly 354.3 km) - Improved Existing Line: 122.1 km - New UMRT: 232.2 km	**450 km** (exactly 465.2 km) - Improved Existing Line: 122.1 km - New UMRT: 343.1 km
No. of Line	5 lines - Existing Line: 3 lines - New UMRT: 2 lines	8 lines - Existing Line: 3 lines - New UMRT: 5 lines	11 lines - Existing Line: 3 lines - New UMRT: 7 lines
Conceptual Railway Network Plan (Draft)			
Fitting with the Urban Functions	**Poor** Some urban functions are not connected by the railway network.	**Fitting for its purpose** All urban functions are connected by the railway network.	**Surplus** All urban functions are connected by the railway network. However, some lines have no urban function because of surplus lines.
Accessibility to Stations	**Poor** Some areas are still far from the nearest station.	**Appropriate** Almost all areas can reach the nearest station within 5 km.	**Quite Convenient** Almost all areas can reach the nearest station within 3 km.
Cost Aspect*	**Low** US$ 16.6 billion - Existing Line Improvement: US$ 3.8 billion - New UMRT Lines: US$ 12.8 billion	**Middle** US$ 34.0 billion - Existing Line Improvement: US$ 3.8 billion - New UMRT Lines: US$ 31.2 billion	**High** US$ 48.4 billion - Existing Line Improvement: US$ 3.8 billion - New UMRT Lines: US$ 44.6 billion
Evaluation	-	***Recommendable***	-

Note: Costs indicated in the table are rough estimation.
Source: JICA Study Team

From the reasons stated above, the railway network length of about 350 km and the layout of Alternative 2 are considered as the most appropriate for the Yangon metropolitan area in 2040.

(2) Infrastructure Layout

The proposed short-, medium-, and long-term conceptual draft infrastructure layout plans for railway sector are shown in the following figures. These infrastructure layout plans are established in consideration of the following:

i) To fit with the concept and layouts of the urban function of each target years.

ii) To give priority to the improvement and upgrading of the existing railway line, instead of constructing a new line.

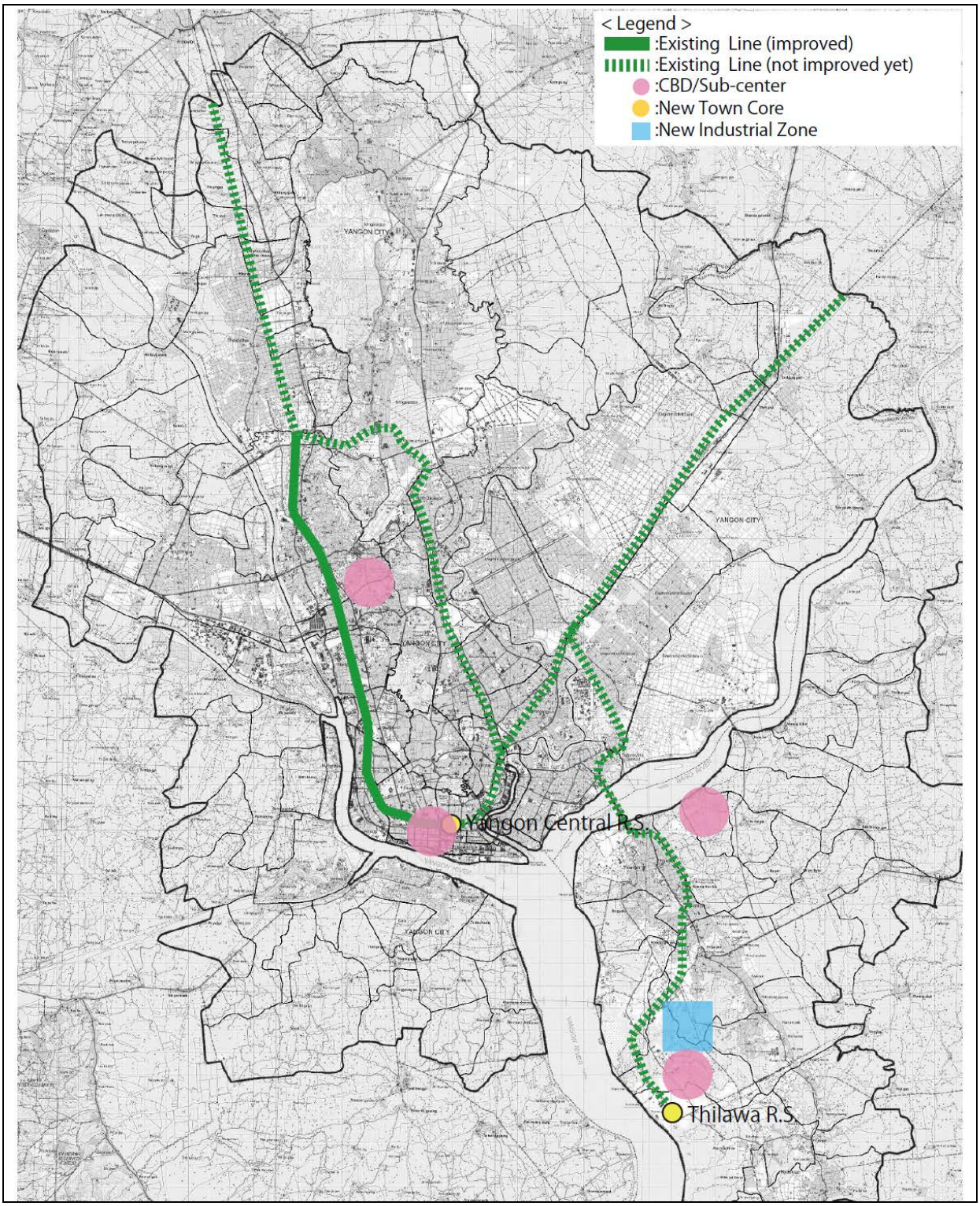
iii) To give priority to high population density areas in case of improvement of the existing railway line.

In order to realize the infrastructure layout plans, a total of 13 projects are listed as follows. Especially, it is emphasized that Yangon Circular Railway Modernization (Western Half Loop) is selected as a Short-term project in terms of the importance of the urgent transport capacity enhancement of the North-South axle from/to CBD which suffer from the continuous terrible traffic jam.

Table 5.3.7: List for Proposed Railway Projects

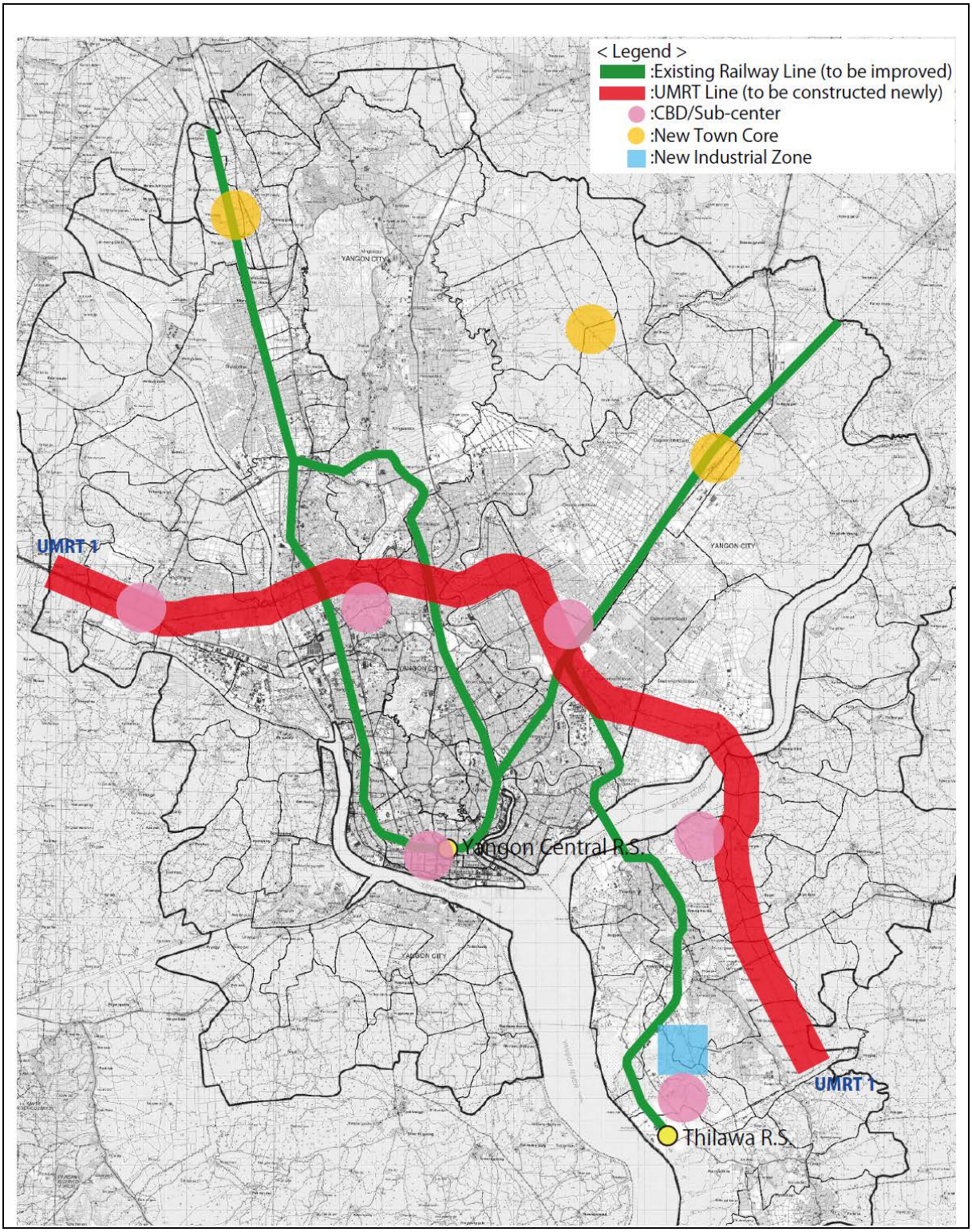
Category	Project Name	Remarks
Urgent	Automatic Level Crossing Installation in Yangon Circular Railway (Road Traffic Congestion Improvement)	Emergency measure to improve road traffic congestion
	Bottleneck Elimination between Yangon Central Station and Pazundaung Station	Emergency measure to improve punctuality of train operation
	Urgent Improvement of the Signalling System in Yangon Circular Railway	Emergency measure to improve punctuality of train operation
Short-term (Target year: by 2018)	Yangon Circular Railway Modernization (Improvement and Electrification) Phase 1: Western Half Loop	Between Yangon Central Station and Danyingone Station via Insein Station The project scope includes develop station plazas at the main stations including Yangon Central Station Redevelopment in order to connect the railway with other feeder services like bus, etc.
Medium-term (Target year: by 2025)	Yangon Circular Railway Modernization (Improvement and Electrification) Phase 2: Eastern Half Loop	Between Yangon Central Station and Danyingone Station via Mingalardon Station
	Yangon-Mandalay Line Modernization (Yangon metropolitan's section)	Between Yangon Central Station and Ledaungan Station The project scope includes improvement of access line connecting with Sat San Freight Station because the freight station is improved and used as mentioned in 5.4: Port and Logistics.
	Yangon-Pyay Line Double Track and Modernization (Yangon metropolitan's section)	Between Danyingone Station and Hmawbi Station
	Thilawa Line in Double Track and Modernization (Yangon metropolitan's section)	The purpose is for both commuter and freight transport from/to Thilawa
	UMRT Line 1 Construction (East-West Line 1)	Approximately 54 km
Long-term (Target year: by 2035)	UMRT Line 2 Construction (North-South Line 1)	Approximately 45 km
	UMRT Line 3 Construction (North-South Line 2)	Approximately 43 km
	UMRT Line 4 Construction (East-West Line 2)	Approximately 52 km
	UMRT Line 5 Construction (East-West Line 3)	Approximately 46 km

Source: JICA Study Team



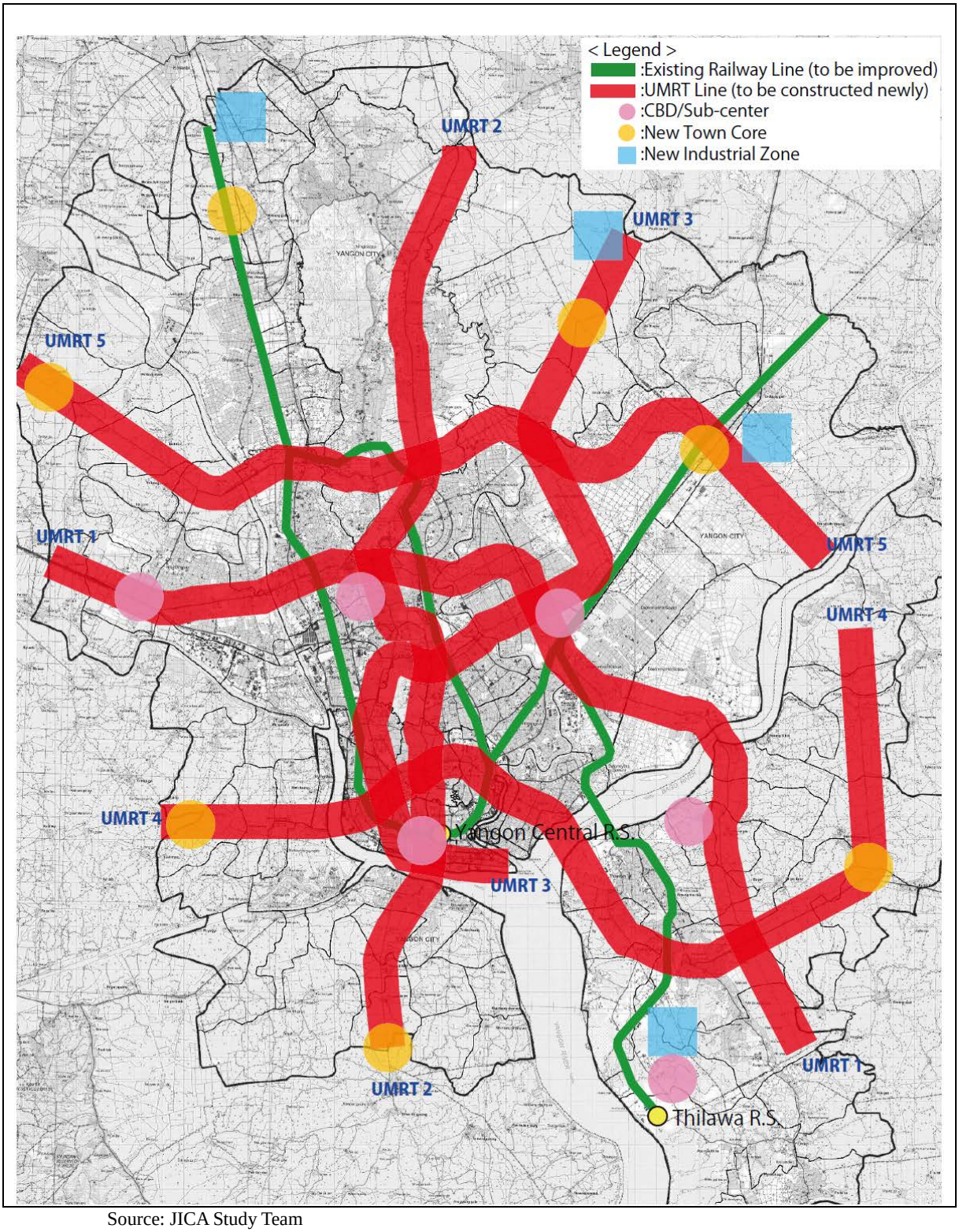
Source: JICA Study Team

Figure 5.3.10: Short-term Conceptual Infrastructure Layout Plan (Target Year: 2018)



Source: JICA Study Team

Figure 5.3.11: Medium-term Conceptual Infrastructure Layout Plan (Target Year: 2025)



Source: JICA Study Team

Figure 5.3.12: Long-term Conceptual Infrastructure Layout Plan (Target Year: 2035)

(3) Implementation Schedule

The implementation schedule for the railway sector is shown in Table 5.3.8. The basic precondition to establish the implementation schedule is as follows:

i) It is assumed that urgent projects will be completed within two years from commencement of the feasibility study. Regarding other projects, it is assumed that a) 2.5-3.0 years from the commencement of the feasibility study to the commencement of construction works, b) three years for the existing line improvement project, and c) five years for UMRT construction project;

ii) Short- and medium-term projects are given high priority to enhance the railway network of the existing developed areas. On the other hand, long-term projects are given high priority to assure railway access connecting to new town cores and new industrial zones;

iii) The implementation schedule should be synchronized with the abovementioned infrastructure layout plans of each target year; and

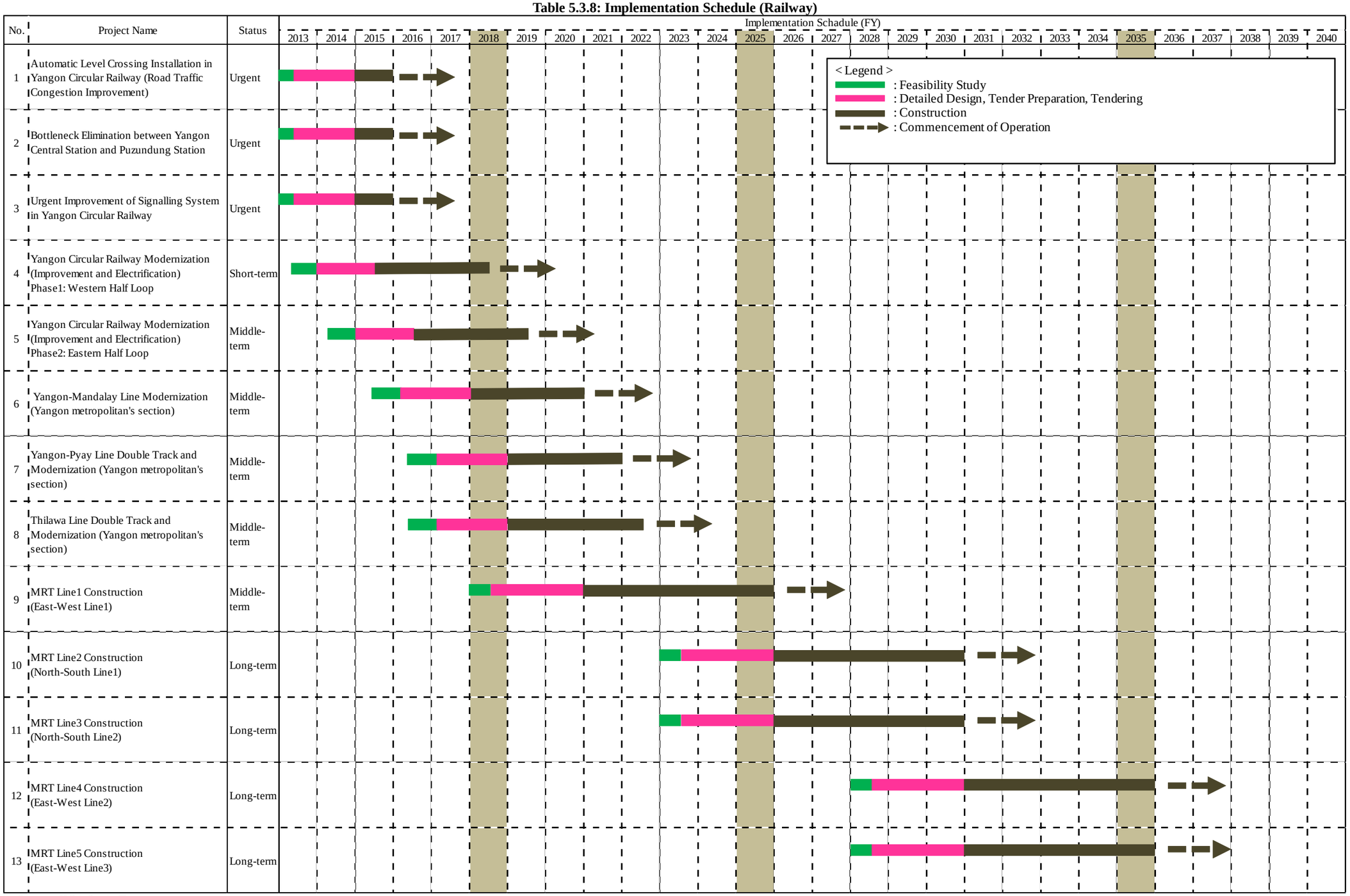
iv) To avoid overlapping, the implementation schedule of UMRT projects with huge project cost should be taken up in full advantage in order to reduce the financial burden of the Myanmar government.

(4) Priority Projects

The priority projects are shown in the project sheets in Chapter 6.3.

Table 5.3.8: Implementation Schedule (Railway)

No.	Project Name	Status
1	Automatic Level Crossing Installation in Yangon Circular Railway (Road Traffic Congestion Improvement)	Urgent
2	Bottleneck Elimination between Yangon Central Station and Puzundung Station	Urgent
3	Urgent Improvement of Signalling System in Yangon Circular Railway	Urgent
4	Yangon Circular Railway Modernization (Improvement and Electrification) Phase1: Western Half Loop	Short-term
5	Yangon Circular Railway Modernization (Improvement and Electrification) Phase2: Eastern Half Loop	Middle-term
6	Yangon-Mandalay Line Modernization (Yangon metropolitan's section)	Middle-term
7	Yangon-Pyay Line Double Track and Modernization (Yangon metropolitan's section)	Middle-term
8	Thilawa Line Double Track and Modernization (Yangon metropolitan's section)	Middle-term
9	MRT Line1 Construction (East-West Line1)	Middle-term
10	MRT Line2 Construction (North-South Line1)	Long-term
11	MRT Line3 Construction (North-South Line2)	Long-term
12	MRT Line4 Construction (East-West Line2)	Long-term
13	MRT Line5 Construction (East-West Line3)	Long-term



Source: JICA Study Team

5.4 Ports and Logistics

The proposed infrastructure development concept for the transport sectors (Urban Transport, Road Network, Railway, Ports and Logistics) is summarized as shown Figure 5.1.1 in this chapter. Appendix 1.1 (three sheets of A3 size) is an enlarged version of Figure 5.1.1.

5.4.1 Demand Analysis

Myanmar is the westernmost country of the Southeast Asia, and faces the Bay of Bengal. Myanmar is also bounded by land leading to nearby countries like Bangladesh, India, China, Laos, and Thailand. Myanmar is thus situated at the gates of international economic corridors such as the East-West Economic Corridor and the Southern Economic Corridor of the Greater Mekong Subregion (GMS).

Myanmar has a large cross sectional width and with long territory from north to south. The main river of Myanmar -the Ayeyarwaddy River flows from north to south. As a result, the longitudinal logistics is much more developed than the lateral logistics. The main logistic route for waterway, rail, and road transport is between Yangon (the former capital of Myanmar) and Mandalay (a former site of a dynasty), and the branch routes cover all over the country.

The principal products in Myanmar differ by regions. For example, rice is produced in regions like Delta and Bago, beans in central dry regions (Mandalay and Magway), timbers in Mandalay, Magway, and Sagaing regions, and natural rubber in Taninthatyi region. On the other hand, industrial products are mainly produced in Yangon and Mandalay.

The major land border trade route from China is China - Muse - Mandalay, and that from Thailand is Thailand - HpaAn - Yangon. The sea trade connects Yangon to Singapore, Malaysia and other countries.

Yangon is the logistic hub for all modes of the transport. Imported containers are transported by container trailers from Yangon Port to the consumption areas or factories in Yangon. Empty containers are transported to ICD for the stockpile. Truck cargos from Yangon to provinces and states are transported by small trucks (less than 4-ton capacity) and accumulated mainly at the Bayint Naung Warehouse (public truck center), then cargos are transported by large trucks. Water-borne cargos for the Delta are transported to the jetties at Lammadow Township.

Teak (raw wood) is transported from Sagain State to depots in Yangon. After auction, sold teak is transported by trailers to the factories or Yangon Port for export. There are many fishing ports along the Yangon River and the Pazungdan Creek. Fishes are caught at the coast at Mon State or Twante Canal, and brought to the fresh markets or the processing factories. River sand dredged at the Yangon River or river stones transported by barges from Mandalay are unloaded at the construction material shops at the Pazungdan Creek, and distributed by small trucks. Railway cargos for upcountry are accumulated at cargo stations at Pazungdan. Railway cargos for Mon State are accumulated at the Yangon Station, and passenger-cargo trains bring them to the destinations.

For inter logistic transportation in Yangon, expect for carrying teak wood or containers (though only designated roads), small trucks (less than 4 ton capacity) are used. Railway is not used for inter logistic transportation. Ferry boats carry goods and passengers from and to the opposite sides of the Yangon River.

In order for the optimization of the logistic transportation, following measures will be taken:

- YCDC has designated the roads allowed for heavy trucks and trailers. However, the separation of heavy vehicles from the small vehicles is not sufficient, and the road physical condition is not satisfactory. Road separation and improvement will be necessary to alleviate the road congestion in Yangon.
- Relocation of the exiting truck terminal to the suburb, on the planned ring road or further outer will be necessary to alleviate the road traffic around the current Bayint Naung Warehouse (truck center). The new truck terminal shall have a bonded area, and containers to/from port are concentrated at the truck center. From the truck center cargos are distributed to final destinations in Yangon or other regions and states, and vise varsa.
- Port function is currently heavily concentrated at Yangon Main Port. Relocation of port function to the suburb, especially to Thilawa Area will be necessary to establish the efficient logistic flow.
- Currently, container cargos from ports to Mandalay or upper Myanmar are transported by trailers, or unpacked from container and transported by trucks. As the expected future containerization, container cargos will increase, which will result in further traffic jam in Yangon. Transport of container by barges through the Ayeyarwaddy River will be one of the mitigation plans.

5.4.2 Development Policy

The sector vision and basic policy of the logistics sector are in agreement with the instructions given by the President of Myanmar in June 2012.

Table 5.4.1: Summary of the President's Instructions

Theme	Policy
Five Year Plan (2011-2015)	Review the weight of each sector, and stress on the industry
Increase efficiency by privatization	Establishment of privatization committee chaired by the Vice President
Renovation Strategy	Establishment of renovation strategy for projects in each sector
30-year plan	1) Village development and poverty eradication, 2) Human development plan, 3) Investment plan, 4) Trade development plan, 5) Industrial development plan, 6) Financial and monetary development plan, and 7) Regional development plan.
Utilization of foreign aid	Thorough consideration of loan projects. Efficient management of aid. Bottom-up decision of grant projects.
Investments by domestic and foreign investors	Protection of investors. Careful evaluation of investment items.
Steady supply of electricity	Establishment of energy plan. Improvement of services by the National Energy Management Committee.
Economic Policy	1) Development of agriculture, 2) Equal distribution of budget to the regions, 3) Achievement of development target of each region, and 4) Policy determination by accurate economic statistics.

Visions and basic policies are established with due consideration of the current situation and future forecast of the ports and logistics, as mentioned in the previous sections.

Sector Vision	**Realization of An Environment-friendly, Comfortable and Convenient Transport System (High Safety, Mobility and Reliable Waterway Transport System Led by Modernized Port, Ship, Dockyard and Navigation Aid, Logistics Facilities and Contribution to Promote The Planned New Urban Development)**
Basic Policy	1) In Response to Increasing Cargo Volume, Establishment of Efficient port Terminal Operating System, and Reallocation of Port Terminals in order to Alleviate the Traffic Congestion. 2) Establishment of Safe, Punctual, and Speedy Waterway Commuting Services. 3) Development of Relaxing and Scenic Waterfront Area 4) Development of Environmentally Friendly Inland Waterway Transport System 5) Improvement of Waterway Transport for Rural Development 6) Capacity Building in Port and Waterway Management 7) Establishment of Efficient Truck Logistics Facility 8) Rehabilitation of Railway Cargo Stations

Background and details of each basic policy are explained as follows:

(1) Port expansion plan in response to increasing cargo volume

Currently, only about 20% of cargo throughput in Yangon Port is carried in containers. Compared to other major ports in other countries, this containerization ratio is rather low. For efficient cargo transportation, containerization is urgently required in Myanmar.

As stated in the previous section of this report, container handling capacity in Yangon Main Port, including future renovation or expansion, is merely 725,000 TEU. However, due to the limitation of the waterfront and the hinterland areas, further increase of cargo-handling volume in Yangon Main Port cannot be expected. Thus, in the future, majority of increased container-handling volumes will be shifted to Thilawa Area Port. In order to handle the ever-increasing volume of the cargo, establishment of a modern and efficient port terminal operation system, and construction of more ICDs will be essential and inevitable. Furthermore, construction of a road network connecting Thilawa Area Port to the CBD of Yangon and the industrial estates on the fringes of the urban areas will be necessary and imperative.

(2) Establishment of safe, punctual, and speedy waterway commuting services.

Greater Yangon, which includes YCDC and parts of six other peripheral townships including Thnalyn, is separated by the Yangon River, Bago River, and Tawante Canal. At present, the bridges that connect these areas are not sufficient, resulting in traffic concentration and congestion near and on the bridges. Thus, the ferry boat services across the rivers have been developed and are widely used by residents in Greater Yangon. Ferry services by large boats are operated by Inland Waterway Transport (IWT). Also, there are about 200 small private ferry boats with the passenger capacity of up to 24 tons only.

The current ferry boats owned by IWT are very old, inefficient and slow. There might also be problems on safety and punctuality. Thus, the rehabilitation/renewal of the boats, jetties, and the ship yards shall be carried out in order to provide high mobility and safety in ferry services.

Furthermore, the laws governing ship building and inspection were made in the early 1900s, and have not been revised ever since. There are some clauses which are irrelevant and obsolete, and cannot be

applied to the current situations. Thus, a review of the laws and regulations must be done in order to improve the safety and adapt to modern operations of the ferry services.

(3) Development of friendly waterfront area

Historically, Yangon has grown with the river and port along the Yangon River, and the shoreline of the Yangon River has been kept open with thick greenery and wide strand. The view of the Yangon River has always been part of the charm of the city. At present, however, almost all the shoreline of the Yangon River is currently occupied by port facilities and ship yards.

In the future, as the port-handling capacity gradually shifts from the Yangon Main Port to Thilawa Area Port, it is expected that some parts of the shoreline can be developed as a waterfront park with required amenities like restaurants or hotels, and an excellent view of the river. In order to implement the development strategy, rehabilitation of the old port and relocation of the facilities are necessary.

(4) Development of environmentally friendly inland waterway transport system

In general, CO_2 emission in waterway transport is less than that in road transportation. However, the current vessels are aged, and especially, the engines are old and fuel efficiency is low. In addition, the port facilities are not environmentally friendly in terms of CO_2 emission. Thus, the rehabilitation and replacement of the aged and inefficient vessels and port facilities are needed to achieve environmentally friendly inland waterway transport system. .

(5) Improvement of waterway transport for rural development

Yangon is the logistics hub in Myanmar in terms of the waterway transport with cargo transits and changes of the mode of transport to/from the waterway. In order for the development of the much expected rural industries (agriculture, mining, tourism, forestry, manufacturing, and fisheries) and improvement of the rural living standard, improvement of the infrastructure in the waterway is essential. Waterway transport is suitable for long and mass transportation, and currently, the transportation volume (per ton-km) is larger than those of road and railway transportation. Although the cost of the transportation by waterway is lower than that of road transportation, further reduction of the cost by improving the vessel and port facilities for better efficiency will be necessary.

(6) Capacity building in port and waterway management

The government organizations responsible for the port and waterway are the Myanmar Port Authority (MPA), Inland Waterway Transport (IWT), and Directorate of Water Resources and Improvement of River Systems (DWIR). Due to the long economic sanctions, the technical capabilities of the staff are not up to the required level. Especially, capacity building programs in port terminal management, port security, navigation channel management, and ship building and inspection are urgently required.

(7) Establishment of efficient truck logistics facility

The current truck logistics center, Bayint Naung Warehouse, is located at one of the most congested area in Yangon. Furthermore, increasing cargo volume and truck sizes worsen the situation. Relocation of the truck logistics center is inevitable. At the same time, the total truck logistics system, including container trailers, log trailers, and other types of trucks, shall be established.

In current Yangon cold chain and communication system in logistics have not been established. Due to the lack of the cold chain, transportation of cool or frozen agriculture or fisheries products is not efficiently carried out. Furthermore, due to the lack of the communication system, tracing the goods

under transportation is very difficult. Improvement of truck logistic center as well as the communication system and the vehicles themselves will improve the efficiency of logistics, and as a result, the goods will add the values.

(8) Rehabilitation of railway cargo stations

Although the cargo stations have sufficient land areas, cargo handling is not efficiently carried out. For example, the cargo loading and unloading are carried out by manual labors. The current cargo volume going out of Yangon is merely about 80,000 ton per month. There will be a high potential for increasing the cargo volume by modernization of the cargo stations.

5.4.3 Development Goals and Target Effect Indicators

To evaluate the future waterway and logistics development and to confirm its outcomes, the following development goals and effect indicators are prepared:

Table 5.4.2: Development Goals and Effect Indicators (Port and Logistics)

Development Goal	Effect Indicators
a) Effectiveness of Port Handling	Average Time in Port (6.5 days → 3 days)
b) Speed of Inland Waterway Transport	From Mandalay to Yangon (6 days → 3 days)
c) Containerization	Ratio of Container (20% → 40%)
d) Efficiency of Truck Transportation	Relocation of public truck center and double the area (26ha → 52ha)

It is noted that the effect indicators are limited to the items that can be actually counted or quantitatively grasped based on surveys or statistical data in future. The reasons for the selection of these indicators are as follows:

1) Efficiency of Port Handling

The average elapsed time between entering and exiting of vessels to/from the port area (Average Time in Port) is currently 6.5 days according to the statistical data in August 2012 by MPA. When the navigational safety system and cargo-handling system are improved, this indicator can be halved. In other more developed ports with good facilities, the value ranges from 1-5 days only.

2) Speed of Inland Waterway Transport

Currently IWT's ferry takes six days to navigate from Mandalay - Yangon three days: Mandalay - Pyey, three days: Pyey - Yangon). By replacing the old ferry vessels with new ones, improving the river channel, and improving the port facilities, the speed of the ferry will be increased and the navigation time will be reduced. In comparison with the truck transportation, ferry transportation has merits in cargo charge (1/5) and fuel consumption (1/2). However, reliability on time (speed and punctuality) is deficient in ferry transportation. After improvement, ferry transportation will be environmentally friendly, and will serve for the development of the rural regions.

3) Containerization

In the major ports in Asia, the containerization ratio for cargoes for Europe and the USA services are about 40%. The goal is set to be near this number for other ports.

4) Efficiency of Truck Transport

The Bayint Naung Warehouse, only public truck center, is located at the busy traffic areas, and existence of this truck center further aggravates traffic jam. Furthermore, the narrow parking spaces and small streets/roads in the Bayint Naung Warehouse have become unsuitable for the increasing numbers and sizes of the trucks. The relocation and the modernization of the truck centers are inevitable. Considering the congestion of the current truck center and the increase of truck cargo, the area shall be at least double of the current one.

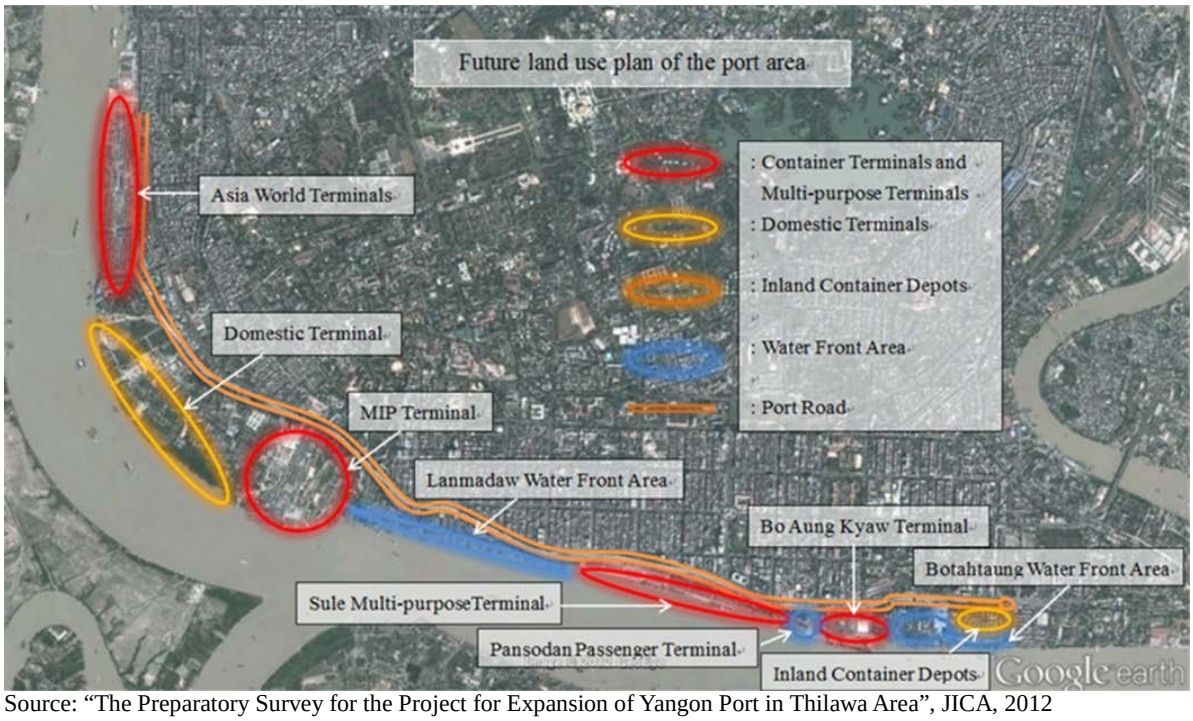
5.4.4 Preliminary Development Plan

Outlines of the infrastructure plan, infrastructure schedule, and priority projects to achieve the development goals are described as follows:

(1) Infrastructure Layout

Future land use plan of the port area is depicted in the figure below. The development concept is consistent with that in JICA's "The Preparatory Survey for the Project for Expansion of Yangon Port in Thilawa Area". The basic concept is summarized as follows:

- Utilize the existing international port terminals.
- Relocation and concentration of the inland waterway ports to the "Domestic Terminal" area.
- Relocation of facilities not directly necessary in urban area, such as shipyard, to suburbs.
- Develop the waterfront as an amenity for the citizens.



Source: "The Preparatory Survey for the Project for Expansion of Yangon Port in Thilawa Area", JICA, 2012

Figure 5.4.1: Future Land Use Plan of the Port Area Plan

(2) Implementation Schedule

Based on the Key Findings and Main Issues, listed in Section 2.3.4, total 23 projects are

proposed in this Study. The relation of each project to the Key findings and Main Issues are summarized in the following table.

Table 5.4.3: Development Goals and Effect Indicators

Key Findings and Main Issues (Refer to Section 2.3.4)		Implementation Schedule										
(1)	Port Facilities	1	2	3	4	6	10	11	12	13	14	15
(2)	Inland Waterway Facilities	5	17	19	20	21						
(3)	Old Shipyard Facilities	21										
(4)	Deep-Sea Port	16										
(5)	Truck Transport Efficiency	7	8	9	18	22						
(6)	Railway Cargo Station Modernization	23										

Source: JICA Study Team

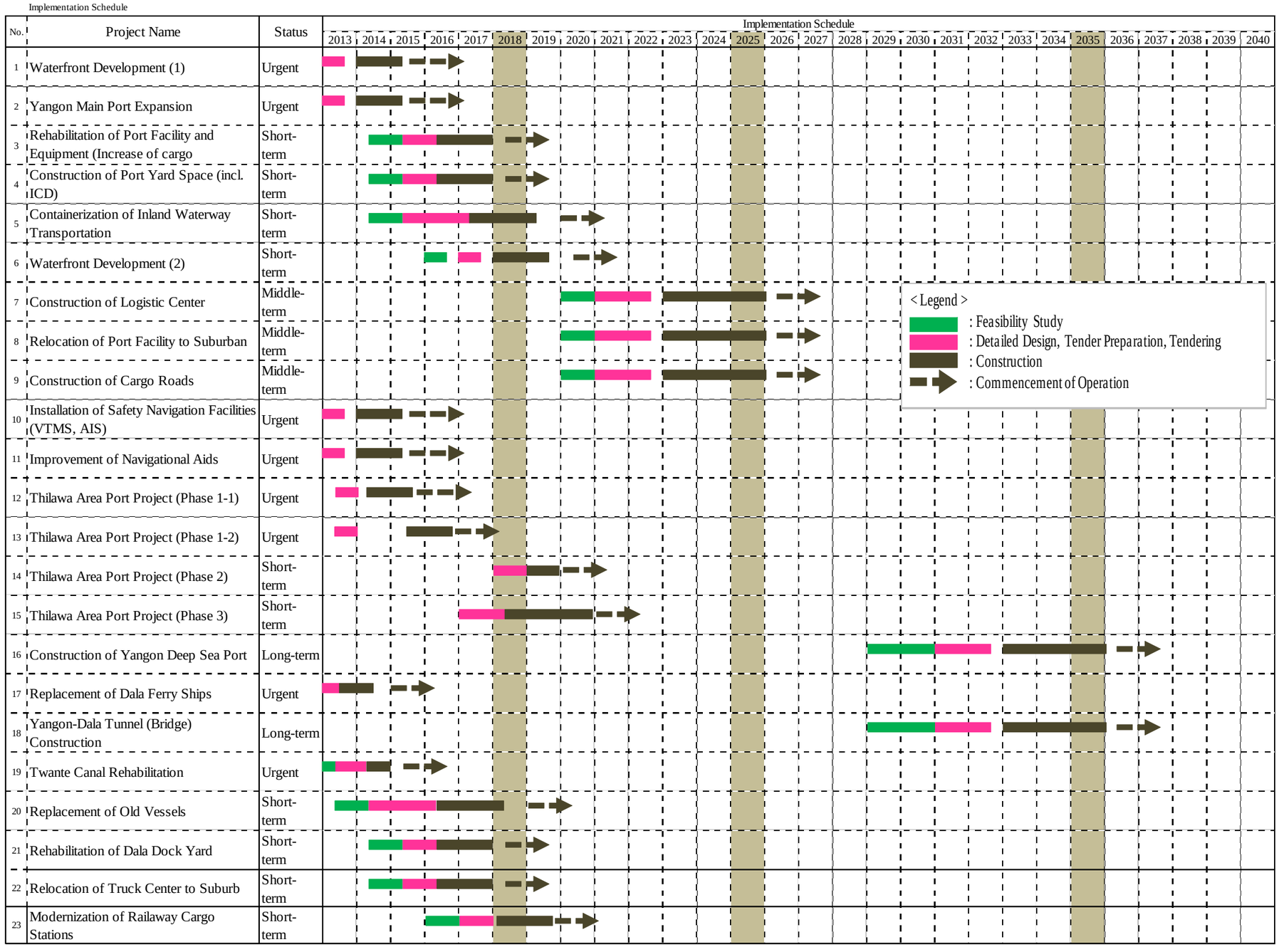
The implementation schedules for Short-term (2018), Medium-term (2025), and Long-term (2035) are indicated in the bar-chart schedules in the following page. In addition, the projects in urgent status are also indicated in the schedule.

Among the urgent projects, Tawnte Canal Rehabilitation Project shall be given priority, and the details are explained in the next part of this report.

Table 5.4.4: Implementation Schedule (Port and Logistics)

Implementation Schedule

No.	Project Name	Status
1	Waterfront Development (1)	Urgent
2	Yangon Main Port Expansion	Urgent
3	Rehabilitation of Port Facility and Equipment (Increase of cargo	Short-term
4	Construction of Port Yard Space (incl. ICD)	Short-term
5	Containerization of Inland Waterway Transportation	Short-term
6	Waterfront Development (2)	Short-term
7	Construction of Logistic Center	Middle-term
8	Relocation of Port Facility to Suburban	Middle-term
9	Construction of Cargo Roads	Middle-term
10	Installation of Safety Navigation Facilities (VTMS, AIS)	Urgent
11	Improvement of Navigational Aids	Urgent
12	Thilawa Area Port Project (Phase 1-1)	Urgent
13	Thilawa Area Port Project (Phase 1-2)	Urgent
14	Thilawa Area Port Project (Phase 2)	Short-term
15	Thilawa Area Port Project (Phase 3)	Short-term
16	Construction of Yangon Deep Sea Port	Long-term
17	Replacement of Dala Ferry Ships	Urgent
18	Yangon-Dala Tunnel (Bridge) Construction	Long-term
19	Twante Canal Rehabilitation	Urgent
20	Replacement of Old Vessels	Short-term
21	Rehabilitation of Dala Dock Yard	Short-term
22	Relocation of Truck Center to Suburb	Short-term
23	Modernization of Railaway Cargo Stations	Short-term



Source: JICA Study Team

Brief explanation and rationale of each project is summarized in the following table:

Table 5.4.5: Brief Explanation and Rationale of the Project

No.	Project name	Explanation of Project
1	Waterfront Development (1)	As of December 2012, biddings of four projects in Yangon Main Port are underway. Three of them are commercial development projects.
2	Yangon Main Port Expansion	As of December 2012, a BOT project to construct port facility at the current shipyard owned by IWT is underway.
3	Rehabilitation of Port Facility and Equipment (Increase of cargo throughput)	As of December 2012, biddings of four projects in Yangon Main Port are underway. One of them is the rehabilitation project of the Yangon Main Port.
4	Construction of Port Yard Space (incl. ICD)	In Yangon Main Port, the hinterland is narrow and the spaces for the ICD is insufficient. ICD owned and operated by MAP is over-occupied. For further development of the logistics, construction of ICD is inevitable.
5	Containerization of Inland Waterway Transportation	Inland waterway is not containerized, and the transportation efficiency is low. By containerizing the inland waterway, logistic efficiency will be improved.
6	Waterfront Development (2)	In addition to No.1, further development of the waterfront will be necessary.
7	Construction of Logistic Center	Construction of the logistic center with bonded area, which will be the hub of road, waterway, and air transportation, will be necessary.
8	Relocation of Port Facility to Suburban	As the Yangon becomes congested with traffic, function of each port in Yangon Main Port shall be reshuffled, and part of the facilities shall be removed to less congested suburban.
9	Construction of Cargo Roads	As the cargo volume increases, the special cargo roads connecting Yangon Main Port, Thilawa Area Port, Industrial Estates in the suburb, and the the exit roads to the provinces will be necessary.
10	Installation of Safety Navigation Facilities (VTMS, AIS)	Nowadays VTMS and AIS are the standard navigation equipment. Yangon Port, which is the gateway of Myanmar, shall also equipped with these equipment to improve navigation safety and efficiency of port operation.
11	Improvement of Navigational Aids	Yangon Main Port is river port, which is located 32km from the river mouth. Yangon River channel is long, narrow, and curved, which makes the vessel's navigation very difficult. As the number of the calling vessel increases, the appropriate navigation aids are inevitable.
12	Thilawa Area Port Project (Phase 1-1)	This is the most priority areas among the port development of Plot 25 and part of Plot 26. To meet the container cargo increase and serve for the SEZ in Thailawa Area, this project is urgent one. One berth (200m) will be completed.
13	Thilawa Area Port Project (Phase 1-2)	Same construction package as Phase 1-1. Another 200m berth will be completed.
14	Thilawa Area Port Project (Phase 2)	This is the terminal area construction project of Plot 26. The timing of the project commencement is subject to the cargo volume increase.
15	Thilawa Area Port Project (Phase 3)	This is the project to develop Plot 23 to 24 of the Thilawa Area. The timing of the project commencement is subject to the cargo volume increase.
16	Construction of Yangon Deep Sea Port	Water depth of Yangon Port, including Thilawa Area Port, is merely 9m, thus considering the future development of Myanmar deep sea port as deep as 14m will be necessary. Though there are plans for deep sea ports in Dawei and Kyauk Pyu, they are very far from Yangon. There will need a deep sea port near Yangon to serve for the largest consumption place.
17	Replacement of Dala Ferry Ships	This is the replacement of old ferry boats connecting Yangon and Dalla, passenger of which is about 30,000/day. In March 2013, grant agreement was signed between Japan and Myanmar Governments.
18	Yangon-Dala Tunnel (Bridge) Construction	Yangon city is expanding, and in 20 years it is expected that Dalla Area will also become the expansion area. Current ferry service will not sufficient to transport goods and passengers. Tunnel or bridge will be necessary, though a large scale land filling at Dalla side will be necessary.
19	Twante Canal Rehabilitation	The Twante Canal is the only canal for the inland waterway, which connects Yangon to Delta regions and upper Myanmar. Furthermore, due to the erosion of the river banks, the houses near the canal are in jeopardy. Myanmar Government has requesting Myanmar government strongly for the rehabilitation of the Twante Canal.
20	Replacement of Old Vessels	Most of IWT vessels are more than 40 years old (In Japan only 1/3 is older than 14

		years), thus problems in safety, fuel consumption, and high repair costs. If the replacement od vessels are carried out by Japanese ODA loan, improvement of inland waterway will be promising.
21	Rehabilitation of Dalla Dock Yard	Dalla Shipyard is historic shipyard established some 150 years ago. But the obsolete of facilities and equipment hinters the inspection, repair, and ship building of the vessels. For the consistent development of the inland waterway, rehabilitation of the shipyard is inevitable.
22	Relocation of Truck Center to Suburb	Bayint Naung Warehouse, only public truck center, has become unsuitable for the increasing numbers and sizes of the trucks. The relocation and the modernization of the truck centers are inevitable.
23	Modernization of Railway Cargo Stations	The current cargo volume going out of Yangon is merely about 80,000 ton per month. But the loading/unloading is carried out manually, and efficiency of the cargo handling is low. This project is to modernize the current Sat San cargo station.

Source: JICA Study Team

(3) Priority Project

The priority projects proposed in this study are shown in the project sheets in Chapter 6.3.

- Supplementary Explanation of Twante Canal Rehabilitation Project:

Twante Canal was constructed in the 19th century during the British Colonial Rule, and since then, the canal has been heavily used for the gateway to transport cargo and passenger from Yangon to the Ayeyarwaddy River Delta region and North Area in Myanmar. This canal is the only waterway that connects Yangon to Delta and upper Myanmar regions. Should the canal become unusable, impacts on the logistics will be tremendous.

Because of the large difference of the tide level and fast current, the embankment has been suffering from erosion and damage. The damages occur chronically due to the lack of proper technical methods for maintenance. Especially, damages are evident at the edges of the sandbar at the entrance to Twante Canal. Kan Gyi Kone Village built on the sandbar, and some of the population commutes to Yangon.

On the 16th July 2012, Myanmar's MOT requested by official letter to Japan's Ministry of Land, Infrastructure, Transport and Tourism for the rehabilitation of the Twante Canal.

To secure the waterway route from Yangon to the Ayeyarwaddy River Delta Region, and further to the regions along the Ayeyarwaddy River including Mandalay, and to protect the lives of the Kan Gyi Kone Village, the urgent rehabilitation of Twante Canal by Japan's technology is of utmost importance and necessity.

IWT Passenger Ferry

Private Ferries

Source: JICA Study Team

Figure 5.4.2: IWT Ferry and Private Ferries between Yangon City and Twante

Source: JICA Study Team

Figure 5.4.3: Twante Area Embankment Damage

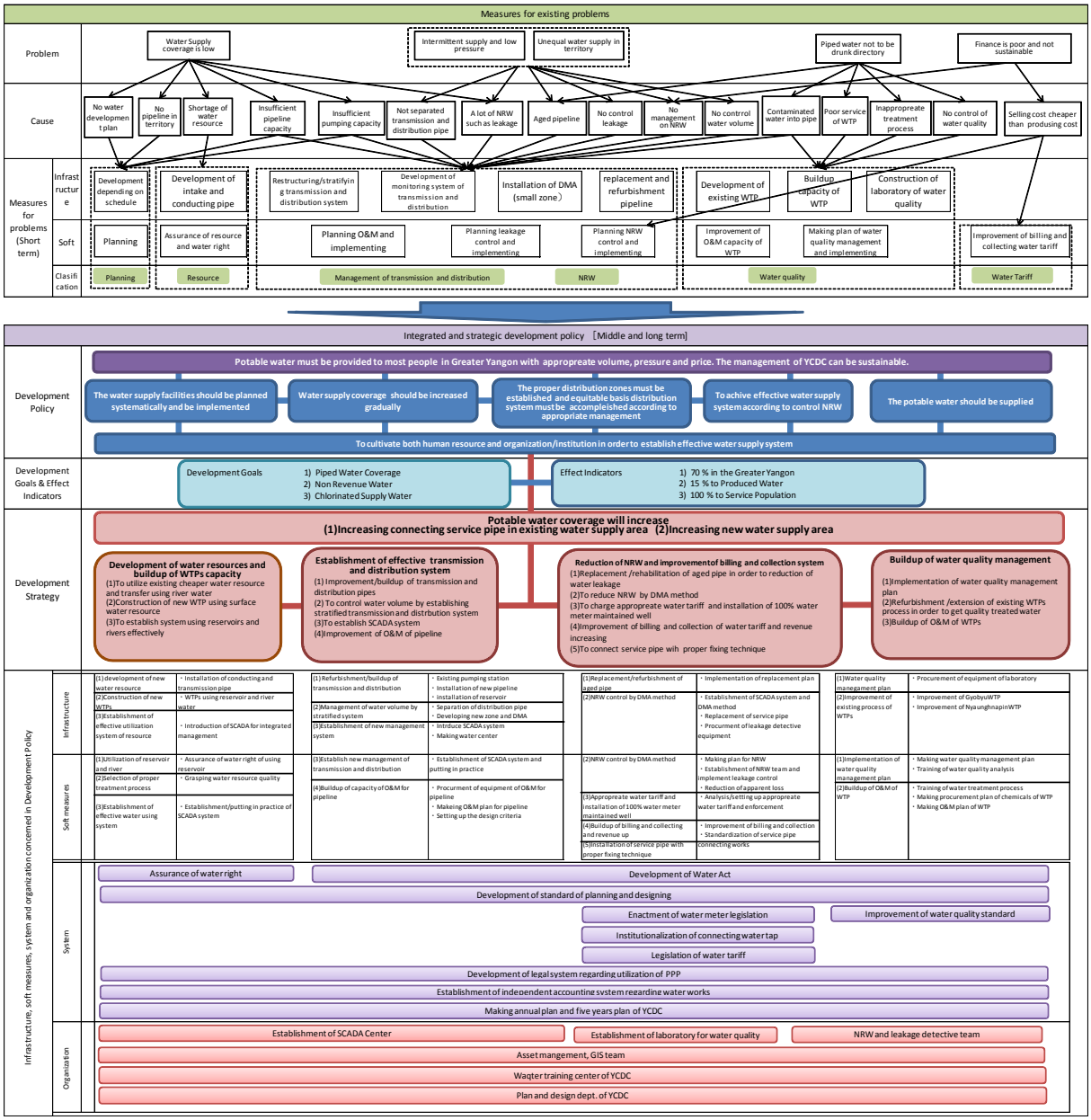
Especially, the damages at the eastern and western edges of the Kan Gyi Kone Village are evident as indicated by circles in the next figure. The above pictures show the damages at the eastern edge of the village.

Source: JICA Study Team

Figure 5.4.4: Locations of Damages in Kan Gyi Kone Village (marked in red circles)

5.5 Water Supply

The proposed infrastructure development concept for the water supply sector is summarized as shown in Figure 5.5.1. Appendix 1.2 (two sheets of A3 size) is an enlarged figure of Figure 5.5.1.

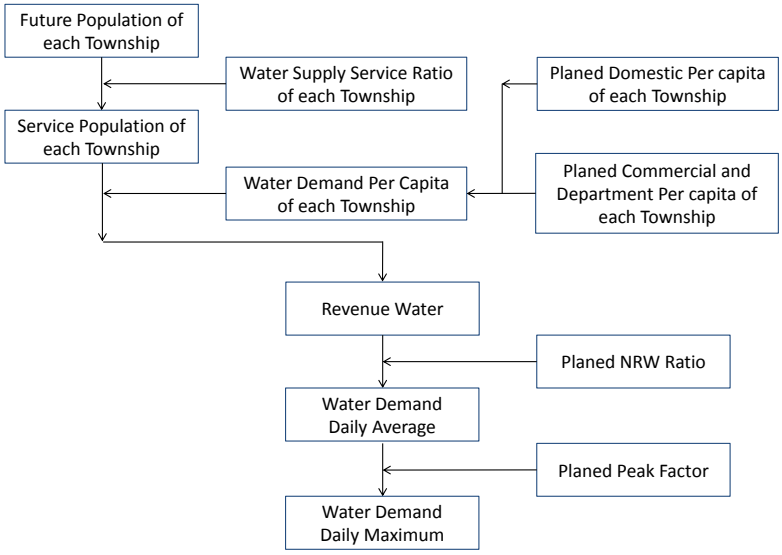


Source: JICA Study Team

Figure 5.5.1: Infrastructure Development Concept

5.5.1 Demand Analysis

The target area is the Greater Yangon including Yangon City and six suburban township areas. The target year of the demand analysis is 2040. The demand analysis was conducted by the JICA Study Team on "The Improvement of Water Supply, Sewerage and Drainage System in Yangon City". The results of the analysis are summarized below. As YCDC will drive forward the installation of water meters to customers, the metered rate of water tariff will be applied for 100% of the customers in 2040. Although it is estimated to improve the quality of citizens' life, water consumption is projected to be lower than the existing flat rate tariff system. The flow of water demand forecast is shown in Figure 5.5.2.



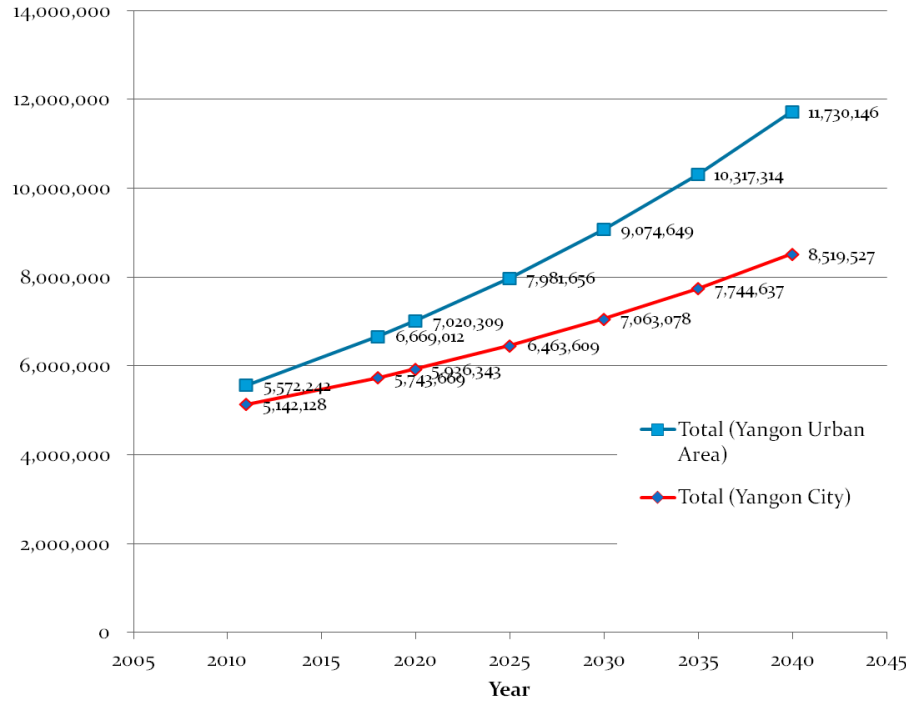
Note: Future population of each township were given by the City Planning Study
Source: JICA Study (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

Figure 5.5.2: Flow of Water Demand Forecast

(1) Population

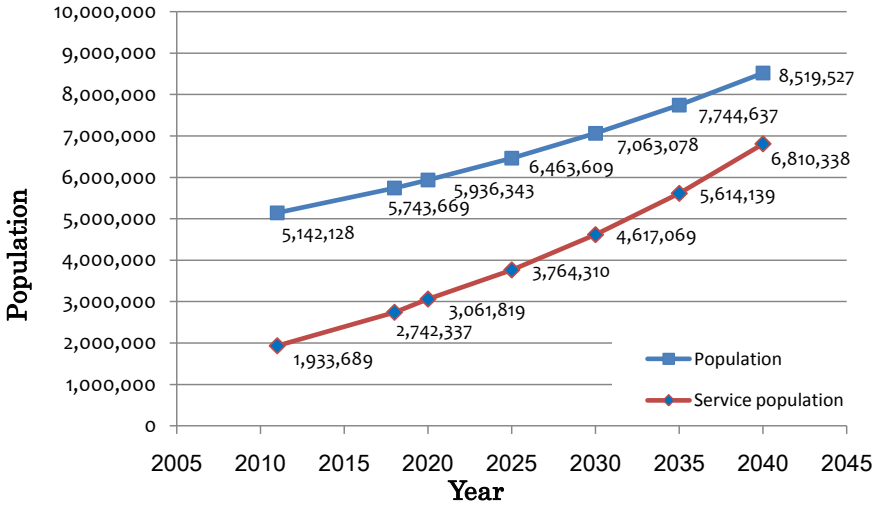
The projection of the total population of the Greater Yangon and Yangon City up to 2040 is shown in Figure 5.5.3.

The projection of total population and water service population for Yangon City is shown in Figure 5.5.4.



Source: JICA Study Team

Figure 5.5.3: Projection of Population of Greater Yangon and Yangon City Up to 2040

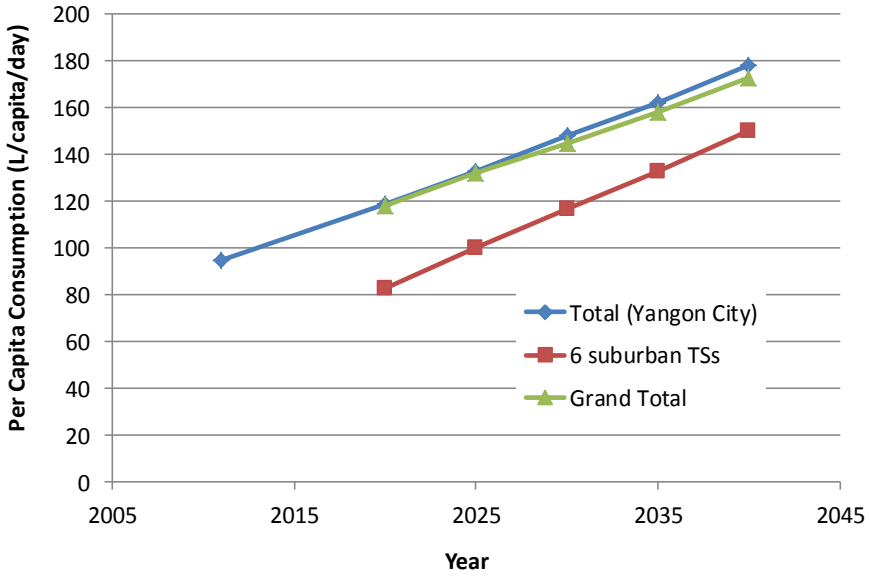


Source: JICA Study Team

Figure 5.5.4: Projection of Total Population and Service Population for Yangon City Up to 2040

(2) Water Consumption

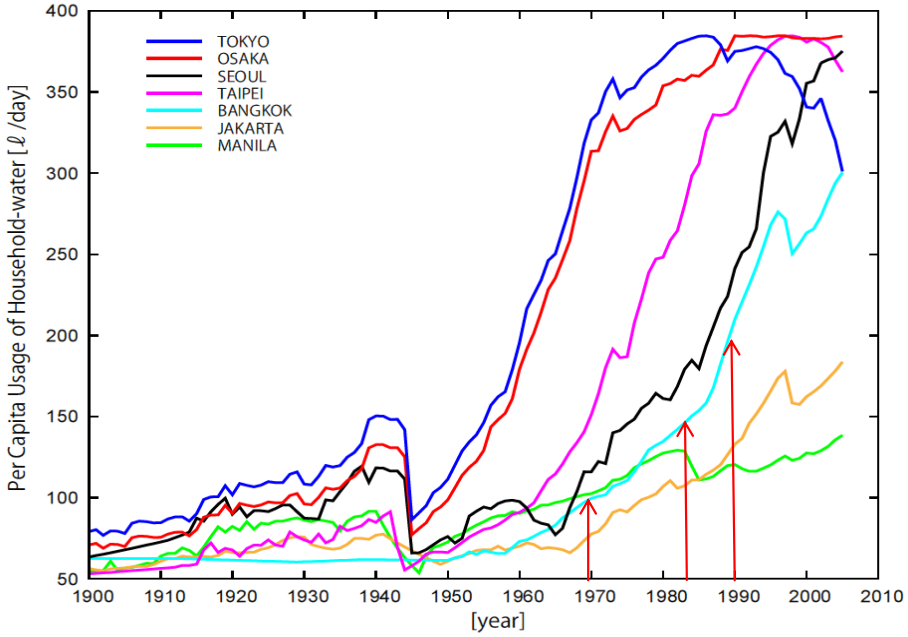
The projection of domestic water consumption per capita up to 2040 is shown in Figure 5.5.5.



Source: JICA Study (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

Figure 5.5.5: Projection of Domestic Water Consumption per Capita Up to 2040

For the purpose of reference, the per capita usage of water in other Asian cities is shown in Figure 5.5.6. This figure shows that the per capita usage of water in Bangkok, Thailand has reached to 200 L/day in 1990.



Source: JICA Study (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

Figure 5.5.6: Per Capita Usage of Water in Other Asian Cities

It is estimated that the infrastructure of water supply works in the Greater Yangon lags 25 to 30 years compared with Bangkok, Thailand.

(3) Water Demand

- The population of the Greater Yangon is estimated to be 11.7 million in 2040 according to the study by the JICA Study Team.

- The service population of the Greater Yangon has been estimated at 8.1 million and the daily maximum water consumption is calculated at 2.9 million m^3/day. The service population of Yangon City has been estimated at 6.8 million and the daily maximum water consumption is calculated at 2.5 million m^3/day. The supply water volume in 2040 will increase by approximately 3.5 times of 2011.
- It is predicted that standard level of living will go up drastically by 2040. In this regard, the domestic water consumption per capita will be around 173 L/day in Greater Yangon and 180 L/day in Yangon City which shows an increase of approximately 1.84 times from the 94 L/day in 2011.
- New reservoirs and rivers are planned to be tapped for the needed new water sources. Examples of these sources are the Ngamoyeik Reservoir, Kokkowa River, Gwadanshe Intake (Hlaing River) and the Toe River.
- Several new water treatment plants (WTPs) are planned with a capacity of 120,000 m^3/day to 1.2 million m^3/day. This is in accordance with the current water resource conditions and the existing WTPs that should be rehabilitated. It is also important to consider supplying sufficient water to Thilawa SEZ.

5.5.2 Development Policy

(1) Necessity of Development Policy for Water Supply

The Greater Yangon is one the most important cities in Myanmar as well as in the ASEAN countries. However, the situation of infrastructure on water supply does not catch up with the level of other international cities. Indicators such as coverage of water supply, water meter installation ratio, service levels of water quality and pressure, billing and collection of water tariff and overall water works management are not favorable and needs improvement.

Modernization of the city's water supply was generally delayed and sometimes unattended due to the prolonged economic sanctions on Myanmar. In its due course, there was no clear and decisive discussion from Japan to support Myanmar in driving forward the development of water supply in Greater Yangon to such a level as an international city.

Sector Vision	**Provision of Potable Water to more Citizens with Appropriate Volume, Pressure and Price, and Realization of Sustainable Management**
Basic Policy	1) Water supply facilities should be planned and implemented systematically. 2) Water supply coverage should be increased gradually. 3) Proper distribution zones must be established. An equitable basis distribution system must be accomplished according to appropriate management. 4) Achieve effective water supply system by control of non-revenue water (NRW). 5) Potable water should be supplied. 6) To cultivate both human resources and institution/organization in order to establish effective water supply system.

(2) Viewpoints for Basic Policy

Construction of water supply facilities needs a large sum of cost and takes a long term to plan. After the facilities are completed, O&M shall need human resource, technology, costs for electricity and chemical inputs. Therefore, water supply facilities should be planned systematically over a long term. YCDC has to implement the plan continuously in regards with the annual budget of Yangon City. The increase of potable water coverage will go up each year depending on the annual budget and extent of implementation.

The level of water tariff is one of the most important matters for the citizens in any country. The water tariff tends to be set lower than the cost of production in developing countries in consideration of its affordability to poor people. If all citizens in Greater Yangon are to be charged on equitable water tariff on metered consumption rate and they pay accordingly every month, YCDC can improve the billing and collecting system to increase the revenue by a greater margin. YCDC can drive forward to establish appropriate O&M and develop water supply service to citizens. However, YCDC has much NRW which causes losses for the management of YCDC. If NRW can be effectively managed and reduced by a greater margin in the near future, YCDC can be more sustainable financially. YCDC has the responsibility to provide potable water to its citizens continuously and sustainably.

With gradual removal of economic sanctions, YCDC should start the improvement of institutions, development of human resources and strengthening of organizations which will be the bases for the establishment of an effective water supply system management.

5.5.3 Development Goals and Target Effect Indicators

(1) Development Goals

The development goal is that all citizens in Greater Yangon shall have access to potable water anywhere, 24-hours a day and seven days a week. The development should be carried out gradually until 100% service ratio is achieved. The target year of this development plan is 2040.

(2) Target Effect Indicators

Target effect indicators must be considered from past water consumption records in Yangon City and other suburban towns. The indicators should also be predicted in comparison with other big cities in Southeast Asia.

For the purpose of evaluation of future water supply development and to confirm its outcomes, the following development goals and effect indicators were prepared:

Table 5.5.1: Development Goals and Effect Indicators (Water Supply)

Development Goal	Effect Indicators
a) Water service population	Greater Yangon: 8.1 million Yangon city: 6.8 million
b) Piped water coverage	Yangon City:80% (38% in 2011) Greater Yangon: 69% (35% in 2011)
c) Daily maximum supply water	Greater Yangon: 2.9 million m^3/day Yangon City: 2.5 million m^3/day
d) Non-revenue water	15% of produced water (67% in 2011)
e) Facility utility factor	More than 80 %
f) 24-hour service	100% of total service population
g) Chlorinated supply water	100% of total service population
h) Water quality	Compliance ratio: 100% of the WHO guidelines

Source: JICA Study Team (The Strategic Urban Development Plan of the Greater Yangon)

The water supply situation of some Southeast Asian cities is shown in Table 5.5.2.

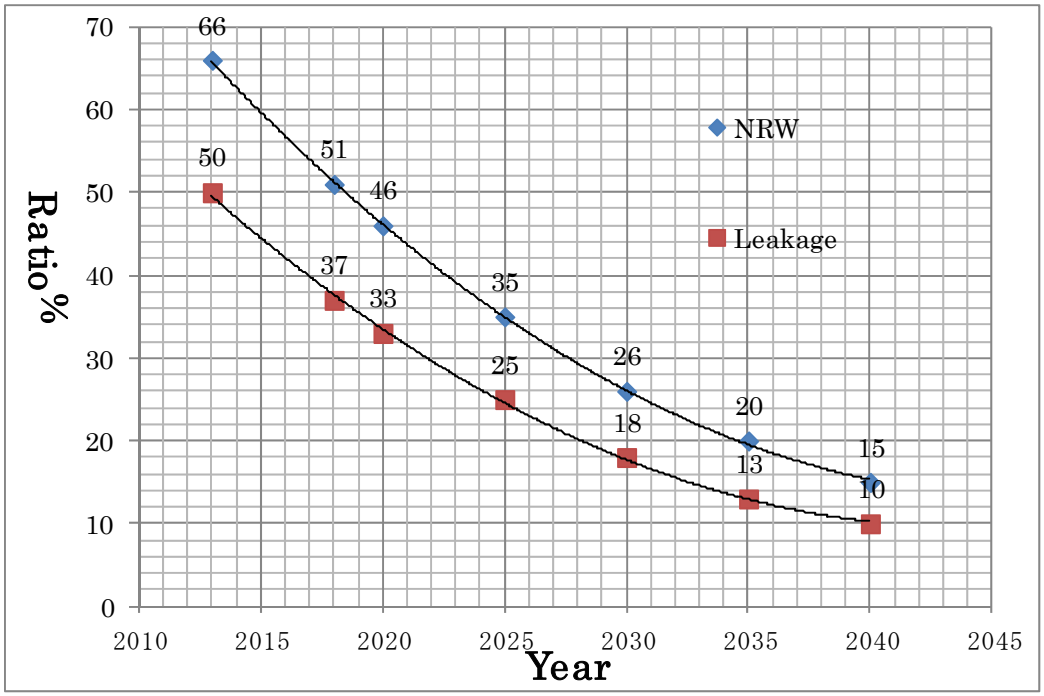
Table 5.5.2: Water Supply Situation in Southeast Asian Countries

Items	Yangon In Myanmar	Ho-chi-minh In Vietnam	Johor in Malaysia	Cebu in Philippine
Population (million)	5.7	5.7	3.1	1.6
Water Coverage (%)	44	72.3	100	55.1
Service Hours (hrs)	18	24	24	20
Per Capita (lpcd)	100	113	191	98
Produced Water (m^3/p/day)	0.258	0.263	0.445	0.217
NRW (%)	70	42.8	37.4	27.4
Staff (p/1000connection)	7.05	5.3	2.1	8.0

Source: ADB (except Yangon)

- The ratio of piped water coverage to the total population in Yangon City (population of 8.5 million) is set at 73%, which is 60% of the total population of Greater Yangon (population of 11.7 million) in 2040.
- Rate of NRW will be reduced to 15 % in 2040 from 63% in 2011.
- Ratio of 24-hour service population should be 100% to the total service population in 2040.
- Supplied water chlorinated should be 100% of the total service population.
- Compliance ratio on water quality according to WHO guidelines should be 100% of the total service population.

The projected reduction in NRW of Yangon City is shown in Figure 5.5.7.



Source: JICA Study (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

Figure 5.5.7: Estimated NRW Components

5.5.4 Preliminary Development Plan

(1) Preliminary Development Plan

1) Development of Water Resources and Build-up of WTP Capacity

- Utilization of cheaper water resources from existing reservoirs and transfer of water using river sources.
- Construction of new WTPs using surface water resources such as reservoirs and rivers.
- Establishment of the system using water resources from both reservoirs and rivers effectively.

2) Establishment of Effective Transmission and Distribution System

- Build-up of capacity of transmission and distribution as the result of water improvement
- Control of water volume by establishing stratified transmission and distribution system
- Introduction of the SCADA system and putting it into practice for water transmission and water distribution
- Enhancement of the technology of operation and maintenance of pipeline facilities

3) Reduction of NRW and Improvement of Billing and Collecting System

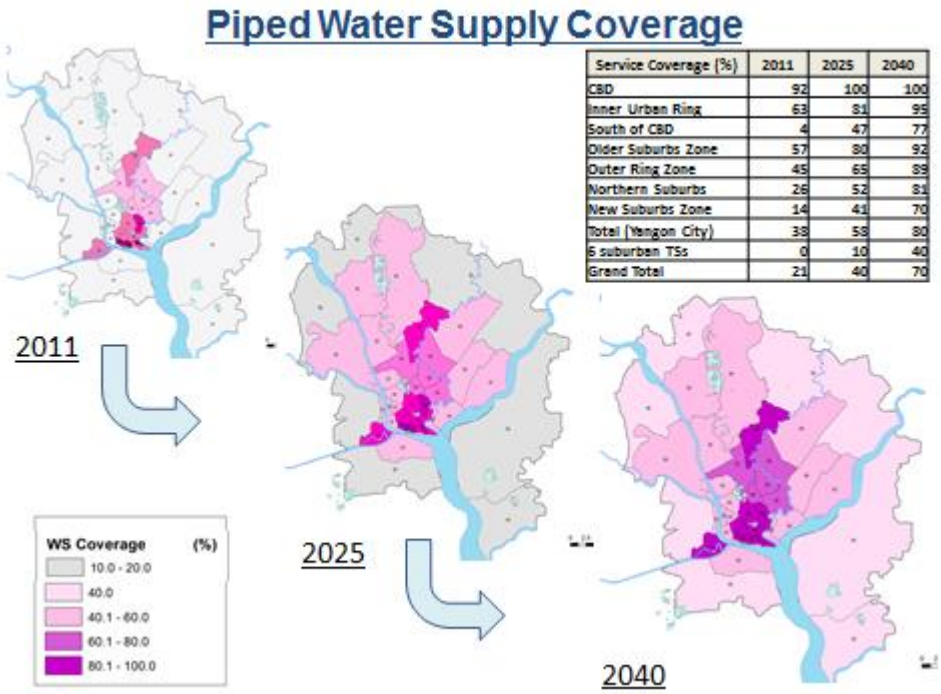
- Replacement/rehabilitation of old distribution pipes in order to reduce water leakage
- Reduction of NRW as a result of putting the DMA method into practice
- Charging of appropriate water tariff to customers after installation of 100% water meter. Water meters must be maintained well by YCDC.
- Capacity buildup regarding billing and collecting water tariff and increase service revenue as a result of improvement
- Connection of service pipes to customers using proper fixing techniques.

4) Capacity Buildup of Water Quality Management

- Implementation of the water quality management plan
- Improvement of existing water treatment process and extension of facilities in order to get quality treated water
- Capacity buildup of operation and maintenance of WTPs

(2) Infrastructure Layout

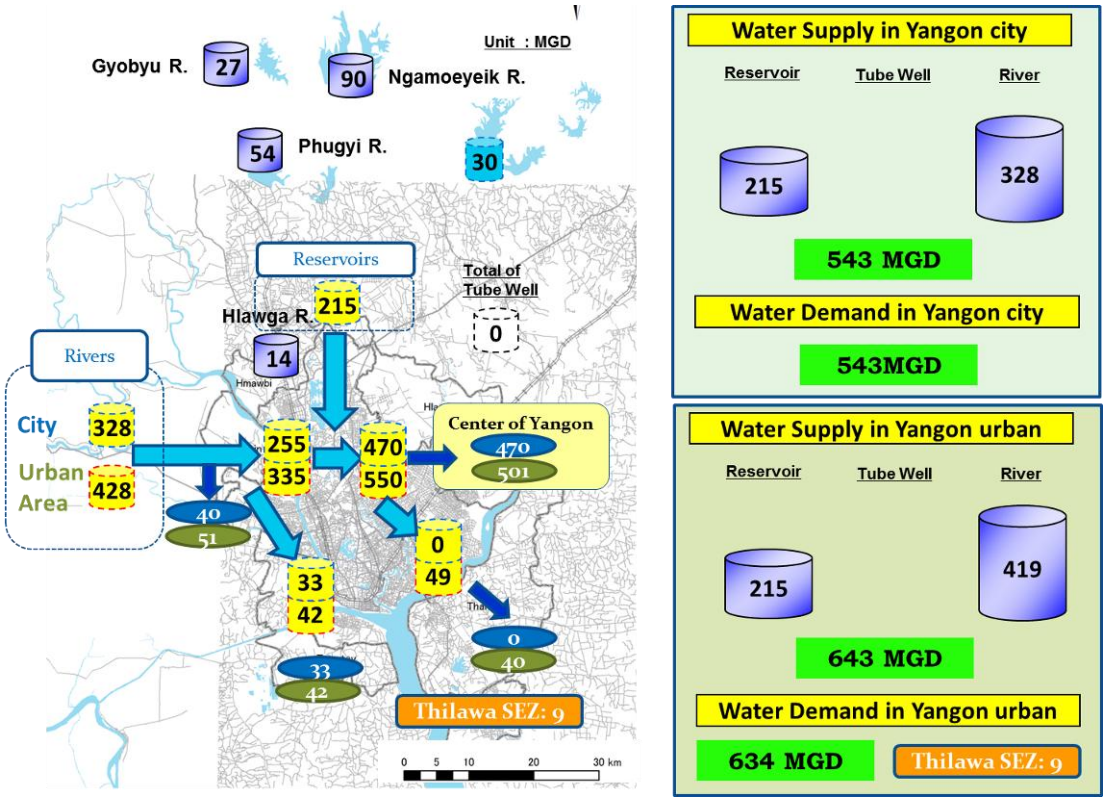
Piped water supply coverage is shown in Figure 5.5.8.



Source: JICA Study (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

Figure 5.5.8: Piped Water Supply Coverage

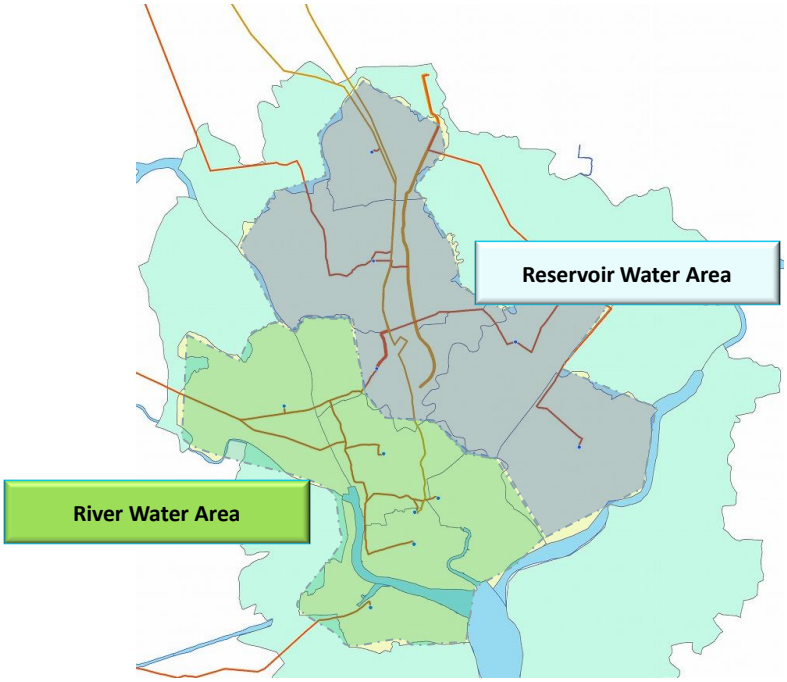
Water sources allocation and balance plan are shown in Figure 5.5.9.



Source: JICA Study (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

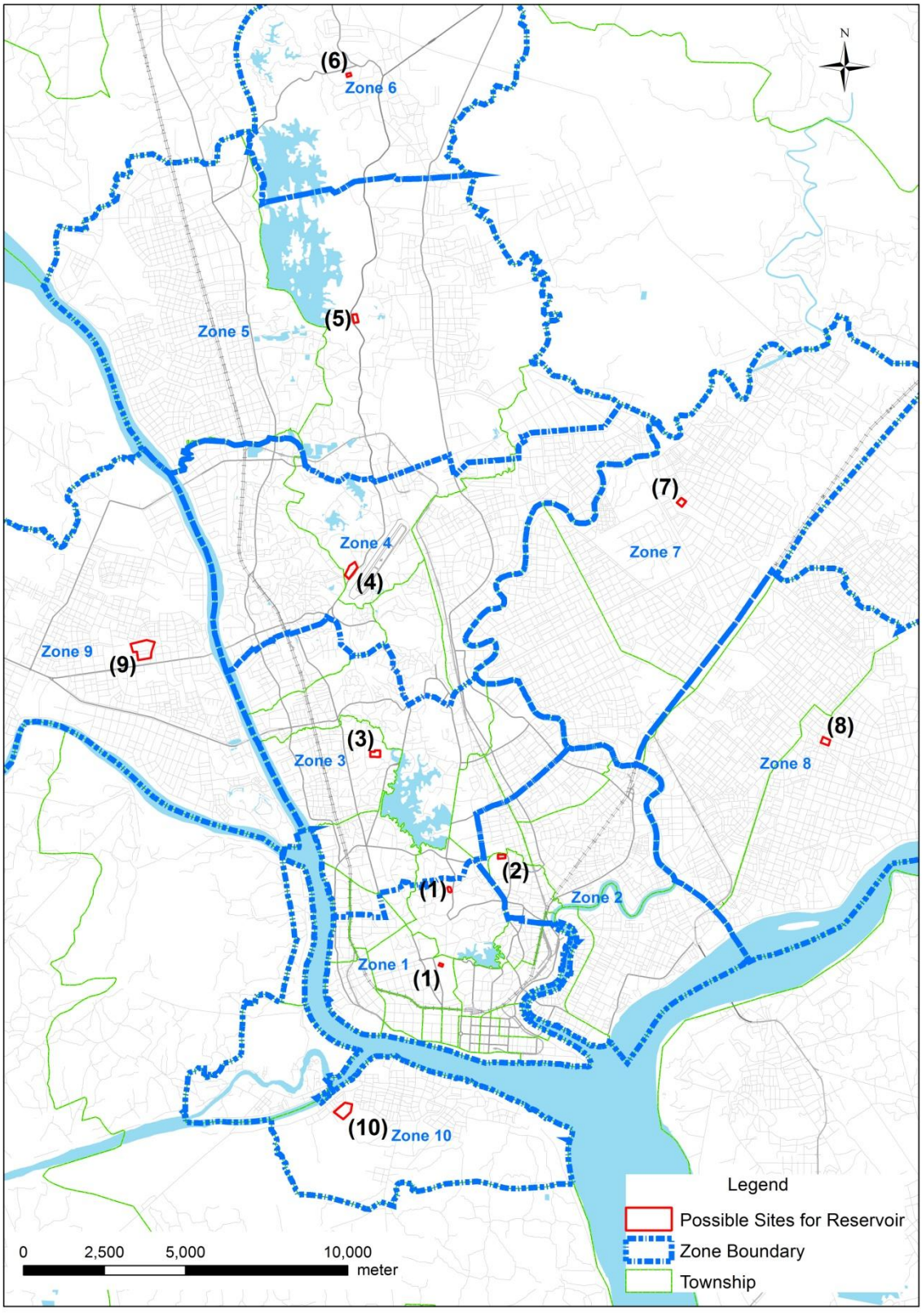
Figure 5.5.9: Water Sources Allocation Plan and Balance Plan in 2040

Reservoir water demand area and river water demand area are shown in Figure 5.5.10. Water distribution zoning and reservoirs plan of 2040 is shown in Figure 5.5.11.



Source: JICA Study (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

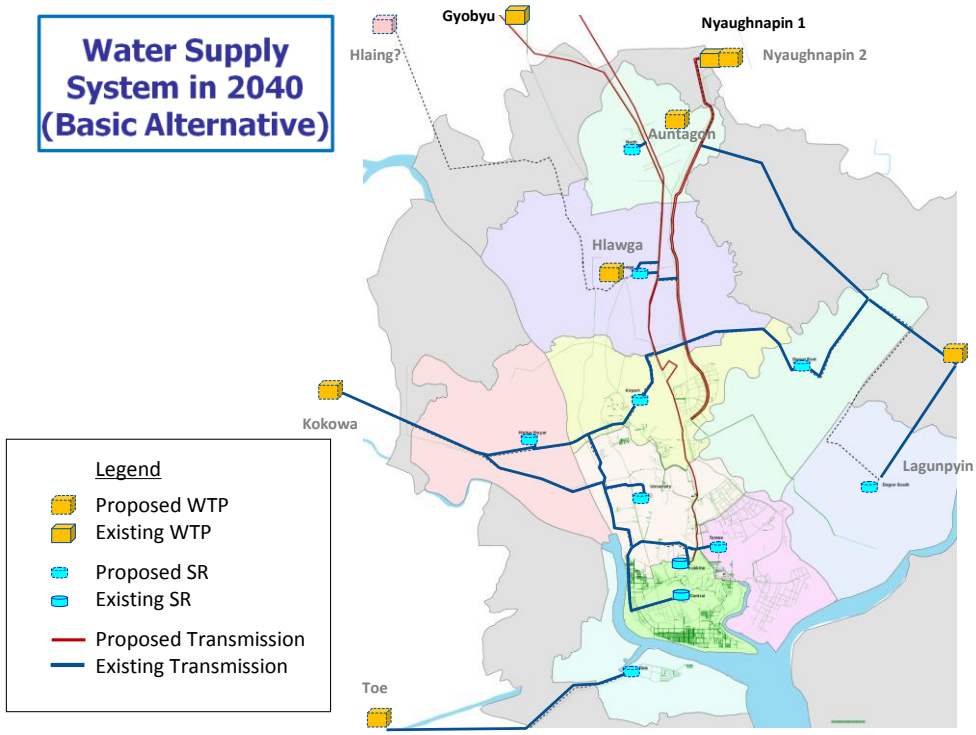
Figure 5.5.10: Water Source and Demand Area in 2040



Source: JICA Study (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

Figure 5.5.11: Water Distribution Zoning and Reservoirs Plan in 2040

The water supply system and proposed WTPs in 2040 are shown in Figure 5.5.12. This figure shows six new WTPs being proposed.



Source: JICA Study (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

Figure 5.5.12: Water Supply System and Proposed WTPs in 2040

The basic principles for the short-, middle- and long-term development plans are tabulated in Table 5.5.3. Following these principles and necessary time for designing, tendering procedures and construction, the implementation schedule is illustrated in Table 5.5.4.

- Development of water resource and buildup of WTP capacity
- Establishment of effective transmission and distribution system
- Reduction of NRW and improvement of billing and collecting system
- Capacity buildup of water quality management

Urgent replacement of old pipelines is required to reduce NRW.

However, this project will cost a huge amount and it will take a long term to finish its construction works, depending on the annual budget and implementing ability of YCDC. The useful life of distribution pipes is around 25 to 40 years and the replacement work shall go after pipeline sections that are older. This project will be urgent and continuous.

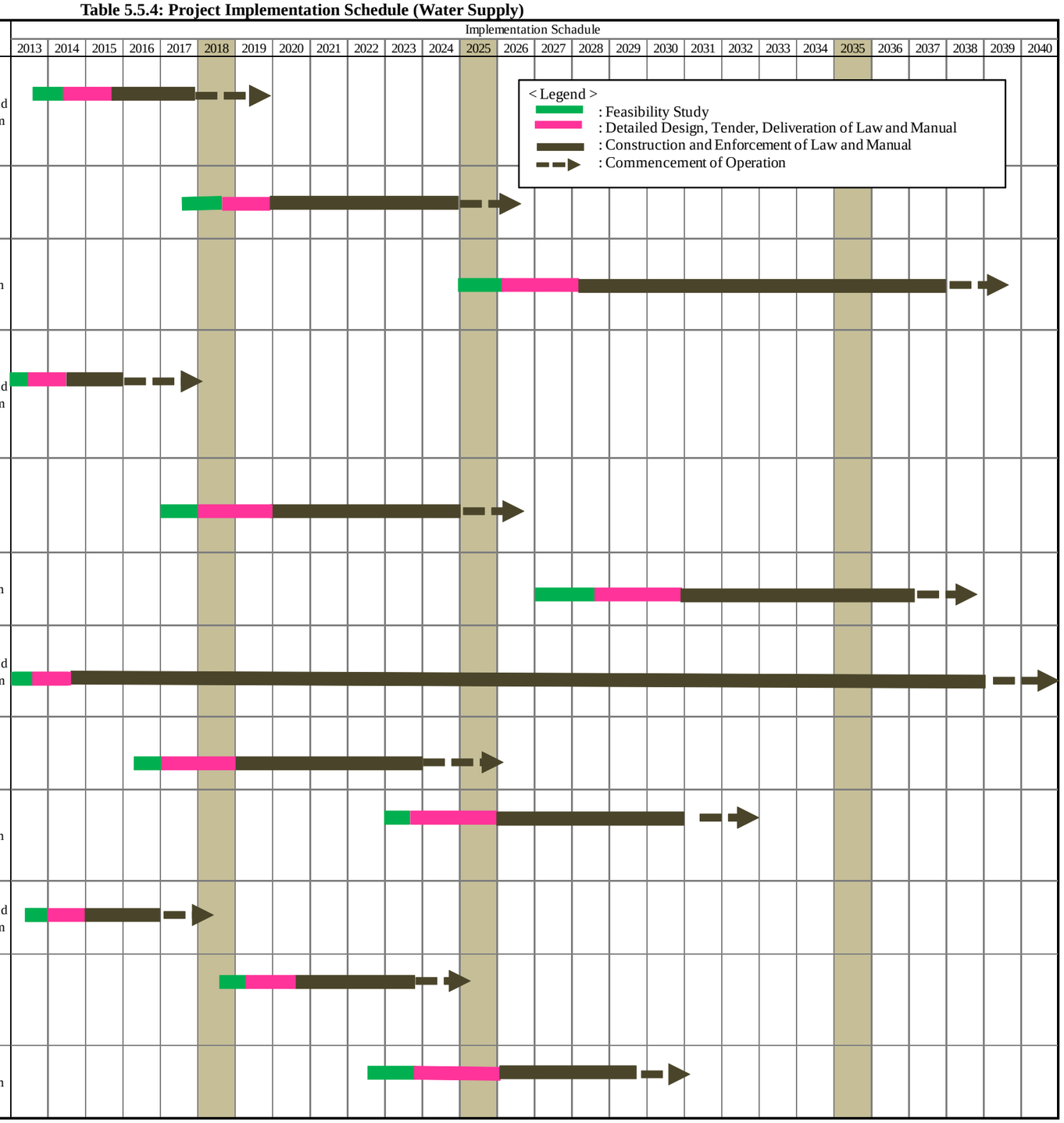
Table 5.5.3: Basic Principles for a Time Wise Development

Basic principle time-wise development	Period	Item	Coverage of potable water (the Greater Yangon) (present→target)		Water resource and capacity of WTP		Effective transmission and distribution system (Present→Target)		NRW and billing/collecting of water tariff (Present→Target)		Management of wsater quality (Present→Target)	
	Short term (~2015)	Target	・Coverage pop. ・Ratio ・Unit ・Water demand	・1.93→2.74 million ・35→41% ・94→117LPCD ・142→180MGD	Total water resource (MGD)	・Reservoir : 195 ・Ground water : 20 ・River : 0	・Defective water service area	・100→90%	・Leakage ratio ・NRW	・Estimated 50→44% ・Estimated 67→60%	Coverage of potable water	・Turbidity : 50→100% ・Residual chlorine : 50→100%
		Strategy	・Increasing served population in existing supply area		(1)Utilization of cheaper water from existing reservoir		(1) Refurbishment of transmission and distribution system and buildup		(1)Replacement and rehabilitation of aged pipe (3)Approprate water tariff and 100% meter installation and maintenance (5)Installation of service pipe with proper fixing technique		(1)Buildup of capacity of water quality control (3)Buildup of capacity of O&M for WTP	
		Infrastructure			(1) (2) Using reservoir and construction of WTP	・Improvement of existing WTP ・Conduction popeline ・New WTP for reservoirs ・Transmission pipeline	(1) Buildup of transmission and distribution system	・Existing pump stations ・New transmission pipeline ・Existing reserviors	(1)Aged pipe (3)Water meter (5)Connecting service pipe	・Implementation of plan ・Procurement of meter ・Standerdization of connecting service pipe	(1)Buileup of capacity of water quality control	・Improvement of equipment of laboratory ・Making water quality standard
		Soft measures			(1)Utilization of reservoirs	・Assurance of water right from reservoirs			(3)Water tariff and meter maintenance	・Considering tariff and procurement of equipment of meter accracy	(1)Capacity of water quality control (3)Enhancement of O&M	・Making plan and training ・Water treatment process ・Making procurement manual of chemicals ・Making manual for O&M
		System, Organization					Development of legal system about the water act		・Improvement of water act ・NRW team		Improvement of water act Laboratory for water quality Training center for YCDC	
	Middle term (~2025)	Target	・Coverage pop. ・Ratio ・Unit ・Water demand	・2.74→3.92 million ・41→49% ・117→133LPCD ・196→278MGD	Total water resource (MGD)	・Reservoir : 195→250 ・Ground water : 20 ・River : 0	・Defective water service area	・90→75%	・Leakage ratio ・NRW	・Estimated 44→25% ・Estimated 60→35%	Coverage of potable water	・Turbidity : 100% ・Residual chlorine : 100%
		Strategy	・Increasing served population in existing supply area ・Development of new service area		(1)Utilization of reservoir (lake water) and new resource from rivers (2) Construction of new WTP		(1) Refurbishment/buildup of transmission and distribution system (2) Restructuring and manageing by stratified pipeline system (3)Establishment of SCADA system (4)Buildup O&M of pipeline		(1)Replacement of aged pipeline (2)Lekage and NRW controled by DMA method (3)Water Tariff and water meter instalation and maintenance (4)Buildup of finance and increasing revenue (5)increasing sevice pipe connection		(1)Buildup of capacity of water quality control (2)Improvement of existing WTP process and extension (3)Buildup of capacity of O&M for WTP	
		Infrastructure			(1) (2)Utilization of reservoir and construction of WTP	・Conduction pipeline ・New WTP from reservoirs ・Transmission pipeline	(1) Refurbishment and buildup of system	・Existing pump stations ・New transmission ・New reservoirs	(1)Aged pipe	・Implementation of plan	(1)Capacity of water quality control	・Improvement of equipment of laboratory
							(2)Restructuring and stratifying	・Separated distribution ・Zoning distribution area ・Put DMA in practice	(2)Leakage and NRW	・DMA and SCADA system ・Replacement of service pipe ・Procure equipment for leakage detective	(2)Improvement of existing WTP process and extension	・Improvement of Gyobyu WTP ・Improvement of Nyaunghnapin WTP ・Making training manual and implementation
					(1) (2)Utilization of rivers and new WTP	・Intake and conduction pipeline ・New WTP from rivers ・Transmission pipeline	(3)New management system	・Introduction of SCADA ・Making Water Center	(5) Connecting service pipe	・Connecting service pipe		
		Soft measures			(3)Utilization of river water ・Assurance of water right from river		(3)Development of new system	・Putting in practice of SCADA system	(2)Leakage and NRW controled by DMA	・Planning of NRW ・NRW detactive team ・Reduction of apparent loss ・Controling leakage	(1)Capacity of water quality control	・Revision of manual
							(4)Capacity buildup of O&M regarding pipeline	・Procurement of equipment for O&M of pipe ・Making management plan of pipeline ・Setting up design criteria	(3)Water Tariff and 100% water meter	・Setting up water tariff and enforcement	(3)Buildup of capacity of O&M	・Training of water analysis ・Training of WTP process ・Making purocurement manual of chamicals ・Recision manual of O&M for WTP
									(4)Buildup of finance and increasing revenue	・Improvement of system		
									(5)Service pipe connection	・Standardization and rationalization		
		System, Organization					Development of legal system about the water act		・Development of water act ・Enactment of water meter ・Institutionalization of service pipe connection ・Institutionalization of water tariff		Improvement of water act Improvement of water quality standard	
	Long term (~2040	Target	・Coverage pop. ・Ratio ・Unit ・Water demand	・3.92→8.10 million ・49→70% ・133→173 LPCD ・278→558MGD	Total water resource (MGD)	・Reservoir : 250 ・Ground water : 0 ・River : 350	・Defective water service area	・75→0%	・Leakage ・NRW	・Estimated 25→10% ・Estimated 35→15%	Coverage of potable water	・Turbidity : 100% ・Residual chlorine : 100%
		Strategy	・Increasing served population in existing supply area ・Development new service area		(1)Transfering water resource to river water (3)Effevtive management of surface resources by SCADA system		(2) Restructuring and manageing by stratified pipeline system (3) Establishment of SCADA system		(1)Replacement of aged pipeline (2)Lekage and NRW controled by DMA method (3)Water Tariff and water meter instalation and maintenance		(1) Buildup of capacity of water quality control (2) Improvement of existing WTP process and extension (3)Buildup of capacity of O&M for WTP	
		Infrastructure			(1)Utilization of rivers	・Intake and conduction pipe ・New WTPs from river water ・Transmission pipeline	(2) Restructuring and managing by stratified transmission and distribution system	・Progress and extension of restructuring and stratifing ・Put DMA in practice	(1)Aged pipeline	・Inplementation of plan		
					(3)Effective management by SCADA system	・Introduction of SCADA system for integrated management			(2)Leakage and NRW controled by DMA	・Putting in practice of DMA and SCADA system ・Equipment for leakage detective		
		Soft measures			(1)Utilization of river water	・Assurance of water right for rivers	(3) Development of new system for transmission and distribution	・Put SCADA system and DMA method in practice in Greater Yangon	(2)Leakage and NRW controled	・Leakage control ・Reduction of apparent loss	(1)Capacity of water quality control	・Application to nation wide in Myanmar
					(3)Effective management	・Integrated effective management and put into practice			(3)Water tariff and water meter installation and maintenance	・Setting up water tariff and enforcement	(2)Exixting process and extension	・Cultivation to nation wide in Myanmar
											(3)Capacity of O&M for WTP	・Application to naton wide in Myanmar
		System, Organization										

Source: JICA Study Team

Table 5.5.4: Project Implementation Schedule (Water Supply)

Project Name		Status	Implementation Schadule
Development of Water Resource and Builedup of WTP Capacity	(1) Improvement/extension of existing WTP(Gyobyu) (2) Construction of conducting and transmission pipes (3) Installation of WTP (Lagunpyin) for reservoirs	Urgent and Short-term	
	(1) Construction of WTP (Aungtagon) for reservoirs (2) Construction of WTP (Kokowa) for rivers (3) Installation of conducting and transmission pipe	Middle-term	
	(1) Utilization of water from reservoirs and rivers and construction of WTPs (Toe, Hlaing) (2) Integrated O&M of WTPs by SCADA system	Long-term	
Establishment of Effective Transmission and Distribution System	(1) Improvement of existing pumping stations (Naunghnapin, Lawga) and refurbishmeent of pipeline (2)Installation of new transmission and distribution pipes (3) Replacement of existing reservoirs (Central, Kokine) and installation of new reservoirs	Urgent and Short-term	
	(1) Refurbishment and buildup of pipe facilities (2) Introduction of SCADA system and put in practice (3) Zoning and stratifying pipe system (4) Improvement of O&M for pipeline	Middle-term	
	(1) Progress of stratifying transmission and distribution system (2) Putting SCADA and DMA in practice	Long-term	
Reduction of NRW and Improvement of Capacity of Billing and Collecting System	(1) Replacement of aged pipes (2) Inprovement of water tariff and installation of 100% water meter to customers (3) Connecting service pipe and standardization	Urgent and Short-term	
	(1) NRW is reduced by SCADA system and DMA method (2) Progress of connecting service pipe	Middle-term	
	(1) Progress of reduction of NRW and improvement of revenue system (2) Improvement by SCADA system and DMA method	Long-term	
Improving Water Quality Control	(1) Making and implementation of water quality management plan (2) Improvement of laboratory (3) Making O&M manual	Urgent and Short-term	
	(1) Buildup of water quality analysis (2) Improvement of existing WTP process and extension (3) Applying and revising O&M manual	Middle-term	
	(1) Making water quality analysis act and spread to nation wide (2) Spread of education/training to nation wide	Long-term	



Source: JICA Study Team

(4) Priority Project

The JICA Study Team on the "Improvement of Water Supply, Sewerage and Drainage System in Yangon City", YCDC and the Master Plan Study Team have been discussing to select two urgent projects and two short-term projects.

1) Urgent Projects

1) Renewal of Pump Station of Nyaunghnapin WTP

- Construction works: Replacement of all pump facilities, improvement of water hammer prevention, refurbishing of pump house and installation of monitoring equipment.
- Selection basis: The Nyaunghnapin WTP is the most important facility because it supports the water supply of nine townships and the Yegu pumping station. YCDC does not have any alternative facility. Damage to pumps happen because of the occurrence of water hammer from frequent power failure and disruption of water supply from several repair works.

2) Renewal *of Distribution Pipeline in the Town of Yankin*

- Construction works: Replacement of distribution pipeline between the Kokkin reservoir to the Yegu pumping station, CIP 42, and the establishment of DMA and LMB
- Selection basis: Improvement of the main pipeline which has aged and caused many water leakages. Also, the improvement of the trunk/main distribution pipe network in order to establish DMA and LMB.

2) Short Term Project

1*) Construction of Kokkowa WTP and transfer/distribution pipeline*

- Construction works: Intake pump facilities from Kokkowa river and conduct pileline, New WTP(75MGD), Transfer/distribution pipeline
- Selection basis: To meet increasing water demand. The first WTP which has river water in Greater Yangon

2*) Construction of Lagunpyin WTP and transfer/distribution pipeline*

- Construction: New WTP(40MGD) of which water resources is Lagunpyin reservoir. Transfer/distribution pipeline(19km)
- Selection basis: To meet increasing water demand. It is the nearist water resouece from Thilawa SEZ and support improving Thilawa SEZ.

3*) Renewal of distribution pipe network of Zone 1*

- Construction: Renewal of distribution pipe network (556km), Rehabilitation of existing reservoirs(2), Installation of DMA(30), Installation of distribution pumps for higher area
- Selection basis: To work out stable water supply, To reduce NRW and to increase supply water

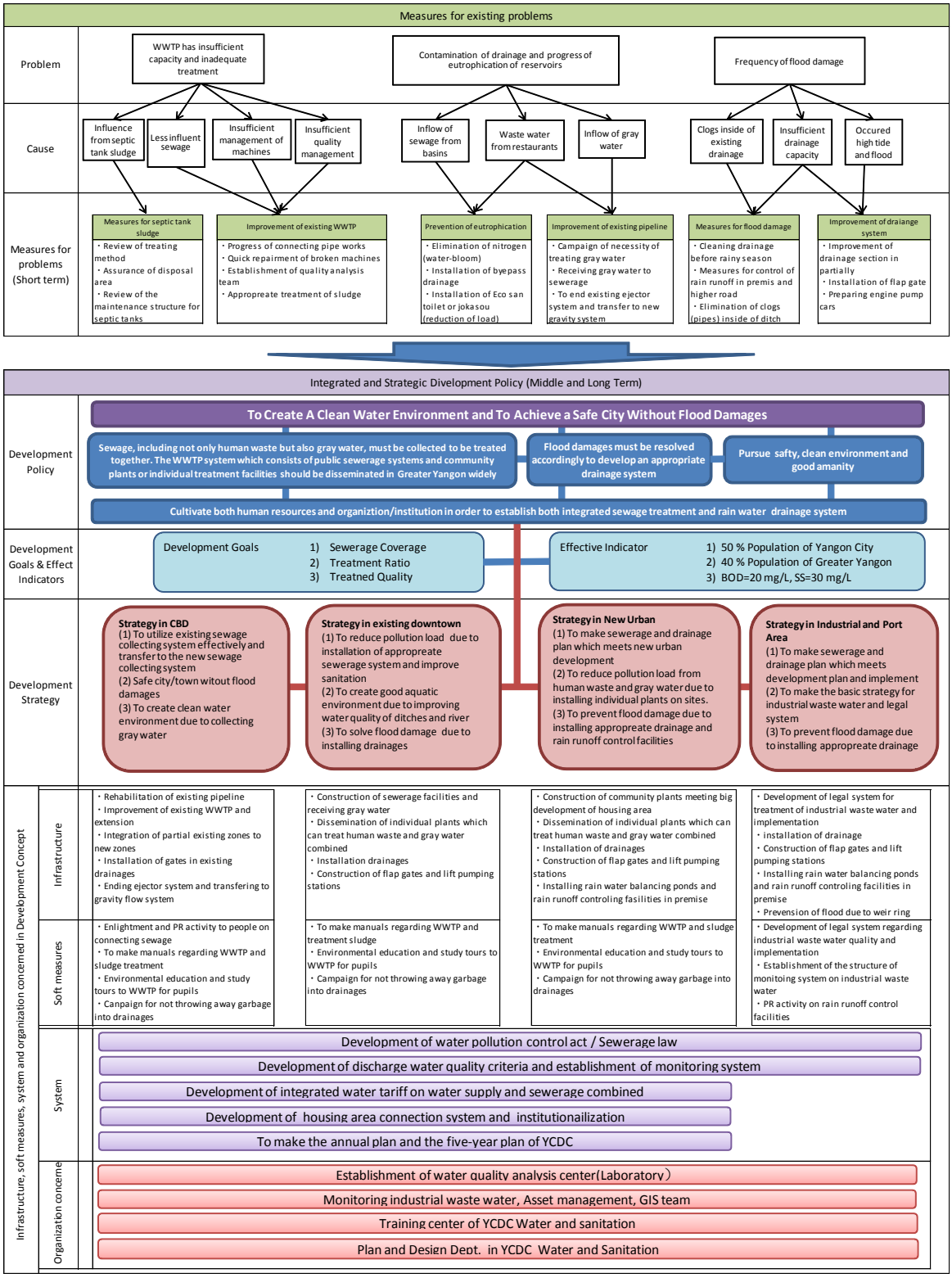
4) Installation of disinfect facilities

- Construction: Installation of disinfection facilities, such as Gyobyu WTP(27GPD), Naunghnapin WTP(90MGD), Hlawaga pumping station(68MGD)
- Selection basis: To supply safe and potable water.

The priority projects are shown in the project sheets in Chapter 6.3.

5.6 Sewerage and Drainage

The proposed infrastructure development concept for the sewerage and drainage sectors is summarized as shown in Figure 5.6.1 below. Appendix 1.3 (two sheets of A3 size) is an enlarged figure of Figure 5.6.1.



Source: JICA Study Team

Figure 5.6.1: Infrastructure Development Concept

5.6.1 Demand Analysis

(1) Basic Concept of Demand Analysis

1) Sewerage

When the sewerage and drainage development plan of the Greater Yangon is considered, it is important to follow the development plan of the JICA Study entitled "The Improvement of Water Supply, Sewerage and Drainage System in Yangon City". Population allocation should follow the urban master plan and structure plans of this study. The sewage network design is dependent on the water supply demand mentioned in the previous section. The wastewater treatment plant (WWTP) must also meet the water supply vision.

Wastewater generation should include consumed water volume and infiltration.

2) Drainage

Return period is five years.

(2) Demand Analysis

1) Sewerage

- Public sewerage system in the Greater Yangon up to 2040 should be applied to the highly urbanized CBD area where the population density is more than 100 people/ha. Community plants or individual treatment facilities should be applied to six suburban townships outside of the sewerage area
- It is estimated that 2.72 million m^3/day of wastewater shall be generated in Yangon City, 3.14 million m^3/day in Greater Yangon by 2040. The 1.53 million m^3/day wastewater will be treated by WWTPs including the existing WWTP.
- Service population is estimated to be 4.21 million in 2040, this accounts for around 49 % of the total population (8.52 million) in Yangon City.
- Six WWTPs with capacities ranging from 70,000 m^3/day to 720,000 m^3/day should be constructed.

2) Drainage

- The drainage master plan covers 22 main drains, as well as the drains in the CBD area. The improvement of drains and provision of gates and pumps will be recommended based on the storm water runoff analysis. For the remaining area, recommendations will be made for countermeasures against flooding.

5.6.2 Development Policy

(1) Necessity of Development for Sewerage and Drainage

According to the questionnaire survey, citizens in Greater Yangon seek a healthy and sanitary environment, with the decrease of water-borne infectious diseases. They also hope to resolve flood damages in low lying areas. An environmental conservation plan should be accomplished to create water amenity space for rivers, lakes and marshes.

YCDC has to improve and extend appropriate sewerage systems and develop community plants or individual treatment facilities on-site for the proper collection and disposal of human waste and gray water in order to create a clean water environment.

Sector Vision	**To Create Clean Water Environment and To Achieve a Safe City Without Flood Damages**
Basic Policy	1) Sewage, including not only human waste but also gray water, must be collected to be treated together. The WWTP system which consists of public sewerage systems and community plants or individual treatment facilities should be disseminated in Greater Yangon widely. 2) Flood damages must be resolved accordingly to develop an appropriate drainage system. 3) Pursue safety, clean environment and good amenity. 4) Cultivate both human resources and organizations/institutions in order to establish both integrated sewage treatment system and rain water drainage system.

(2) Viewpoints for Development Policy

The existing sewerage system in the Greater Yangon treats only human waste. The system currently does not treat gray water which causes contamination in rivers, lakes and marshes. New sewerage systems can treat both human waste and gray water in order to create clean water environment amenity. The construction of sewerage facilities needs a long term and a large sum of cost. Thus, the installation should be implemented step by step in accordance with the appropriate construction plan.

Citizens in the Greater Yangon who live in low lying areas are always affected by flood damages because of insufficient drainage systems. Flood damages may cause water-borne diseases for people. As YCDC develop appropriate sewerage system and drainage system, proper amenities will ensure its citizens' safety.

YCDC has to improve the institutions and cultivate human resources and organizations that will be the bases for the establishment of effective sewerage and drainage systems.

5.6.3 Development Goals and Target Effect Indicators

(1) Development Goals

- The development goal is for all citizens living in the Greater Yangon to enjoy a safe and healthy life with access to a sewerage system. However, the development must progress gradually. The target year of this development plan is 2040.

(2) Target Effect Indicators

- For the purpose of evaluation for future sewerage and drainage development and to confirm its outcomes, the following development goals and effect indicators were prepared:

Table 5.6.1: Development Goals and Effect Indicators (Sewerage and Drainage)

Development Goal	Effect Indicators
a) Coverage of Sewerage	50% (4.3% 2011) of the total population of Yangon City
b) Service Ratio of Wastewater Treatment	Including sewerage and community plant and on-site system 40%
c) Water Reuse Ratio	6.0% of treated volume of sewage
d) Water Quality	Effluent from treatment plant BOD= 20 mg/L, SS= 30 mg/L
e) Solution of Flood Damage	There will be no flood damage in downtown and CBD area till 2040 Downtown includes 22 drainage districts in YCDC

Source: JICA Study Team

- The target sewerage coverage in Yangon City will be around 4.2 million, which is 50 % of the total 8.5 million population in 2040.
- The service ratio of wastewater treatment (including sewerage and on-site systems) is estimated at around 40%. In suburban towns including Thilawa SEZ, around 0.4 million population is predicted to receive wastewater treatment service. Therefore, about 5.6 million or 40% of the total population of Greater Yangon can receive wastewater treatment service.
- Water reuse ratio: The reused water volume is estimated to be around 75,000 m^3/day in 2040. This is about 6.0% of the total treated wastewater which is 1.25 million m^3/day.
- Effluent water quality from treatment facilities: It is considered that effluent quality shall be the same as in Japan, such as BOD=20mg/L and SS=30mg/L.

5.6.4 Preliminary Development Plan

(1) Preliminary Development Plan

1) Preliminary Development Plan in CBD

- Effective utilization of the existing infrastructure and smooth transfer to the new sewerage collection system. The existing sewerage collection system which uses compressors and ejectors should be replaced as its useful life has already expired. Basic gravity flow system will be applied for collecting sewage.
- A safe city/town without flood damage
- Creation of a clean water environment as the result of the collection of gray water into the sewerage system.

2) Preliminary Plan in the Existing Downtown

- Reduction of pollution load caused by gray water due to the installation of appropriate sewerage system and improved sanitation.
- Creation of a good aquatic environment as the result of improved water quality of drainages, rivers and lakes. Sewage is collected by a separate system without rain water in order to conserve the water environment.
- Prevention of flood damage as a result of the improvement of drainage system.

3) Response to New Urban Development

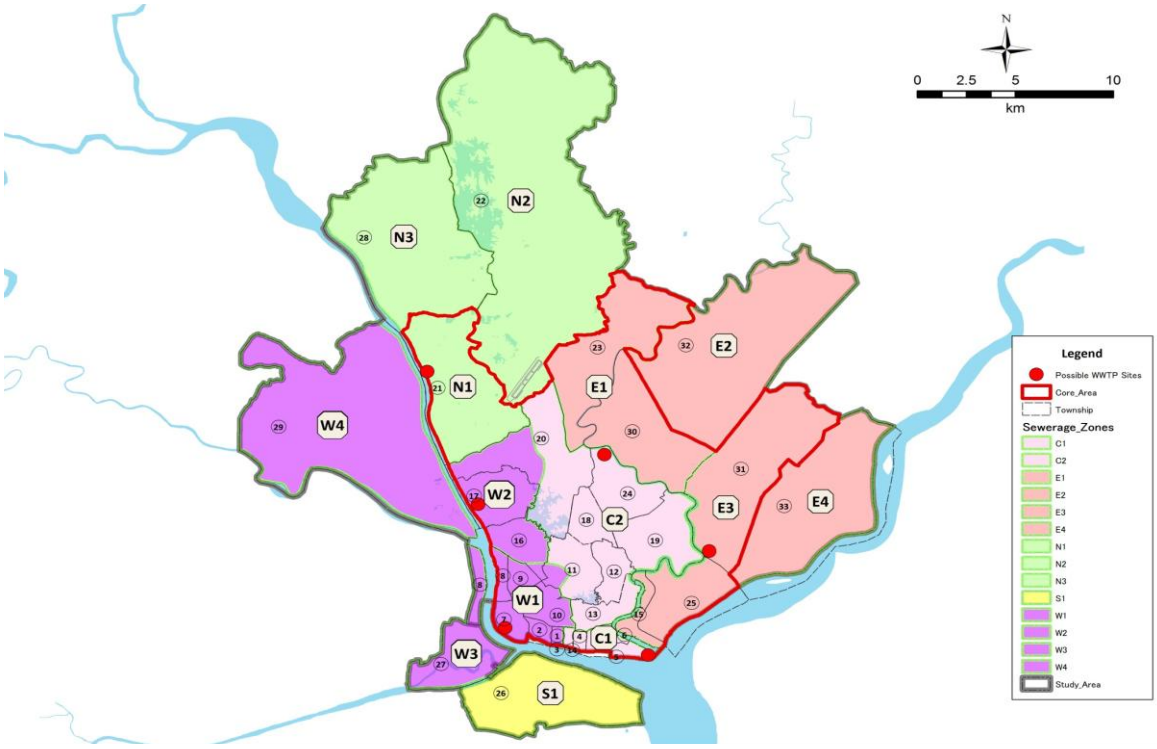
- Preparation of plans for wastewater treatment and drainage system in order to meet the plans for new urban development
- Reduction of the pollution load caused by human waste and gray water by installing individual treatment plants on site. The wastewater from suburban town areas that are out of the sewerage area should be treated by community plants or individual treatment facilities. It is better to regulate the treatment of wastewater under a new law.
- Prevention of flood damage by installing appropriate drainage and rain water runoff control facilities

4) Response to Industrial and Port Areas

- Preparation of sewerage and drainage treatment plans which meet the development plans and proper implementation of these plans.
- Formulation of the basic strategy for treating industrial wastewater and development/implementation of a legal system regarding this issue. Industrial wastewater should be treated using the private company's own treatment plant. It is best that this situation be regulated under a new law.
- Prevention of flood damage by installing appropriate drainage and rain runoff control facilities

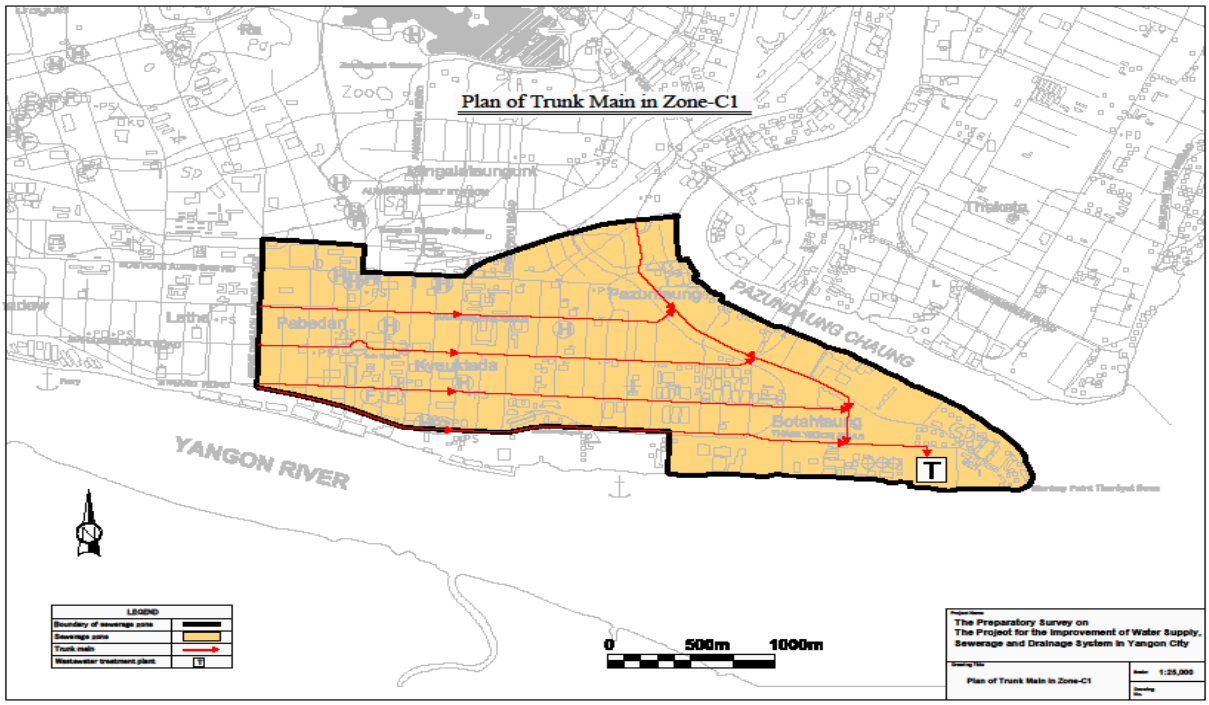
(2) Infrastructure layout

The plan for sewerage development in 2040 is shown in Figure 5.6.2. According to this plan, each sewerage zone shall have one WWTP, with a total of six WWTPs in Yangon. The layout plan for trunk main, sewerage zone C1 and W1 are shown in Figures 5.6.3 and 5.6.4.



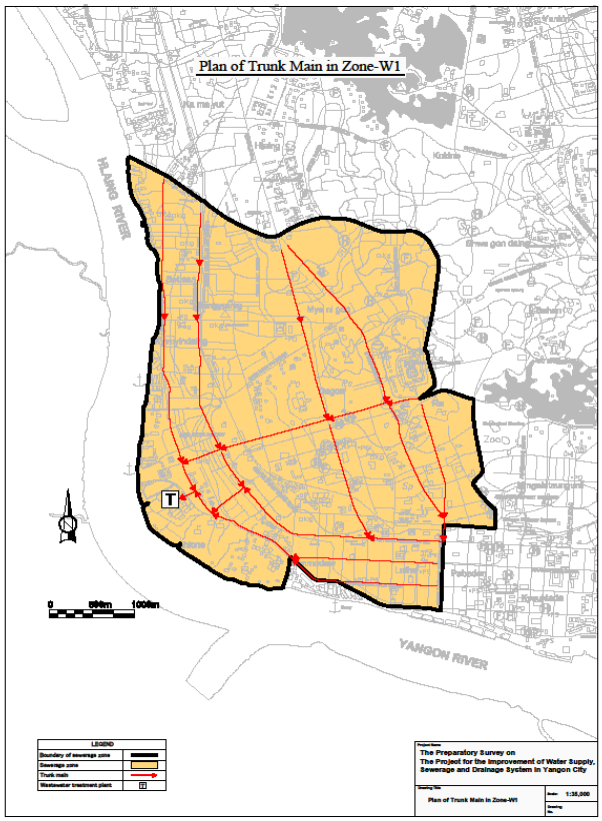
Source: JICA Study Team (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

Figure 5.6.2: Sewerage Plan in 2040



Source: JICA Study Team (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

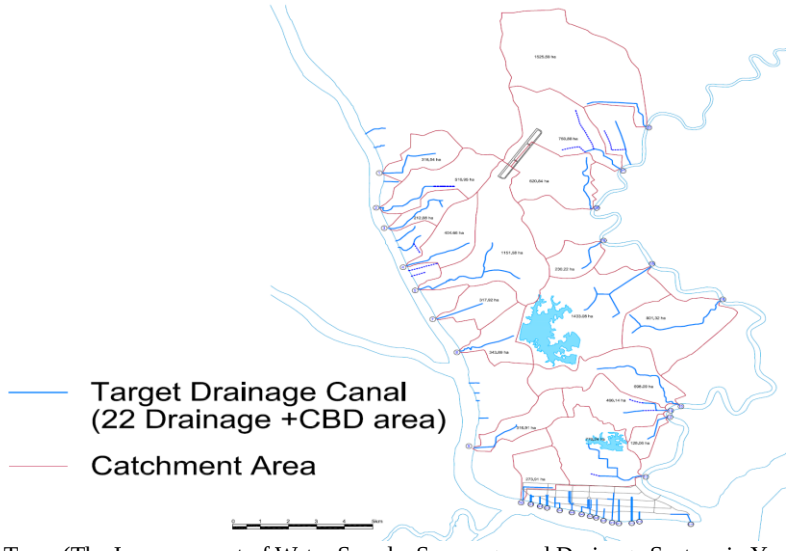
Figure 5.6.3: Layout Plan of the Main Trunk of Sewerage Zone C1



Source: JICA Study Team (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

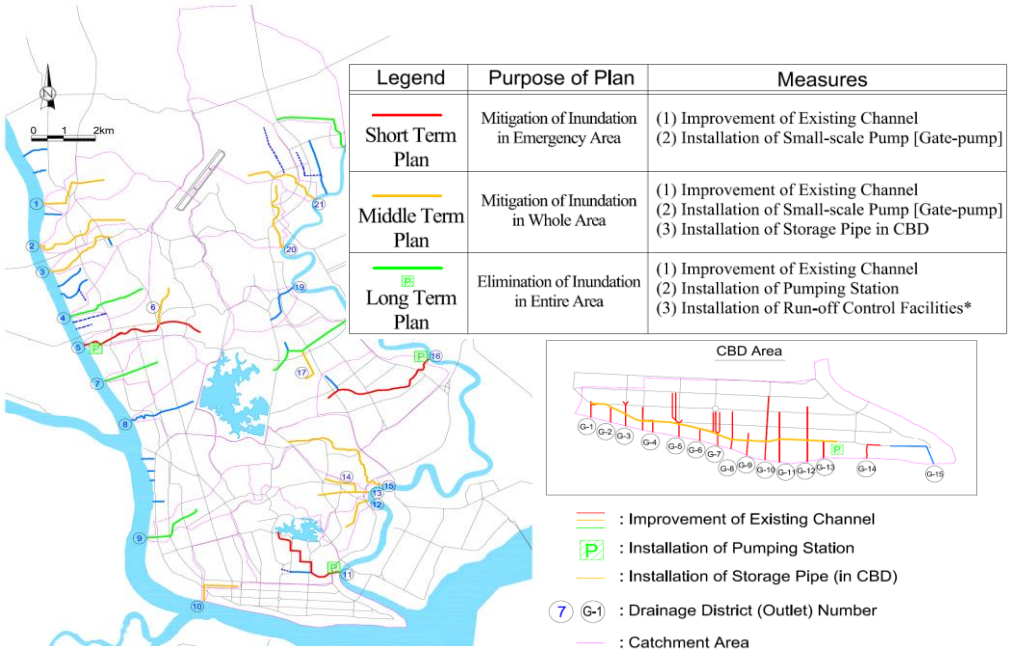
Figure 5.6.4: Layout Plan of the Main Trunk of Sewerage Zone W1

The target of the drainage plan is shown in Figure 5.6.5 and the improvement plan of drainage facilities is illustrated in Figure 5.6.6.



Source: JICA Study Team (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

Figure 5.6.5: Target of the Drainage Plan



Source: JICA Study Team (The Improvement of Water Supply, Sewerage and Drainage System in Yangon City), 2012

Figure 5.6.6: Improvement Plan of Drainage Facilities

(3) Implementation Schedule

The basic principles for the short-, middle- and long-term development plans are tabulated in Table 5.6.2. The following are the principles and corresponding time for designing, tendering procedures and construction listed in the implementation schedule shown in Table 5.6.3.

- Development of a sewer pipe network
- Development/extension of WWTP

- Development of a storm water drainage system

The development of institution/organizations and cultivation of human resource are vital to effective management of the system. It is very urgent to switch from the existing sewerage collection system to a new collection system that uses gravity flow. The useful life of the existing system that uses a compressor and ejector had already expired. However, construction works will be continued while keeping the safety of citizens that uses piped water and sewage. The construction works should progress depending on the YCDC budget and its ability for implementation.

Table 5.6.2: Basic Principles for Time Wise Development

Basic principle for time-wise development	Period	Basic Strategy	Development Target	Sewage Pipeline	WWTP	Drainage	System, organization and human resource
	Short term(～2015)	・To solve challenges YCDC is facing and transfer to new system smoothly ・To make master plan and action plan ・To establish organization and institution for middle and long term development ・Education and cutivation of human resource ・Improvement of existing sewerage coverage	・Effect Indicator: 20% of the goal ・Analysis: Treated water quality from exixting WWTP is improved. Sewerage coverage is increased. Thus water environment will be improved. ・Flood damages of CBD is reduced	・To receive gray water ・Rehabilitation/improvement of existing pipeline ・To end existing ejector system and transfer to new gravity system ・Progress of connecting pipe to customers	・Improvement/extension of existing WWTP ・Dissemination of individual treatment plants and establishment of O&M structure	・Development of drainage in flood damage zones ・Installation of tide barrior gates ,such as flap gates and gate pumps) ・Utilization of engine pump cars ・PR activities for development of rain runoff control facilities	・Development of water polution control act/ sewerage law ・Development of discharge criteria for industrial waste water ・Development of integrated water tariff on water supply and sewerage combined ・Development of organization/institution of Water and Sanitation Dept. ・Establishment of O&M structure
	Middle term (～2025)	・To construct WWTPs gradually for meeting for sewage in 2025 ・Improvement of coverage ratio of all townships in YCDC including existing sewerage area ・To create quality environment due to receive gray water ・To solve flood damages in downtown	・Effect Indicator: 60% of the goal ・Analysis: Water environmental improvement will progress much due to new WWTP and increasing connection. ・Flood damages will be reduced due to drainage and rain runoff control.	・To develop main facilities, such as trunks and pumping station, gradually ・To construct sewage network gradually and progress connecting works ・Ending the ejector system utterly	・Construction of WWTP in priotity zone ・Construction of WWTPs gradually ・Dissemination/improvement of individual treatment facilities or community plants in subarban townships	・Development/buildup of main drainage facilities ・Development of lifting pump stations & pipe and rain balanced ponds ・Progressing of development of rain runoff control facilities	・Development of legal system regarding rain water runoff control ・To continue/build up cultivation of human resource ・Establishment of structure for waste water monitoring ・Consideration of BOTand PPP
	Long term (～2040)	・To construct WWTPs gradually for meeting for sewerage in 2040 ・To extend sewerage system to new suburban townships ・To establish the water circulation system for reusing treated sewage	・Effect Indicator: 100% of the goal ・Analysis: Target will be succeeded due to increasing WWTP and community plants. ・Industrial waste water will be treated and the reuse of treated water get started.	・To construct distribution network for reusing treated sewage ・Reduction of water consumption in CBD due to reuse treated water	・Construction of advanced treatment plants for reusing treated sewage ・Establishment of reusing sludge	・Establishment of reusing system of rain water ・Constructing lifting pump stations	・Buildup of penalty to violation of law

Source: JICA Study Team

Table 5.6.3: Project Implementation Schedule (Sewerage and Drainage)

No.		Project Name	Status	Implementation Schadule (FY) 2013 2014 2015 2016 2017 2018 2019 2020 2021 2022 2023 2024 2025 2026 2027 2028 2029 2030 2031 2032 2033 2034 2035 2036 2037 2038 2039 2040
1	Improvement of Sewage Collecting Pipeline	(1) Installation of gravity collecting system(C1,W1) (2) Maintenance, rehabilitation and replacement (3) Installation of connecting pipe (4) Putting an end of existing ejector system	Short term	
		(1) Installation of sewage pipe and pump stations (C2,W2) (2) Installation connecting pipes	Middle-term	
		(1) Installation of sewage pipe (E1,N1,E3) (2)Installation pipeline network for reusing treated sewage on CBD (3)Monitoring System of Reduction of water consumption in CBD because of reusing	Long-term	
2	Improvement of WWTP	(1) Improvement & extension of existing WWTP (C1,W1) (2) Installation of indivisual WWTPs and establishment of maintenance structure	Short term	
		(1) Installation of WWTPs step by step (C2,W2) (2) Installation of community plants and indivisual treatment facilities on site	Middle-term	
		(1) Installation of WWTPs step by step (E1,N1,E3) (2)Installation of advanced WWTPs (3)Istablishment of reusing system of sludge	Long-term	
3	Improvement of Drainage and Ditch	(1) Installation of drainages in infiltration area in CBD (All of 14 Drains) (2) Improvement of drainage (No.5, No,6, No.11) out of CBD (3) Installation of tide prevention gates and pumps	Short term	
		(1) Improvement of 11 drainages out of CBD (2) Installation of rain pump stations and pipe type reservoirs (3) PR for Installation of rain runoff control facility	Middle-term	
		(1) Installation of rain reservoirs and rain runoff control facilities (2)Establishment of reusing system of rainwater (3)Installation of rain pump stations	Long-term	
4	Improvement of Institution, Organization and Human Resouece	(1) Improvement of legal system,such as regulation and criteria (2) Improvement of water and sewerage tariff revision (3) Establishment of O&M organization	Short term	
		(1) Development of legal system for rain runoff control fasility and implementation (2) Establishment monitoring system for quality	Middle-term	
		(1) Enforcing penalty against violations of law	Long-term	

< Legend >
: Feasibility Study and Planning/consideration
: Detailed Design, Tender and Enactment of Legislation
: Construction, Enforcement of Law
: Commencement of Operation and Law Reform

Source: JICA Study Team

(4) Priority Project

YCDC and the Study Team (Water Supply, Sewerage and Drainage) discussed and selected two short-term projects. The implementation schedule of priority projects is shown in Table 5.6.3.

1) Short-Term Projects

- Installation of sewerage system in CBD area

The CBD is the existing sewerage area which has the highest urbanization and high population density. The existing sewage collecting system should be changed to gravity flow system. The existing WWTP should also be rehabilitated and built-up.

- Installation of sewerage system in W1 Zone

A partial area of the W1 zone is selected as the existing sewerage area. The W1 zone has the second highest urbanization area.

- Improvement of water quality of Kan Dow Gyi Lake

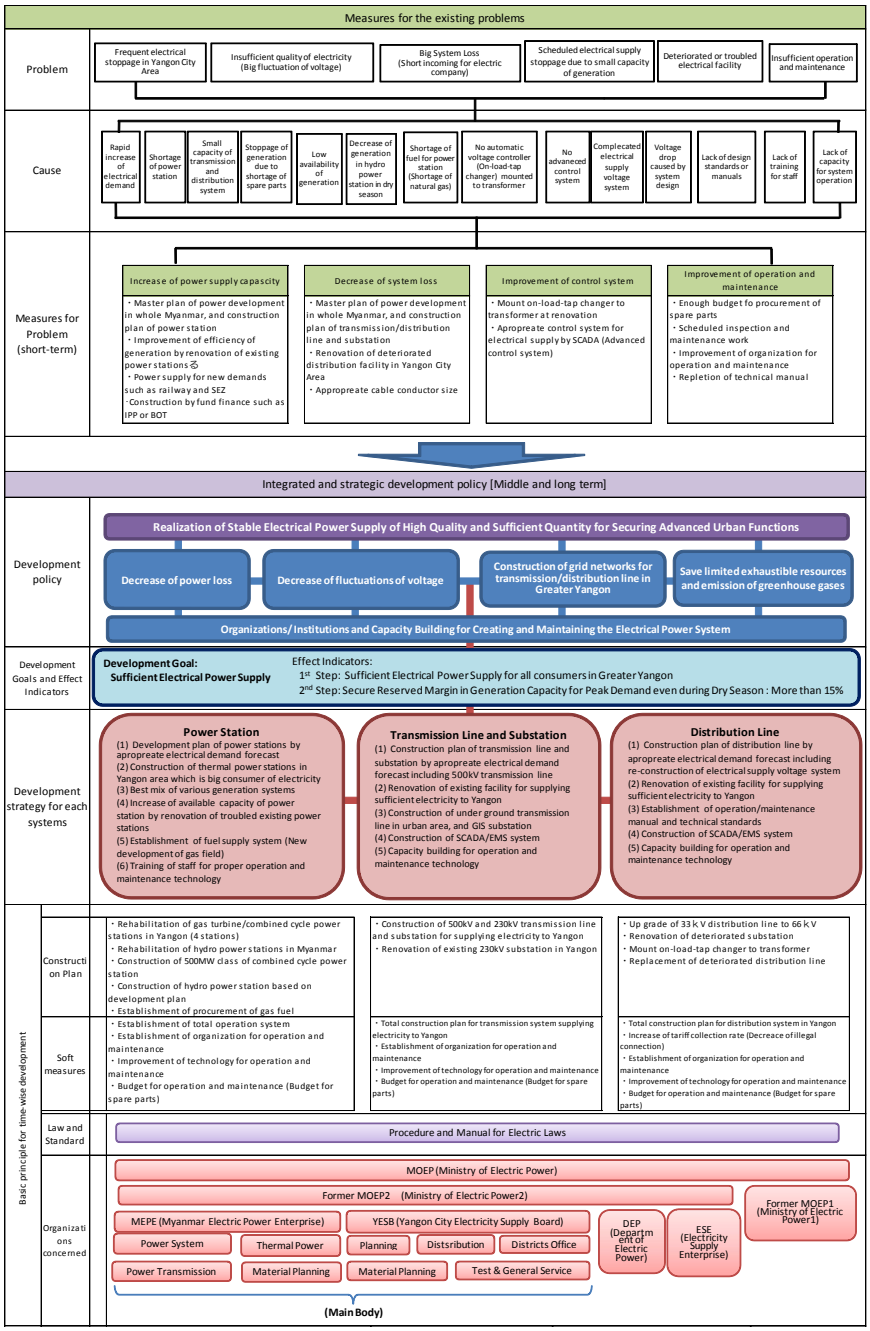
Kan Dow Gyi Lake is the most popular rest and relaxation place for citizens in Greater Yangon. A lot of water bloom grew in lake and reek smell become of eutrophication. Improving water quality will be amenity for citizens.

The priority projects are shown in the project sheets in Chapter 6.3.

5.7 Power Supply

In order to secure the functions of infrastructures for urban development, power supply, which is the fundamental source of energy, must be readily available to the community. Capacity of power supply for Greater Yangon is currently insufficient. Moreover, considering transition from primary economic/industrial activity to secondary economic/industrial activity in Greater Yangon in the future, sufficient power supply is essential and becomes more important.

Based on above situations, the proposed infrastructure development concept for the power sectors is summarized as shown in Figure 5.7.1. Enlarge view of the figure is shown in Appendix 1.4 (one sheet of A3 size).



Source: JICA Study Team

Figure 5.7.1: Infrastructure Development Policy (Power Supply)

5.7.1 Demand Analysis

Forecast of electrical power demand in Yangon City which is the electrical power supply area by YESB, is shown in Table 5.7.1.

Table 5.7.1: Forecast for Electrical Power Demand in Yangon City

Year	Electrical power demand analysis (MW)					Growth rate of electrical power demand
	Electrical power demend for general use	Railway	Thilawa SEZ (Class-A)	Thilawa SEZ (Class-B)	Total	
2011	925 [Estimated demand]				925	
2012	1,026 (10.9%)				1,026	10.9%
2013	1,138 (10.9%)				1,138	10.9%
2014	1,262 (10.9%)				1,262	10.9%
2015	1,400 (10.9%)		2		1,402	11.1%
2016	1,552 (10.9%)		5		1,558	11.1%
2017	1,722 (10.9%)		11		1,733	11.2%
2018	1,910 (10.9%)	23	18	28	1,979	14.2%
2019	2,118 (10.9%)	80	27	56	2,281	15.3%
2020	2,349 (10.9%)	138	36	84	2,607	14.3%
2021	2,606 (10.9%)	195	45	112	2,958	13.4%
2022	2,890 (10.9%)	253	54	140	3,337	12.8%
2023	3,205 (10.9%)	310	63	167	3,745	12.2%
2024	3,555 (10.9%)	368	72	195	4,190	11.9%
2025	3,943 (10.9%)	425	91	223	4,682	11.7%
2026	4,373 (10.9%)	485	90	251	5,199	11.0%
2027	4,850 (10.9%)	540	99	279	5,768	10.9%
2028	5,379 (10.9%)	598	108	307	6,392	10.8%
2029	5,966 (10.9%)	655	117	335	7,073	10.7%
2030	6,617 (10.9%)	713	126	363	7,819	10.5%
2031	6,978 (5.5%)	770	135	391	8,274	5.8%
2032	7,359 (5.5%)	828	144	419	8,750	5.7%
2033	7,761 (5.5%)	885	151	446	9,243	5.6%
2034	8,184 (5.5%)	943	157	474	9,758	5.6%
2035	8,630 (5.5%)	1,000	160	502	10,293	5.5%
2036	9,101 (5.5%)	1,000	162	530	10,793	4.9%
2037	9,598 (5.5%)	1,000	162	558	11,318	4.9%
2038	10,121 (5.5%)	1,000	162	558	11,841	4.6%
2039	10,674 (5.5%)	1,000	162	558	12,394	4.7%
2040	11,256 (5.5%)	1,000	162	558	12,976	4.7%

Source: JICA Study Team

The demand for electrical power will basically grow proportionally with the growth of GDP. Therefore, in this study, while the demand for railway and for Thilawa SEZ are forecast based on demand calculation, the demand for general use such as for household, industry, commercial and other activities are based on middle scenario of the growth of GDP, which is discussed in Section 3.2 of this report. Growth rates in each scenario are shown in Table 5.7.2.

Table 5.7.2: Growth Rates in each Scenario

Socioeconomic Growth Scenario	Annual GDP growth rate/capita (A) *(1)	Annual population growth rate (B) *(2)	Annual power demand growth rate (A)x(B)
High Scenario	10.3%	3.3%	13.9%
Middle Scenario	8.1%	2.6%	*(3) 10.9%
Low Scenario	6.7%	2.4%	9.3%

Note*(1): Annual GDP growth rates/capita are from Table 3.2.9.
*(2): Annual population growth rates/capita are from Table 3.2.1.
*(3): After 20 years (2031), growth rate will go down to half of past year.
Source: JICA Study Team

As shown in Table5.7.3, the average growth rate of electrical power demand in Yangon City for past six years is 9.7% per year. YESB forecasts a growth rate of the electrical power demand as 15% per year on the average.

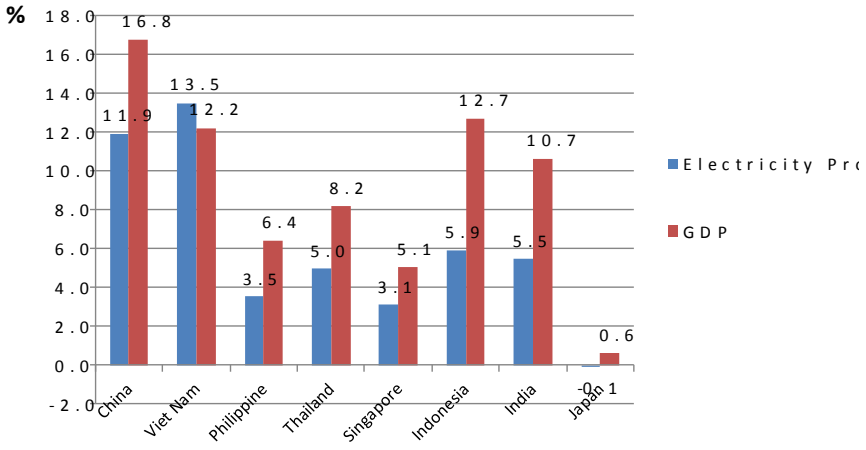
Table 5.7.3: Electrical Power Demand in Yangon City in the Past Six Years

Year	Population in 33 townships in YCDC (*1)	Population in the area supplied electricity by YESB (*2)	Demand of electricity (MW) (*3)	Growth rate of electricity demand	Average growth rate of demand per capita	
					for 6 years	for 5 years
2005		6,460,000	442.0			
2006		6,600,000	426.8	-3.4%	7.4%	
2007		6,724,000	495.6	16.1%		9.7%
2008		6,849,000	511.8	3.3%		
2009		6,944,000	515.0	0.6%		
2010		Estimation (7100000)	638.0	23.9%		
2011	5,142,128	Estimation (7200000)	679.5	6.5%		

Source: (1*): YCDC
(2*): Statistical Year Book 2010
(3*): YESB

Growth rates of electrical production and GDP in Asian Countries in the past ten years are shown in Figure 5.7.2.

Growth rates of electrical production are half to two thirds of GDP growth rates in most countries, while in Viet Nam, which is similar to Myanmar in terms of development of socioeconomic and infrastructure, the growth rate of their electricity production is almost the same as their GDP.



Source: World Development Indicators, WB

Figure 5.7.2: Annual Average Growth of Electricity Production and GDP for the Past Ten years (2000 to 2009) in Asian Countries

5.7.2 Development Policy

Sector Visions are shown below, according to the basic policy of MOEP, and the results of reviewing current conditions for the power sector.

Sector Vision	**Realization of Stable Electrical Power Supply of High Quality and Sufficient Quantity for Securing Advanced Urban Functions**
Basic Policy	1) Decrease of power loss 2) Decrease of fluctuations of voltage 3) Construction of grid networks for transmission/distribution line in Greater Yangon 4) Organizations/ Institutions and Capacity Building for Creating and Maintaining the Electrical Power System 5) Save limited exhaustible resources and emission of greenhouse gases

National Development Policy for Power Sector prepared by the Ministry of Energy and Development for each sector/department are as follows:

(1) National Development Policy for Power Sector

Energy Planning Department (EPD) of Ministry of Energy (MOE) has established the policy of energy in 1990s, and even now the policy is still effective and is being followed. The following five items are related to the electrical sector in the policy of energy, and two items, (i) and (iv), are urgent issues for improvement and development of Greater Yangon.

(i) As a short term plan, construction of new gas turbine power station for avoiding scheduled stoppage of electrical supply

(ii) As a middle or long term plan, construction of hydro-power station utilizing a lot of water resources in Myanmar, and exporting electricity to countries neighboring

(iii) Construction of transmission and distribution facilities are important infrastructures, which should be based on economic growth

(iv) Reductioin of power loss along the transmission and distribution systems, and enlightenment of energy savings

(v) Development of new energy and renewable energy

(2) Current Situation of Power Supply to Yangon Division

1) Shortage of Power Supply

Demand for electricity in whole Myanmar is approximately 1,850 MW, which is according to MOEP's estimation, but the total actual generation is approximately 1,622MW (24th Sep. 2012). Accordingly, shortage of electricity supply is about 230 MW for the whole Myanmar.

Shortage of electrical power in Greater Yangon which is consuming about half of electrical power to the whole Myanmar is also in a serious situation, and shutting-off of electrical power supply occasionally occurs.

Causes of "shortage of electrical power supply" are itemized as follows:

- Rapid growth of demand for electrical power
- Stoppage of power station due to failure of power station mainly caused by gas turbine/combined cycle power station
- Stoppage of gas turbine/combined cycle power stations due to shortage of spare parts
- Changing gas field supplying fuel gas to power station from inland to off-shore. Calorific value of gas in off- shore is lower than that of inland gas.

2) Insufficient Quality of Electrical Power

If fluctuation of voltage and frequency will be over ±10%, electrical facility can be damaged and will cause bad effects to electrical facility.

Actual fluctuations of voltage (drops of voltage) in 230 kV transmission line are 242 kV to 208 kV (+5% to -10%)

Actual fluctuations in distribution line in Greater Yangon are 9 kV in the 11kV line (-18%), and 190 V to 50 V in the 230 V line (-17% to -78%).

Causes of "insufficient quality of electrical power" are itemized as follows:

- Absence of on-load-tap changer mounted to transformer for distribution
- Deteriorated facility for transmission/distribution
- Big current load to small capacity of transmission/distribution facility
- Insufficient control system

3) Large Distribution System Loss

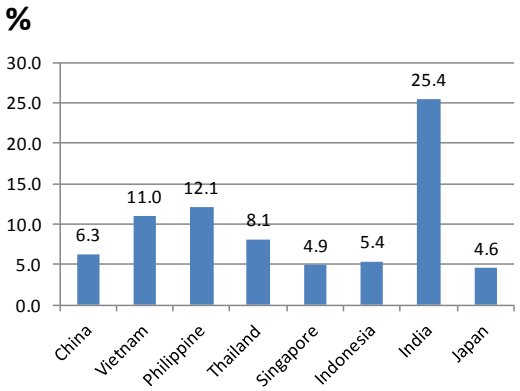
Distribution system loss in electrical power supply system in Yangon is decreasing for several years as shown in the past records and as reflected in Table 5.7.4. However, even in 2012, system loss is approximately 25%, which is very large compared with those of other countries..

Table 5.7.4: Transmission and Distribution System Loss in YESB

Year	System loss (%)		
	Distribution	Transmission	Total
2007	24.4		
2008	22.6	NA	
2009	22.0	NA	
2010	20.5	NA	
2011	19.8	NA	
2012	18.0	7.0	25.0

Source: MEPE and YESB

Transmission and distribution system losses in Asian countries are mostly less than 10% as shown in Figure 5.7.3. Illegal connection is also one of the causes of large system losses. System losses in Greater Yangon should be decreased by 10% in the near future, which is the rate achieved by most Asian countries, as shown in Figure 5.7.3, This may be achieved by the improvement of transmission/distribution system and decrease of illegal connections.



Source: World Development Indicators 2009, WB
Notes: Data of 2006

Figure 5.7.3: Transmission and Distribution System Losses in Asian Countries

(3) Policy for power development

1) Hydro-power development

MOEP has a plan for hydro-power development, and some portion of developed power will be supplied to the national grid including Greater Yangon.

According to the above hydro-power development plan, 43 hydro-power stations will be constructed by 2030, and its generating capacity is approximately 25,500 MW, of which about 9,300 MW can be supplied to the Myanmar grid. However, stable electrical power supply from hydro-power stations to Greater Yangon is very small as shown in Section 5.7.3 (1) and (2).

Hydro-power development plan up to year 2030 by MOEP is shown in Table 5.7.5.

Table 5.7.5: Summary of Hydro Power Development Plans (Plan as of Sep, 2012)

Name of Project	Planned Construction Year	Name of Project	Planned Construction Year
Upper Paunglaung (140MW)	2012-2013	Wxhongze (60MW)	2016-2017
Nancho (40MW)	2012-2013	Hkankwan (140MW)	2017-2018
Upper Yeywa (280MW)	2015-2016	Lawingdin (435MW)	2017-2018
Shweli (3) (1,050MW)	2016-2017	Tongxinqiao (320MW)	2015-2016
Phyu (40MW)	2013-2014	Upper Thanlwin (Konlone) (1,400MW)	2017-2018
Manipu (380MW)	2015-2016	Hutgyi (1,360MW)	2016-2017
Tahtay (111MW)	2015-2016	Laymyo (600MW)	2026-2027
Ann (10MW)	2013-2014	Laymyo (2) (90MW)	2026-2027
Upper Buu (150MW)	2015-2016	Ywathit (4,000MW)	2026-2027
Upper Kengtaung (51MW)	2014-2015	Htukyan (105MW)	2026-2027
Thaukyekhat-2 (120MW)	2012-2013	Hanna (45MW)	2026-2027
Baluchaung (3) (52MW)	2013-2014	Takwa (150MW)	2026-2027
Upper Baluchaung (30.4MW)	2015-2016	Paloung (105MW)	2026-2027
Anyarphar (9MW)	2014-2015	Bawlakae (180MW)	2026-2027
Chibwe (3,400MW)	2017-2018	Namtapet (180MW)	2026-2027
Wutsok (1,800MW)	2024-2025	Shweli (2) (520MW)	2016-2017
Kaunglangpuu (2,700MW)	2024-2025	Sinedin (76.5MW)	2026-2027
Yenam (1,200MW)	2024-2025	Yazakyo (4MW)	2013-2014
Pisa (2,000MW)	2024-2025	Myogyi (30MW)	2013-2014
Lasa (1,900MW)	2017-2018	Myittar (40MW)	2014-2015
Chibwengae (99MW)	2012-2013	Kanyin (5MW)	2012-2013
Gawlan (100MW)	2017-2018		

Source: MEPE

2) Thermal power development including gas turbine and combined cycle power station

It is difficult to supply electrical power to Greater Yangon only by hydro-power station. Therefore, thermal power station including gas turbine/combined cycle power station will be constructed in Greater Yangon.

The most urgent issue is the renovation of malfunctioning or deteriorated gas turbine/combined cycle power stations due to failure or shortage of spare parts. However; the existing gas turbine/combined cycle power stations in Greater Yangon are comparatively old. The life of gas turbine/combined cycle power station is around 25 years. In this study, such life cycle shall be taken into account for its deterioration and improvement of thermal efficiency.

In case that the life of gas turbine or combined cycle power facility is around 25 years, the life of all power facility in Greater Yangon will reach 25 years in 2025.

New power stations will be basically constructed in the area with four existing power stations. In case that power station will be constructed in a new area, secure of cooling water and making up water for boiler shall be taken into consideration for the selection of area.

Delay of development of natural gas field and decrease of calorific value of natural gas, are also issues to be solved for securing generation of electrical power of gas turbine or combined cycle power station.

Supply of diesel fuel oil to power stations should be considered in order to mend the above problematic situation on natural gas.

MEPE has construction plan of new power stations in Greater Yangon, which is shown in Table 5.7.6. Power stations are mostly combined cycle types.

Table 5.7.6: Summary of Thermal Power Development Plans (Plan as of Nov, 2012)

Plan	Planed or Funded by	Planned Construction Year
Hlawgar gas engine power station : 53.4MW	IPP	2013
Ywama gas engine power station : 55.9MW (4.3MW x13units)	IPP by Caterpillar USA (Under construction)	2013
Ywama combined cycle power station : 240MW	IPP	2013
Ahlone combined cycle power station : 120MW	IPP	2013
Thaketa gas engine power station : 50MW	IPP	2013
Hlawgar combined cycle power station : 500MW	BOT	2014
Thaketa combined cycle power station : 500MW	BOT	2014
Thilawa combined cycle power station : 450MW	(Under planning)	
Ywama (or Shew Ling Pan) combined cycle power station : 450MW	(Under planning)	

Source: MEPE

3) Other Renewable Power Development

Hydro-power is one of the renewable energies, and a number of hydro-power stations has been constructed. With regards to other renewable power development in Myanmar, the progress is currently very small.

Only the feasibility studies on wind power generation (Total capacity: 1000MW) in Mon State, Karean State and Tanintharyi Region are in progress.

Study on renewable power including solar power, micro-hydro power, geo-thermal power and bio-mass power in Myanmar should start with the investigation of natural condition of candidate area for confirming the possibility of development.

The Ministry of Science and Technology is the responsible ministry for renewable energy development, and is discussing about development of renewable energy with related ministries.

The possibility of renewable energy such as solar power should be studied in primary stage as supplemental and individual power source supplying power for infrastructures (such as building, etc.) in Greater Yangon.

(4) Policy for Power Transmission and Distribution

1) Power Transmission

MEPE is now carrying out the plan up to 2015, and main contents are as follows:

- Construction of 230kV/132kV/66kV transmission lines and substations
- Renovation of 230kV/132kV/66kV transmission lines and substations

Also, MEPE has a plan to construct 500kV transmission lines between northern portion of Nay Pyi Taw and Greater Yangon for improving the supplying power efficiently.

Moreover, construction of 500kV transmission lines to Greater Yangon will proceed.

In Greater Yangon, deteriorated transformer is now under replacement in Hlawga 230kV substation, and replacement or renovation of deteriorated facility in other substation will follow.

2) Power Distribution

YESB is now carrying out the five year plan (2010/11 to 2015/16), with the following main contents:

- Construction of upgraded substations
- Upgrading voltage of transmission/distribution lines from 33kV to 66kV.
- Replacement of small size cables to large one in transmission/distribution lines
- Replacement of bare overhead wire to insulated overhead wire
- Replacement of consumption meter from electro-magnetic type to electronic type
- Installation of capacitor bank in substation for improvement of power factor
- Cutting trees which interfere with overhead wire
- Investigating illegal connection

The main project in 2011/12 and 2012/13 of the five year plan are shown in Table 5.7.7, and the main issue surrounding the five-year plan is the construction of 66kV substation for decreasing system loss in Greater Yangon distribution network.

At the end of this plan (2015/16), the numbers of 66 kV substations in Greater Yangon will increase from 22 to 63.

Renovation of 33kV substation is also included in this five-year plan.

Table 5.7.7: Five years plan in YESB (2010/11-2015/16)

Name of Project	Donor	Description of the Project	Cost	Remarks
【Power Distribution】 5 years plan in YESB (2010/11-2015/16)	Government Budget	● 66kV substation for distribution ● 33kVsubstation for distribution ● 66kV underground power cabling ● 33/6.6kV underground power cabling ● 66kVoverhead wiring	87billion Kyat	・2011/12 : undergoing ・2012/13 : budgeted

Source: JICA Study Team

Notes: Nos. of 66kVsubstation for Distribution: 【2011/12: 4 stations, 2012/13 : 8 stations, 2013/14 : 7 stations, 2014/15 : 7stations, 2015/16 : 6 stations】

5.7.3 Development Goals and Target Effect Indicators

Development goals and target effect indicators are shown in Table 5.7.8.

Table 5.7.8: Development Goals and Effect Indicators

Development Goals and Effect Indicators	
Development Goal	Effect Indicators
Sufficient Electrical Power Supply	● First Step: Sufficient Electrical Power Supply for all consumers in Greater Yangon ● Second Step: Secure Reserved Margin in Generation Capacity for Peak Demand even during Dry Season is more than 15%.

Source: JICA Study Team

For the above development goals and effect indicators, actual studies on development of electrical power supply are as follows:

(1) Power from existing and planned power stations

Expected total available electrical power that can be supplied to Yangon City, from hydro and thermal power stations including future construction plans, calculated up to year 2040 is shown in Table5.7.9.

Existing hydro power stations were mostly constructed only recently, but the existing gas turbine power station and combined cycle power stations are very old which were constructed before year 2000. Therefore, all existing gas turbine or combined cycle power stations might stop its power generation by year 2025 reaching the 25 years of its life.

This calculation is also based on the following conditions.

- Stable capacity of hydro power stations are 50% of installed capacity, considering shortage of water in dry season, control of generation in that season, maintenance work, as well as breakdown of generation unit.
- Stable electrical power in Yangon City from hydro power station is 50% of stable capacity of hydro power stations.
- Stable capacity of other power station such as combined cycle power station is 75% of installed capacity considering maintenance work as well as breakdown of generation unit.
- All power stations which are halting its power generation due to some mechanical problems should undergo maintenance and renovation.

Table 5.7.9: Generating Capacity of Power Stations (Existing and Planned Power Stations)

Year	Hydro Power Station (MW)					Thermal Power Station (MW)				Expected Total Stable Power to Yangon Division (MW) (C)+(E)
	Installed Capacity			Stable Capacity (B)=(A)x50%	Stable Power to Yangon Division (C)=(B)x50%	Installed Capacity			Stable Capacity (E)=(D)x75%	
	Existing Hydro Power Sstation (After renovation) (*2)	New Development Plan (*1)	Total (A)			Existing Thermal Power Station (After renovation) (*3)	New Development Plan of MOEP in Yangon Division (*4)	Total (D)		
2011										
2018	2,180	5112	7,292	3,646	1,823	565.8	1,519	2,085	1,564	3,387
2025	2,180	7268	9,448	4,724	2,362	120.0	2,419	2,539	1,904	4,266
2030	2,180	9313	11,493	5,747	2,873	120.0	2,419	2,539	1,904	4,778
2035	2,180	9313	11,493	5,747	2,873	120.0	2,419	2,539	1,904	4,778
2040	2,180	9313	11,493	5,747	2,873	120.0	2,419	2,539	1,904	4,778

Source: MEPE
Notes: (*1): Supplied power from new hydro power station to national grid, according to new development plan of MOEP.
(*2): Refer to Table 2.3.57
(*3): Refer to Table 2.3.57
(*4): Refer to Table 5.7.6

(2) Balance of electrical supply and demand

Expected balance of electrical power supply capacity and demand of electrical power in Yangon City is shown in Table 5.7.10.

If all future construction plans of power stations will be executed in 2018, the stable electrical power for Yangon City will be 3,387 MW which is more than the demand (1,979 MW), and extra electrical power can be supplied to the other area of the city.

However, in 2025, it is projected that shortage of electrical power supply in Yangon City will occur. Approximately 600MW will be the deficit, making it necessary to construct new thermal power stations similar to the combined cycle power station already constructed and operated.

After 2026 to 2040, shortage of electrical power supply to Yangon City will further increase.

MOEP has no idea about hydro power development after 2030, but thermal power stations should be basically constructed in Yangon City to address the shortage of electrical power from hydro power.

Table 5.7.10: Balance of Electrical Power in Yangon City

Year	Balance of Electrical Power in Yangon Division (MW)			Required Capacity of Thermal Power Station to be newly planned and installed (MW) [A]/0.75
	Stable Power Supply Capacity (*1)	Demand	Balance [A]	
2011	680	925	-246 (73.5%)	
2018	3,387	1,979	1408 (171.2%)	
2025	4,266	4,682	-415 (91.1%)	554
2030	4,778	7,819	-3042 (61.1%)	4056
2035	4,778	10,293	-5515 (46.4%)	-
2040	4,778	12,976	-8198 (36.8%)	-

Source: JICA Study Team, MEPE
Note *1: Power Supply from existing power station and planned power stations to be constructed.

(3) Monitor and Control System

Electrical power supply system in the whole Myanmar is controlled at two main control centers. One is the control center located in Nay Pyi Taw (NCC: National Control Center), while the other is in Yangon (LDC : Load Dispatch Center).

NCC is controlling the electrical power supply system in the whole Myanmar. They are using the actual method of control in NCC which is through the frequency meters and telephone systems. The staff at the control system is observing the frequency meters, the control demand, and supply of electrical power over telephone.

No voltage meter or any other meters for monitoring are installed in the control system, accordingly it is difficult to control or adjust the fluctuation of voltage at real time.

LDC is mainly cooperating with NCC and dispatching real time demand and supply for Divisions and States by the same method as adopted by NCC.

As the result of above, a problem on wide voltage fluctuation sometimes occurs in Yangon and other areas.

Therefore, more advanced monitor and control system such as the Supervisory Control and Data Acquisition (SCADA) System for the whole Myanmar should be installed urgently.

MEPE in already interested in introducing SCADA System in some substations. For instance, the control facility which was installed only recently particularly in Hlawgar substation is equipped with the facility for future connection to SCADA system, as shown in Figure5.7.4.

(Present situation) (Future)

Source: JICA Study Team

Figure 5.7.4: Control Facility in Hlawgar Substation

MEPE has plans on SCADA system by three stages:

- First step: Installation of monitoring system
- Second step: Installation of control system for substation
- Third step: Installation of total monitor and control system (SCADA system) including hydro power station

(4) Capacity Building

YESB is confronted with problems in terms of organization, management, and operation and maintenance. The problems are recognized by JICA Study Team and the details are shown in Table 5.7.11.

Capacity building should be carried out for solving these problems.

After carrying out the countermeasures shown also in Table 5.7.11, sound organization and system of operation and maintenance will be realized for electrical power supply in Greater Yangon.

Table 5.7.11: Problems in Organization, Managing, Operation and Maintenance in YESB

Class	Current problems	Countermeasures
Organization	• Many works are concentrated into a limited number of officers and managers • Many vacant positions in the organization • Lack of system for educating and training employees	• Strengthen the organizational functions through management training. • Implement technical trainings (In Classroom training and On the Job Training [OJT] schemes).
Management	• Small budget, insufficient renovation and maintenance	• Sufficient budget for renovation and maintenance
Technology	• Small systematic knowledge regarding power generation, transmission and distribution. • Knowledge for compiling equipment plans, for example, power demand forecasting and system analysis are lacking	• Implement technical trainings (In Classroom training and OJT schemes) • Implement safety management classes • Implement technology transfer concerning power demand forecasting and system analysis.
Work Basis	• Insufficient spare parts • Planned equipment maintenance is not implemented due to small budget	• Sufficient budgeting for procurement of spare parts and maintenance
Equipment	• Levels of equipment deterioration, degradation and capacity shortage are extreme. • There is no equipment for conducting the centralized monitoring of operating conditions at power stations and substations.	• Renovation of existing equipment or additional installation of new equipment • Construction of SCADA system

Source: JICA Study Team

5.7.4 Preliminary Development Plan

(1) Infrastructure Plan

1) Basic Plan of Power Supply

Infrastructure plans shown in this section are basic plan at current stage. Therefore, these plans should be studied furthermore in the study of master plan for power sector which will be followed.

i) Present power supply

Present situations of power stations and 230 kV transmission lines in Greater Yangon are shown in Figure 5.7.5.

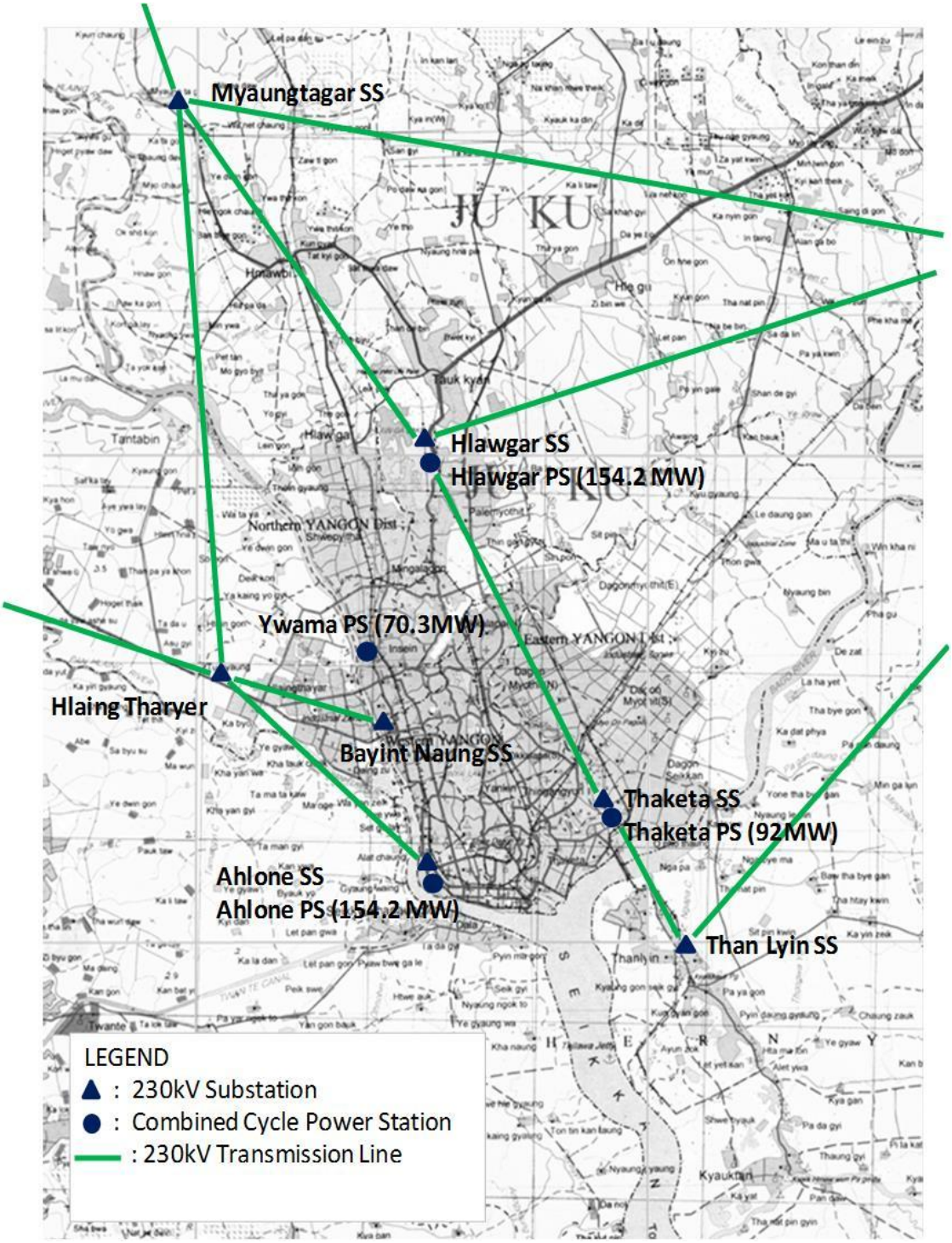


Figure 5.7.5: 230kV Transmission Line and Power Station in Greater Yangon in 2012

ii) Power Supply in Year 2018

Expected power stations and 230 kV transmission lines in Greater Yangon in 2018 are shown in Figure 5.7.6.

Several power generating facilities will be constructed in the existing power station areas according to the current development plan of MEPE, and also the planned 230 kV substations and transmission lines will be constructed for Thilawa SEZ.

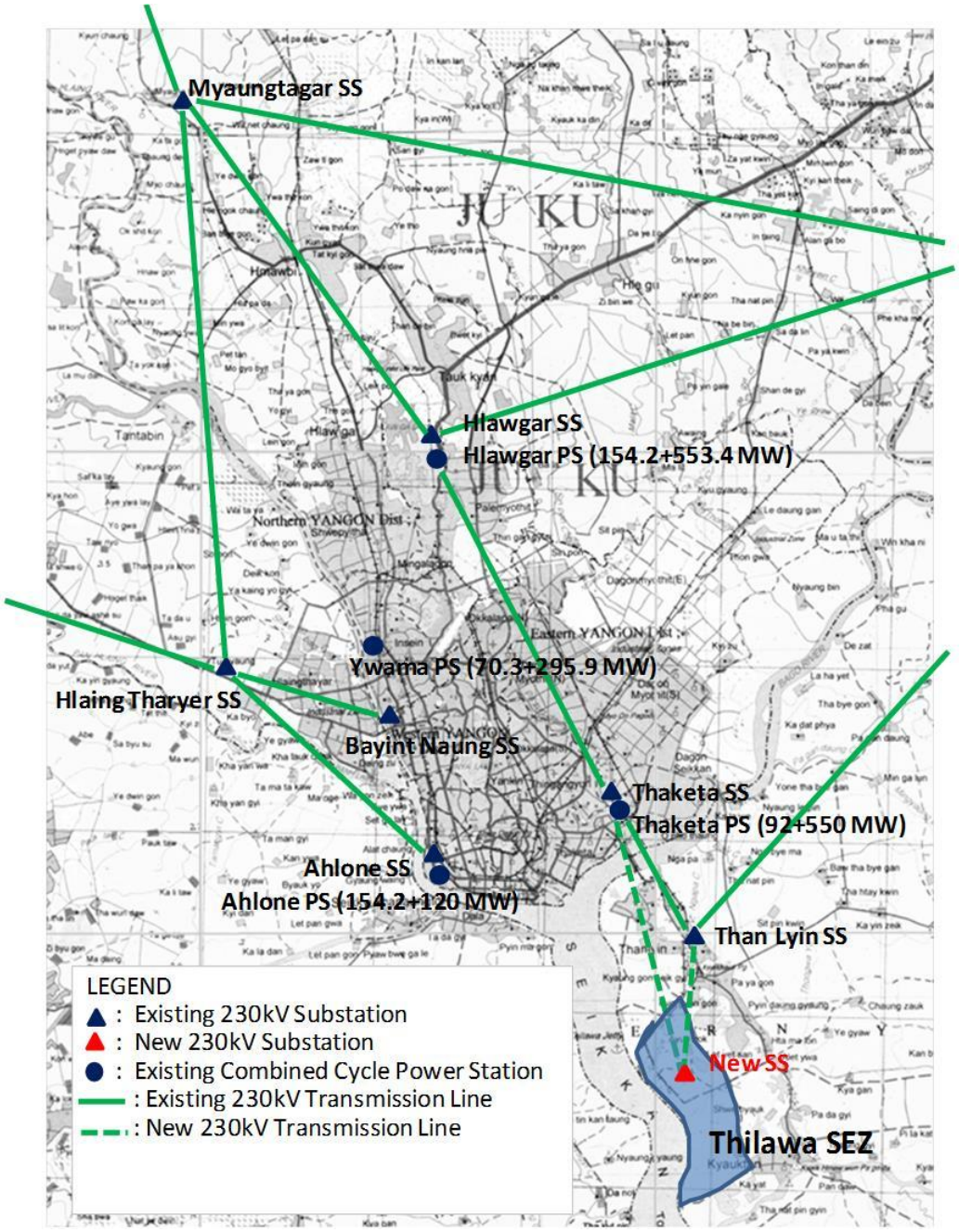


Figure 5.7.6: 230kV Transmission Line and Power Station in Greater Yangon in 2018

iii) Power Supply in Year 2025

Expected power stations, 500kV and 230kV transmission lines, which will be installed in Greater Yangon in 2025, are shown in Figure5.7.7.

All the existing gas turbine/combined cycle power facility of year 2012 will stop operation in 2025 as it reaches the end of its usable and economic life. New power developing facility will be constructed in the existing power station areas and Thilawa SEZ according to the plan of MEPE. However, further power development facility with capacity of approximately 700MW will be necessary to augment the existing deficiency in the electrical power supply. Moreover, further improvement of substations and transmission/distribution lines will be necessary.

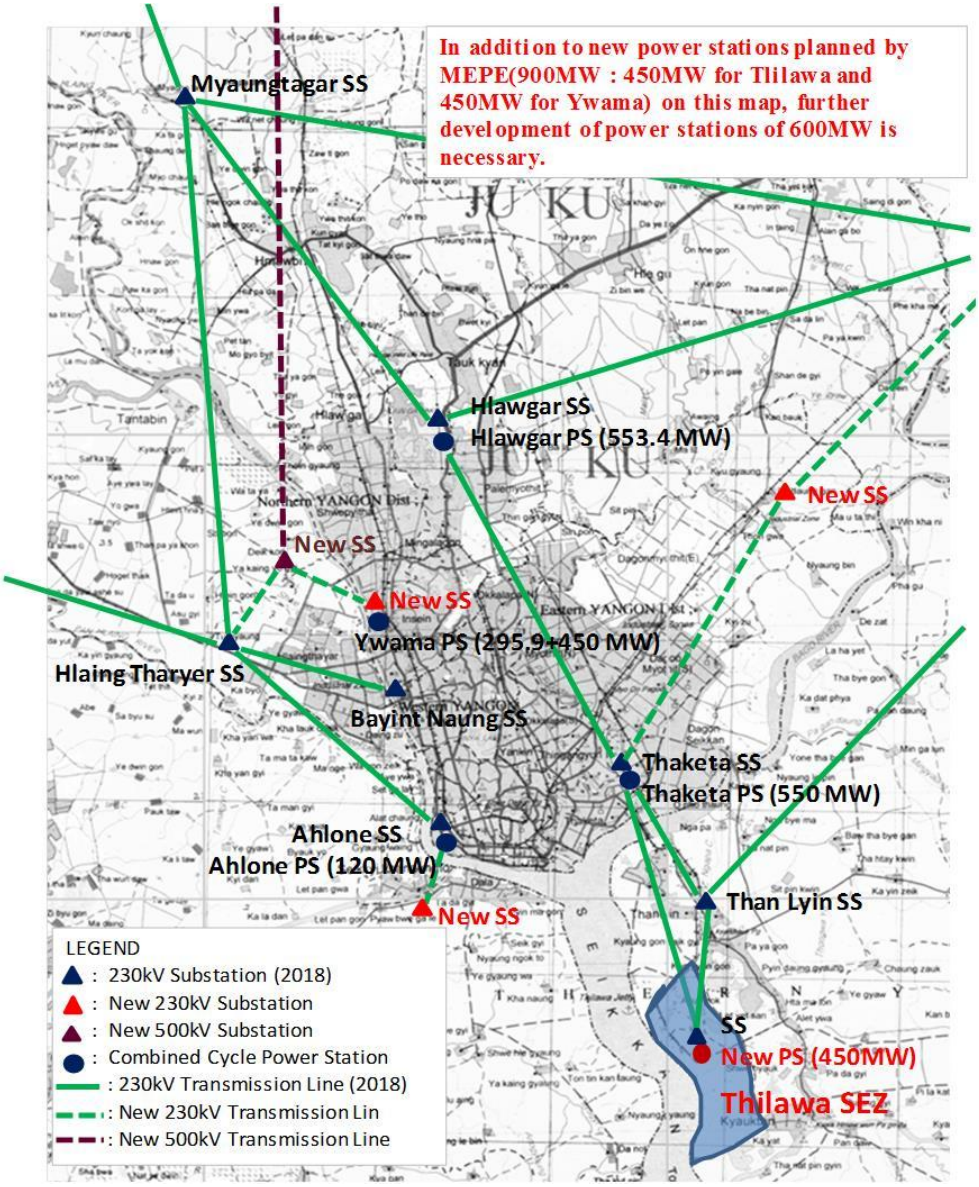


Figure 5.7.7: 500kV and 230kV Transmission Line and Power Station in Greater Yangon in 2025

iv) Power Supply in Year 2040

Growth of electricity demand will continue to increase after 2025.

Six places in CBD and other sub-Centers and Thilawa SEZ are expected to be developed up to 2040 according to the study conducted by JICA Study Team. Summary of the findings are shown in Figure 5.7.8.

After 2025, the capacity of power station, transmission/distribution lines and substations shall continue to increase for supplying electricity especially to these urban centers. Also, construction of a grid network of 230kV transmission line between Ahlone Substation and Thaketa Substation is crucial in order to improve the reliability of the power supply.

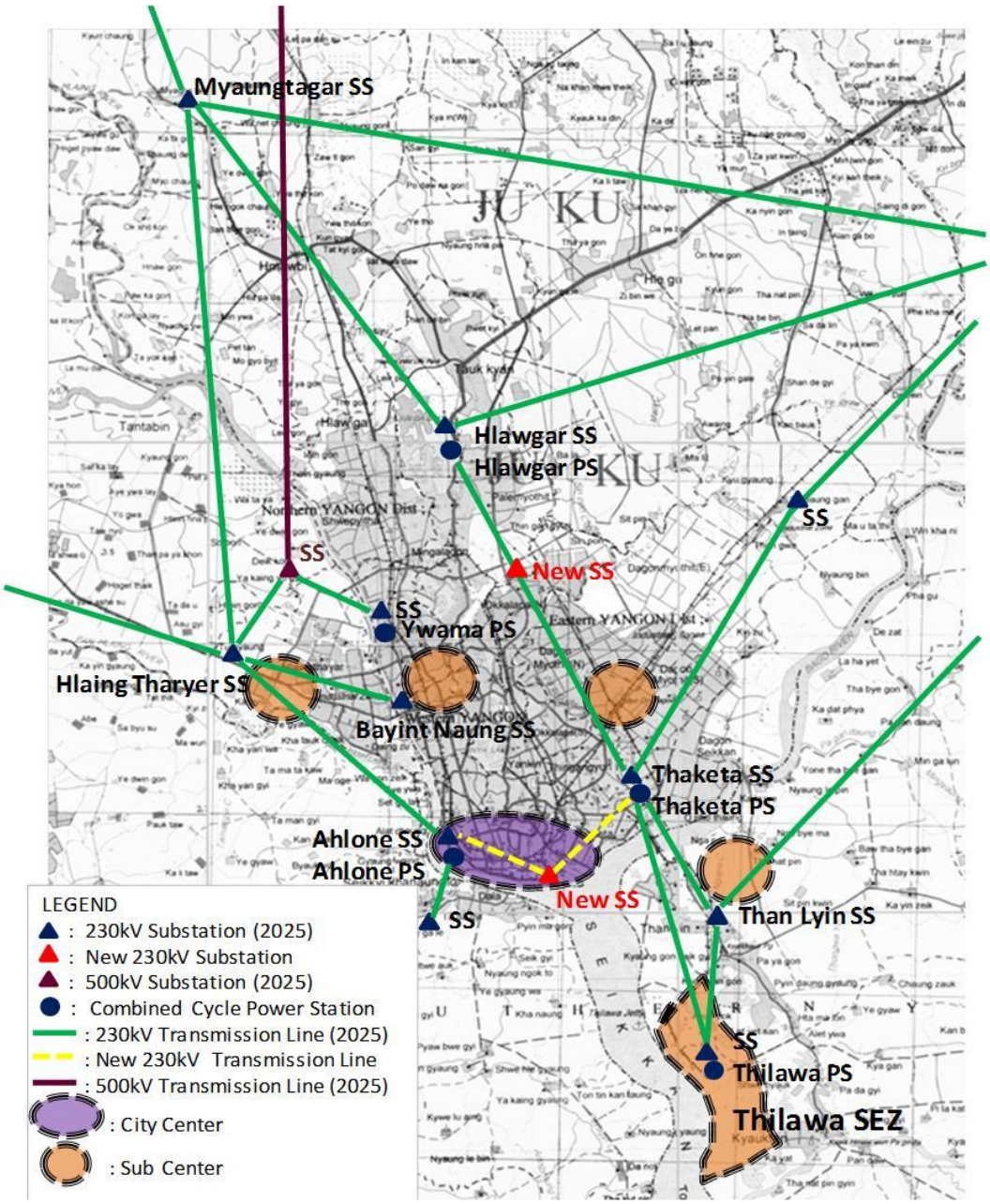


Figure 5.7.8: 500kV and 230kV Transmission Line and Power Station in Greater Yangon in 2040

2) Power Supply to Special Power Demand

i) Power Supply for Thilawa Special Economic Zone (SEZ)

- Outline of Thilawa SEZ Development

The Preparatory Survey on Thilawa SEZ Infrastructure Development by JICA (called as JICA Thilawa Study) is in progress, including the study on power supply plan to Thilawa SEZ. According to the information given by JICA Thilawa Study Team, the candidate site of Thilawa SEZ is located at 25 km to south from the center of Yangon along the Yangon River in Thanlyin and Kyauktan townships and the area is estimated at 2,400ha.

The Myanmar Government has an intension to start the commercial operation of Thilawa SEZ in 2015 although the power supply infrastructure is currently not sufficient for the estimated power demand in Thilawa SEZ.

- Electricity Load Forecast

The load for full tenants in the whole area of SEZ (=2,400ha, including Class-A and Class-B) is estimated to finally achieve approximate 800 MVA.

To focus the power demand on Class-A (420ha), the tenants lots are predicted to be sold at 20ha/year in average with load density at 0.5MVA/ha. Under these conditions, the power demand for Class-A is estimated as shown in Table 5.7.12.

Table 5.7.12: Power Demand of SEZ (Class A)

Unit: MVA

Year	2015	2017	2019	2021	2023	2025	2027	2029	2031	2033	2035	2037
Load of SEZ (Class-A)	2	12	30	50	70	90	110	130	150	168	178	180

Source: JICA Study Team

Meanwhile, since the development scenario for Class-B has not been drawn up, the power demand for Class B (1980ha) is not yet clear. Therefore, the power demand is forecasted based on an assumption that the commercial operation starts in 2018 and the tenants would be steadily occupied throughout 20 years after 2018.

- Power Supply System Plan to Thilawa SEZ

The electric power demand for whole Thilawa SEZ 2,400 ha is estimated to grow from 2MVA to 800 MVA since commencement of business in 2015.

Stage-1 : The early power supply facilities are required to commence the operation by October 2015, i.e. before the Thilawa SEZ starts for business. As an early countermeasure, construction of new 33kV distribution line may be a possible way to supply maximum 20 MW (per circuit) for Thilawa SEZ.

Stage-2 : Stage-2 plans to set up 50MW backup generators in Thilawa by 2018. The backup generators are recommended to be designed as dual-fuel (gas and diesel oil) turbine in consideration of risk in unstable fuel supply. A new single circuit 230kV transmission line connecting Thanlyin – Thilawa will also be constructed.

Stage-3 : There is an on-going IPP project in Takheta at approximate 20km far to north from Thilawa. This IPP project is aimed to construct a new gas turbine combined cycle power plant (500MW) at an adjacent site to Takheta P/S. In Stage-3, the additional power 168MW

is to be fed from IPP to Thilawa substation. Accordingly, the total supply capacity will grow to 218 MW in total in Stage-3.

Stage-4 : In order to supply further power from gird, two more substations (100MVA x 3 units x 2 substations) may be constructed at separate locations in Thilawa SEZ.

ii) Power Supply for Prospective Railway Projects

The total length of railway to be expanded in Yangon is forecasted in Table 5.3.4 in the Section 5.3.4. As all the future railways will be improved or constructed as electrified railway, the stable power supply will be essential for the train operation.

The power demand for future railway operation is estimated under assumptions as mentioned below.

Table 5.7.13: Expected Train Operation

Year	2018	2035
Operation Interval	10 min.	5 min.
Max. running train number at the moment	8	280
The number of rolling stock per a set of train	8	8
Average Speed	40 km/hr	40 km/hr
Type of Electric Motors	Same as rail vehicle for Marunouchi Line	Same as rail vehicle for Marunouchi Line

Source: JICA Study Team

The calculation of individual power demands for each year is conducted based on the following procedure.

a) The power demand (23MW) in 2018 is calculated in consideration of the required power for i) traction, ii) auxiliary facilities, iii) operation of various services.

b) The power demand (1,000MW) in 2035 is calculated by proportion of numbers of trains, i.e. 23MW x 280 /8 trains = 805MW plus 20% margin.

c) The power demands for an intermediate year are calculated at the rate proportional.

It is suggested that the transmission and power generation facilities should be constructed to meet its corresponding growth as forecasted power consumption of electric railway services as pictured in Section 4.3 in this Chapter.

(2) Standard Construction Cost

Standard construction costs for thermal power station, substation and transmission line, currently being used in MOEP, are shown in Table 5.7.14, Table 5.7.15 and Table 5.7.16, respectively. Reportedly, there are projects done thru construction by direct work facilitated by MEPE, but the work on the main equipment such as power generating facility and main transformer should be imported from outside countries.

Therefore, in case that the construction work is performed by international bidding in order to undertake the system improvement, it is anticipated that the construction cost will be higher than the direct work facilitated by the authority.

Table 5.7.14: Standard Cost for Thermal Power Station

No	Description	Unit Construction Cost
1	Thermal Power Station	1,000,000USD/MW

Source: MEPE

Table 5.7.15: Standard Cost for Substation (In Case of MEPE's Direct Construction Work)

No	Description	Construction Cost (US$)		
		Material	Construction	Total Cost
1	500kV, 500MVA Substation	27,000,000	3,500,000	30,500,000
2	230kV, 100MVA Substation	8,000,000	2,500,000	10,500,000
3	132kV, 60MVA Substation	6,000,000	2,000,000	8,000,000
4	66kV, 5MVA Substation	1,500,000	660,000	2,160,000
5	230kV, Switch Bay (1) No extension	800,000	38,000	838,000
6	132kV, Switch Bay (1) No extension	700,000	33,000	733,000
7	66kV, Switch Bay (1) No extension	500,000	27,000	527,000

Source: MEPE

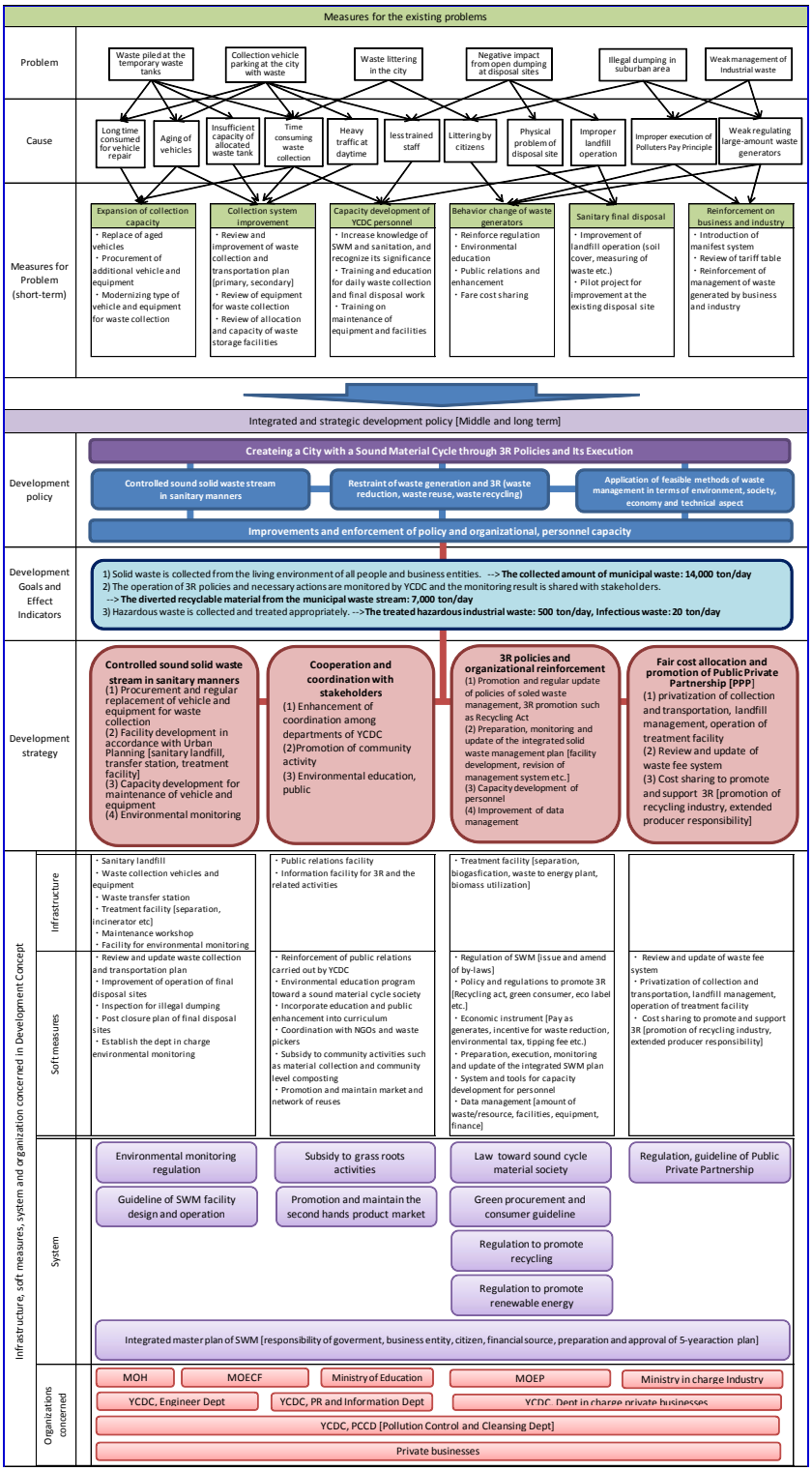
Table 5.7.16: Standard Cost for Transmission Line (In case of MEPE's Direct Construction Work)

No	Description	Construction Cost per mile (US$)		
		Material	Construction	Total Cost
1	500kV, Transmission Line	850,000	170,000	1,020,000
2	230kV, Double Circuit Transmission Line	240,000	86,000	326,000
3	230kV, Single Circuit Transmission Line	180,000	67,000	247,000
4	132kV, Double Circuit Transmission Line	120,000	22,000	142,000
5	66kV, Double Circuit Transmission Line	80,000	36,000	116,000
6	66kV, Single Circuit Transmission Line	50,000	38,000	88,000

Source: MEPE

5.8 Solid Waste Management

The proposed infrastructure development concept for the Solid Waste Management (SWM) sector is summarized in Figure 5.8.1. For greater appreciation of the concept of SWM, the enlarged version of Figure 5.8.1 is in Appendix 1.5.



Source: JICA Study Team

Figure 5.8.1: Development Concept of Solid Waste Management

5.8.1 Demand Analysis

(1) Basic Conditions

1) Target Types of Solid Wastes

According to "the by-laws of Yangon City Development Committee [YCDC] (Order No.10/99)", the Pollution Control and Cleansing Department (PCCD) collects, transports and disposes the solid waste generated in the city. In reference to the present situation, the requirements stated in the by-laws and the basic principles for environmental conservation given in the Environmental Conservation Law issued by the Union, the targeted solid wastes will include municipal wastes, but exclude construction waste. As for hazardous wastes from private industries and infectious wastes generated from medical facilities, PCCD intends to extend their capacity for treating those types of wastes while all the costs shall be borne by waste generators.

Since rubbles such as soils, waste bricks and stones should be taken cared of by their generators, they are not covered in regular solid waste collection. These wastes are only occasionally generated during construction and demolition works. Therefore, these wastes are considered and handled differently from domestic and other municipal wastes.

Table 5.8.1: Target Solid Wastes Types in the Plan

Category	Waste Type	Target Waste
Solid waste (Municipal waste)	Household waste (domestic waste)	Yes
	Other municipal wastes (OMW): (Commercial, industrial [non-hazardous], garden refuse)	Yes
	Construction and demolition wastes	
Hazardous waste	Industrial waste (hazardous)	Yes
	Infectious wastes from hospitals (IW)	Yes

Source: JICA Study Team

2) Amount of Target Waste in the Initial Year

Fiscal Year 2011 is set as the initial or base year for the analysis since the latest statistical data of collected solid waste by the YCDC is available for this latest year.

The collected amount of solid wastes in year 2011 is shown in the following Table 5.8.2. The breakdown of collected solid wastes in terms of percentage compositions of domestic and other municipal wastes are pegged at 62% and 38%, respectively. These amounts of collected solid wastes were transported to the existing dump sites.

Table 5.8.2: Breakdown of Collected Solid Wastes by Types in Year 2011 (as Amount in Initial Year)

Category	Types of Wastes	Amount (ton/day)	Ratio
Municipal waste	Domestic waste	870	0.62
	Other municipal wastes (OMW)	533	0.38
	Total	1,403	1.00
Hazardous waste	Industrial waste (hazardous)	0.14*1	-
	Infectious wastes from hospitals (IW)	1.4	-
	Total	-	-

Note: *1. Average amount of collected solid wastes for the last seven years.
Source: PCCD, YCDC

3) Basis of Demand Estimation

The basis of estimation for solid waste generation is shown in Table 5.8.3:

Table 5.8.3: Basis of Estimation for Solid Waste Generation

No.	Category	Waste Type	Basis of Estimation for Demand Projection
1.	Domestic waste	Domestic waste	Based on population and unit generation
2.	Other municipal wastes (OMW)	Commercial, industrial (non-hazardous), institutional waste, street waste, garden waste	Proportionally will increase with economic growth
		Industrial (non-hazardous) waste from Thilawa SEZ	Projection by METI study on Thilawa SEZ
3	Hazardous waste	Industrial waste (hazardous), Infectious wastes from hospitals	Proportionally will increase with economic growth

Source: JICA Study Team

4) Future Population

The existing population is projected by JICA Study Team up to envisaged target year (Refer to Chapter 3.3).

5) Physical Composition of Municipal Waste

The physical composition of solid waste is assumed to change based on the heterogeneous nature of waste materials and due to unpredictable prices of basic commodities. Their contributions on the physical composition of the municipal solid wastes are shown in Table 5.8.4. In order to predict the composition of solid wastes that will be collected now and in the future, the following conditions are adopted:

- The ratio of the organic waste in relation to the whole generated waste decreases and that of recyclables increases with the economic growth.
- The ratio of organic wastes and recyclable materials in the total generated wastes in more advanced Asian cities is 50-59% and 34-40%; respectively (see Table 5.8.5).

Table 5.8.4: Physical Composition of Solid Waste

Category	2011	2040
Organic material [kitchen waste, leaves, woods]	80%	55%
Recyclables [paper, glass, plastic, metal]	15%	40%
Others	5%	5%
Total	100%	100%

Source: JICA Study Team

Table 5.8.5: Physical Composition of Solid Wastes in Asian Countries

Category	Bangkok, Thailand *1	Jakarta, Indonesia *2	Malaysia *3
Organic material [kitchen waste, leaves, woods]	50%	59%	51%
Recyclables [paper, glass, plastic, metal]	40%	34%	36%
Others [rubber, textile, other]	10%	7%	13%
Total	100%	100%	100%

Source: *1 Data of Bangkok Metropolitan Administration (2010), *2 Data of Jakarta City (2007),
*3 Data of National Recycling Program of Malaysia (2004)

6) Waste Diversion

Diversion of resources from the solid waste stream in year 2011 is assumed to be 10%, as the recyclable wastes such as plastic, paper, glass, aluminium, and steel are collected by private recyclers. For kitchen waste, it is assumed that waste diversion is pegged around 8% which is realized through conventional practice by the people such as feeding the wastes to domestic animals and land burying or composting.

7) Non-Service Coverage and Illegal Dumping

The ratio of non-service coverage and illegal dumping against total waste generation is assumed based on available data and is shown in Table 5.8.6. The services are to be provided to all waste generators of the targeted types of solid wastes by year 2020 and will be maintained up to year 2040.

Table 5.8.6: Non-service Coverage and Illegal Dumping of Solid Wastes

Category	2011	2018	2020~2040
Domestic waste	30%	7%	0%
Other municipal waste (OMW)	20%	4%	0%

Source: Estimated and set by PCCD-YCDC and JICA study team

(2) Projection of Domestic Waste

1) Projection Model

The future amount of domestic waste can be calculated by multiplying the anticipated unit waste generation rate, the projected population and the percentage collection coverage area. Thus the amount of waste to be collected in the year *i* (*DWi*) is expressed by the following formula:

$$DWi = (WGRi * POPi * SCi)$$

Where, *WGRi* is the waste generation rate (kg/capita/day) in the year *i*.
POPi is the population in the year *i*.
SCi is the service coverage (%) in the year *i*.

2) Waste Generation Rate

Three scenarios are set for waste generation rate (WGR) in the target year considering values obtained in seemingly more advanced Asian cities. In fact, waste generation rate varies by region as well as by country while it is generally regarded that the value increases as a result of economic growth. It is assumed that the value of WGR in Yangon City which is relatively low in year 2011 will reach a certain value similar to those cities. The values are shown in Table 5.8.7.

Table 5.8.7: Waste Generation Rate of Domestic Waste

	Current	2018	2025	2035	2040
Scenario 1	0.396	0.421	0.446	0.482	0.500
Scenario 2	0.396	0.469	0.543	0.648	0.700
Scenario 3	0.396	0.518	0.639	0.813	0.900

Note: Unit is kg/capita/day.
Source: Assumed and estimated by JICA Study Team referring the data in Asian cities shown in the table below.

Table 5.8.8: Waste Generation Rate in Advanced Asian Cities

	Waste Generation Rate		Waste Generation Rate
Malaysia *1	0.50	Delhi *2	0.47
Jakarta *1	0.60	Bangkok *2	0.88
Singapore *1	0.94	Japan *3	0.97

Note: Unit is kg/capita/day.
Source: *1. UNEP (2005), *2. APO (2007), *3. Gov. of Japan (2010)

(3) Projection of Other Municipal Wastes

1) Other Municipal Wastes excluding Thilawa SEZ

The future amount of other municipal wastes which excludes that from Thilawa SEZ is projected based on the assumptions that waste generation increases according to economic growth.

Based on the above assumptions, the amount of other municipal waste to be collected in the year *i* (*OMWi*) is expressed by the following formula:

$$OMWi = OMW_{(i-1)} * (1 + R_i) * SCi = OMW0 * \prod_{k=1}^{i} (1 + R_k) * SCi$$

Where, *OMW0* is the amount of waste collected in the initial year (see Table 5.8.2).
R_i is the growth rate of GDP in the year of *i*.
SCi is the service coverage (%) in the year of *i* (see Table 5.8.6).

2) Industrial Waste (non-hazardous) from Thilawa SEZ

The amount of industrial waste generated in Thilawa SEZ was estimated in the study of Thilawa SEZ by METI. The amount is shown in Table 5.8.9 below.

Table 5.8.9: Amount of Industrial Waste from Thilawa SEZ

Category	2018	2020	2025	2030-2040
Non hazardous	476	793	1,719	2,645
Hazardous	84	140	303	467
Total	560	953	2,022	3,112

Note: 1. Unit is ton/day.
2. Ratio of hazardous (15%) and non hazardous (85%) is decided by referring to the available data in Vietnam
Source: Allocated by JICA Study Team based on the projection by METI study

(4) Projection of Hazardous Industrial and Infectious Waste

The future amount of hazardous and infectious waste is projected based on assumptions which is basically the same as other municipal waste. The assumption is that waste generation increases according to the economic growth. In case of hazardous industrial waste, the amount generated in Thilawa SEZ is added to the estimated amount derived from the above assumptions.

1) Hazardous Industrial Waste (HIW)

The amount of hazardous waste in the base year *i* (*HIWtotal(i)*) is expressed by the following formula:

$$HIWtotal(i) = HIWi + HIWthlw(i)$$

$$HIWtotal(i) = HIW_{(i-1)} * (1 + R_i) + HIWthlw(i) = HIW0 * \prod_{k=1}^{i} (1 + R_k) + HIWthlw(i)$$

Where, *HIW0* is the amount of waste collected in the initial year (see Table 5.8.2).
HIWi is the amount other than Thilawa SEZ in the year of *i*.
HIWthlw(i) is the amount from Thilawa SEZ in the year of *i* (see Table 5.8.9).
R_i is the growth rate of GDP in the year of *i*.

2) Infectious Waste (IW)

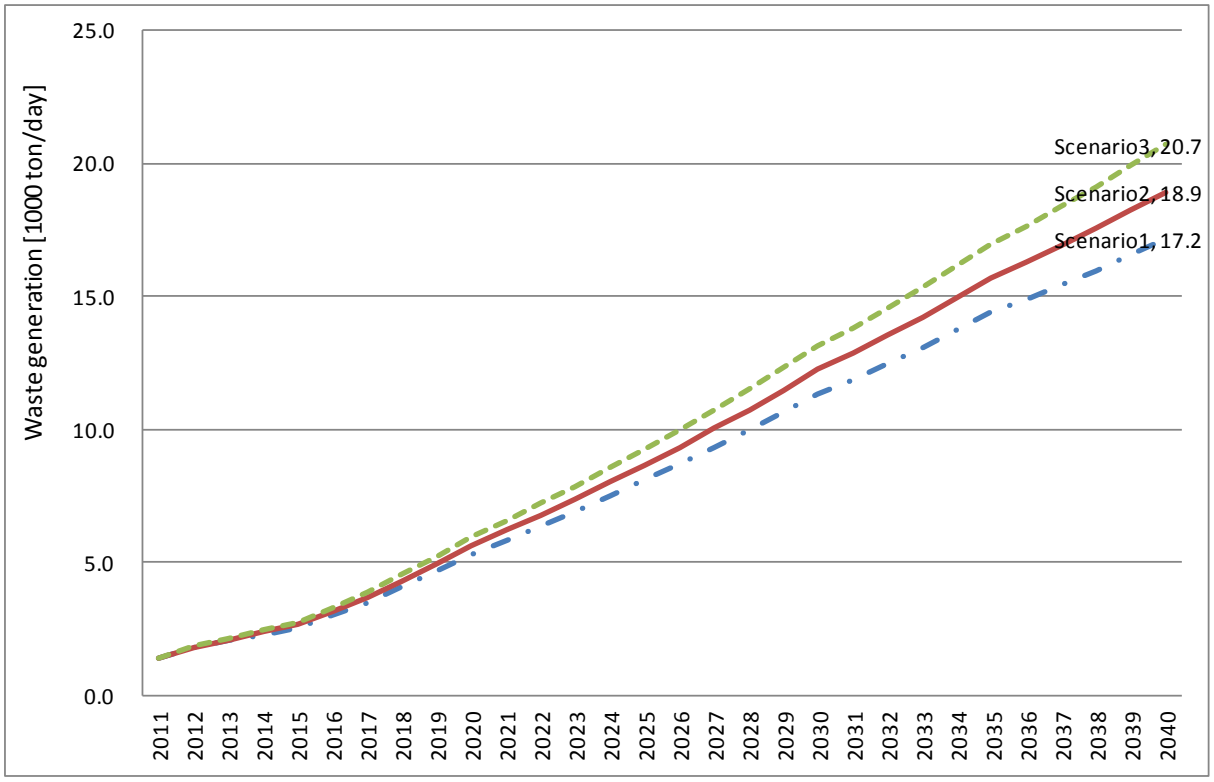
Based on the above assumptions, the amount of infectious waste in the year *i* (*IWi*) is expressed by the following formula:

$$IWi = IW_{(i-1)} * (1 + R_i) = IW0 * \prod_{k=1}^{i} (1 + R_k)$$

Where, *IW0* is the amount of waste collected in the initial year (see table 5.8.2).
R_i is the growth rate of GDP in the year of *i*.

(5) Future Amount of Municipal Solid Waste Generation

The future amount of solid waste generated in the Planning Area is projected as shown in Figure 5.8.2. Generation amount will be around 17-21 thousand ton/day in year 2040 according to various scenarios of waste generation rate.



Source: JICA Study Team

Figure 5.8.2: Future Amount of Solid Waste Generation

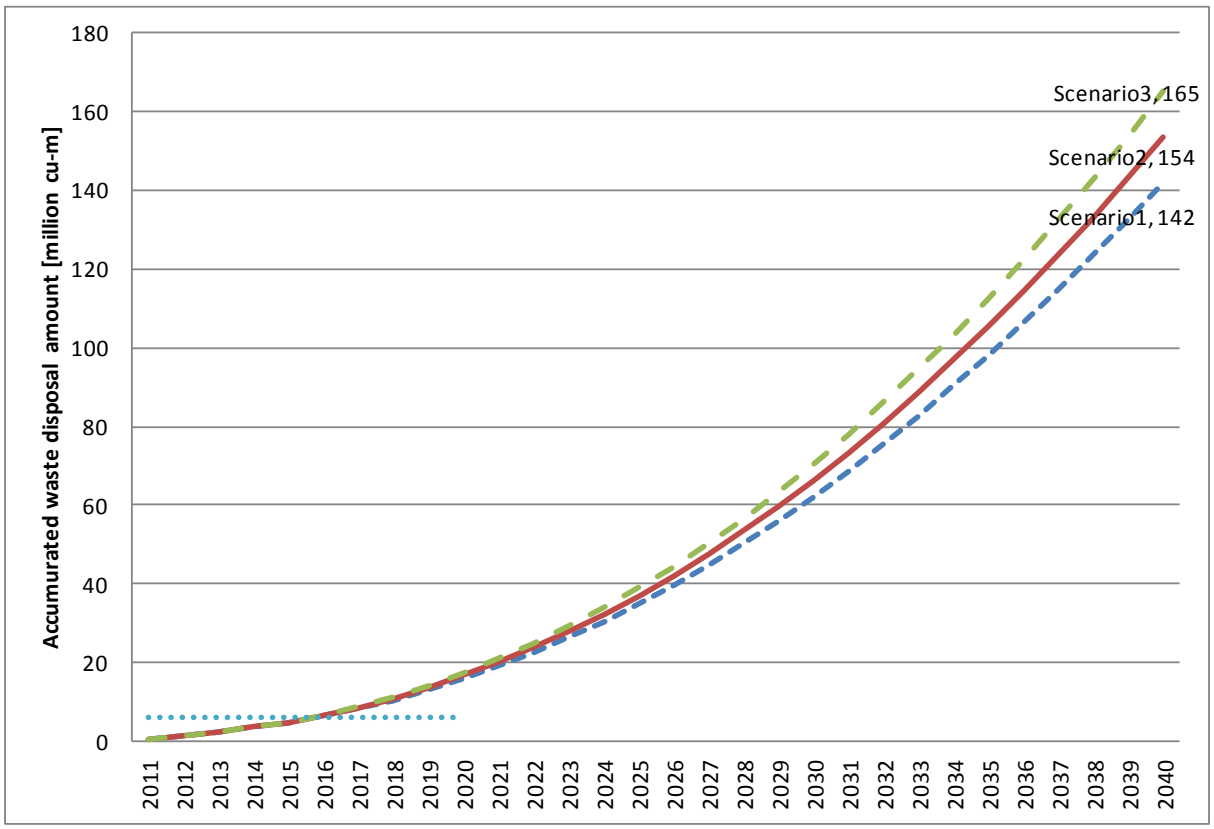
(6) Capacity Demand for the Final Disposal Site without Effect of 3Rs and Treatment Measures

The capacity demand for the final disposal site calculated under the following conditions is shown in Figure 5.8.3.

- The capacity is the accumulated amount of waste generated in the target period [2012-2040].
- Bulk density of waste at final disposal site: 0.8 ton/cu-m
- Amount of soil covering for disposed waste: 20% of dumped waste in volume

The total capacity of the final disposal, not including possible effects of 3Rs (Reduce, Reuse and Recycling) and other intermediate treatment, reaches around 142-165 million cu.m. in all three scenarios. It is estimated that the two existing final disposal sites, namely: Htein Bin and Htawe Chaung, will be full within five years of its operations as the amount of solid wastes to be disposed increases.

It is roughly estimated that more than 20 numbers of sanitary landfills with 100-ha. area is required to secure the final disposal capacity estimated above, if project site has flat terrain and the 15m height of waste layer.



Source: JICA Study Team

Figure 5.8.3: Necessary Capacity of Final Disposal Site by 2040 without Reduction

(7) Demand for the Waste Collection and the Final Disposal with Effects of 3Rs and Treatment Measures

1) Scenario Setting

The reduction in the amount of wastes to be managed by YCDC should be tackled seriously in consideration of the SWM Framework. The estimate shows that quite large area for final disposal would be required in the future unless some measures are taken.

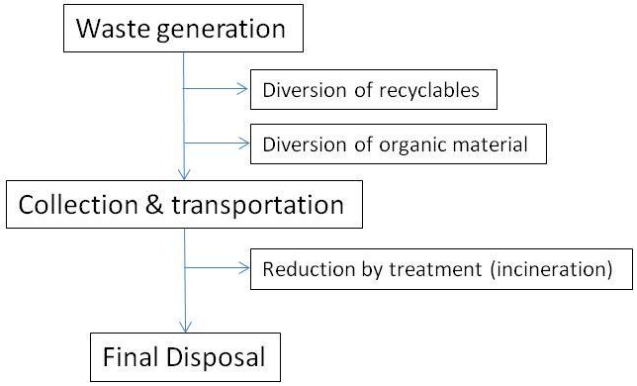
Considering the potential effects of 3Rs and intermediate treatments in the demand analysis of waste amount, four scenarios are assumed for year 2040 which are shown in Table 5.8.10. The diagram considered for the analysis is shown in Figure 5.8.4. The potential amount of waste diversion is shown in Table 5.8.11. These scenario diversions, except by incineration, are set to be carried out at waste generation sources before waste collection, although there are other options in which diversion is done after collection. While there are various diversion measures such as Refuse Derived Fuel (RDF), incineration, bio- gasification, incineration is used for setting one of the scenarios because it is the most effective method in terms of reduction of the final disposal volume.

WGR is set for all scenarios to be 0.700kg/capita/day in year 2040 which is an intermediate value among the three scenarios of WGR set in Table 5.8.7. While the value of WGR in developed cities is more than 0.700kg/capita/day, the value of the Greater Yangon is to remain this level of value through execution of measures for waste reduction such as 3Rs policies and measures which are discussed in section 5.8.3.

Table 5.8.10: Scenario of Effects of 3Rs and Treatment

	Scenario A	Scenario B	Scenario C	Scenario D
WGR-Scenario 2 (0.700 kg/capita/day in 2040) Same percentage of waste diversion as the present (diversion of 10% of recyclable material, 8% of organic material)	Applied	Applied	Applied	Applied
30% diversion of recyclable material from waste generation, 20 points increase in diversion ratio	-	Applied	Applied	Applied
20% diversion of organic material from waste generation, 12 points increase in diversion ratio	-	-	Applied	Applied
85% of reduction of incinerated amount - 50% of collected waste is incinerated from 2025 - 100% of collected waste is treated from 2035	-	-	-	Applied

Source: JICA Study Team



Source: JICA Study Team

Figure 5.8.4: Waste Diversion and Reduction by Treatment

Table 5.8.11: Amount in Waste Diversions

Type of Material	2018	2025	2035	2040
Diversion of Recyclable Materials (ton/day)	843	2,139	5,203	7,071
	15%	20%	27%	30%
Diversion of Organic Materials (ton/day)	619	1,501	3,514	4,714
	11%	14%	18%	20%

Source: JICA Study Team

2) Amount of Wastes with Effect of 3Rs and Treatment Measures

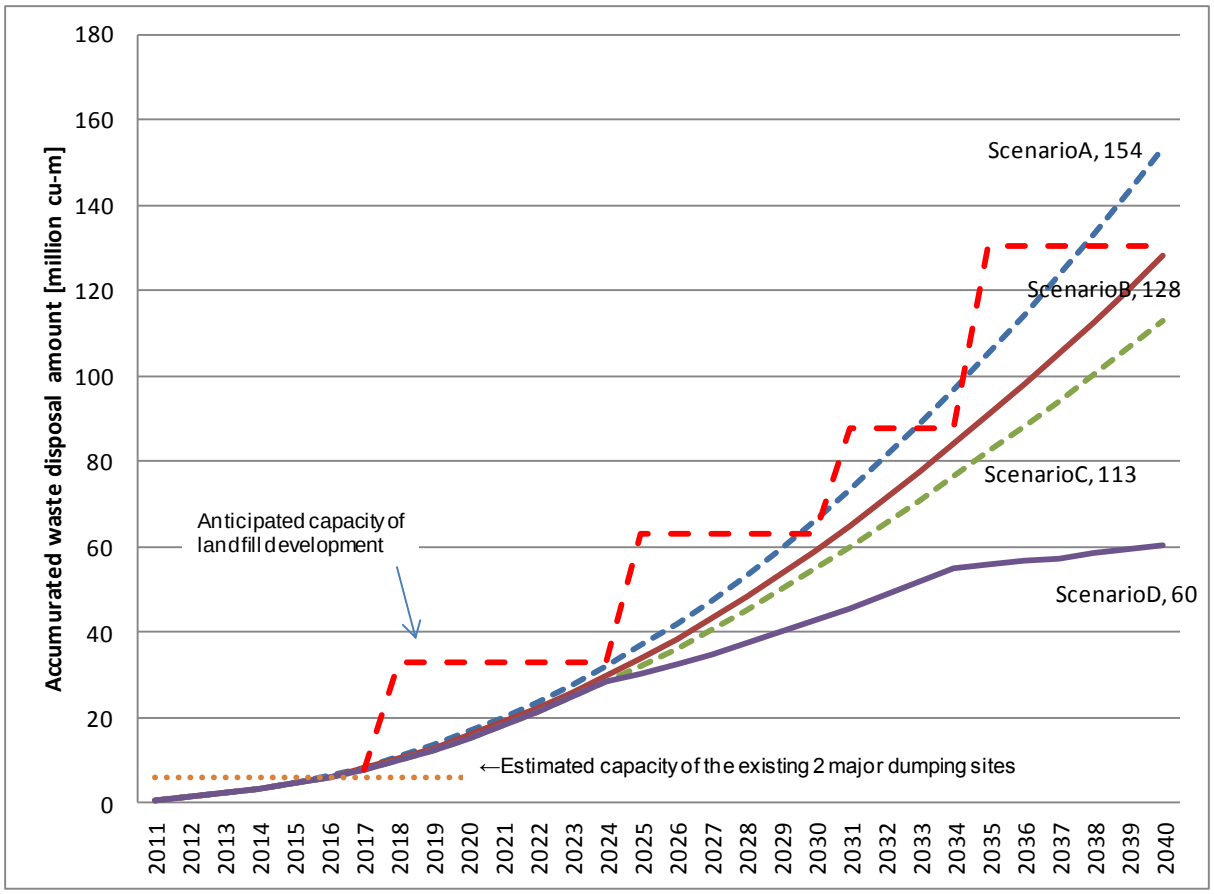
The amount of wastes in the four scenarios is calculated as shown in Table 5.8.12 while the capacity demand for final disposal is shown in Figure 5.8.5. Scenario D offers quite substantial potential reduction of the final disposal amount.

For setting the goals of this development policy, Scenario B, with a contributory effects of around 30% of waste diversion of recyclables is recognized as a base case scenario because 20% of diversion of organic waste and introduction of treatment measures for waste reduction such as incineration have uncertainties due to its high investment and operational costs as of the moment.

Table 5.8.12: Amount of Wastes with Effects of 3Rs and Treatment Measures

		2018	2025	2035	2040
Scenario A	Collection	4,301	8,674	15,687	18,943
	Disposal				
Scenario B	Collection	4,030	7,653	12,520	14,323
	Disposal				
Scenario C	Collection	3,868	7,040	10,620	11,551
	Disposal				
Scenario D	Collection	3,868	7,040	10,620	11,551
	Disposal		4,048	1,593	1,733

Note: Unit is ton/day
Source: JICA Study Team



Source: JICA Study Team

Figure 5.8.5: Capacity Demand of Final Disposal Site by Year 2040 with Waste Reduction (Municipal Waste)

(8) Future Amount of Hazardous Wastes

The amount of hazardous waste is calculated starting year 2018 up to year 2040 and the breakdown is shown in Table 5.8.13. The amount is estimated to be 469 ton/day of hazardous industrial waste and 21 ton/day of infectious waste in year 2040.

Table 5.8.13: Projected Amount of Hazardous Waste

Category	2018	2025	2035	2040
Hazardous Industrial Waste	84.3	304.2	468.5	468.9
Infectious Waste	3.6	7.9	16.8	21.0

Note: Unit is ton/day.
Source: JICA Study Team

5.8.2 Development Policy

A proper SWM, which ensures safe and clean environment to people and encourages them to join a life style with less negative environmental impact, is one of the key components to build the city envisaged in this strategic urban development planning. Revisions in SWM Framework can contribute to realizing and achieving the development visions.

The sector vision of SWM is "creating a city with a sound material cycle through 3Rs policies and its execution." The environmental friendly, a sound material cycle nationwide as well as citywide is to be pursued because this is a necessary and sufficient condition for achieving the sector visions of strategic urban planning such as "a well managed infrastructure city", "a city of good governance" and "a

comfortable city". The idea of sound material cycle is also to be considered in creating "an international hub city" which will encourage smooth transfer and exchange of material as well as people and information.

Sector Vision	**Creating a City with a Sound Material Cycle through 3Rs Policies and Its Execution**
Basic Policy	1) A controlled and sound solid waste stream in sanitary manners 2) Restraint of waste generation and 3Rs (waste reduction, waste reuse, waste recycling) 3) Application of feasible methods of waste management in terms of environment, society, economy and technical aspect

For the improvement of the sector itself as well as for implementation of planned city, an integrated approach to tackle various issues of solid waste is needed. As projected in the previous section, the unit waste generation rate in the Greater Yangon will also increase in parallel with the anticipated growth of the city and its economy while the present situation still needs improvement for creating a sanitary waste stream from generation to final disposal as a basic objective of SWM.

The sector vision is to be achieved through three basic policies to solve middle- and long-term issues, as follows:

1. The first policy is the minimal requirement for safe living environment for the city. The following are considered for deciding applicable measures:
   - Solid waste management system development should be carried out in a way that there is little or no environmental and social impact from generation to final disposal.
   - Waste collection services should be provided and maintained for the whole urban population by the target year.
2. The second policy is a challenge for the next steps required to achieve waste reduction and wise use of natural resources which are intended not only for the present but also for the next generations. The following matters are to be discussed:
   - Waste segregation at the source, which is a waste reduction measure, should be promoted as YCDC envisages.
   - Recent concepts such as Sound Material Cycle Society and Extended Producer Responsibility at the long term of the urban planning should be adopted and introduced.
3. The third policy is to be considered for selecting treatment options in the future. There is a possibility of using new technology of treatment as well as improvement of the existing technologies in the middle and long terms. The optimum options should be selected based on evaluation from the view point of environmental, social, economic and technological aspects.

In addition to the above three aspects, "improvements and enforcements of policy and organizational, personnel capacity" is indispensable as a base for executing the applicable measures.

5.8.3 Development Goals and Target Effect Indicators

Development goals and target effect indicators in year 2040 for evaluation of future development and confirmation of its outcomes are set as follows:

Table 5.8.14: Development Goals and Effect Indicators (Solid Waste Management)

Development Goal	Effect Indicators
a) Solid waste is collected from the living environment of all people and business entities.	The collected amount of municipal waste: 14,000 ton/day (See Table 5.8.12, Scenario B)
b) The operation of 3Rs policies and necessary actions are monitored by YCDC and the monitoring result is shared with the stakeholders.	The diverted recyclable materials from the municipal waste stream: 7,000 ton/day (See Table 5.8.11)
c) Hazardous waste is collected and treated appropriately.	The treated amount of hazardous waste: Hazardous industrial waste: 500 ton/day Infectious waste: 20 ton/day (See Table 5.8.13)

Source: JICA Study Team

5.8.4 Preliminary Development Plan

The outline of the development plan for SWM is illustrated in Figure 5.8.1. The structure and the individual measure of each strategy are described below:

(1) Preliminary Development Plan

The following four strategies are set up to approach the development policy of SWM sector as shown in Figure 5.8.1. Under these strategies, hard and soft measures, system and organizational set-up are combined for forming the preliminary development plan.

(i) A controlled and sound solid waste stream in sanitary manners;

(ii) 3Rs policies and organizational reinforcement;

(iii) Cooperation and coordination with stakeholders; and

(iv) Fair cost allocation and promotion of Public Private Partnership [PPP]

1) A controlled and Sound Solid Waste Stream in Sanitary Manners

Infrastructures play an important role under this strategy compared to other strategies which require regulating, participating and involving the stakeholders such as waste generators and private sectors. It is obvious that the envisaged waste stream cannot be built without appropriate infrastructures even if other strategies can be progressed as expected.

1) Infrastructure

- *Sanitary Landfill*

A sanitary landfill provides as containment of disposed wastes with space isolated from the surrounding environment so that the negative impact of solid wastes can be eliminated. Among several types of landfill system discussed so far, the semi-aerobic landfill is recommended for the Greater Yangon, which requires less operation cost, produces less pollutant in leachate, and requires a shorter period of post closure operation by next use of the site. The facilities shown in Table 5.8.15 have to be developed for the semi-aerobic sanitary landfill.

Table 5.8.15: Facilities of Sanitary Landfill

Category	Facility		Description
Principal facilities	Landfill	Waste disposal facility	Embankment for retaining the solid wastes
		Lining system	Waterproof liner
		Leachate collection facility	Interconnected pipes and surrounded with gravels
	Landfill gas exhaust facility		Distribution of landfill gas exhaust pipes
	Leachate treatment facility		Treatment of leachate before discharge to the environment
	Storm water drainage		Prevention of rainwater flowing into disposal area
	Monitoring facility		Tube Wells for ground water monitoring
Administration	Administration building		Office building and transport/access control station
	Others		Weighing bridge, parking lots
Others	Road network		Hauling road, entrance road, on-site road
	Enclosure facilities		Fence, gate etc.

Source: JICA Study Team

The required capacity of the landfill at its final disposal year 2040 was projected and fully discussed in Section 5.8.1. By comparing the projected ultimate landfill capacity and the estimated remaining capacity of the existing landfill sites, it was found out that additional sanitary landfill sites have to be developed before the onset of year 2016 even if the waste reducing measure would be effective to some extent.

The following Table 5.8.16 shows preliminary evaluation on the new candidate sites for final disposal site selected by YCDC according to criteria shown in the same table. Only Kyi Su site satisfies and meet all the evaluation criteria among the six candidate sites. However, there is a current serious issue on the authority to use the land between YCDC and the people who occupy the Kyi Su site although the YCDC owns this land. This problem must be solved for the landfill development. In case of Maso site, it could be selected but the area is smaller than 100 ha.

Table 5.8.16: Evaluation of Candidate Site of Sanitary Landfill

Name	Area [ha]	Evaluation by criteria								Remarks
		1	2	3	4	5	6	7	8	
Hlaw Gar	40		No	No	No					
Mingalar Done	7		No	No						
Maso	75		No					No		
Kyi Su	100									Issue of use of the area
Dagon Myo Thit	100			No		No				
Dala	240			No					2035~	

Evaluation criteria:
1. Location: within 10 to 40km from the places of waste generation such as the populated area, especially in case no waste transfer stations are developed.
2. Land area of the site: more than 100ha (about 250 acres) is preferable.
3. Distance from nearest residential area: more than 400m
4. Distance from large scale intake facilities from water body for drinking water: more than 1.0 km
5. Distance from the aerodrome facility: more than 13km
6. No existence: Nature conservation area, habitat area of the endangered species of flora/fauna, historical/religious valuable places.
7. Area designated for public facilities and close to public facilities shall be avoided.
8. Availability of access road

Source: JICA Study Team

YCDC should assess new candidate sites to accommodate the huge amount of solid wastes to be collected and disposed of by year 2040. The location of preliminarily proposed final disposal sites is listed in Table 5.8.17. The following assumptions and conditions are considered for the selection of site locations.

i) Waste amount projected as Scenario B for the final disposal capacity.

ii) A sanitary landfill development is proposed in a short-term at the unused plot of the existing Htein Bin dumping site. This would be a pilot project so that YCDC would be able to start learning the sanitary landfill and to operate and maintain its function properly for securing a controlled sanitary solid waste stream.

iii) Amount of solid waste generation in every township: the plural disposal sites are distributed to shorten the distance of waste transportation.

iv) The populated condition and the present land use

v) Accordance with urban development such as the locations of sub-center/town core for non-disturbance to human life and economic activities, the road network for accessibility from generation sources to final disposal sites

vi) Simplification of each landfill size: 100 ha or 200 ha are assumed for most landfills since the actual sites have not been discussed and decided yet except Maso and Kyi Su sites.

vii) Five-year development: While about ten years are preferable for landfill planning, the development sequence are set in every about five years due to huge amount of waste to be disposed of.

Table 5.8.17: Location of Final Disposal Site by 2040 [as preliminary]

Period	2012-2017	2018-2024	2025-2029	2030-2035	2036-2040
Sanitary landfill	-	- Htein Bin (30ha) - Hlaing Tharyar (150ha) - Kyi Su, (100ha) - Thanlyin1, (200ha) - Dala1, 50ha	- Htein Bin 1 (200ha) - Hlegu1, (200ha) - Thanlyin2, (100ha) - Dala2, (100ha)	- Htein Bin 2 (200ha) - Hlegu2, (200ha) - Thanlyin3, (100ha) - Dala2, (100ha)	- Htein Bin 3 (200ha) - Hlegu3, (200ha) - Thanlyin4, (200ha) - Dala3, (250ha)
Open dumping site	- Htein Bin - Htawe Chaung	-	-	-	-
Temporary site (open dumping)	- Mingalardon - Shwe Pyi Thar - Seikgyikhanaungto - Dala	-	-	-	-

Note: 1. Out of sites for 2018~2040, the exact location is identified only for Htein Bin and Kyi Su as of 2012.
2. Anticipated locations are shown in Figure5.8.6~5.8.9.

Source: JICA Study Team

In parallel with the development of a new sanitary landfill, the proper closure of the existing open dumping sites shall be considered with mitigation measures. The negative impact from the disposed waste can be avoided through improvements of present landfill operation to some extent. Necessary improvements of landfill operation are described in Section 5.8.4.1(1), 2).

Since a large area will be required for a sanitary landfill, the location and use after closure of the site should be considered in urban planning. Due to the unstableness of ground after closure of the dumping site, the land use of the closed dumpsite is limited. Examples of land use after closure include: park, farm, parking lot, waste treatment facility, play field, sports ground and storage site. For use of the closed SWM facility, the ground conditions must be checked at the time of designing.

- *Waste Collection Vehicle and Equipment*

Appropriate waste collection and transportation provides safe condition and safeguard of the living environment. The current capacity of waste collection and transportation systems must be checked and, if required, must be expanded immediately so that delay of waste removal and subsequent pollution of the living environment will be eliminated.

The following two actions should be taken as soon as possible together with review of waste collection system proposed as an intermediate or soft measure:

i) Replacement of aged vehicles; and

ii) Reinforcement of maintenance capacity of vehicle and equipment.

In the middle and long terms, the necessary number of vehicle and equipment should be regularly examined and procured in accordance with the updated waste collection and transportation system.

The estimated required number of vehicle for short term development is shown in Table 5.8.18. The conditions shown below are considered.

- Primary collection at narrow streets is carried out by push carts through door to door method as presently practiced. Waste generators put their waste in plastic bags as PCCD instructs currently. Collected wastes are brought to the iron container or temporary waste tank by push carts.
- Compactor trucks replace the old trucks used for secondary collection from temporary waste tank and transportation to the final disposal sites. The size of compactor trucks is assumed as similar capacity of the old vehicles currently used.
- Compactor trucks with the loading device collect waste from plastic waste bins placed on the curbside. The locations of plastic waste bins must be reviewed and replaced so that the compactor truck can access these locations.
- Iron container hauled by the arm-roll truck, which has the largest capacity of the present transportation system, are still in use until year 2018

Table 5.8.18: Necessary Number of Vehicle and Equipment (Year 2018)

Compactor truck, 5ton	Compactor truck, 10ton	Arm-roll truck	Iron containers, 25 m^3
50	40	20	30

Source: JICA Study Team

- Waste Transfer Station

In the waste transfer system, the solid waste hauled by smaller vehicle is replaced by a larger capacity vehicle or containers. The current practice observed in Yangon City, which is transfer from push carts and small trucks to iron containers, is recognized as a small-scale of waste transfer at the waste transfer station. The compressing system of solid waste at the transfer station which increases the secondary transferring capacity is assumed for the Greater Yangon.

Utilization of the waste transfer station is effective when transportation distance becomes long. A sanitary landfill tends to be located at a remote place from the populated area, as the urban area expands largely in the middle and long terms.

Since this facility promotes efficiency of transportation rather than sanitary waste stream, its development is considered in the middle, and long terms of the planning. From the viewpoint

of effectiveness of transportation, the location of transfer stations should be near the area where waste is generated. The preliminary plan for development of the waste transfer stations are shown in Table 5.8.19.

Table 5.8.19: Location of Waste Transfer Station [as preliminary]

Period	2025-2034	2035-2040
Location	- Site in the eastern side (such as Ale Yea (the closed dumping site)) - Site in the western outer ring zone (Kamayut or Hlaing township)	
Operation capacity	800 ton/day each	1,200 ton/day each (Capacity expansion)

Note: Anticipated locations of the facility are shown in Figure5.8.6~5.8.9.
Source: JICA Study Team

- *Treatment Options*

Method of waste treatment should be carefully examined and selected because there are various technical options which have both merits and demerits. An optimal option must be different depending on the economic, social situation and policy of the city in the future. Comparison of treatment options are show in Table 5.8.20.

While incineration has strong merit of waste reduction as analyzed in the previous section, the feasibility of this option should be carefully checked in consideration of the cost of investment and operation as well as necessary skills for the operation. In fact, advanced Asian cities such as Bangkok, Jakarta have not adopted this technology for treatment of municipal waste, while it is adopted in some cities in China.

While a material segregation facility after collection is also an option to be considered in the development concept, it is not adopted because there is a possibility to promote material recovery at source before waste collection, which offers an advantage to reduce waste collection. It is assumed that material recovery at generation source could be promoted and enhanced through setting policies and regulation identifying obligation of waste generators.

Table 5.8.20: Options of Waste Treatment

	Merit	Demerit	Remarks
Incineration	- Effective for sanitization of wastes - Effective for reducing waste volume - Potential of heat recovery as energy source	- High investment and operation cost - High skilled operation - Not applicable for low calorie waste	- Technically reliable
Bio-gasification	- Utilization for organic waste results in reducing waste disposal - Recovery of bio-gas as renewable energy	- High investment and operation cost - Not applicable for mixed waste with organic and inorganic - High skilled operation	- Rare case of large scale plant
Refuse Derived Fuel	- Product for thermal recycling - Expected demand for fuel	- The quality as fuel is not high derived from mixed waste	- Stable demand of this type of fuel is to be confirmed.
Large scale composting	- Utilization of organic waste results in reducing waste disposal - Less investment and less operation cost - Simpler operational methodology	- Difficulty in keeping good quality of product - Negative impression of consumers to waste derived product - Competition with low price chemical fertilizer - Less demand of produced compost in urbanized area	- The use of the product such as soil cover on waste is an alternative.

Source: JICA Study Team

- *Hazardous Waste Treatment*

Hazardous waste including infectious waste from medical activities and toxic waste from industries must be treated separately from municipal waste because of its nature.

In developed countries, these wastes are strictly managed under the Polluter Pay Principle, thus, the waste generators must have responsibility for its management. Although the polluter pay principle should be reinforced in Yangon City as well, considering the present practice of treatment/disposal, capacity of private sector for the management, and anticipated increasing amount of this kind of waste, it may be a practical solution to enhance the capacity of YCDC in a short term. The necessary capacity of treatment facilities are shown in Table 5.8.21.

It should be considered that a pilot incineration facility be developed in the short term after capacity development of YCDC for operation and maintenance of this type of facility in order to accelerate improvement for this management required for tacking the anticipated volume of these waste. As previously mentioned, relatively high operation skill and cost is needed for an incinerator. Nevertheless, the management of hazardous waste is to be improved to protect living environment of the people of the Greater Yangon. The candidate site for the pilot facility is assumed at the unused plot of Htawe Chaung existing dumping site.

In middle and long terms, private business must be developed for the management of hazardous and infectious waste and YCDC is expected to function as the regulating authority. The locations of facilities are assumed to be located at the closed dumping site or besides the final disposal site in operation in future.

Table 5.8.21: Hazardous Waste Treatment Facility[as preliminary]

Facility	Location as tentative	2018-2024	2025-2034	2035-2040
Incinerator for hazardous industrial waste	Htawe Chaung	100 ton/day		
	Site beside the eastern Transfer Station	-	500 ton/day	
Incinerator for infectious waste	Htein Bin	-	15 ton/day	15 ton/day
	Thanlyin	-	-	10 ton/day

Note: Anticipated locations of the facility are shown in Figure5.8.6-5.8.9.
Source: JICA Study Team

- *Facility for Environmental Monitoring*

The facility for environmental monitoring especially for SWM sector is not necessarily required. However, considering the fact that one of the responsibilities of PCCD is pollution control and inspection of possible pollutants sources including industry and other business, permanent facility for this purpose such as a laboratory should be developed under YCDC.

2) Soft measures

- *Review and Update of Waste Collection System*

Present system of waste collection is very time consuming, both in primary collection by push carts and in secondary collection from temporary waste tanks by vehicles. Considering the narrow roads at present, collection by push carts cannot be replaced by other method for the time being. In accordance with changing conditions of collection area, the collection method and collection system should also be reviewed and updated.

- *Improvement of Operation of Final Disposal Site*

Table 5.8.22 below shows the possible improvements that may be implemented at the present dumping sites. The negative impact to the environment would be lessen through these

improvements for a while since developing sanitary landfill takes some time, from the design phase until completion of the construction phase. These practices are also to be carried out at the developed sanitary landfills.

Table 5.8.22: Improvement applicable at the Present Final Disposal Sites

Component	Actions for improvement
Access Control	1. Strict control of access by outsiders to the site
Landfill Planning	2. Estimate and review of necessary capacity of landfill based on the record of waste amount
Operation Planning	3. Setting waste hauling hours to landfill for better management
Regular operation	4. Burying of waste and compaction 5. Soil cover on the disposed waste
Safety Control	6. Safety training of staff
Environmental and social consideration	7. Monitoring of the quality of leachate and water quality surrounding water body including ground water
Budget Estimation	8. Precise record of income and expenses for planning

Source: JICA Study Team

- *Inspection for Illegal Dumping*

Raising of awareness and environmental education of people and business owners are not enough for controlling illegal dumping. Reinforcements of inspection and detection system are also necessary for the vicious dumping.

In addition to regular inspection by YCDC, cooperation with police and reporting system by citizens should be promoted.

- *Reinforcement of Hazardous Waste Management*

Management of hazardous waste which requires special attention different from municipal waste is not well regulated in Myanmar as well as YCDC while basic system of municipal waste is stipulated in the YCDC by-laws (Order No.10/99).

The MOECF is going to prescribe hazardous material that is its responsibility stipulated in Environmental Conservation Law 2012. The requirements in managing hazardous wastes are expected to be reinforced gradually at national level. Nevertheless, the YCDC should take care of controlling this type of waste for safety of its citizens.

As for infectious waste mostly generated from hospitals, initiative by the Ministry of Health (MOH) for its management is necessary as the ministry in charge of medical sector. YCDC should coordinate with the ministry to promote proper management of infectious waste.

2) 3Rs Promotion and Organizational Reinforcement

The amount of waste can be reduced through execution of 3Rs (waste reduction, reuse and recycling), which may result in reduction of investment and operation cost, and better utilization of natural resources.

The recycling plant which YCDC presently operates which makes several products is considered as a kind of demonstration to initiate recycling in Yangon City but it is actually not profitable. Since the recycling is one of economic activities, its operation should be handed over to the private sector in the long run.

1) Soft measures

- *Update the Regulation on SWM [an amendment of by-law(s)]*

The By-laws of Pollution Control and Cleansing (Order No.10/99) is being discussed for amendment. In the amendment, the concept and necessity of promotion of 3Rs in SWM and life of citizens of Yangon is to be mentioned for reduction and restraint of solid waste generation.

- *Policy and Regulations to Promote 3Rs*

Materials recovery and recycling activities are carried out in Yangon City mainly by private sectors. Individual waste pickers and small scale recycling shops supports this system. In order to support this system by YCDC, policies and regulation related to 3Rs should be discussed and prepared before the current system face some difficulties for continuation. It has been observed in other countries, as the economy grows, generation of certain type of waste exploded and operation of recycling system which used to rely on cheapest labor force broke down. The examples of policy and regulation of 3Rs are shown in Table 5.8.23.

Table 5.8.23: Examples of 3Rs Policies and Regulations

3Rs Policies and Regulations	Description
Recycling act	Set the target rate of recycling rate for specific product. Define the responsibility of the concerned bodies in recycling.
Green procurement	Require use and procurement of eco-friendly product
Eco label certificate	Certificate environmental friendly, less impact, less waste generating product. The certified products are sold with indication of Eco-label.

Source: JICA Study Team

- *Economic Instrument*

Economic instruments for SWM are classified into two types; one is for charges and the other for incentives. The examples of these types of measures are shown in Table 5.8.24. These measures stimulate behavior change of waste generator through awareness of its economic merit.

Table 5.8.24: Examples of Economic Instrument for 3Rs

Measures	Description
Environmental tax	Tax on the factors which give negative impact on the environment. The revenue of tax is disbursed only for environmental protection purpose including SWM
Pay as generates	Waste service fee is decided by how much waste is generated by the beneficiary of the service.
Charge on the use of plastic bags	Charges on the use of plastic bags adopted at the shopping malls as a symbol of one-way product
Incentive for waste reduction	For example, tax exemption to the companies contributing waste reduction or other activities for SWM and 3Rs

Source: JICA Study Team

- *System and Tools for Capacity Development for Personnel*

Regular and continuous capacity development system is necessary for improvement and upliftment of the concerned personnel. Although this is normally being carried out at the actual working place at present, formulating the system and development of tools would make differences in awareness of the personnel.

It is perceived that personnel will understand the importance of their work and be proud of their work and performance for public health and safety of life.

- *Data Management*

The PCCD as well as YCDC have accumulated a lot of data of SWM and these are very useful for understanding the situations of SWM and planning for the future. The data on the amount of waste, operation of vehicle and equipment and financial matters should be continuously accumulated and digitized for analysis and other utilization.

3) Cooperation and Coordination with Stakeholders

While 3Rs policies and regulations mentioned in the previous section are a kind of approach to stakeholders, the approaches encouraging their active participation should be implemented.

1) Infrastructure

Large scale infrastructure is not necessarily required for this aspect. Anticipated facilities are as follows:

- *Public Relations Facility*

This facility may be used not only for SWM but for other aspects handled by YCDC such as information dissemination, public relation activities and getting feedback from people and other stakeholders.

- *Information Facilities for 3Rs and the Related Activities*

This is the facility for information exchange between communities, NGOs and individuals who are dealing with grass roots and community activities. The expected role of YCDC is to facilitate and encourage communication and activities.

It may offer space for events such as flea markets, exchange of used products, and training for handicraft making using reused material.

2) Soft measures

- *Reinforcement of Public Relations carried out by YCDC*

Public relation by PCCD should be reinforced through coordination among the different departments of YCDC such as the Public Relations and Information Department. The PCCD in-charge of the SWM can make use of the experience and knowledge of other departments and encourage information exchange among YCDC personnel.

- *Environmental Education Program toward a Sound Material Cycle Society*

The PCCD is currently carrying out presentations at schools covering environmental protection, solid waste management, global warming, etc. The subjects of presentation are to be updated in accordance with the policies of PCCD and YCDC. The target group and methodologies are also to be reviewed and examined so that the purpose of the environmental education program may be achieved.

- *Incorporate Education and Public Enhancement in Regular Curriculum*

Environmental deterioration as worldwide common issue has to be mentioned in the regular curriculum. Inputs from YCDC into regular education about environmental problem may be helpful for localization of this issue and understanding to teachers and students. At the same time, YCDC could make use of teachers' skill of education and communication with students.

- *Coordination with NGOs and Waste Pickers*

Presently, the coordination among the environmentally oriented NGOs and waste pickers or recycling shops that collects recyclables should be considered for promotion of 3Rs. Their voluntary efforts or unselfish motives for improving living conditions would be effective, sustainable and influential to others.

- *Subsidy to Community Activities*

Subsidy system would be effective in encouraging community activities and stimulating motivation to participation in such activities. For example, subsidies to activities such as recyclable material collection and recovery by community and that to community level composting are anticipated.

- *Promotion and Maintenance of Market and Network of Reuses*

A lot of second hand products and materials are presently available and marketable in Yangon City. This material cycle should be promoted and maintained so that a sound cycle material society would be created in the future. The system involving stakeholders in maintaining the market is required; otherwise, the cycle might be cut as the economy grows.

4) Fair Cost Allocation and Promotion of PPP

Specific hard infrastructures are not necessary for this component. Infrastructures which may be necessary in privatization of SWM are covered and described in the first strategy.

1) Soft measures

- *Review and Update of Waste Fee System*

In a short term, waste fee charged to households and business entities and method for fee collection should be reviewed so that income from waste service fees can be increased. Especially, renovation of fee collection method needs to be reinforced because collection rate is very low. The calculated amount of potential waste fee collection from household according to the number of households in year 2012 and present tariff table is MMK 3.72 billion which is more than five times of the total income in year 2011. This implies big potential of income increase by improving fee collection rate.

As for the amount of waste fee to household, possibility of acceptance of higher amount than those shown in Table 2.3.77 (ex. MMK 600/household/month for CBD is maximum for household) was implied in the result of HIS. About 21% of respondents replied that their household might accept more than MMK1,000/month and another 27% might accept MMK 500-1,000/month. This is another potential for improving financial status of SWM operation.

- *Privatization of Operation of SWM*

Though the regulation of Public Private Partnership (PPP) has not been prepared yet in Myanmar, YCDC envisages PPP for service sectors including SWM.

YCDC used to outsource waste collection and transportation to private sectors but it was stopped due to unsatisfactory performance of the contractor. In order to utilize private sector for operation of SWM again, the responsibility of the concerned parties should be carefully defined. Also, capacity of monitoring and inspection by PCCD should be improved beforehand.

- *Cost sharing to promote and support 3Rs and Sound Material Cycle*

At present, Polluter Pay Principle has not been commonly adopted in Myanmar and the polluters are not required to bear expense matching to pollution because regulations on this issue are not well organized yet. This situation is the same in generating solid waste either non-hazardous or hazardous. The manifest system can be adopted for chasing the record of treatment and disposal waste from private businesses whereby the kind of waste, waste generators, and all steps from generation to disposal are registered in the system.

Cleaner production methods which produce less or zero pollutants in all processes of production should be promoted as well.

5) Organization concerned for Development of SWM

The organizations concerned with SWM development and their responsibilities are summarized in Table 5.8.25. The PCCD of YCDC should continue to take the most important and biggest role which include upgrading sanitary waste management, regulating/leading private business/industry and promoting 3Rs policies and activities in this sector of the Greater Yangon and in the future as well.

In the short term development, the expansion of administrative jurisdiction of YCDC as well as the PCCD is proposed to manage the vast amount of solid wastes to be generated in Thilawa SEZ.

Table 5.8.25: Concerned Organization and Roles

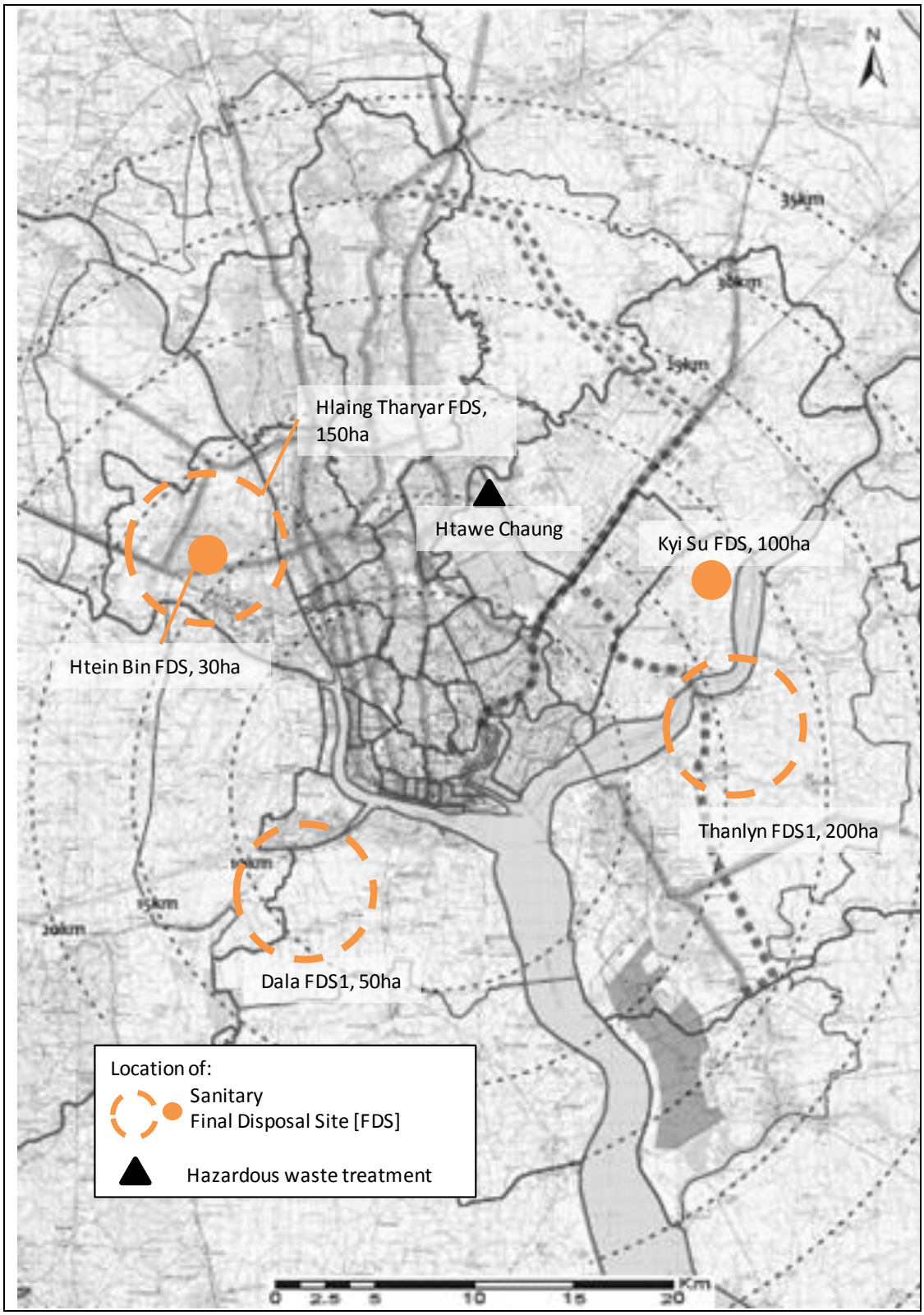
Organization/ Entity	Role and Responsibility
Ministry of Environmental Conservation and Forestry	Preparation of law and regulation for SWM and promotion of 3Rs. Since the operation of SWM is at cities' or townships' development committee, the coordination and feedback to the ministry must be useful for development of the sector.
Ministry of Health	This ministry should take initiative in management of infectious wastes which is mostly generated in hospital since operational procedure in hospitals is decided by the ministry.
Ministry of Electric Power	There is possibility of electric power generation at the waste incineration. The rule and guideline for power generation and its sales should be decided by the ministry.
Ministry in charge industry	Preparation of law and regulation for promoting and regulating recycling industry.
Engineer Dept., YCDC	The Engineer dept is expected to support the PCCD for development of large facilities such as sanitary landfill, transfer station, and treatment facilities.
Public Relations and Information Dept., YCDC	The public relation and information dept is to be involved for promotion of 3Rs activities of citizens, execution of environmental education, and other public relations activities.
Dept in charge private business, YCDC	Preparation of by-laws for promoting and regulating recycling industry.
PCCD, YCDC	PCCD is in charge of operation of SWM and 3Rs. The department should expand their function of inspection for pollution control to the performance of the private contractors or partners, once operation of SWM is privatized.
Private business entity	Private business owners are one of major actors to develop SWM sectors. Their compliance to SWM and 3Rs regulation to be issued will contribute and support the operation of SWM. Private sectors are expected to be a part of SWM operator under PPP mechanism to be developed as well.

Source: JICA Study Team

(2) Infrastructure Layout

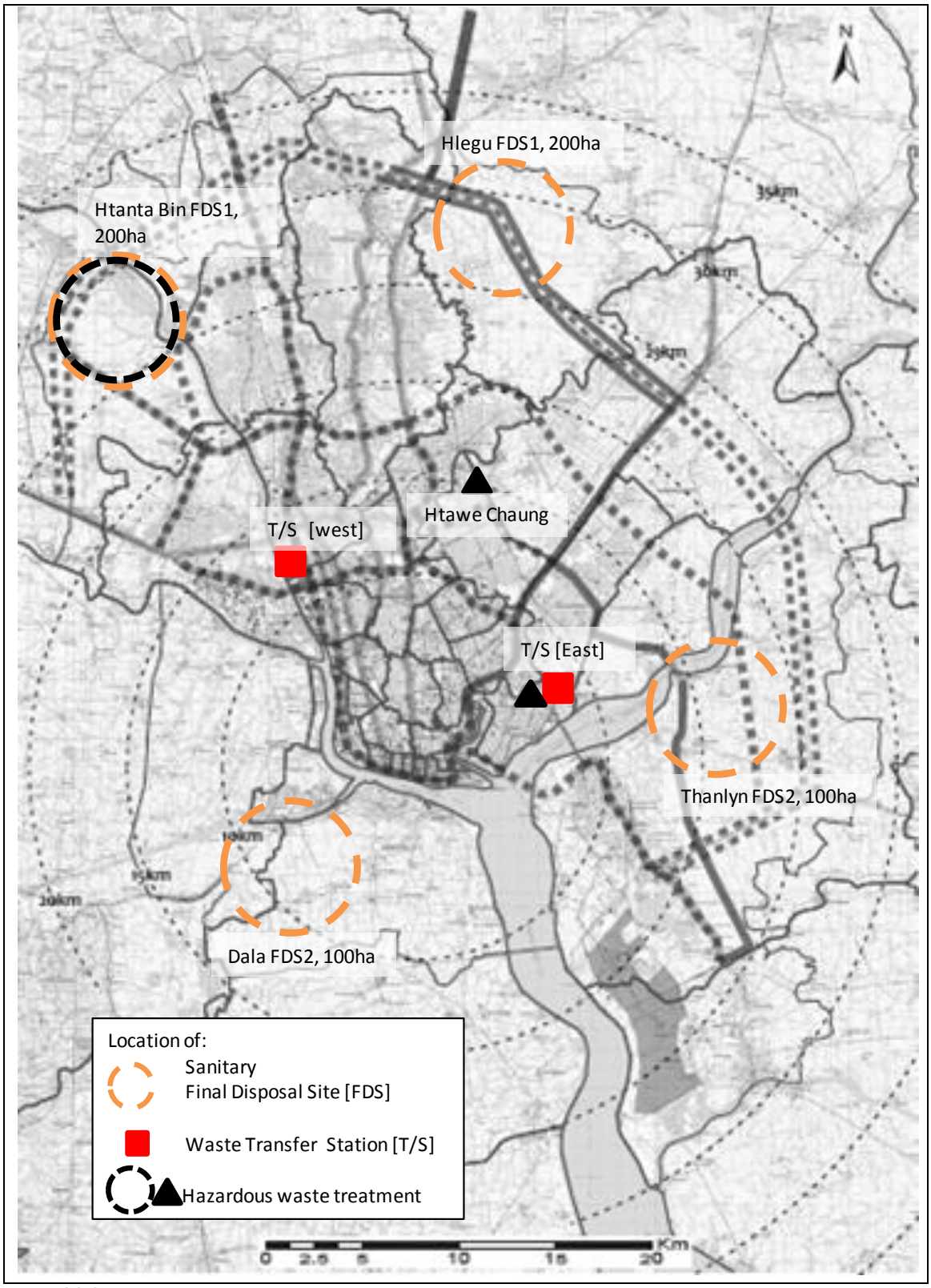
The proposed short-, middle-, and long-term layout plans of SWM facilities are shown in Figures 5.8.6-5.8.9. In the layout plans, the necessary number and location of the final disposal sites to meet the full capacity of the landfill-final disposal as projected in Section 5.8.1 and shown in Figure

5.8.5 as Scenario B. No intermediate treatment facilities for municipal waste (non-hazardous) are specified in the layout because detailed analysis is to be conducted in order to decide appropriate technologies.



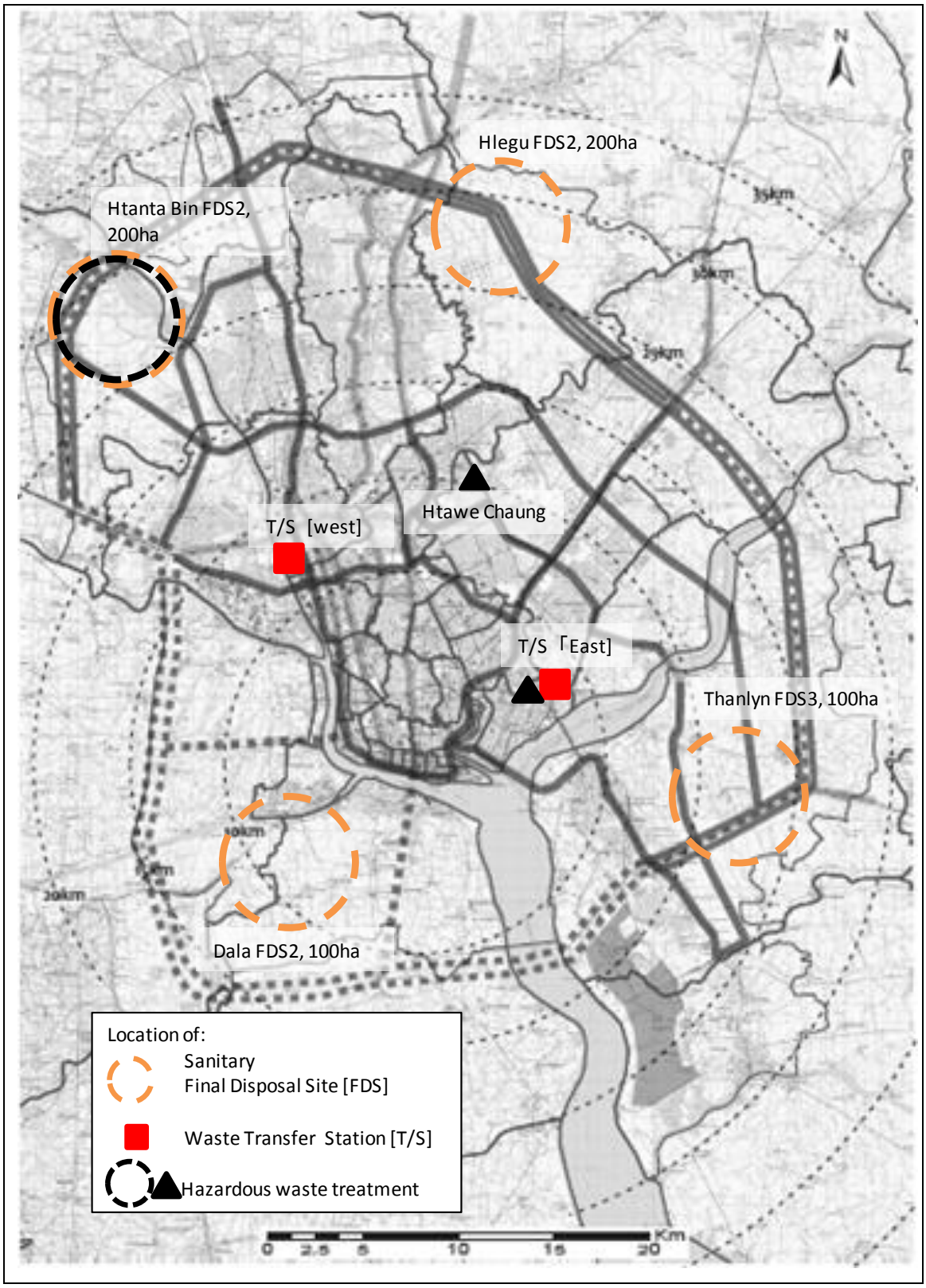
Source: JICA Survey Team

Figure 5.8.6: Short-term Infrastructure Layout Plan (Target Year: 2018-2024)



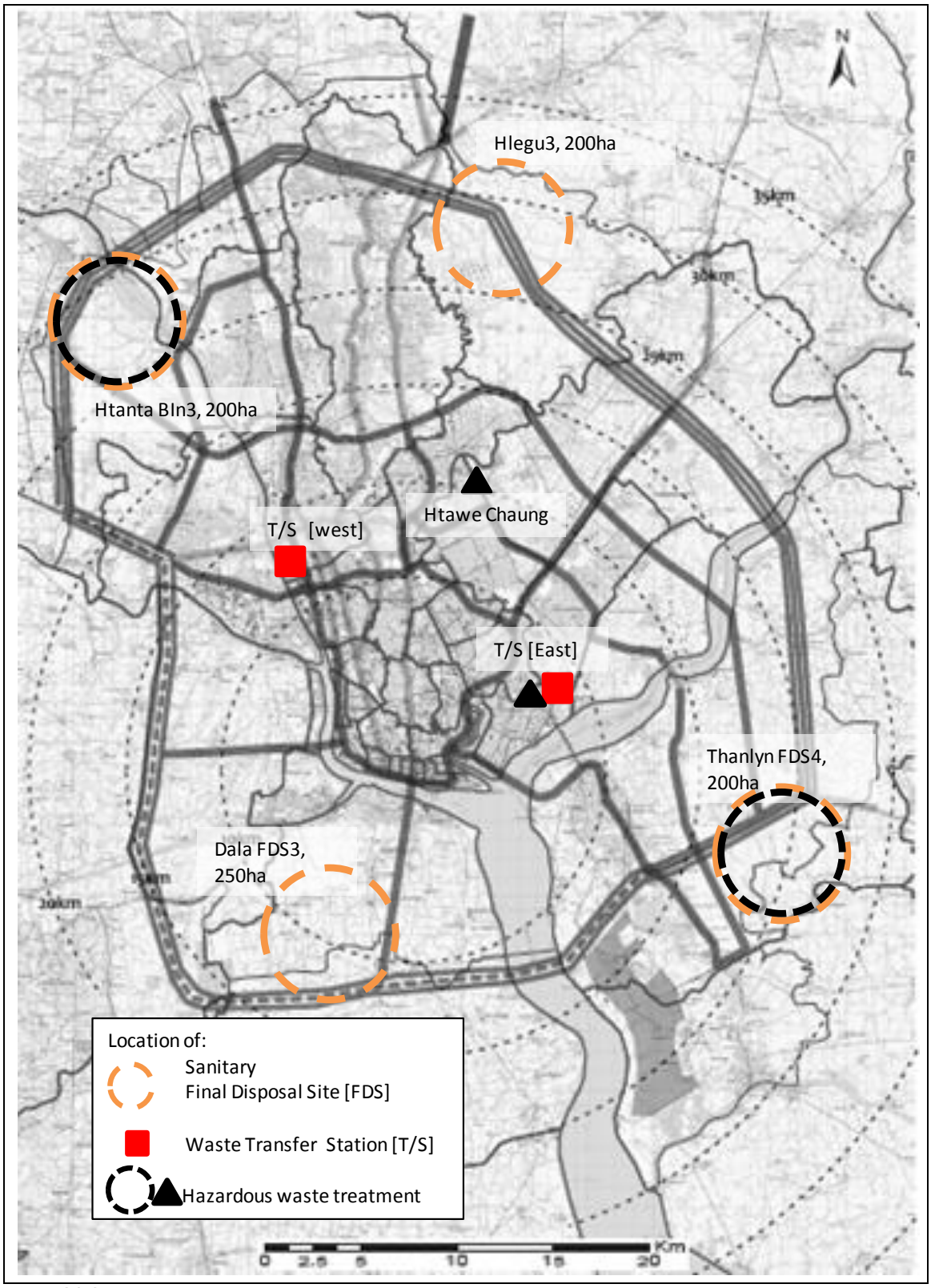
Source: JICA Survey Team

Figure 5.8.7: Middle-term Infrastructure Layout Plan 1 (Target Year: 2025-2030)



Source: JICA Survey Team

Figure 5.8.8: Middle-term Infrastructure Layout Plan 2 (Target Year: 2031-2034)



Source: JICA Survey Team

Figure 5.8.9: Long-term Infrastructure Layout Plan (Target Year: 2035-2040)

(3) Implementation Schedule

The basic principles for three terms of development are shown in Table 5.8.26. Following these principles and necessary time for designing, tendering procedures and constructions, the implementation schedule is illustrated in Figure 5.8.10.

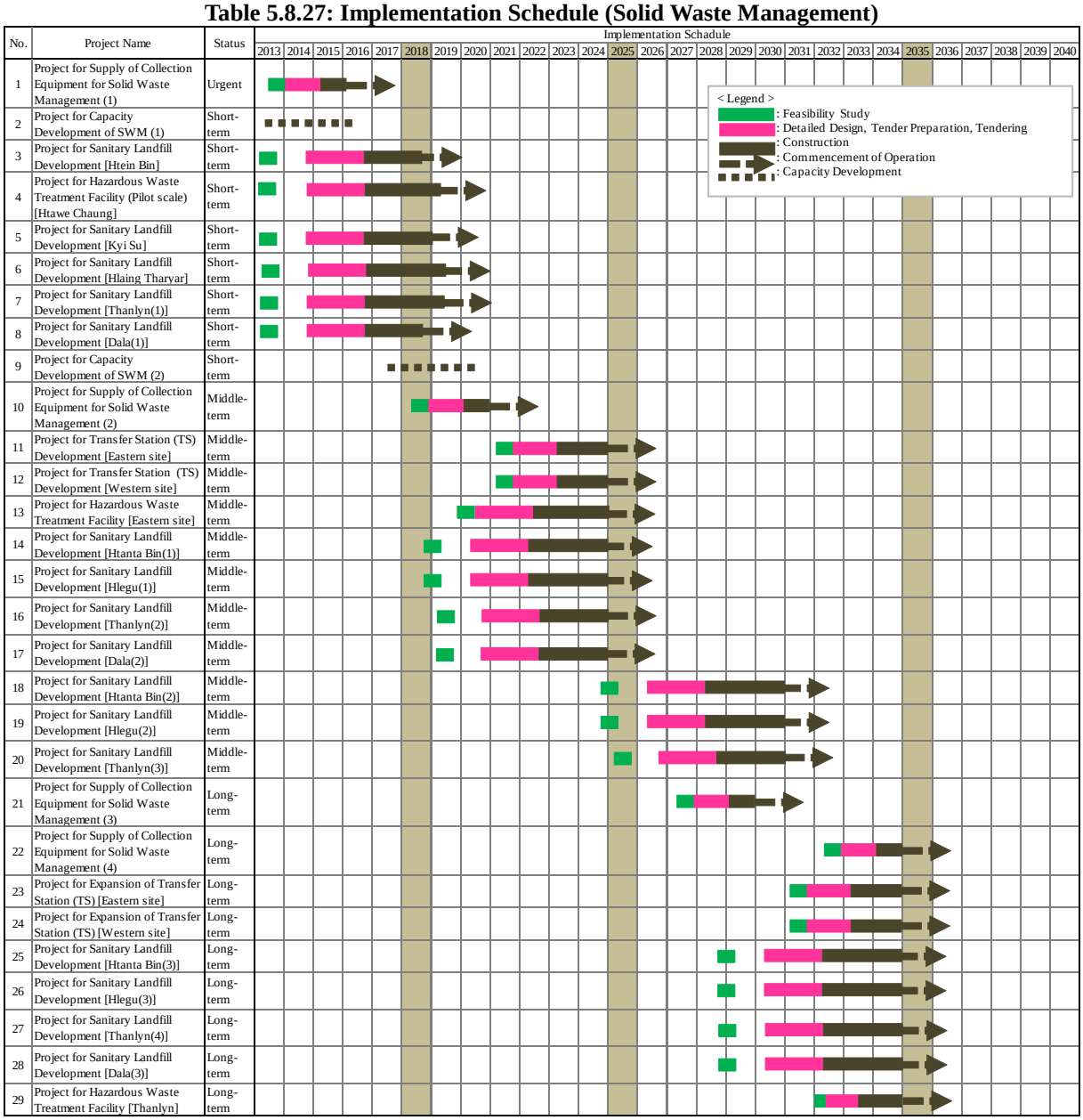
Table 5.8.26: Basic Principle for time-wise Development

Term	Basic principle	A Controlled and sound solid waste stream in sanitary manners	Cooperation and coordination with stakeholders	3Rs promotion and organizational reinforcement	Fair cost allocation and promotion of PPP
Short term [2018]	・Enhancing measures to solve the existing problems ・Policy setting and organizational improvement for middle term development ・Development of personnel [Ensure the sanitary solid waste stream]	・Replace of aged vehicles ・Review of waste collection system ・Improvement of landfill operation ・development of sanitary landfill ・Hazardous waste treatment facility ・Capacity development of maintenance of vehicle and equipment ・Environmental monitoring	・Coordination among departments of YCDC ・Review of the existing recycling system including recycling shops ・Enhancing the recycling system ・Coordination with NGOs [Environmental education program etc.]	・Development and update of regulations for SWM ・Preparation of the integrated master plan of SWM ・Capacity development of personnel ・Reinforcement of data management	・Review and update of waste fee [household, private entities] ・Review and update waste fee collection system
Middle term [2025]	・Infrastructure required for middle-term urban planning ・Development of facility and equipment to meet the increased waste generation ・Preparation and execution of 3Rs policies （Infrastructure to meet the increased waste generation according to economic growth and city expansion, restrain waste generation through 3Rs policies and its execution]	・Procurement and regular replacement of collection vehicles ・Development of transfer station ・Development of sanitary landfills and treatment facility for districts	・Environmental education in regular curriculum ・Coordination with NGOs for reduction and utilization of waste	・Preparation and execution of 3Rs policies [requirement to private business and industry]	・Execution and monitoring of the updated waste fee system ・Privatization of waste collection, landfill operation and operation of treatment facilities
Long term [2035]	・Infrastructure required for long-term urban planning ・Regional system for solid waste management	・Procurement and regular replacement of collection vehicles ・Development of transfer station ・Development of sanitary landfills and treatment facility for districts	・Promotion of community program ・Private participation to the environmental education program	・Introduction of the extended producer's responsibility	・Promotion of cleaner production

Source: JICA Study Team

Table 5.8.27: Implementation Schedule (Solid Waste Management)

No.	Project Name	Status	Implementation Schedule
1	Project for Supply of Collection Equipment for Solid Waste Management (1)	Urgent	
2	Project for Capacity Development of SWM (1)	Short-term	
3	Project for Sanitary Landfill Development [Htein Bin]	Short-term	
4	Project for Hazardous Waste Treatment Facility (Pilot scale) [Htawe Chaung]	Short-term	
5	Project for Sanitary Landfill Development [Kyi Su]	Short-term	
6	Project for Sanitary Landfill Development [Hlaing Tharyar]	Short-term	
7	Project for Sanitary Landfill Development [Thanlyn(1)]	Short-term	
8	Project for Sanitary Landfill Development [Dala(1)]	Short-term	
9	Project for Capacity Development of SWM (2)	Short-term	
10	Project for Supply of Collection Equipment for Solid Waste Management (2)	Middle-term	
11	Project for Transfer Station (TS) Development [Eastern site]	Middle-term	
12	Project for Transfer Station (TS) Development [Western site]	Middle-term	
13	Project for Hazardous Waste Treatment Facility [Eastern site]	Middle-term	
14	Project for Sanitary Landfill Development [Htanta Bin(1)]	Middle-term	
15	Project for Sanitary Landfill Development [Hlegu(1)]	Middle-term	
16	Project for Sanitary Landfill Development [Thanlyn(2)]	Middle-term	
17	Project for Sanitary Landfill Development [Dala(2)]	Middle-term	
18	Project for Sanitary Landfill Development [Htanta Bin(2)]	Middle-term	
19	Project for Sanitary Landfill Development [Hlegu(2)]	Middle-term	
20	Project for Sanitary Landfill Development [Thanlyn(3)]	Middle-term	
21	Project for Supply of Collection Equipment for Solid Waste Management (3)	Long-term	
22	Project for Supply of Collection Equipment for Solid Waste Management (4)	Long-term	
23	Project for Expansion of Transfer Station (TS) [Eastern site]	Long-term	
24	Project for Expansion of Transfer Station (TS) [Western site]	Long-term	
25	Project for Sanitary Landfill Development [Htanta Bin(3)]	Long-term	
26	Project for Sanitary Landfill Development [Hlegu(3)]	Long-term	
27	Project for Sanitary Landfill Development [Thanlyn(4)]	Long-term	
28	Project for Sanitary Landfill Development [Dala(3)]	Long-term	
29	Project for Hazardous Waste Treatment Facility [Thanlyn]	Long-term	



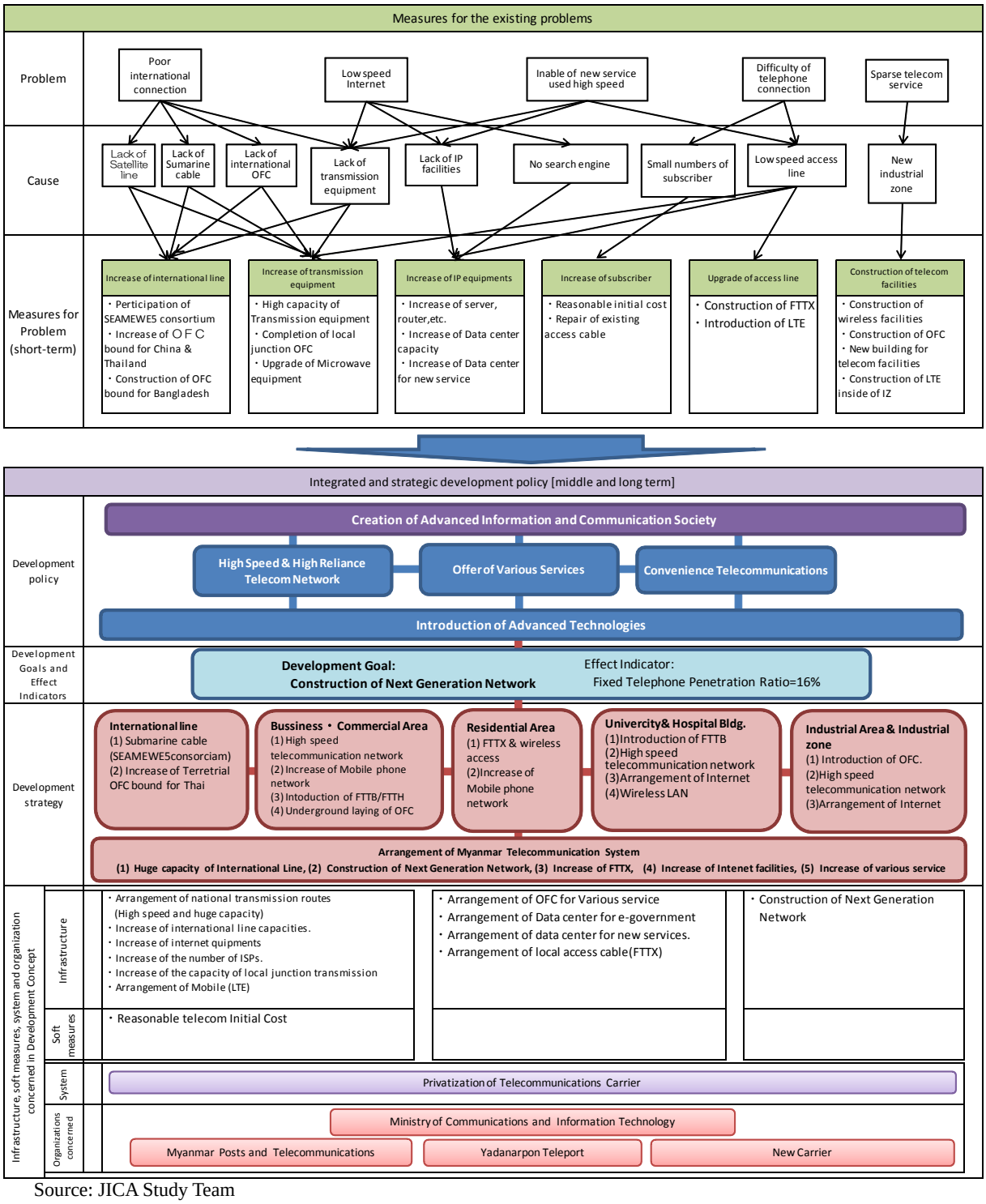
Source: JICA Study Team

(4) Priority Projects

The priority projects are shown in the project sheets located under Chapter 6.3.

5.9 Telecommunication

The proposed infrastructure development concept for the telecommunication sector is summarized in Figure 5.9.1. The enlarged version of said figure is shown in Appendix 1.6.



Source: JICA Study Team

Figure 5.9.1: Telecommunications Development Concept

5.9.1 Demand Analysis

(1) Demand Analysis of Fixed Telephone

The number of fixed telephone subscribers in Myanmar was 1,077,084 in 2009, of which 5.99,914 is in Yangon City. The telephone penetration rates in Myanmar and Yangon City were 2% and 10%, respectively.

In the near future, the GDP of Myanmar and Yangon City will grow rapidly, and correspondingly, the penetration rate of fixed telephone will become similar to ratio that of other Asian countries. Therefore, the forecast formula of penetration ratio has been calculated in reference to the penetration ratios of neighboring Asian countries such as Thai, Laos, Malaysia, Cambodia and Vietnam. The forecasted numbers of fixed telephones is shown in Table 5.9.1

Table 5.9.1: Forecasted Numbers of Fixed Telephones

	2015	2018	2020	2025	2035	2040
Yangon GRDP/Capita (US$)	2,437	3,368	4,089	5893	9500	10402
Penetration Ratio(%) a	8.6	10.5	11.7	13.9	16.8	17.3
Yangon Population b	5,698,130	6,154,240	6,478,420	7,365,563	9,520,934	10,824,712
No of Fixed Telephone c = a x b	487,352	646,912	757,104	1,023,762	1,598,655	1,877,012
Adjusted No of Fixed Telephone d=c+300,000	787,352	946,912	1,057,104	1,323,762	1,898,655	2,177,012

Source: JICA Study Team

The process of forecasting numbers of fixed telephones are explained below..

Table 5.9.2 presents the actual number of fixed telephone subscribers.

Table 5.9.2: Actual Number of Fixed Telephone Subscribers

	2004	2005	2006	2007	2008	2009
Myanmar Population	47,570,000	47,970,000	48,723,000	49,129,000	49,563,000	50,020,000
No of Fixed Telephone in Myanmar	434,182	500,396	594,475	716,349	846,705	1,077,084
No of Fixed Telephone in Yangon	228,654	269,333	351,068	384,451	419,268	499,914

Source: Myanmar Statistics Book, 2010

The conditions for the calculation adopted in the demand forecast are summarized below:

(i) The penetration ratio of fixed telephone is calculated referring the penetration rate of five Asian countries (Thailand, Malaysia, Vietnam, Cambodia, Laos)

(ii) The formula applied for the demand forecast in Table 5.9.3 below is "Y=6.0551ln(x)-38.668" .

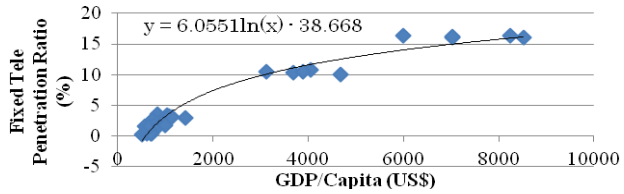
(iii) The numbers of fixed telephone subscribers were calculated by multiplying the population of Yangon by the forecasted penetration ratio. The calculated value is 281,000 in 2011 which is only 56.2 % of the recorded actual value of 500,000 in 2009.

(iv) The above ratio of penetration is maintained, and adjusted forecast is re-calculated by adding 300,000.

Table 5.9.3: Fixed Telephone Penetration Ratio (Five Asian Countries)

Countries	Indicators	2006	2007	2008	2009	2010
Thailand	GDP per Capita (USD)	3116	3689	4043	3892	4680
	Fixed Tele Penetration Ratio (%)	10.51	10.36	10.83	10.49	10.02
Malaysia	GDP per Capita (USD)	6001	7033	8239	7023	8519
	Fixed Tele Penetration Ratio (%)	16.33	16.08	16.41	16.19	16.1
Vietnam	GDP per Capita (USD)	716	825	1046	1103	1195
	Fixed Tele Penetration Ratio (%)	10.19	13.13	17.18	20.05	18.67
Cambodia	GDP per Capita (USD)	516	603	711	703	729
	Fixed Tele Penetration Ratio (%)	0.19	0.27	0.31	0.39	2.54
Laos	GDP per Capita (USD)	582	671	840	869	996
	Fixed Tele Penetration Ratio (%)	1.58	1.6	2.12	1.64	1.66

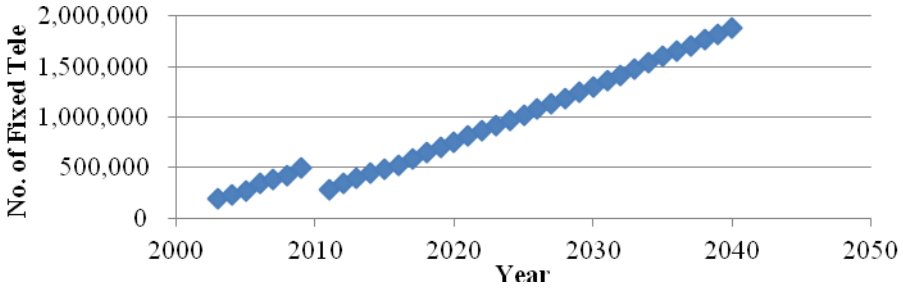
source：ICT World Telecommunication/ICT



Source: JICA Study Team

Figure 5.9.2: Forecast Formula for Fixed Telephone

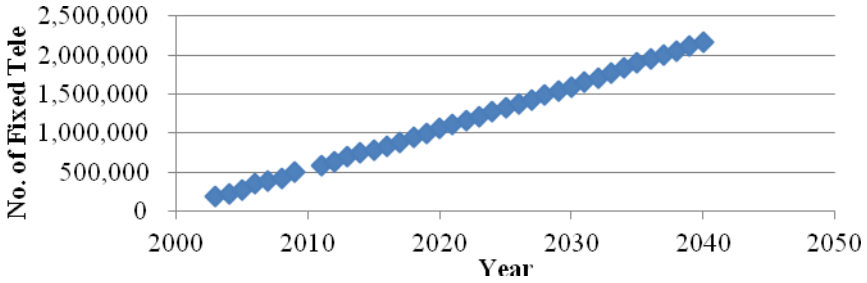
The demand forecast of fixed telephone, which is calculated by multiplying the population of Yangon by the targeted penetration ratio, is shown in Figure 5.9.3 below.



Source: JICA Study Team
Note: The forecast formula is "Y=6.0551ln(x)-38.668".

Figure 5.9.3: Forecasted Number for Fixed Telephone

Figure 5.9.4 shows the adjusted demand forecast.



Source: JICA Study Team
Note: The adjusted formula is "Y=6.0551ln(x)-38.668 + 300,000".

Figure 5.9.4: Adjusted Demand Forecast for Fixed Telephone

(2) Demand Analysis of Mobile Phone

The number of mobile phones in Myanmar was 579,909 in year 2009, of which 297,040 belonged to Yangon. The penetration ratio was 1.2% and 4.3%, respectively. The forecasted number of mobile phones is estimated using the same method for fixed telephones. The result of the demand forecast is shown in Table 5.9.4

Table 5.9.4: Forecasted Number of Mobile Phones

Items	2015	2018	2020	2025	2035	2040
Yangon GRDP/Capita (US$)	2,437	3,368	4,089	5893	9500	10402
Penetration Ratio(%) a	78.5	86.5	91.3	100.3	112.0	114.2
Yangon Population b	5,698,130	6,154,240	6,478,420	7,365,563	9,520,934	10,824,712
No of Mobile phone c = a x b	4,474,402	5,322,672	5,912,508	7,384,785	10,665,104	12,367,226
Adjusted No of Mobile phone d=c-2,450,000	2,024,402	2,872,672	3,462,508	4,934,785	8,215,104	9,917226

Source: JICA Study Team

The process for forecasting the number of mobile phones is explained below:

Table 5.9.5: Actual Number of Mobile Phone Subscribers

Items	2004	2005	2006	2007	2008	2009
Myanmar Population	47,570,000	47,970,000	48,723,000	49,129,000	49,563,000	50,020,000
No of Mobile phone in Myanmar	92,007	128,700	196,049	287,707	399,830	579,909
No of Mobile phone in Yangon	72,560	103,144	143,240	185,338	211,432	297,940
No of Mobile phone in other area	19,447	25,556	52,809	102,369	188,398	281,969

Source: Myanmar Statistics Book, 2010

(i) Penetration ratio of mobile phones is calculated by using the data gathered from five Asian countries (Thailand, Malaysia, Vietnam, Cambodia, Laos).

(ii) The forecast formula is "Y=24.618ln(x)-113.46".

(iii) The number of mobile phone is calculated by multiplying the population by the targeted penetration ratio.

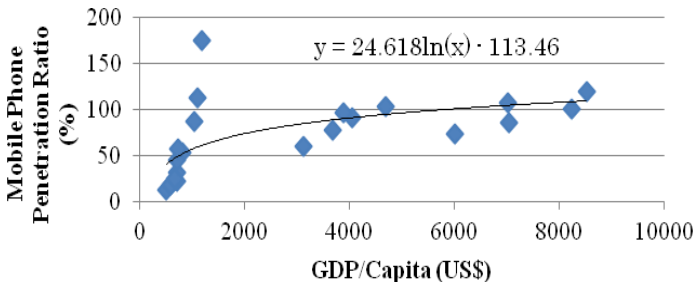
(iv) The forecasted value is 3,369,000 in 2011, but the actual recorded value is 298,000 in 2009.

(v) The above ratio of penetration is maintained, and the adjusted forecast is re-calculated by deleting 2,450,000.

Table 5.9.6: Mobile Phone Penetration Ratio (in Five Asian Countries)

Countries	Indicators	2006	2007	2008	2009	2010
Thailand	GDP per Capita (USD)	3116	3689	4043	3892	4680
	Mobile Phone Penetration Ratio (%)	60.53	78.14	90.58	95.99	103.62
Malaysia	GDP per Capita (USD)	6001	7033	8239	7023	8519
	Mobile Phone Penetration Ratio (%)	73.21	86.31	100.77	100.77	119.22
Vietnam	GDP per Capita (USD)	716	825	1046	1103	1195
	Mobile Phone Penetration Ratio (%)	22.47	52.96	87.11	113.03	175.3
Cambodia	GDP per Capita (USD)	516	603	711	703	729
	Mobile Phone Penetration Ratio (%)	12.74	18.9	30.65	44.84	57.65
Laos	GDP per Capita (USD)	582	671	840	869	996
	Mobile Phone Penetration Ratio (%)	17.28	24.93	33.58	52.92	64.56

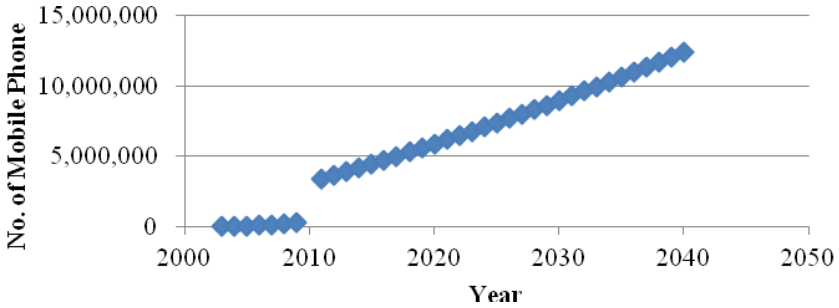
Source：ICT World Telecommunication/ICT Indicators, 2011



Source: JICA Study Team

Figure 5.9.5: Forecast Formula for Mobile Phones

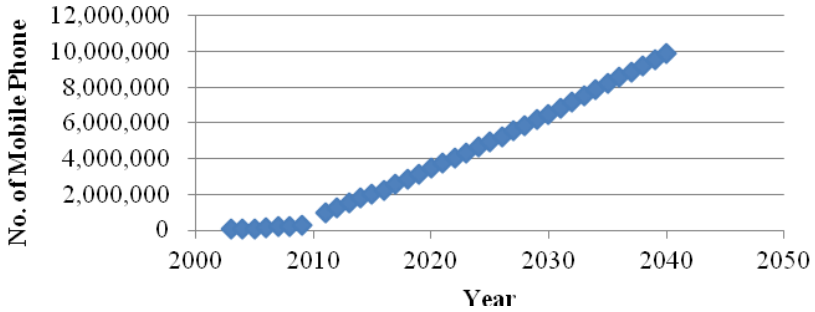
The demand forecast for mobile phones shown in Figure 5.9.6 below is calculated by multiplying the population of Yangon by the forecasted penetration ratio.



Source: JICA Study Team
Note: The forecast formula is "Y=24.618ln(x)-113.46".

Figure 5.9.6: Forecasted Numbers for Mobile Phones

Figure 5.9.7 shows the adjusted demand forecast.



Source: JICA Study Team

Figure 5.9.7: Adjusted Demand Forecast for Mobile Phones

5.9.2 Development Policy

Sector Vision	**Creation of Advanced Information and Communication Society**
Basic Policy	1) High Speed & High Reliance Telecom Network 2) Offer of Various Services 3) Convenience Telecommunications 4) Introduction of Advanced Technologies

(1) High Speed and Highly Reliable Telecom Network

Telephone and data are transmitted through the telephone network. The copper wires used for subscriber access network could not offer a high speed and highly reliable transmission. Introduction of optic fiber cable (OFC) for subscriber access network will meet these demands.

(2) Offer Various Services

Telecommunications network can offer various services such as card-payment, banking system, e-government, e-education, video on demand, and etc.

(3) Convenience Offered by Telecommunications

Money remittance by bank draft is more convenient and safer than payment by cash. Such services can be provided through the telecommunications system.

(4) Introduction of Advanced Technologies

The old telephone network will be changed to the Next Generation Network (NGN) using the internet protocol technology. NGN will be merged with the internet network in the near future.

It is highly recommended to strengthen telecommunication network as follows in line with the basic development policy above.

1) Fixed Telephones (NGN)

The telecommunications network is one of the social infrastructures that are important for transmitting information and communication within a society. Various offers from different telecommunications network services are increasing. A telecommunications network with high speed and highly reliance is urgently needed. NGN can comply with these requirements in order to contribute to a sustainable information and communication system of a society.

2) International Line

The international communication traffic is increasing due to the introduction of foreign capital and the growth in the penetration of mobile phones and internet. Existing SEAMEWE-3 submarine cable and international terrestrial OFC lines suffer occasional service interruptions. International communication lines require good quality, high speed and reliability. For the participation of consortium of SEAMEWE-5, submarine cable and construction of new terrestrial OFC line bound for Thailand should be planned. Furthermore, upgrading of satellite communication networks and exiting national gateway (NGW) must be accelerated as well as

improving the capacity and reliability of the international communication backbone network in Yangon.

3) Metro Network in Yangon

Yangon metro network connecting and handling the subscriber's fixed telephone network is old and in need of improvement. Establishing a high capacity metro network with ring topology and moving toward optical fiber network instead of current metallic system is therefore needed.

4) Intercity Backbone and Core Network

With the enhancement of fixed telephone network in Yangon, upgrading a connecting backbone network as well as a core network between Yangon and Nay Pyi Taw, Mandalay and other major cities will be essential. A key point of interest will be augmenting the networks' reliability by establishing redundant network configurations.

5) Intercity Backbone and Core Network

Other issues to address in this sector are enhancing telecommunication network security and IPv6 implementation. Telecommunication networks have had a substantial social and economic impact in recent years. Networks' security and quality assurance will remain to be key issues to consider. With the worldwide spread of IP networks, there has been a shortage in IP addresses. Since Myanmar's IPv4 global address allocation is extremely small, migration to IPv6 is imperative.

The development plan focuses on fixed telephone (NGN) implementation in Yangon among issues addressed above from following reasons:

(i) There are several on-going projects for international network lines including the construction of new international terrestrial OFC lines.

(ii) The metro network in Yangon is recently being upgraded by the Japanese grant aid scheme with a target of successful SEA game implementation.

(iii) Issues of the backbone/core network as well as security enhancement and IPv6 should not be limited to Yangon City, but should addressed as an overhaul of the telecommunication network on a national scale.

5.9.3 Development Goals and Target Effect Indicators

For the purpose of evaluation of future telecommunications network development and to confirm its outcomes, the following development goals and effect indicators are prepared:

Table 5.9.7: Development Goals and Effect Indicators (Telecommunication)

Development Goal	Effect Indicators
Construction of Next Generation Network	Penetration Ratio = 16%
	Satisfaction of users

Source: JICA Study Team

Development indicator of telecommunications is a fixed telephone penetration ratio set at 16%. Construction of OFC and the inside portion of the plant is needed to achieve NGN. The mobile phone carriers, service companies and the government can offer new services (such as banking system, card payment, e-government, e-education, etc.) by using the OFC as the backbone and access lines. Users' satisfaction ratings are an important development indicator. The telecommunication network traffic should be improved and extended based on demand.

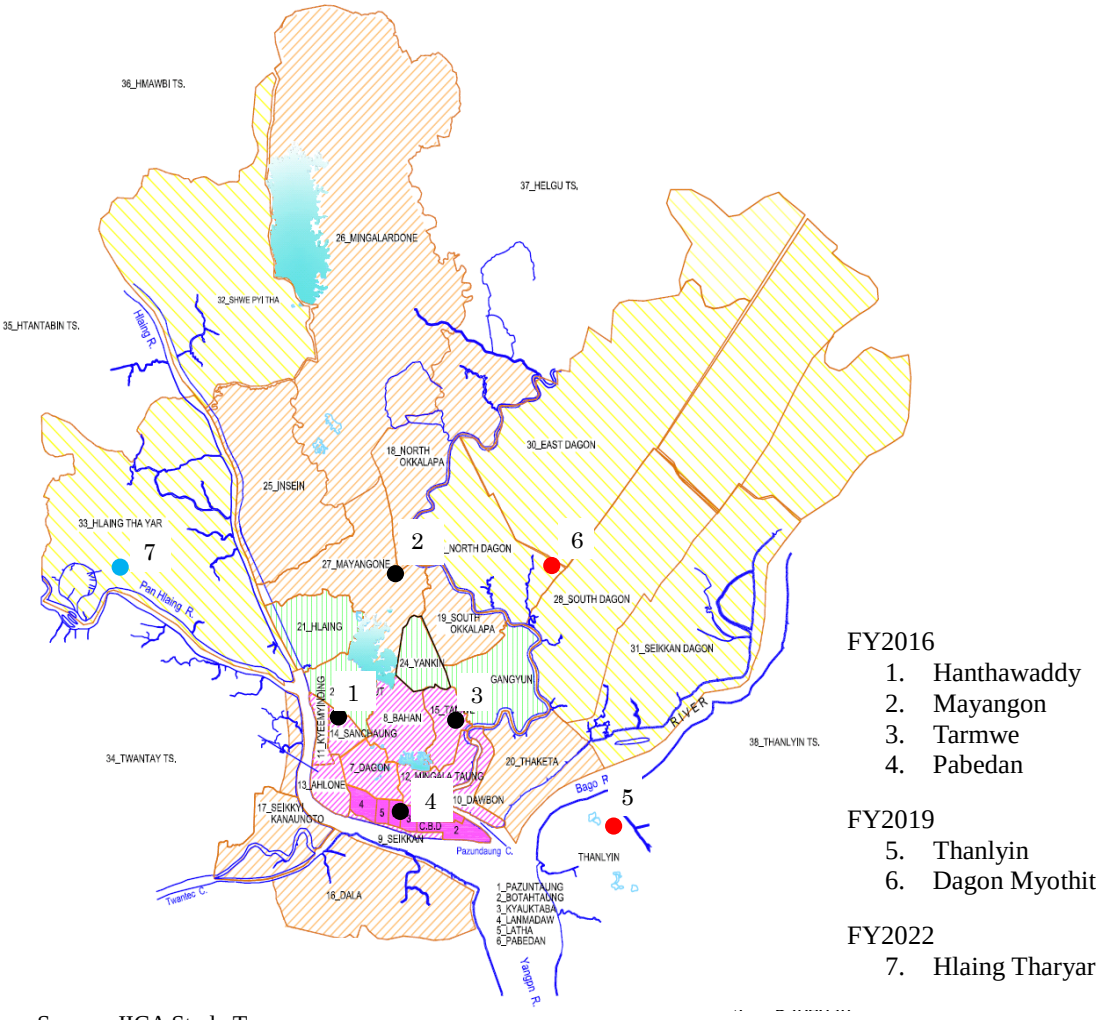
5.9.4 Preliminary Development Plan

(1) Preliminary Development Plan

The old transmission facilities were only used for telephone communication. The OFC line will be used not only for telephones but also for providing high speed data transmission, internet, various new services, and mobile phone backbone. OFC (FTTB) will be connected to universities, large scale hospitals and big shopping centers to facilitate internet communications and high speed data transmission. Every township office and ward office need to be connected with high speed telecommunications facilities to promote e-government. For the results to show early on, FWA (Fixed Wireless Access) and LTE (Long Term Evolution) should be deployed in addition to the optic fibers when connecting with subscriber as last one mile connection. NGN will be constructed in all areas of Yangon City in the near future.

(2) Infrastructure Layout

NGN should be constructed in all areas of Yangon based on the demand forecast. In the first step, the core facilities of NGN will be constructed in the center of Yangon, Pabeden, Hanthawaddy, Tamwe, and Mayangon. Hanthawaddy has a national gateway while Mayangon has an international gateway. The number of subscribers will be 300,000 based on the demand forecast. In the second step, the core facilities of NGN will be constructed in suburbs, such as Thanlyin and Dagon Myothit with 300,000 subscribers in with development area. In the third step, the core facilities will be constructed in Hlaing Tharyar with 300,000 subscribers. The NGN core facilities' location is shown in Figure 5.9.8



Source: JICA Study Team

Figure 5.9.8: Proposed Layout of NGN Core Facilities

(3) Implementation Schedule

Implementation schedule for fixed telephones (NGN) is shown in Table 5.9.8.

Table 5.9.8: Implementation Schedule (Telecommunication)

No.	Project Name	Status	Implementation Schadule (FY)																												
			2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
1	NGN (Hanthawaddy, Myangon, Tamwe, Pabedan)	Short-term																												
2	NGN (Thanlyin, Dagon Myothit)	Middle-term																												
3	NGN (Haing Tharyar)	Long-term																												

< Legend >
: Feasibility Study
: Detailed Design, Tender Preparation, Tendering
: Construction
: Commencement of Operation

Source: JICA Study Team

A rapid penetration of NGN will be expected, and NGN core facilities will be constructed at four stations. Fiber to the x (FTTx) connection will offer a wide range for convenience.

(4) Priority Project

The priority project is shown in the project sheets in Section 6.3.

CHAPTER 6

Urban Development and Management Programs

< Part-II: The Master Plan >

CHAPTER 6: URBAN DEVELOPMENT AND MANAGEMENT PROGRAMS

6.1 Capacity Development Plan

6.1.1 Issues of Administrative Works for Urban Planning and Development

(1) Categories of administrative works for urban planning and development

The following six categories are considered related works for urban planning and development by the administrative organizations from its initial stage of planning until the final stage of construction. A capacity development plan is formulated in consideration of the current capacity of relevant organizations and its need for capacity development corresponding to these categories of works:

1) Coordination

Prior to making a plan for urban planning and development, it is necessary to identify relevant stakeholders and to share future development visions, goals, and matters to be considered. In addition, it is necessary to set the roles and responsibilities of every relevant organization.

For the above mentioned purpose, it is necessary to appoint a responsible organization which will coordinate the projects and its roles.

The following are example of roles of responsible organization:

- To coordinate discussion with relevant administrative organizations;
- To coordinate necessary preparation of development activities;
- To formulate a development/planning policy concerning inter-regional or inter-township matters; and
- Consensus building among relevant stakeholders.

2) Survey and research

In order to make decisions and policies on urban development and improvement, current spatial situation and problems should be grasped. For this reason, collecting related information, its continuous maintenance, and its sharing are indispensable.

Following are examples of related activities:

- Collect necessary information for planning;
- Conduct survey for data collection and revision;
- Manage and maintain the information system and its data; and

- Offer technical advices and suggestions for planning matters.

3) Planning

The planning process for urban planning is not as simple as making a proposal of spatial design, but it should be a result of a study, judgment, decision, and an agreement among different stakeholders, which may have a connection with the target area.

In this context, the following are considered examples of related activities:

- Prepare a comprehensive urban master plan;
- Supervise planning works by the consultant; and
- Endorse the plan among relevant organizations (union ministries, regional government, and district/ township).

4) Establishing a legal system

For implementing a plan which is described in the form of an urban planning document, it is necessary to establish legal systems, such as laws, regulations or bylaws. In order to make spatial formulation rules into effect, the following legal procedures are needed to be taken by respectable administrative organizations:

- Formulate plans into legal regulations;
- Prepare legal systems for the implementation of plans;
- Formulate related laws; and
- Formulate bylaws, regulations, and technical requirements.

5) Controlling

Corresponding to the legal system, a spatial control system is also necessary to be established. For control on urban space and development, it is necessary to appoint a responsible organization and establish control procedures. The following matters are considered examples of related activities:

- Evaluate application document, that is submitted by developers;
- Provide permits for building construction and town/district development;
- Give suggestions for the development plans; and
- Monitor building construction and development implementation status.

6) Realization

For accelerating urban development, partnership between private companies, residents, and public organizations is an important step. In order to guide the project for public profit, assistance and guidance by the administrative organization are expected for project realization.

Following are examples of the above mentioned activities:

- Coordination of project implementation;

- Budget preparation for development;
- Coordination with relevant agencies and private investors; and
- Promotion of balanced development progress.

(2) Current situation of administrative works for urban planning and development

The current administrative works which are executed by each administrative organization, are shown in Table. 6.1.1.

Previously, the whole process of urban development from planning to implementation is mainly conducted by the Union Ministry of Construction. Moreover, the budget for development and construction are also arranged by the Union government through the same ministry. And the examination of application document for building construction is rarely done by the local administrative organization (YCDC).

In the last few years, after the information for PIC (Planning Implementation Committee) has been requested by the Union Ministry of National Planning and Economic Development, local administrative organizations, such as regional government, district offices, and township offices are involved in urban planning and spatial improvement matters.

Considering the rapid progress of large scale development and building construction by private developers, it is necessary to change the administrative organization's role from the previous one. Under this context, the role of the administration should be shifted from planning and implementation by themselves towards realization by control and coordination among different levels of union and local governments.

Table 6.1.1: Administrative Works for Urban Planning and Development (Current Situation)

Categories of Administrative works for Urban Planning	Organizations				
	Union Ministry	Regional Ministry	District	Township	YCDC
1. Coordination	- Coordination with other relevant union ministries - Evaluate proposed subprojects from PIC.	- Coordination with other relevant regional ministers	- Discussion with relevant departments for "Planning Implementation Committee" (mostly district matters)	- Discussion with relevant departments for "Planning Implementation Committee" (mostly township matters)	- Discussion with private developers about effective use of city-owned land (Department of Engineering, building)
2. Survey and Research			- Possessing basic social information (ex. population) - Possessing information on related public facilities	- Possessing basic social information (ex. population) - Possessing information of related public facilities	- Conducting basic survey on urban planning related matters (ex. Survey on traffic volume, by the Deparment of Engineering, road and bridges) - Possessing basic social information (ex. commercial shop listing, by the Department of Engineering, general stores)
3. Planning	- Formulating development project plan (former) - National land use planning in regional planning level	- Formulating development policies and subprojects to be implemented, through PIC - To formulate related sector plans (ex. transport planning)	- Formulating development policies and subprojects to be implemented through PIC	- Formulating development policies and subprojects to be implemented through PIC	- Formulating the "Urban Development Master Plan", (Urban Planning Division with assistance of the JICA Study Team)
4. Establishing a Legal System	- Formulating the "Myanmar National Building Code"				
5. Controlling	- Structural examination of application document for building construction (large scale building)	- Structural examination of application document for building construction (large scale building)		- Provide recommendation letter for building construction (Chief of ward)	- Examination of application document for building construction
6. Realization	- Conducting development projects (former)				

Source: JICA Study Team

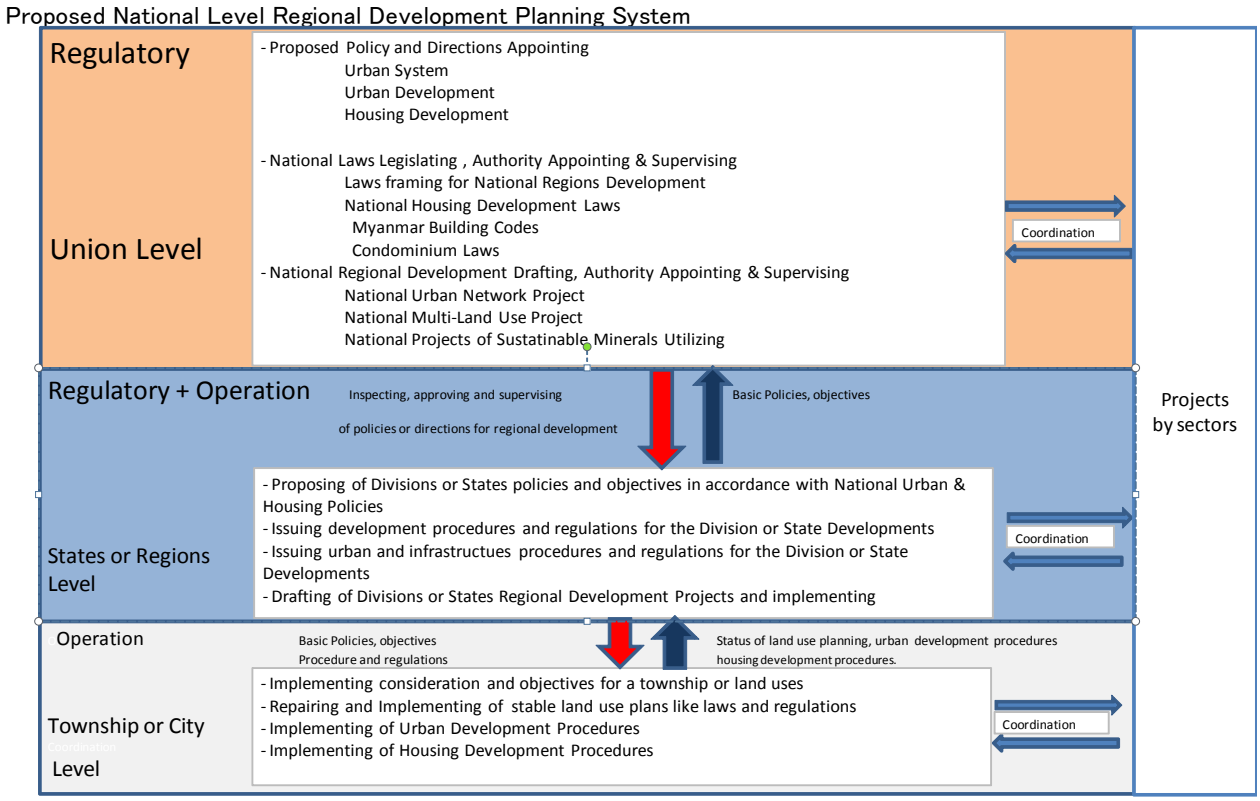
(3) Existing future vision of role sharing between administrative organizations

The Department of Human Settlement and Housing Development (DHSHD) of the Ministry of Construction outlines a future vision of role sharing between the relevant administrative organizations as shown in Figure 6.1.1.

In this vision, the main roles of the Union government will be policy making for national level development, formulation of legal matters, and planning of regional development matters.

Involvement of the regional government is expected for urban planning matters within the region and its operation. It means that urban planning would be handled by the regional government in the future.

Implementation of individual urban planning projects is expected to be executed by the local administrative organizations (district, township or city = YCDC).



Source: Ministry of Construction, DHSHD

Figure 6.1.1: Future Vision of Role Sharing between Administrative Organizations

(4) Related issues of administrative organizations

Before formulating a capacity development program for each relevant administrative organization, it is necessary to outline the future roles of individual organizations at first. Subsequently, the target of capacity development will be set in conformity with the expected future function and current situation.

The current official status, roles, characteristics (strengths, weaknesses, opportunities, and threats), and possibilities of organizations are also important factors to determine their future roles and functions realistically.

The following are matters to be considered in the overview of future role sharing regarding urban planning/development matters:

1) Personal assignment

At present, the number of urban planning experts and engineers are quite limited. And thus, it seems difficult to carry out all the expected roles which are related to urban planning and development issues.

In addition, future supply of personnel will also be limited.

Four Yangon universities provide lectures on urban planning for bachelor students of civil engineering and architecture departments. But most of the students got job opportunities in foreign countries or in private companies after graduation. Moreover, only few students were engaged in administrative organizations.

Yangon Technological University restarted to offer urban planning course since 2012 for postgraduates. However, the number of students is only about 20 to 30 a year, and their future jobs are still unclear.

Following are the current situation of personnel assignments in relevant organizations:

- Union Ministry (Ministry of Construction)

About 20 engineers/planners are assigned in DHSHD and work for regional planning and urban planning matters. They cover the whole Myanmar therefore, it is difficult to conduct planning and its implementation in detail level.

- Regional government (Yangon regional government)

The Union Ministry of Construction has an office in the regional government and has one assigned staff. It seems difficult to satisfy all the expected roles regarding urban planning matters.

- District office

The number of persons in charge in urban planning matters is limited (one person in most cases). And their education, professional experience, and knowledge about urban planning are limited.

- Township office (under the Ministry of Home Affairs)

Same as the district office, the number of persons in charge for urban planning matters is limited (one person in most cases). Furthermore, their education, professional experience, and knowledge about urban planning are limited.

- YCDC (Urban Planning Division)

About 50 engineers are assigned in the Urban Planning Division. But their professional experience about urban planning is short and limited. Therefore, technical training is necessary for them.

2) Allocation of budget

Formerly, budget for the implementation of public-oriented urban development projects were decided and allocated by the Union ministries (e.g. implementation budget for new town development).

Currently, DHSHD does not have any budget for the implementation of urban development. And the Department of Public Works of the Ministry of Construction has a budget mainly intended to be used for maintenance.

The Union government is planning to delegate gradually the budget planning power to the regional government. In this context, it is necessary to arrange adequate staff for project planning and implementation for local administrative organization. Also, their capacity development program concerning this professional field needs to be considered.

3) System of government

At present, YCDC is assigning more staff in the urban planning division than in other administrative organizations. But the authority and power of YCDC on urban planning/ development matters are not clearly defined, and the conventionally assigned tasks under the current system are quite limited.

On the other hand, few staff is assigned in the local government organizations, which have authority and power in urban planning matters, such as the regional government, district offices, and township offices.

Considering the above mentioned situation, it is realistic to assume that YCDC functions as supporting agency for urban planning and its implementation (e.g. provision of planning information, support for planning, and offering technical advices). For the assumed future role sharing among relevant administrative organizations, it is necessary to consider these possibilities of cooperation between different organizations.

6.1.2 Future Expected Administrative Roles in Urban Planning and Development and Prospect

In this chapter, the current problems corresponding to the categories of administrative works in urban planning and development will be identified at first. Subsequently, the expected responsible organization and its countermeasures will be proposed.

(1) Coordination

Corresponding to the request from PIC, the union ministers, regional government, district offices, and township offices are involved in collecting urban planning information and reporting them to higher administrative organizations at present. These activities are mostly done as internal work within each organization. In addition, discussions and coordination among neighboring townships have not been held for decision making process.

Township offices of YCDC support them partly in its data collection, but they are quite limited roles.

- Expected relevant organizations and their countermeasures

The Union ministry and regional government are expected to take the initiative in coordinating with relevant local administrative offices in order to discuss and make decisions on inter-district and inter-township matters.

For local administrative offices (district, township, and YCDC), strengthening of coordinating functions with private developers and residents are necessary.

(2) Survey and research

Under the current administrative system, urban planning information is scattered among each organization and is not shared with others. As a result, it is difficult to immediately utilize necessary information.

In order to solve this situation, the following should be considered:

・Determine the common contents of information, its data format, and its updating procedure;

・Set the roles of each organization for data collection, survey, and data entry; and

・Establish data sharing system for utilization for urban planning purposes.

- Expected relevant organizations and their countermeasures

The Union ministry is expected to take the initiative in the formulation of necessary information items, data format, and procedures with consideration of its application to the whole country.

The Urban Planning Division of YCDC is the suitable organization for data collection and data entry because it has commenced part of the related works with necessary personnel arrangement. It is expected to extend these functions and take roles in updating and provision of necessary information to other relevant organizations.

Table 6.1.2: Administrative Works for Urban Planning and Development (Future Proposal) (1)

Categories of Administrative Works for Urban Planning	Organizations				
	Union Ministry	Regional Ministry	District	Township	YCDC
1. Coordination	- Coordination with other relevant union ministries - Evaluate proposed subprojects from PIC - Necessary budget allocation for public oriented projects	- Coordination with other relevant regional ministries - Coordination of necessary discussion with relevant union ministries - Coordination with districts for inter-regional planning matters	- Discussion with relevant departments for the implementation of PIC - Consultation with regional government - Coordination with districts for inter-township planning matters	- Discussion with relevant departments for the implementation of PIC - Consultation between private developers with public institutions - Public consultations	- Discussion with private developers about effective use of city-owned land (Deparment of Engineering, building) - Assistance for coordination between different stakeholders - Assistance for discussion between residents and administrative organizations
2. Survey and Research	- Formulation of necessary survey/research items to be requested from regional/state government and local administrative office - Formulation of survey/ research data format	- Data collection about examples on land transactions - Data collection about urban planning related matters	- Possessing basic social information (ex. population) - Possessing information on related public facilities	- Possessing basic social information (ex. population) - Possessing information on related public facilities	- Collecting basic survey on urban planning related matters (ex. survey on traffic volume, commercial shop list) - Collecting additional urban planning related information (ex. building use, land use) - Data management about urban planning information with its updated works

Source: JICA Study Team

(3) Planning

About urban planning matters, the Union Ministry of Construction is engaged in the formulation of the national land use plan. The plan intends to determine the functions of major cities and important areas, and to formulate strategic development plan under the national level. However, these planning results cannot be used directly to detail the urban and infrastructure plans.

The regional government, district offices, and township offices are working to grasp and assess the current spatial situation and urban planning issues. They are useful to determine priorities of development/improvement activities. But it is necessary to integrate these matters into a general spatial plan for urban planning and development purposes.

Corresponding to the above mentioned necessity, functions based on complementary relations of relevant organizations is expected.

- Expected relevant organizations and their countermeasures

  The regional government, district offices, and township offices are expected to continue their PIC related activities, such as grasping urban situation and problems, making project programs, and monitoring.

  The following matters are proposed as YCDC roles, which intend to contribute to the spatial execution of the plan.

  - Updating the "Urban Development Master Plan";
  - Giving technical advices on regional, district, and township planning; and
  - Consultancy services in formulating public/administrative oriented development plans.

(4) Establishing a legal system

The current building requirements (based on the bylaws for Yangon Region) and the "Myanmar National Building Code" (under the preparation of the Ministry of Construction) put emphasis on the control of individual buildings. However, the area based on building regulations is not emphasized.

Establishment of a legal system and its application are essential for the execution of planned matters in urban planning, such as land use control, zoning system, implementation of urban infrastructure, and construction of public facilities.

In order to make the urban planning legal system function well, the following matters are necessary:

- Enactment of related laws, regulations, and bylaws;
- Formulation of the spatial regulation plan based on the legal system (e.g. land use map in a formal manner).

- Expected relevant organizations and their countermeasures

  According to the current legal power, the Union Ministry of Construction is the only organization which can promote the preparation and legalization of the necessary laws and regulations. For the same reason, the regional government should take a role in the preparation and legalization of the bylaws. Moreover, authorization of the related plans and drawings are considered under the responsibility of the Union ministry and regional government.

On the other hand, YCDC is considered as a candidate organization, which will prepare the draft plan and related regulations with related basic studies

Table 6.1.3: Administrative Works for Urban Planning and Development (Future Proposal) (2)

Categories of Administrative Works for Urban Planning	Organizations				
	Union Ministry	Regional Ministry	District	Township	YCDC
3. Planning	- National land use planning in regional planning level	- To formulate the implementation plan of subprojects according to PIC - To formulate related sector plans (ex. Transport planning)	- To formulate the implementation plan of subprojects according to PIC	- To formulate the implementation plan of subprojects according to PIC	- Updating the "Urban Development Master Plan" - Giving technical advices on regional, district, and township planning - Consultancy services for formulating public/ administrative oriented development plans
4. Establishing a Legal System	- Formulating the "Myanmar National Building Code" - Preparing laws/ regulations on urban planning matters - Preparing laws/ regulations on large scale development matters - Preparing planning/ application manual for urban planning/ development matters - Formulating detailed technical requirement for development/con struction matters	- Formulating detailed spatial plan for control on land use and development capacity - Legalization of spatial control and technical requirements into bylaws, regional regulation and/or guidance according to the detailed spatial plan (land use control, development permits, district planning, etc.) - Formulating technical standard to be applied for development and construction	- Formulating detailed spatial plan for control on land use and development capacity	- Formulating detailed spatial plan for control on land use and development capacity	- Giving technical advices in the formulation of bylaws, regulations, standards and requirements - Consultancy services in formulating detailed spatial plans

Source: JICA Study Team

(5) Controlling

The permit system in building construction is the only system of the current spatial control in the Yangon City area. According to this regulation, YCDC examines application documents for building construction and provides permits for construction (high-rise buildings are examined by union/regional government).

Considering the acceleration of district/urban scale development by private developers, it is necessary to establish a control system on these development activities and guide them to contribute to public interest and to follow urban development strategies.

The introduction of control measures on specific matters, such as urban landscape control and design control on public space, should be considered as mid- and long-term subjects.

- Expected relevant organizations and their countermeasures

  The control system on urban and district development is considered to be established according to the progress of the legalization of relating laws and regulations. Considering the current competence of relevant organizations, it is assumed that authorization of development projects will be done under the responsibility of the Union Ministry and Regional Government based on these legal frameworks.

  Engineers with specific knowledge are necessary in the technical evaluation and examination of urban/district development. Considering the current situation of relevant organizations, YCDC is considered as a candidate organization, which carries out technical examination services and provides consultancy services.

  Under the assumption of this role sharing, district offices and township offices are expected to develop a consensus of neighboring residents and to give suggestions on the proposed project.

(6) Realization

Formerly, urban development and housing development in the Yangon area were led by the Union ministries. Planning, preparation of budget, and project implementation were done by the ministries. Considering the tendency that many development projects will be conducted by private developers with private funding, the role of the administrative organization will shift from an implementation body towards a coordinating agency.

Corresponding to these changes, new roles (e.g. project coordination with private sectors and preparation of financial support for project function) are expected for the administrative organizations.

- Expected relevant organizations and their countermeasures

  Establishing a specific project scheme and budget preparation are considered roles of the Union ministry and regional government, which have related competence.

  The role of coordination with relevant stakeholders (developers, residents, and other administrative organizations) for the project is supposed to be taken by local administrative organizations (district offices and township offices).

  With regard to this matter, YCDC is supposed to take the role of technical support and consultancy service. Promotion of effective land use of current city land is also considered as YCDC's role.

Table 6.1.4: Administrative Works for Urban Planning and Development (Future Proposal) (3)

Categories of Administrative Works for Urban Planning	Organizations				
	Union Ministry	Regional Ministry	District	Township	YCDC
5. Controlling	- Assessing and providing development permits for special development areas	- Assessing and providing development permits for large scale development. - To authorize the district plan, which are formulated by residents, private organizations and/or public initiatives	- Giving suggestions and advices in the formulation of development permits and district plans	- Provide recommendation letter for building construction (Chief of ward) - Giving suggestions and advices in the formulation of development permits and district plans	- Examination of application document for building construction (including structural examination on large scale building construction) - Giving technical advices in the formulation of district plans and its regulations - Consultancy services for assessing development permits - Consultancy services for landscape, townscape, and urban space design control - Consultancy services for public spatial design control and its management
6. Realization	- Necessary budget allocation for public-oriented projects	- Necessary budget allocation for public-oriented projects	- Advancement of development/spatial improvement projects by assistance and coordination with administrative offices	- Advancement of development/spatial improvement projects by assistance and coordination with administrative offices	- Advancement of development/spatial improvement projects in city-owned land - Supporting public-oriented development/spatial improvement projects by public financial assistance and micro finance

Source: JICA Study Team

6.1.3 Formulation of Capacity Development Plan

(1) Expected subprograms for capacity development and technical assistance according to categories of administrative works

Corresponding to the subjects in Section 6.1.1, the necessary capacity development program and technical assistance program were assumed as shown in Figure 6.1.2.

Counterpart organizations are described based on supposition. Therefore, it is necessary to re-evaluate their appropriateness according to the situation and prospect of role sharing at each point of time in the execution of the programs.

Also, time framework is set according to sequential order between related subprojects. Time period can be adjusted according to the progress of each subproject.

Categories of administrative works for urban planning	Purpose of Capacity building	Activity	Supposed Counterpart	Trial study through pilot project	Following projects								Remarks
				2013	14	15	16	17	18	19	20	21	
1. Coordination	– Establish collaborating relationship between Union/ Region/ Local Government and administrative organizations – Exchange of views on urban planning matters in region ministers – Exchange of views on urban planning matters between engineers	1a. Assitance for publicity of master plan and result of PIC	Union (MoC, Min of National Planning & Economic Development) Region (Office of MoC) District, Township										
		1b. Planning coordination and discussion about above mentioned plans and its implementation	Union/ Region/ District/ TS / YCDC										
		1c. Assistance for sharing about technical knowledge for urban planning	Union/ Region/ District/ TS / YCDC	*1									*1: Technical transfer is possible, but relating agencies are not officially allocated as C/P
2. Survey, research	– Formuation of information list of survey for urban planning – Execution of preliminary survey	2a. Assistance for formulation of information list, data collection mannual and its format	Union (MoC, MoNPED and other relating infrastructure ministries)										
		2b. Assistnace for execution of data collection	District/ TS/ YCDC										
		2c. Assistance of DATA management (GIS)	Region/ YCDC (District/ TS)										
3. Planning	– Formalization of legal procedure for urban planning procedures – Formalization of integration of planned matters into urban planning drawing – Formalization of detail planning for control	3a. Assistance for formulation of planning items to be drawn in the plan	District/ YCDC	*2									*2: Draft proposal for pilot study area will be shown
		3b. Assistance for formulation of detailed spatial plan for control	TS/ YCDC (Region/ District)	*2									*2: Draft proposal for pilot study area will be shown
		3c. Assistance for integration of detail plan according to PIC and development strategy of different administrative organizations	Region/ District/ TS (YCDC)	*2									*2: Draft proposal for pilot study area will be shown
4. Establishing legal system	– Establishment of relative laws, regulations and requirements to be applied as landuse control measures – Establishment of permission for large scale development – Establishment of relative legal system (district planning, urban redevelopment etc.)	4a. Assistance for assesment on application of introduction of new control measures	Union (MoC)/ Region (District/ TS)										
		4b. Establish strategy for introduction of spatial control measures	Union (MoC)/ Region										
		4c. Assistance for formulation of study on urban planning law, standard and regulation	Union (MoC)		*3								*3: MoC prepares as their own activity
		4d. Assistance for formulation of its application manual and information sharing for regional/ local urban planning agency	Union (MoC)/ (Region)										
		4e. Assistance for study on contents to be included in bylaw, regulation and requirements	Region	*4									*3: Draft proposal will be prepared. It will not mean getting full agreement by relating administrative organizations
5. Controlling	– Establishment of consultation and permission system for development – personnal arrangement and capacity development for the task	5a. Trial application of control measures for pilot projects or pilot area (ex. ward)	District/ TS/ YCDC (Region)										
		5b. Technical assistance for training on application of control measures and evaluation on development plans	District/ TS/ YCDC (Region)										
6. Realizing	– Capacity development for public consultation, coordination with residents and private sector – Capacity development for project implementation – Capacity development for project management	6a. Study and assistance for possible acceleration measures for implementation of urban development projects	YCDC (Dept of building) District/ TS										
		6a. Study and assistance for possible acceleration measures for community based urban spatial improvement	District/ TS										
		6a. Study and assistance for possible acceleration measures for public oriented project	Region										

Source: JICA Study Team

Figure 6.1.2: Expected Subprograms for Capacity Development and Technical Assistance According to Categories of Administrative Work

6.2 General Principles for Urban Development Management Program

Progress of urbanization is a widely observed trend in the world, and this is true to Myanmar, too. The United Nations[1] estimates that the rate of urban population to the total population (urbanization rate) is 47% in 2011 for LDC countries, and the rate is projected to grow to 60% or so by 2040 for LDC. For Myanmar, the urbanization rate in 2010 is 32%, or about 15 points lower than the LDC average, as the urbanization in Myanmar has been relatively slow compared to other countries. In line with the world trend in urbanization, the urbanization rate for Myanmar shall be quickly pick up soon, with the progress of democratic regime and more market oriented economy.

Also, the UN delivers a prospect that cities with more than half a million population generally show a clear indication of higher growth than smaller cities worldwide. While Yangon is the primary city in Myanmar and the fastest growing economic center of Myanmar, the master plan must be ready to accommodate a reasonably high population growth in the future, in line with an increasing urbanization rate in Myanmar. The present master plan takes into account these aspects in setting its framework.

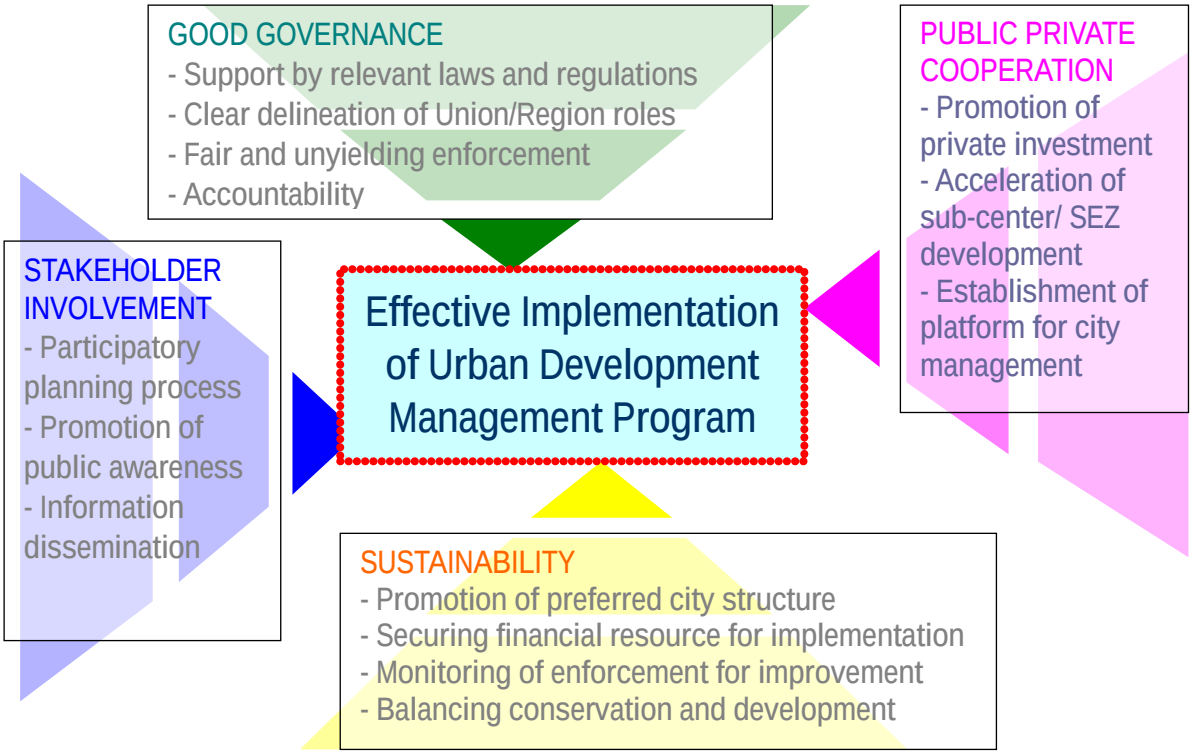
When the population in the city grows, either the city area has to be expanded, or the population density of the urbanized area has to be heightened, or both. In either case, the city has to go through intense pressure of transformation. When such changes are happening slowly, it may be either naturally absorbed within the existing urban area, or could be consolidated in harmony. However, when the change takes place very quickly and without much regulatory intervention, the transformation of the urban area may result in random, sporadic and uncontrolled urbanization, causing the deterioration of urban environment. Such outcome, often referred to as "urban sprawl," has to be avoided by all means.

Thus the importance of urban planning for the growing cities such as Yangon is recognized as such. The urban planning involves depicting, analyzing and building on the desirable future image of the city shared by the residents of the city. The desirable future image of the city could be formulated as the vision in an urban master plan including the spatial structure, zoning and infrastructure networks. The urban planning thus commands a step to realize the residents' perception of desirable future of the city.

The formulation of the master plan, despite its importance, may only mark the first step to regulate and control the urbanization that is taking place in the city. The real task comes after the formulation of the urban master plan – that is the enforcement and implementation of the urban master plan, namely the urban development management program.

In this section, general principles to be observed in the implementation of the urban development management program shall be discussed. The following figure shows the overall structure of the principles related to effective and successful implementation of the urban development plan.

[1] United Nations, World Urbanization Prospects - The 2011 Revision: Highlights, New York, 20132.



Source: JICA Study Team

Figure 6.2.1 Principles for Effective and Implementation of Urban Development Management Program

6.2.1 Good Governance

Good governance is considered to be an indispensable element in urban planning and management, and it is eqaully important in Myanmar. The concept of good governance in urban planning generally relates to the democratic process and transparency in plan formulation, decision and enforcement.

(1) Support by Relevant Laws and Regulations

As urban development planning often involves partial regulation of individual's property right, the urban planning system has to be supported in full by laws and regulations that are officially enacted within the country's legal and administrative systems. In Myanmar, a town planning law has not been enacted yet, while the Union Government is said to be in preparation of a draft. The enactment of a town planning law has to be accelerated as much as possible to eradicate the situation lacking the basic law for city planning and its enforcement.

(2) Clear delineation of Union/Region roles

In Myanmar, the roles and responsibilities between the layers of local government systems are not clearly defined in some part, particularly in conjunction with the three local entities with City Development Committees. This lack of clear delineation of roles and responsibilities also affect the delineation of roles and responsibilities between the Region and the three local entities, including YCDC. This has to be eradicated as soon as possible.

(3) Fair and Unyielding Enforcement

The on-going building permit system is enforced by YCDC, but the underlying regulations for permission are not clearly dissimilated to the public to follow. City's ordinances, when they relate in any part to the citizens daily lives, they must be posted and/or publicized to the citizens.

Also, the enforcement has to be fair. When the rules and regulations are not observed strictly and fairly, people may feel unfair, and tend to disregard them or at best evade efforts to follow them.

In order to promote fair and unyielding enforcement, the urban development planning has to be established as administrative system supported by the laws and regulations, as mentioned earlier. For this, actions such as strict warning or penalization need to be imposed in case of any violation of rules and regulations as determined in the urban development master plan.

(4) Accountability

The accountability means that the administrative action must be explained rationally and the reason for the decision should be accountable and acceptable. To increase the accountability in urban planning, the conditions for decisions have to be clarified in advance as rationally as possible, and compiled in a document form.

The urban planning parameters, such as height of buildings, FAR and COS, are some of the conditions that need to be pre-determined in the urban development plan. Once a decision is made, the public administrative body should be able to explain to the citizens about the rationality for such decision following the determined rules and regulations. Higher accountability in urban planning could minimize room for corruption in relation to urban development.

6.2.2 Stakeholder Involvement

An urban master plan pertains to a city inhabited by people, and thus in the first place it should reflect the opinions and perceptions of the people about their city. This is the reason why this Study has carried out a large scale Household Interview Survey to understand the people's opinions, perceptions and expectations about the desirable future of Yangon. Stakeholder involvement shall provide the necessary strength to implement the urban master plan in sustainable manner over a long period of time.

(1) Participatory Planning Process

JICA has a Guideline for Social and Environmental Considerations which has been applied to various activities and studies carried out by JICA, including a master planning project such as the present study. It requires stakeholder involvement at an early stage of the study. The outcome and results of this study are mainly built up on the discussion and direction received during the Working Group meetings and Stakeholder Meetings.

Source: JICA Study Team

Figure 6.2.2: A Stakeholder Meeting in Yangon

During the implementation phase, the feedback from the stakeholders should be given an attention to improve the effectiveness of the implementation as well as providing the base for a future revision of the master plan. Accordingly, the day to day feedback from the stakeholders has to be recorded and necessary analysis may be conducted as per requirement.

(2) Promotion of Public Awareness

Promotion of public awareness refers to improving the level of perception of general public about the issues related to the improvement of Yangon and its surrounding areas. Higher public awareness would result in better understanding and will facilitate in the enforcement of the urban master plan and improving the landscape of the city.

The JICA Study Team will conduct public seminars in Yangon and Ney Phi Taw in June 2013 together with public exhibition of the master plan.

(3) Information Dissemination

The urban master plan has to be shared with the citizens for their observation and use. Particularly the zoning map and regulations should be made available in proper scale to the citizens. This will be very useful to them while buying or leasing property or planning or designing a new building. Thus the urban master plan has to be made available either in the form of a hard or soft copy at the administrative office of Yangon and should easily be accessible to the citizens. Also, provision of providing necessary urban planning related information in a GIS format may also be considered.

The essence of the master plan was summarized in full color brochures. This brochures, as a tool for improving the understanding the master plan and its implementation, were distributed in public seminars and other occasions to the citizens in Yangon.

Source: JICA Study Team

Figure 6.2.3: Brochure of Urban Panning for Yangon

6.2.3 Public and Private Cooperation

In general, a large part of the city is built for and by the private sector with private funding. Such private part of the city comprises most of the housing units and commercial buildings meant for offices, hotels and shops. Whilst, the public part only encompasses the infrastructure such as roads, water supply and sewerage systems, public parks, and so on, and public service facilities such as public schools, hospitals and so on. Thus, it is nearly impossible for the public sector alone to build the city with its limited resources. Thus, it requires extensive collaboration and/or cooperation with the private sector. In the following sub-section basic principles for promoting the public private partnership are elaborated.

(1) Promotion of Private Investment in Urban Development

The role of the private sector has been increasing rapidly as a partner in a number of urban development projects. In general, private sector has better access to the market information and is more versatile and responsive in managing the project and making a profit from the investment than the public sector.

Competitive bidding is one of the most important principles in promoting a PPP approach in urban development. The maximum value for money (VfM) is achievable only in a competitive bid where several bidders compete to win a bid. Competitive bidding also minimizes the room for corruption and thus serves the benefits to citizens with the least cost in investment. Institutionalizing a basic policy for competitive bidding in PPP projects with a law or a regulation has to be considered immediately.

(2) Acceleration of Sub-center / SEZ Development

Development of sub-centers/SEZ will be a crucial task for Yangon to be a sustainable urban center for Myanmar. Such large scale urban development shall be best achieved through the collaboration of the public and private sectors under a PPP arrangement, and with the support of international donors' agencies. Incentive scheme to promote investment in sub-center development should also be considered, such as the bonus scheme for height and/or FAR for the sub-center to be more attractive than other possible urban development sites.

Also, the role of public sector will be crucial in promoting the sub-center and SEZ development. For example, formulation of the master plan and building of infrastructures by the public sector, prior to the private sector investment, is indispensable for the project to move ahead.

Public sector can also initiate relocation of government offices to sub-centers/SEZ, which could be one of the constructive steps for accelerating development. Promoting location of large university/ colleges from the city center area to the sub-center area is also considered to be effective in promoting and accelerating sub-centers development.

(3) Establishment of Platform for City Management

Establishing a new platform will be necessary and required for city management of Yangon, including improving the city's landscape, creating new parks, upgrading living environment in the city and conserving historic heritage.

As the city management activities require not only infrastructure development but also the improvement of individual buildings and houses, the platform must be established involving wide range of stakeholders in city management, such as hoteliers, shop owners, residents and land owners. For the establishment of this platform, the public sector should play the role of initiator/coordinator as well as the infrastructure provider.

International donors should support the activity of such platform as self-motivated and sustainable improvement movement.

6.2.4 Sustainability

The effects of urban master planning are gradual and cumulative. This is why the implementation of urban development master plan has to be sustainable in the sense that the effects of the plan continues to take place over the long period of time.

(1) Promotion of preferred city structure

For the future of Yangon, a structure pan of "Sub-center with Green Isle System" was chosen. In order to achieve this preferred structure of Yangon in the future, pubic works to be implemented in future ought to comply with and strengthen the structure.

It is important to conceive that the main part of urban planning pertaining to a particular city should be carried out by the local government themselves. For this, the tasks of the central and local governments should be clearly delineated, so that there should be neither room for duplication nor there is any gaps.

(2) Securing Enough Financial Resource for Implementation

In many of developing economies, the majority of the tax revenue and development assistance by international donors goes to the central government. This is also true to Myanmar, and consequently local governments tend to be short in public finance for urban planning and development management.

In order to replenish the funding requirement at the local level, reallocation of public revenue and donor assistance to local government has to be seriously considered.

In line with clearly delineated roles and responsibilities of the Union, Region and City, the development budget shall be rationally channeled to respective government entities. Public housing, for example, has been under the jurisdiction of Ministry of Construction in the Union Government. If some part, or all of this responsibility is to be transferred to local entities, such as YCDC, the corresponding budget has also to be transferred accordingly.

A new tax regime for YCDC may also be considered to fill the gap between the necessary and available funding for development. Imposing a local tax on urban development project may be a way to enhance the local government's capacity for carrying out the necessary infrastructure development and others.

(3) Capacity Development for Urban Planning

Generally, high level human resources tend to be more concentrated in the central government where there are more opportunities for training or experiencing international works, whereas the local government tends to be understaffed and may lack in top notch professional personnel. This gap in the availability of high level human resources has to be rectified, as the local governments are expected to play larger and more important role in local administration

Continuous efforts for human resources development have to be carried out at all levels of government administration including the central and local government. This will enhance the public sector capacity for urban planning and development management.

Higher education for urban planning and development management needs to be improved to attract young people to pursue their career in this field. International donors should support this cause. Also, a system of registering professional engineers may be considered for establishing and creating a larger pool of well trained and educated professional engineers. Such system of expertise will be vital for the development of urban planning and urban management.

(4) Balancing Conservation and Development

If natural environment is lost, it will be irrevocable in the sense that it would not be possible to recreate it by human capability. Thus the importance of conservation is high in urban planning and development management. But if the urban master plan only looks at conservation, the energy of the city may be lost and the livelihood of the citizens may be affected.

Development is important in the light of activating and revitalizing the economy and accruing income to the residents of the city. But again, if only the concentration is towards development without any consideration for natural conservation, the city may lose the base for which it has flourished, and the development may not be sustainable.

Thus the development and conservation have to be well balanced. One may say that the development and conservation are two sides of the coin, meaning that two aspects of the city have to be well harmonized with each other. Eventually, the development and conservation shall be considered to be two elements to be harmonized on the same side of the coin.

6.3 Priority Programs for Urban Development and Management

To achieve the development visions "Yangon 2040" and the sustainable urban development, in total 13 sub-programs, in both urban development sector and urban infrastructure development sector, were identified in this study. Under these sub-programs, in total 26 in urban development sector and 51 in urban infrastructure development sector, were identified for implementation purpose.

6.3.1 Priority Programs for Urban Development Sector

(1) Urban Development and Management

Sub-program of urban development and management (UD) consists of total 11 projects. The projects are shown in Table 6.3.1.

Table 6.3.1: Sub Program of Urban Development and Management (List of Projects)

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
UD-01 **Mindama Secondary CBD Development Project**	**[Current Problem]** − There are no concrete plan for the future − There is no concrete offer from business partners or investors − Due to proximity to the Yangon International Airport, there is a limit on the height of the building **[Project Scope]** − To share some functional activities (business, commercial and Administrative) to Mindama secondary CBD − To control the road traffic congestion in the CBD − To accumulate foreign direct investments to Mindama secondary CBD **[Expected Project Effect]** − To control the road traffic congestion in the CBD − Unused land in the inner area can be urbanized	Approximately US$ 20 mil.	a) For the future land use plan of Yangon City, the new functional areas will be evaluated (2013) b) Formulate a basic plan (2013) c) Make a feasibility study for the plan d) Search for investors who will cooperate for the project
UD-02 **Thilawa SEZ Class-A Area Development Project**	**[Current Problem]** − International competiveness especially with neighbors in GMS is necessary for economic growth − Insufficient infrastructure − Undeveloped operation scheme and regulations of SEZ **[Project Scope]** − To promote various economic activities such as manufacturing, logistics, commerce, services, etc. − To accumulate foreign direct investments (FDIs) − To establish forward and backward linkages between FDI providers and local business societies. − To engage local business societies in non-traditional industries. − To establish an integrated and efficient logistics services in order to contribute to the regional and global supply chain.	Approximately US$ 620 mil.	a) Feasibility Study b) Basic Design, Detailed Design, and Tender Document Preparation c) Select the developers d) Landfill, Construction, Procurement, and Installation e) Promote investors f) Operation

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
	− To contribute in Thilawa SEZ development to achieve rapid economic growth − To create job opportunities for local workers. **[Expected Project Effect]** − To induce FDIs and to utilize the resources of the Greater Yangon − To create non-traditional industries in the nation by absorbing new technologies from FDI and transferring them to local business societies − To diversify the industries of Myanmar by accommodating various types of industries in SEZ − To establish an international gateway in regional and global supply chain by building up manufacturing base firms and creating efficient logistics system		
UD-03 **Bago Riverside Sub-center Development Project**	**[Current Problem]** − There are no concrete plan for the future − There are some settlement and unused land − There is no concrete offer from business partners or investors **[Project Scope]** − To build a good residential area in the suburbs of Yangon City − To form a new district that has easy access to railway − To provide high-rise residential buildings adjacent to the river **[Expected Project Effect]** − To control the road traffic congestion in the CBD − To provide residential areas that can accommodate the increasing number of population in Yangon City	Approximately US$ 29 mil.	a) In the future land use plan of Yangon City, it evaluates the new functional areas b) To formulate a basic plan c) To make a feasibility study for the plan d) Search for investors who will cooperate with the project
UD-04 **Dagon Myothit Sub-center Development Project**	**[Current Problem]** − There are no concrete plan for the future − There is no concrete offer from business partners or investors **[Project Scope]** − To build a pleasant residential area in the suburbs of Yangon City − To build a new district that has easy access to railway **[Expected Project Effect]** − To control the road traffic congestion in the CBD − Unused land in the inner area can be urbanized	Approximately US$ 29 mil.	a) For the future land use plan of Yangon City, the new functional areas will be evaluated b) Formulate a basic plan c) Make a feasibility study for the plan d) Search for investors who will cooperate for the project
UD-05 **Public Facilities and Buildings in CBD Transfer and Renovation Project**	**[Current Problem]** − Inefficient land uses and buildings dominated by public facility and offices in the CBD where land has high value − Shortage of lands for business and commercial uses in the CBD where investors are interested **[Project Scope]** − To promote the relocation of government offices to secondary CBD, sub-centers, or suburbs − To vitalize CBD by converting the vacant	Approximately US$ 39 mil.	a) Select the facility, Basic Plan and Feasibility Study b) Negotiation c) Basic Design and Detailed Design d) Transfer and Reconstruction e) Operation and Advertisement

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
	sites or buildings into new facilities and functions giving more attractions and highlights - To contribute in the renovation of building to boost economic growth - To create job opportunities for local people. **[Expected Project Effect]** - To encourage economic activities in the CBD - To provide efficient public services by gathering public facilities into one area		
UD-06 **Formulation of CBD Renewal Scheme Project**	**[Current Problem]** - Almost all buildings in the CBD area are too old for use - Many families still live in old buildings and many floors at each old building use rights. - No information on the reconstruction of old buildings from land owners or floor owners. - Master plan of CBD area has not been created - There is no mechanism to subsidize the redevelopment of the project **[Project Scope]** - Rapid reconstruction of old buildings in the CBD Offer of information to construction firm about the wish of land and floor right owners to reconstruct the buildings. - Clarify the risk in case of earthquakes in the CBD **[Expected Project Effect]** - To promote the reconstruction of old buildings in the CBD - That the land and floor right owners mutually know each other's intentions regarding reconstruction	Approximately US$ 1 mil.	a) Survey basic information on all the buildings in the CBD (number of storeys, degree of obsolescence, etc.) (2013) b) Make a priority plan for the reconstruction of buildings in the CBD area c) Make a fund management plan for the reconstruction of buildings in the CBD area
UD-07 **Prioritized CBD Renewal and Redevelopment Project**	**[Current Problem]** - Dilapidated buildings have been used without any renovation - Master plan of the CBD area has not been created - There is no mechanism to subsidize the redevelopment project **[Project Scope]** - Implementation of redevelopment projects was carried out in cooperation with the government (YCDC) and the private company - The government will prepare small green areas in the CBD - To make new functional areas (trade center, convention center, etc) with reconstruction of building **[Expected Project Effect]** - To build and locate new functional areas in the CBD - Implement government policy in the CBD - To be prepared for disaster with planned open space	Approximately US$ 0.5 mil.	a) Make a master plan for urban redevelopment plan (2013) b) Select a pilot project c) Make a fund management plan for the reconstruction of the pilot project
UD-08 **A Survey and Utilization Plan for Unused Lands**	**[Current Problem]** - With the relocation of the capital from Yangon City to Nay Pyi Taw, there is a government facility that can combined the	Approximately US$ 0.8 mil.	a) To survey basic information about unused lands in the inner area and in the

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
Project	functional areas − After granting land development permit, these lands remain idle without development activities being developed − Land prices are fast increasing **[Project Scope]** − Utilization of unused land in inner area and in the CBD of Yangon City − Control the development of new residential area in the suburbs **[Expected Project Effect]** − To construct new residential area in inner area (the built-up area) − Control the increase price of land		CBD (2013) b) Check the owners of unused lands c) Interview survey to land owners for future land use
UD-09 **Prioritized Unused Lands Development Project**	**[Current Problem]** − With the relocation of the capital from Yangon City to Nay Pyi Taw, there is a government facility that can combined the functional areas − After granting land development permit, these lands remain idle without development activities being done − Land prices are fast increasing **[Project Scope]** − Utilization of unused land in inner area and in the CBD of Yangon City − Control the development of new residential area to the suburbs **[Expected Project Effect]** − To construct new residential areas in inner area (the built-up area) − Control land prices increase	Approximately US$ 0.3 mil.	a) Make a concrete development plan for the land of cooperative landowners (2013) b) Make a feasibility study for the plan c) Search for investors who will cooperate for the project
UD-10 **Statistics System Elaboration Project**	**[Current Problem]** − Inconsistent with the Ward and Township statistics **[Project Scope]** − Training of ward officers to become a statistic expert − Unification of statistic forms − Preparation of statistic manual − Computerization of statistic reports − Submission of a periodic report to Township Office − Appropriate aggregate calculation by Township Office and YCDC **[Expected Project Effect]** − Continuous and accurate statistics	Approximately US$ 4 mil.	a) Detailed Study: mid-2013 up to end of 2013 b) Technical Transfer: early 2014 up to end of 2015 c) Advisory Works: early 2016 up to end of 2017 d) Completion and Continuation by CPs: early 2018
UD-11 **Household Database Management System Development Project**	**[Current Problem]** − No serial data acquisition of household information **[Project Scope]** − Establishment of household database which includes people's opinion acquired from workshops and sampling surveys − Conduct of periodic sample surveys − Updating and analysis of changes − Utilization of the results to urban planning **[Expected Project Effect]** − Conduct of serial surveys − Updating and management system of household information	Approximately US$ 4 mil.	a) Detailed Study: mid-2013 up to end of 2013 b) Technical Transfer: early 2014 up to end of 2015 c) Advisory Works: early 2016 up to end of 2017 d) Completion and Continuation by CPs: early 2018

Source: JICA Study Team

(2) Social Service

Sub-program of social service (US) consists of total 3 projects. The projects are shown in Table 6.3.2.

Table 6.3.2: Sub Program of Social Service (List of Projects)

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
US-01 Barrier-free for Persons with disabilities (PwDs) Project	**[Current Problem]** − No detail information regarding PwDs − No consideration to the PwDs in public facilities and public transport modes − No employment opportunity for PwDs **[Project Scope]** − Survey on current mobility and accessibility of the PwDs in public facilities and transport modes − Establishment of laws and regulations to create barrier-free environment − Subsidy for construction/renovation of public facilities buildings and replacement of transport mode which applies to the regulations − Special assistance for children with disabilities to study in general schools by physically and educationally − Fostering of social acceptability to PwDs and minorities by public campaign − Provision of medical care services & financial aids for assistive devices − Implementation of livelihood program − Establish sign language-supported media − Support to involve in social activities eg. water festival, and disability-related sport activities **[Expected Project Effect]** − To clarify current condition of PwDs − To establish a barrier-free law − To promote acceptability of people to PwDs − To assist children with disability to study together with normal students	Approximately US$ 6 mil.	a) Detailed Study: Mid-2013 to mid-2014 b) Technical Transfer: mid-2014 to2016 c) Advisory Works: early 2017 to 2019. d) Completion and Continuation by CPs: early 2020
US-02 Education System Strengthening Project	**[Current Problem]** − Not all the 5 years children can go to school − Number of middle school is not enough comparing to number of primary school − The ratio of students eligible for university is low comparing to the number of students in middle school − Difficulty to continue studying after graduation of primary school because of lower number of middle school and distance from remote area **[Project Scope]** − Preparation of school allocation plan according to estimated future population and number of students − Upgrading teacher quality with pre-service and in-service teacher training programs − Improvement of educational infrastructures	Approximately US$ 8 mil.	a) Detailed Study: Mid-2013 to mid-2014 b) Technical Transfer: mid-2014 to2016 c) Advisory Works: early 2017 to 2022. d) Completion and Continuation by CPs: early 2023

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
	such as open more schools with modern teaching aids - Expansion for provision of post-primary schools including middle schools and branch schools - Operation of school bus service to commute from remote area - Launching mobile school program in remote area & special program for over-age children - Upgrading education standard to international level and alignment with the needs of technology driven labor market - Close coordination with monastic schools and government to have consistency with national education policy - Develop regulations that lead to greater complementarities between private and public schools **[Expected Project Effect]** - Increase of students enrollment ratio of 5 years old - Increase of ratio of students eligible for university - Increase of number of teachers		
US-03 Urban Poor Assistance Project	**[Current Problem]** - Existence of students who cannot continue study in school because of poverty - Existence of poor communities particularly in periphery area - Low employment opportunities because of low education level **[Project Scope]** - Survey on existing living condition, education and health status of poverty group - Provision of affordable housing for low income group - Promotion of human development programs - Supporting home-based income-generating activities - Implementation of micro-finance scheme - Launching education-related assistance program such as scholarship program, school book loan program - Support system to connect the urban services **[Expected Project Effect]** - Upgrading of living condition of poverty group - Increase of number of students who can continue studying in school - Increase of number of employment of poverty group	Approximately US$ 6 mil.	a) Detailed Study: Mid-2014 to mid-2015 b) Technical Transfer: mid-2015 to2017 c) Advisory Works: early 2018 to 2020. d) Completion and Continuation by CPs: early 2021

Source: JICA Study Team

(3) Urban Landscape and Heritage

Sub-program of urban landscape and heritage (UL) consists of total 5 projects. The projects are shown in Table 6.3.3.

Table 6.3.3: Sub Program of Urban Landscape and Heritage (List of Projects)

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
UL-01 **Establishment of the Guideline and Promotion of the Management for Heritage Conservation Project**	**[Current Problem]** − Insufficient basic information related to heritage building and urban districts of the CBD. − No regulations and criteria to conserve heritage buildings. − No necessary basic manuals to manage the heritage conservation zone. **[Project Scope]** − To record architectural heritage through text, photos, drawings, etc. − To assess the actual conditions of the heritage buildings and prepare drawings. − To establish a basic database of the heritage buildings and urban district, based on the collected information. − To formulate a guideline for the conservation of heritage buildings. − To establish a system based on the guidelines to be formulated. − To conduct a capacity development for officers who formulate the guideline. **[Expected Project Effect]** − To use the database for the new conservation works as the basic information. − To facilitate the management of the conservation works. − To re-use the heritage building for future development.	Approximately US$ 0.5 mil.	a) Basic Survey: 2013 b) Establish the Guideline: 2014 c) Technical Transfer and Capacity Development: 2014
UL-02 **Yangon Tourism Action Plan Project**	**[Current Problem]** − Insufficient facilities, services, and capacities to accommodate the rapid increase of tourists − Necessity of tourism promotion which contributes to economic development and improvement of living standard − No master plan for tourism development that can facilitate multi-sectors cooperation. **[Project Scope]** − To identify potential tourism resources to create an international tourism destination and gateway − To conduct a tourism baseline survey − To formulate a tourism development vision and strategies − To promote a community-based tourism product development − To formulate an heritage tourism action plan including institution/organization, marketing/promoting, event program, etc. − To formulate action programs including conducting a pilot project **[Expected Project Effect]** − To conduct effective and supportive projects related to tourism development − To maximize the capacity of tourism destination to increase the number of tourists	Approximately US$ 0.5 mil.	a) Action Plan Study: 2013 to 2014 b) Technical Transfer and Capacity Development: 2014 to 2015 c) Pilot Project: 2014 to 2015

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
UL-03 **Tourism and Heritage Promotion Area/Street Development Project**	**[Current Problem]** − Limited attractive tourist spots for foreign and domestic tourists in the CBD − Necessity of a model case to develop a community-based tourism − Poor conditions of heritage buildings in the CBD **[Project Scope]** − To select an area/street to develop a community-based tourism as a model case. − To identify stakeholders and key players to conduct the pilot project − To improve sidewalks and perform road beautification by placing street furniture and trees − To create heritage tourism promotion materials (brochure, guide map, website, tourist guide/info signboard, etc.) − To organize familiarization tours, promotion events, and beautification campaigns − To control car entry and car parking in the area/street − To promote and control building façade and design **[Expected Project Effect]** − To create a new and attractive tourism destination in the CBD and Yangon − To increase the income of stakeholders related to tourism sector − To contribute in the conservation and renovation of heritage buildings	Approximately US$ 13 mil.	a) Basic Plan and Feasibility Study b) Basic Design, Detailed Design, Tender Document Preparation c) Construction, Procurement, and Installation d) Operation and Advertisement
UL-04 **Holding Technical Workshop for the Conservation Management and Construction Technique Project**	**[Current Problem]** − Lack of knowledge about conservation issues in general. − Necessity to share knowledge about conservation management. − Lack of construction technique for conservation works. **[Project Scope]** − To conduct a capacity development for planners such as urban planner, architect, etc., who manage the conservation project. − To conduct a capacity development for construction technicians such as carpenters, painters, plasterer, bricklayer, etc., who perform conservation works on site. **[Expected Project Effect]** − To upgrade the capacity of planning and management of conservation project. − To upgrade the capacity to construct conservation works on site.	Approximately US$ 0.7 mil.	a) Basic Study: 2014 b) Conduct Workshop and Give Certificate: 2014 (annually)
UL-05 **Establishment of the Mechanism for the Realization of Heritage Buildings Project**	**[Current Problem]** − Lack of mechanism to realize the conservation works. **[Project Scope]** − To establish the mechanism based on the guideline to be formulated. − To conduct a capacity development for the officers who give permissions to conservation buildings. **[Expected Project Effect]**	Approximately US$ 0.5 mil.	a) Basic Study: 2013 b) Technical Transfer and Capacity Development: 2014

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
	− To systemize the procedure for the realization of conservation works.		

Source: JICA Study Team

(4) Public Parks and Greenery

Sub-program of public parks and greenery (UP) consists of total 2 projects. The projects are shown in Table 6.3.4.

Table 6.3.4: Sub Program of Public Parks and Greenery (List of Projects)

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
UP-01 **Formulation for Guideline and Standard for Construction of New Public Parks Project**	**[Current Problem]** − Limited number of public parks for current total population − No regulations, standards, or criteria to construct new public parks especially in the development of new towns − Necessity of providing directions to developers in promoting the construction of new public parks or relevant open-space for sustainable urban development **[Project Scope]** − To formulate a guideline and standard for construction of new public parks − To establish the system based on the guideline and standard to be formulated − To conduct a capacity development for officers who check and give direction to new development activities **[Expected Project Effect]** − To provide a comfortable living condition with rich green environment and open-space in urbanized and urbanizing areas − To contribute in the mitigation of climate change, environmental pollution, flood, and other negative impacts.	Approximately US$ 0.8 mil.	a) Study: b) Technical Transfer and Capacity Development:
UP-02 **New Public Parks Construction in New Towns Project**	**[Current Problem]** − Limited number of public parks for current total population − Low elevation of lands for housing development and necessity of large amount of soils for landfill **[Project Scope]** − To conduct a survey and feasibility study of a suitable site for new public parks in new towns to be developed − To conduct land reclamation by making a pond to provide soils − To harmonize the development with the natural environment − To develop basic infrastructures, and to construct pedestrians' path and wood deck − To provide park equipment (playground equipment, benches, small arbors, toilets, lightings, signboards, etc.) − To plant large trees to make shade spaces in the parks − To conduct a capacity development for	Approximately US$ 30 mil.	a) Basic Plan Study: b) Technical Transfer and Capacity Development: c) Construction of model parks

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
	management of public parks **[Expected Project Effect]** − To provide a comfortable living condition with rich green environment and open-space in urbanized and urbanizing areas − To contribute in the mitigation of climate change, environmental pollution, flood, and other negative impacts.		

Source: JICA Study Team

(5) Capacity Development

Sub-program of capacity development (UC) consists of total 5 projects. The projects are shown in Table 6.3.5.

Table 6.3.5: Sub Program of Capacity Development (List of Projects)

Project Name	Project Outline		Project Implementation Schedule
UC-01 **Preparation of Manual for Urban Planning and Implementation**	**[Current Problem]** − Urban planning administrative systems are in the developing stage − Results of the urban planning system and capacity development program should be shared immediately with relevant organizations **[Countermeasure]** − To share the result of capacity development projects through a manual for urban planning **[Project Scope]** − To formulate a manual for urban planning − To execute training of trainers in order to accelerate technical transfer to Myanmar engineers **[Expected Project Effect]** − Spread and progress of execution operations of urban planning matters	Approximately US$ 2 mil.	d) GIS Manual: 2016-2018 e) Spatial Control Management Manual: 2018-2020 f) Manual for the Formulation of Detailed Spatial Plan: middle of 2017-2020 g) Manual for the Acceleration of Urban Planning Project: The result may not be suitable subject for the manual.
UC-02 **Urban Spatial Control Management**	**[Current Problem]** − Inefficient legal system on urban spatial control − Role sharing among relevant organizations not yet decided − Necessity of legalization of spatial control management system, and capacity development on related works **[Countermeasure]** − To strengthen the legal system − To improve the working capacity on spatial control management **[Project Scope]** − Assistance in the formulation of a study on urban planning related to laws, standards, and regulations − Assistance in the study regarding the contents to be included in the by-laws, regulations, and requirements − Assistance in the formulation of the application manual and information sharing for regional/local urban planning agency − Trial application of control measures for pilot projects or pilot area (e.g., ward) − Technical assistance in the training on	Approximately US$ 3.5 mil.	a) Preliminary Study on the Legal System: 2014 b) Detailed Study on the Legal System: 2015-2017 c) Legalization, Enactment of Law (by Myanmar government): 2017-2018 d) Training on Application of Legal System: 2018-2020 e) Formulation of the Application Manual, Training of Trainers: 2018-2020, (mentioned in the "Preparation of Manual for Urban Planning and Implementation")

Project Name	Project Outline		Project Implementation Schedule
	application of control measures and evaluation on development plans - Assistance in the sharing of technical knowledge on urban planning **[Expected Project Effect]** - Establishment of a legal system for urban planning - Improvement of an administrative capacity on spatial control and management		
UC-03 **Formulation of Detailed Spatial Plan**	**[Current Problem]** - Effective spatial control plan, which is based on legal system, is not yet formulated **[Countermeasure]** - To formulate a detailed spatial plan corresponding to "urban development master plan" and progress of legalization **[Project Scope]** - Assistance in the formulation of planning items to be drawn in the plan - Assistance in the formulation of a detailed spatial plan for control measures - Assistance in the integration of a detailed plan according to PIC and development strategy of different administrative organizations **[Expected Project Effect]** - Detailed spatial control plan will be formulated - The planning process will be shared and technical knowledge will be transferred	Approximately US$ 5.5 mil.	a) Preliminary Study on Planning Issues in the Target Area: 2014 b) Formulation of Outline of Planning and Control Matters: 2015-2016 c) Study on the Integration of Result of PIC with Detailed Spatial Plan: 2015-2020 d) Formulation of Detailed Spatial Plan of the Target Area: 2017-2020 e) Training on the Application of Legal System: 2018-2020
UC-04 **Establishment of Information Management System for Urban Planning**	**[Current Problem]** - Improper arrangement of preliminary information related to urban planning - Insufficient sharing of basic information among related agencies - Difficulty in the integration of information among other administrative organizations (e.g., between neighboring townships) **[Countermeasure]** - To design an information database system - To formulate procedures of data maintenance and revision - To make a system for effective use of information, and for public relations **[Project Scope]** - Assistance in the formulation of information list, data collection manual, and format - Assistance in the establishment of role sharing about information management, maintenance, and practical uses - Assistance in the execution of data collection - Assistance in the DATA management (GIS) - Training on information management and maintenance **[Expected Project Effect]** - Capacity for data management will be improved - Collected information will be utilized for planning, evaluation and execution of urban planning matters	Approximately US$ 4 mil.	a) Establishment of the Role Sharing Among Relevant Organizations: 2014-2015 b) Formulation of Information List, Data Collection Manual and its Format: mid-2014-2015 c) Execution of Supplemental Data Collection, Data Entry: 2015-2017 d) Training on Information Management: 2016-2018
UC-05 **Assistance for Possible**	**[Current Problem]** - Limited work experience in the execution of urban planning/ development project	Approximately US$ 3 mil.	a) Selection of Target Project, Formulation of Working

Project Name	Project Outline		Project Implementation Schedule
Acceleration Measures for Urban Planning Project	− Limited work experience in coordination of private public partnership project **[Countermeasure]** − To develop a working capacity through on-the job-training − To develop necessary working process according to the progress of the project **[Project Scope]** − Study and assist for possible acceleration measures in the implementation of urban development projects − Study and assist for possible acceleration measures in the community-based urban spatial improvement − Study and assist for possible acceleration measures in public oriented project **[Expected Project Effect]** − Coordination capacity for the implementation of urban development project will be developed − Practical working capacity will be developed		Organization: 2014-2015 b) Study on the Development Plan, Business Scheme: 2016-2017 c) Execution of Project Coordination: 2018-2020 d) Formulation of Manual for Acceleration of Urban Planning Project: The result may not be a suitable subject for the manual

Source: JICA Study Team

6.3.2 Priority Programs for Urban Infrastructure Development Sector

(1) Urban Transport

Sub-program of urban transport (IT) consists of total 21 projects. The projects are shown Table 6.3.6.

Table 6.3.6: Sub Program of Urban Transport (List of Projects)

Project Name	Project Outline	Preliminary Estimated Cost	Remarks
IT-01 Restructuring of Passenger Bus Network	− Restructuring the passenger bus network − Introduction of functional network system including bus zone − Reorganization of bus operation companies	Approximately US$ 3 mil.	
IT-02 Modernization of the Passenger Bus Services	− Renewal of bus fleets − Provision of information to the passengers and introduction of smart card − Operation management by GPS and traffic safety management	Approximately US$ 50 mil.	
IT-03 Prioritization of Passenger Bus Transportation	− Introduction of bus lane − Introduction of bus priority traffic light	Approximately US$ 15 mil.	3 lines
IT-04 Development of Bus Interchanges	− Connecting point of major bus routes − Construction of facility for transfer passengers	Approximately US$ 20 mil.	10 points
IT-05 Development of Bus Terminals	− Construction of bus terminals for each urban area	Approximately US$ 20 mil.	4 points
IT-06 BRT System Development	− Introduction of bus rapid transit (BRT) system in the north-south urban development corridor	Approximately US$ 200 mil.	2 lines
IT-07 Development of Public Transportation System in the CBD	− Circular bus or LRT in the CBD − Traffic restriction of private vehicles	Approximately US$ 100 mil.	1 line
IT-08 Traffic Congestion Mitigation Project	− Improvement of existing traffic bottlenecks − Installation of traffic signal and improvement of geometric intersection	Approximately US$ 20 mil.	10 bottle necks
IT-09 Intersection Grade-separation Project	− The intersections of main roads that experience traffic congestion.	Approximately US$ 150 mil.	10 points
IT-10 Modernization of Traffic Control and Management System	− Introduction of an Area Traffic Control System, provision of information about traffic conditions	Approximately US$ 50 mil.	Urban center
IT-11 Improvement of Traffic Safety Facility	− Provision of center barrier on the main roads − Construction of pedestrian bridges − Traffic enforcement, installation of traffic lights	Approximately US$ 20 mil.	Main road
IT-12 Improvement of Pedestrian Environment in the CBD	− Enforcement of law regading street vending and provide barrier-free pedestrian facilities − Development of pedestrian mall (shopping arcade)	Approximately US$ 5 mil.	
IT-13 Traffic Safety Education and Propaganda	− Education and propaganda on traffic safety − Capacity development of traffic safety committee	Approximately US$ 3 mil.	

Project Name	Project Outline	Preliminary Estimated Cost	Remarks
IT-14 **Enhancement of Traffic Enforcement**	− Provision of enforcement equipment including cameras − Reform the laws and regulation on road traffic − Simplification of traffic violation ticket	Approximately US$ 20 mil.	
IT-15 **Development of Traffic Accident Database and Traffic Safety Audit System**	− Development of a database for traffic accident − Development of a Traffic Safety Audit System	Approximately US$ 5 mil.	
IT-16 **Computerization of Vehicle and License Registration**	− Computerization of vehicle registration and driver's license	Approximately US$ 5 mil.	
IT-17 **Transport Demand Control in the CBD**	− Pricing and registration control, etc. − Control of motorcycle use	Approximately US$ 20 mil.	
IT-18 **Development of Public Parking and Guidance System in the CBD**	− Effective use of government vacant lands − Construction of multi-storey parking − Parking information system and enforcement	Approximately US$ 30 mil.	
IT-19 **Reform of Law and Regulation on Traffic Management and Transport Demand Management**	− Traffic impact assessment − Garage Law, compulsory parking facilities − Laws and regulations on traffic management	Approximately US$ 1 mil.	
IT-20 **Yangon Urban Traffic Planning Unit**	− Planning and monitoring of urban transport system − Updating of urban transportation database	Approximately US$ 5 mil.	
IT-21 **PTA (Public Transport Authority)**	− Management of public transportation system − Policy development for public transport system	Approximately US$ 5 mil.	

Source: JICA Study Team

(2) Road Network

Sub-program of road network (IR) consists of total 5 projects. The projects are shown Table 6.3.7.

Table 6.3.7: Sub Program of Road Network (List of Projects)

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
IR-01 **Improvement of Signalized Intersections**	**[Current Problem]** − Traffic congestion at major intersections especially in peak hours − Independent operation (not synchronized) of each traffic signal − Improper parameter setting of signals **[Countermeasure]** − To improve the road shape of intersections with minimal land acquisition − Installation of the advanced signal control system such as ATCS (Area Traffic Control System) − Installation of preliminary traffic control center **[Project Scope]** − To improve 20 intersections **[Expected Project Effect]** − To maximize the capacity of intersections and	Approximately US$ 13 mil.	a) Feasibility Study: mid-2013 to mid-2014 b) Basic Design, Detailed Design, Tender Document Preparation, Tendering: early 2015 to mid-2016 c) Construction, Procurement, Installation, Commissioning: mid-2016 to early 2018 d) Commencement of Service: early 2018

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
	reduce the traffic jam		
IR-02 **Construction of Flyovers/Underpasses for Bottleneck Intersections**	**[Current Problem]** - Traffic congestion at major intersections especially in peak hours **[Countermeasure]** - To construct flyovers/underpasses - Provision of pedestrian facilities **[Project Scope]** - To study alternatives such as at-grade intersections with proper signal system - In case of "not applicable of the above at-grade alternative", overpass (flyover) or underpass structure will be constructed. - Installation of pedestrian facilities **[Expected Project Effect]** - To reduce the traffic jam	Approximately US$ 50 mil.	a) Feasibility Study: mid-2013 to end of 2013 b) Detailed Design, Tender Document Preparation, Tendering: early 2015 to end of 2016 c) Construction, Procurement, Installation, Commissioning: early 2017 to end of 2018. d) Commencement of Service: end of 2018
IR-03 **Re-construction of Old Bridge (i.e.Thaketa Bridge)**	**[Current Problem]** - Traffic congestion on the narrow old bridge - Serious damages such as corrosion are observed and YCDC recognizes to re-construct the bridge. - Narrow dangerous pedestrian crossing across the creek **[Countermeasure and Project Scope]** - To construct the new bridge by dismantling the old bridge - Widening or construction of new approach roads - Installation of proper pedestrian facility to enhance pedestrian movement across the creek **[Expected Project Effect]** - To reduce the traffic jam - To enhance people's mobility (pedestrian) - To eliminate possible danger in the collapse of the old bridge	Approximately US$ 35 mil.	a) Feasibility Study: mid. 2013 to end of 2013 b) Detailed Design, Tender Document Preparation, Tendering: early 2015 to end of 2016 c) Construction, Procurement, Installation, Commissioning: early 2017 to end of 2018. d) Commencement of Service: end of 2018
IR-04 **Improvement of Road No.2**	**[Current Problem]** - Mostly 2-lane road except a part of 4-lane section - Urbanization along Road No.2 is developing - Bad pavement condition - Thilawa SEZ will be opened in 2015 and heavy vehicles to and from SEZ will enter the city **[Countermeasure and Project Scope]** - Upgrading the total 6-lane highway (20 km stretch) - Proper pavement structure for heavy vehicle - Connection to the proposed Outer Ring Road (Road No.7) **[Expected Project Effect]** - Enhance economic development along Road No.2 - Reduce heavy traffic to the city	Approximately US$ 60 mil.	a) Feasibility Study: mid-2013 to mid-2014 b) Detailed Design, Tender Document Preparation、Tendering: mid-2015 to mid-2017. c) Construction, Procurement, Installation, Commissioning: mid-2017 to mid-2019. d) Commencement of Service: mid-2019
IR-05 **[Outer Ring Road (Section-1)] Upgrading of Road No.7**	**[Current Problem]** - Narrow road (2-lane) - Critical for urbanization due to poor accessibility - Bad pavement condition - Thilawa SEZ will be opened in 2015 and the heavy vehicle to and from SEZ will enter the city	Approximately US$ 78 mil.	a) Feasibility Study: mid-2013 to mid-2014 b) Detailed Design, Tender Document Preparation、Tendering: mid-2015 to mid-2017.

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
	− Early land acquisition shall be recommended for future Outer Ring Road **[Countermeasure and Project Scope]** − Upgrading the total 4-lane highway (26 km stretch) − To secure ROW for future Outer Ring Road − Proper pavement structure for heavy vehicle − Connection to Road No.1 and Road No.2 **[Expected Project Effect]** − Enhance economic development along Road No.2 and Road No.7 − Reduce heavy traffic to the city		c) Construction, Procurement, Installation, Commissioning: mid-2017 to early 2020. d) Commencement of Service: early 2020

Source: JICA Study Team

(3) Railway

Sub-program of railway (IRW) consists of total 5 projects. The projects are shown in Table 6.3.8.

Table 6.3.8: Sub Program of Railway (List of Projects)

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
IRW-01 **Automatic Level Crossing Installation in Yangon Circular Railway**	**[Current Problem]** − Yangon Circular Railway has 25 level crossings which are manually operated (opened and closed) by railway staff. − Therefore, quite long closing time is required, and it brings chronic traffic congestions at all level crossing points **[Countermeasure]** − To introduce automatic level crossing which open and close barrier works automatically at all existing level crossings. **[Project Scope]** − To install 25 automatic level crossings in Yangon Circular Railway. **[Expected Project Effect]** − To reduce drastically the closing time and shorten the traffic jam length.	Approximately US$ 13 mil.	a) Feasibility Study: April to September 2013 b) Basic Design, Detailed Design, Tender Document Preparation: October 2013 to September 2014. c) Tendering: October 2014 to March 2015 d) Construction, Procurement, Installation, Commissioning: April 2015 to March 2016. e) Commencement of Service: April 2016
IRW-02 **Bottleneck Elimination of Yangon Circular Railway between Yangon Central Station and Pazundaung Station**	**[Current Problem]** − The section between Yangon Central Station and Malwagone Station becomes double-double track, one double track is for Yangon Circular Railway and the other double track is for Yangon-Mandalay Line. − Both double track lines are crossed at grade between Yangon Central Station and Pazundaung Station. − In addition, a part in the section reduce the number of tracks from four (double-double track) to three. − Therefore, trains for Yangon Circular Railway are forced to have unscheduled long time waiting for Yangon-Mandalay long distance trains which are categorized as high-class train. − As it worsened delays, and unreliability of travel, it becomes one of the reasons for low modal share. **[Countermeasure]** − To install an additional track, converting all	Approximately US$ 13 mil.	a) Feasibility Study: April to September 2013 b) Basic Design, Detailed Design, Tender Document Preparation: October 2013 to September 2014. c) Tendering: October 2014 to March 2015 d) Construction, Procurement, Installation, Commissioning: April 2015 to March 2016. e) Commencement of Service: April 2016

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
	sections to double-double track (eliminating three-track sections.). - To change the role of platforms for Yangon Circular trains and Yangon-Mandalay long distance trains. Then, an escalator and elevator should be installed for both platforms because passengers for Yangon-Mandalay long distance train, which carry large baggage are forced to use the platform located far from the concourse and connected by FOB with stairway. **[Project Scope]** - To install an additional track to the current three lines section. - To improve the existing tracks of the section. - To improve the drainage condition. - To install an escalator and elevator at both platforms. **[Expected Project Effect]** - To improve the punctuality and quick-deliverability of both Yangon Circular Railway and Yangon-Mandalay Line - To increase the number of railway passengers, and proceed in the modal shift from road to railway traffic.		
IRW-03 **Urgent Installation of Radio-typed Train Detection System in Yangon Circular Railway**	**[Current Problem]** - Yangon Circular Railway has installed automatic color light signal. However, the system is quite old and has many problems such as frequent malfunction without changing signal color due to fail-safe system caused by short-circuiting as well as, track circuit failure due to water-soaked track in rainy season. It causes chronic train delay and dangerous train operation depending on driver's keen vision even without reliable signal. **[Countermeasure and Project Scope]** - To install radio-typed train detection system that is free from water-soaked track. - The radio-typed train detection system should have future expandability in order to realize moving block typed train control system in the future by adding optional devices/equipment. **[Expected Project Effect]** - To enhance the safety and punctuality of train operation because the instruction from dispatcher to drivers becomes accurate due to working radio train detection system even during signal malfunction.	Approximately US$ 13 mil.	a) Feasibility Study: April to September 2013 b) Basic Design, Detailed Design, Tender Document Preparation: October 2013 to September 2014. c) Tendering: October 2014 to March 2015 d) Construction, Procurement, Installation, Commissioning: April 2015 to March 2016. e) Commencement of Service: April 2016
IRW-04 **Installation of Radio-typed Telecommunication System for Yangon Circular Line (Malwagone- Yangon-Danyingone Section)**	**[Current Problem]** - Current telecommunication system for Yangon Circular Railway is old-fashioned, and forces to communicate telephone line among stations and transceivers between stations and drivers. However, it is not suitable for railway communication system in terms of reliability. Especially, regarding the 28 km section between Malwagone Station and Danyingone Station via Yangon Central Station, the improvement is essential	Approximately US$ 4 mil.	a) Feasibility Study: April to September 2013 b) Basic Design, Detailed Design, Tender Document Preparation: October 2013 to September 2014. c) Tendering: October 2014 to March 2015 d) Construction,

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
	and urgent due to the highest train operation density section and dangerous train operation under signal malfunction. **[Countermeasure]** − To install radio-typed telecommunication system. **[Expected Project Effect]** − To improve safety by the improvement of communication condition among stations and drivers.		Procurement, Installation, Commissioning: April 2015 to March 2016. e) Commencement of Service: April 2016
IRW-05 **Yangon Circular Railway Modernization (Improvement and Electrification) Phase1: Western Half Loop**	**[Current Problem]** − Yangon Circular Railway surrounds the city center by 47 km length line. The line, especially the western half, has high potential as urban railway line is passing through high value areas such as business district, high density residential area, etc. − However, the railway is inferior as compared to other public transport modes such as bus in all aspects such as punctuality, quick-deliverability, safety, comfortability, and accessibility at present due to deteriorated infrastructures, lack of feeder connection, etc. These causes dissatisfaction in using railway to Yangon citizens, especially to high income class. **[Countermeasure and Project Outline]** − The western half of Yangon Circular Railway (Yangon Central Station – Insein Station – Danyingone Station with 21 km length) which passes through high population density areas is categorized as future main transport axis linking the north with the south in the city center. The modernization and electrification should be conducted. − In addition, to develop station plazas at the main stations in order to connect the railway with other feeder services like bus, etc. **[Expected Project Effect]** − To facilitate the modal shift from road to railway transport, especially the north-south direction transport. − To reduce road traffic volume and congestion. − To improve the transport condition between north Yangon and the CBD area drastically, especially the commuting condition.	Approximately US$ 560 mil.	a) Feasibility Study: April 2013 to October 2013 b) Loan Appraisal: December 2013 c) Basic Design, Detailed Design, Tender Document Preparation: January 2014 to April 2015. d) Tendering: May 2015 to September 2015 e) Construction, Procurement, Installation, Commissioning: October 2015 to September 2018. f) Commencement of Service: October 2018

Source: JICA Study Team

(4) Port and Logistics

Sub-program of port and logistics (IP) consists of total 6 projects. The projects are shown in Table 6.3.9.

Table 6.3.9: Sub Program of Port and Logistics (List of Projects)

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
IP-01 **Twante Canal Rehabilitation**	[Current Problem] Embankment damages are evident at the edges of the sandbar at the entrance to Twante Canal.	Approximately US$ 10 mil.	a) Feasibility Study: January to April 2013

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
Project	[Countermeasure] Rehabilitation of the embankment and jetty. [Project Scope] To construct robust embankment [Expected Project Effect] Security of navigation route between Yangon and the Delta and upper Myanmar regions. Safety of villagers' lives and security of the waterway transport. Note: Supplementary information is mentioned below.		b) Basic Design, Detailed Design, Tender Document Preparation: May to December 2013. c) Tendering: January to March 2014 d) Construction, Procurement, Installation, Commissioning: May to December 2014. e) Commencement of Service: January 2015
IP-02 **Waterfront Development**	[Current Problem] Jetties owned by MPA are scattered along the Yangon River, and the waterfront is not efficiently utilized for commercial activities. [Countermeasure] Renovation of waterfront [Project Scope] To construct commercial facilities behind Lanmadaw area (inland waterway terminal) To renovate the Pansodan-Dala Ferry terminal area at the Yangon side into modern terminal and commercial zone. To extend the Botathaung jetty terminals and construct commercial and recreation area [Expected Project Effect] Revive the waterfront commercial activities Provide amenities to the citizen	Approximately US$ 50 mil.	a) Tendering: 3 ongoing packages by MPA (BOT scheme) b) Construction, Procurement, Installation, Commissioning: by early 2014 c) Commencement of Service: First phase will commence in 2014, and full completion will be in 2016
IP-03 **Yangon Main Port Expansion**	[Current Problem] The existing international port terminals are not efficiently operated due to the obsolete facilities or insufficient berthing area. [Countermeasure] Rehabilitation of the existing port terminals [Project Scope] To renovate the Sule Terminals 1, 2, 3, and 4 (by MPA's BOT scheme) To expand the MIP berthing area [Expected Project Effect] Increase the cargo handling capacities	Approximately US$ 100 mil.	a) Tendering: Sule (completed), MIP (own construction) b) Construction, Procurement, Installation, Commissioning: Sule (within 2013), MIP (started construction) c) Commencement of Service: Sule (2014), MIP (2013)
IP-04 **Installation of Safety Navigation Facilities (VTMS, AIS) & Navigation Aid**	[Current Problem] Due to lack of navigation aid system in the access channel, vessels are not allowed to navigate during night time [Countermeasure] Installation of navigation aid [Project Scope] To install equipment, and train to facilitate operation. [Expected Project Effect] Safety navigation during day and night Increase number of vessel calls	Approximately US$ 50 mil.	a) Feasibility Study: 2013 b) Basic Design, Detailed Design, Tender Document Preparation: 2013 c) Tendering: January to March 2014 d) Construction, Procurement, Installation, Commissioning: May to December 2014. e) Commencement of Service: 2015
IP-05 **Thilawa Area Port Project Phase I**	[Current Problem] Cargo handling capacity of Yangon Port will soon become insufficient to handle the increasing cargo volume. [Countermeasure]	Approximately US$ 291 mil.	a) Feasibility Study: completed (2012 by JICA) b) Basic Design, Detailed Design, Tender

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
	MPA to develop the container terminal through yen loan [Project Scope] To construct 400 m length berth and a yard [Expected Project Effect] To meet the increasing cargo volume demand.		Document Preparation: Detailed design will commence in 2013 c) Tendering: mid-2014 d) Construction, Procurement, Installation, Commissioning: Phase I-1 will complete by the end of 2015 e) Commencement of Service: end of 2015
IP-06 **Replacement of Dala Ferry Ships**	[Current Problem] Old ferry ships currently being used do not guarantee safe ferry operation and service. [Countermeasure] Replacement of old ferry ships with new ones. [Project Scope] To provide three new ferry ships [Expected Project Effect] Secure the safe ferry operation and service Passengers' comfort	Approximately US$ 12 mil.	a) Feasibility Study: 2012 (completed by JICA) b) Basic Design, 2012 (completed) c) Tendering: 2013 d) Construction, Procurement, Installation, Commissioning: 2014 e) Commencement of Service: end of 2014

Source: JICA Study Team

(5) Water Supply

Sub-program of water supply (IW) consists of total 6 projects. The projects are shown in Table 6.3.10.

Table 6.3.10: Sub Program of Water Supply (List of Projects)

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
IW-01 **Renewal of Pump Station of Nyaunghnapin WTP**	**[Construction Works]** − Replacement of all pump facilities, improvement of preventing water hammer, refurbishment of house and installation of monitoring equipment **[Selection basis]** − It is the most important facility that supports water supply to nine townships and Yegu Pumping Station. YCDC does not have alternative facility. Damage of pumps due to water hammer from frequent power failure as well as to disrupted water supply caused by many repair works.	Approximately US$ 20 mil. "Replacement of pump station of Nyaungnapin WTP and Distribution pipeline in Yankin Township will be implemented together.	a) Basic/detailed design and preparation of tender will start in 2013 b) Construction work will start in 2014 and will be completed in 2015
IW-02 **Renewal of Distribution Pipeline in Yankin Township**	**[Construction works]** − Replacement of distribution pipeline between Kokkin Reservoir to Yegu Pumping Station, CIP 42", − Establishment of DMA and LMB **[Selection basis]** − Improvement of aged main pipeline caused many water leakages therefore improvement of trunk/main distribution pipe network is important in order to establish DMA and LMB		a) Basic/detailed design and preparation of tender will start in 2013 b) Construction works will start in 2014 and will be completed in 2015

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
IW-03 **Construction of Kokkowa WTP and transfer/distribution pipeline**	**[Construction works]** − Intake pump facilities from Kokkowa river and conduct pipeline − New WTP (75MGD) − Transfer/distribution pipeline **[Selection basis]** − To meet increasing water demand − The first WTP which has river water resource in Greater Yangon	Approximately US$ 520mil.	a) Feasibility study will start in 2014 b) Basic/detailed desigh and preparation of tender will start in 2016 till 2018 c) Construction works will start in 2018 till 2020
IW-04 **Construction of Lagunpyin WTP and transfer/distribution pipeline**	**[Construction works]** − New WTP (40MGD) of which water resource is Lagunpyin reservoir − Transfer/distribution pipeline (19km) **[Selection basis]** − To meet increasing water demand − It is the nearest water resource from Thilawa SEZ and support improving Thilawa SEZ	Approximately US$ 145mil.	a) Feasibility study will start in 2015 b) Basic/detail design and preparation of tender will start in 2016 till 2018 c) Construction：2018 till 2020
IW-05 **Renewal of Distribution Pipe Network of Zone 1**	**[Construction works]** - Renewal of distribution pipe network (556km) - Rehabilitation of existing reservoir (2) - Installation of DMA (30) - Installation of distribution pumps for higher area **[Selection basis]** - To work out stable water supply - To reduce NRW and to increase supply water	Approximately US$75mil.	a) Fesibility study will start in 2013 b) Basic/detail design and preparation of tendering will start in 2014 till 2015 d) Construction: 2016 till 2018
IW-06 **Installation of Disinfection Facility**	**[Construction works]** -Installation of disinfection facilities such as Gyobyu WTP(27MGD), Naungnapin WTP(90MGD), Hlawaga pumping station(68MGD), **[Selection basis]**	Approximately US$ 20mil.	a) Feasibility study will start in 2013 b) Basic/detail design and preparation of tendering will start in 2014 till 2015 e) Construction: 2016 till 2018

(6) Sewerage and Drainage

Sub-program of sewerage and drainage (IS) consists of total 2 projects. The projects are shown in Table 6.3.11.

Table 6.3.11: Sub Program of Sewerage and Drainage (List of Projects)

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
IS-01 **Improvement of water quality of Kan Dow Gyi Lake**	**[Construction Area]** − Waste water collecting pipe and pumping station − Eliminating water bloom and dredging up sludge from bottom − Rain water discharge facilities (7) **[Selection basis]** − Realization of citizens' amenity − Improvement of water environment	Approximately US$ 4.6 mil	a) Feasibility study will start in2013 b) Basic/detailed design and preparation of tender will start in 2014 c) Construction：2015
IS-02 **Installation of Sewerage System**	**[Construction Area]** − CBD area **[Selection basis]** − C1 zone and W1 zone are the existing sewerage area and the highest urbanized area with high population density	Approximately US$ 105 mil	a) Feasibility study will start in 2013 b) Basic/detailed design and preparation of tender will start in 2014 till 2014

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
			c) Construction work will start in 2016 and will be completed in 2018

Source: JICA Study Team

(7) Solid Waste Management

Sub-program of solid waste management (ISW) consists of total 5 projects. The projects are shown in Table 6.3.12.

Table 6.3.12: Sub Program of Solid Waste Management (List of Projects)

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
ISW-01 Project for Supply of Collection Equipment for Solid Waste Management	**[Current Problem]** - Most of the waste collection vehicles are very old and frequently require repair and maintenance. - Weak capacity of waste collection and transportation cause delay in the removal of waste from living environment. **[Countermeasure]** - To replace the aged vehicle with new waste vehicle - To improve the capacity of maintenance equipment **[Project Scope]** - To procure number of waste vehicles and equipment. - To procure and equip maintenance tools and equipment **[Expected Project Effect]** - To improve solid waste removal from the living environment of YCDC.	Approximately US$ 16 mil.	a) Feasibility Study: July to December 2013 b) Basic Design, Detailed Design, Tender Document Preparation: January 2014 to November 2014 c) Tendering: December 2014 to March 2015 d) Procurement, Installation, Commissioning: April 2015 to December 2015 e) Commencement of Operation: Jan.uary 2016
ISW-02 Project for Capacity Development of Solid Waste Management (1)	**[Current Problem]** - There is no integrated SWM plan based on quantitative analysis. - Facility development plan is not prepared and authorized. - Inefficient waste collection system - No specific facility for hazardous waste treatment - Less capacity for public enhancement - No regular training of YCDC personnel for SWM **[Countermeasure]** - To carry out capacity development in the organizational and individual level to solve/improve the current problems listed above **[Project Scope]** - To prepare an action plan for short term development based on the development concept prepared, which is to cover facility development plan - To review, update and modify the waste collection system - To develop operation manual of hazardous waste management including separation at source, reinforcement of the polluter pay	Approximately US$ 5 million	a) Implementation of the project: mid-2013 to mid-2016 [approximately for three years]

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
	principle and operation of its treatment facility - To prepare and execute public enhancement program. To coordinate with the concerned stakeholders including depts. Of YCDC, Ministry, NGO and private sector - To develop and execute a regular training program for SWM **[Expected Project Effect]** - To formulate and authorize a short-term policy of SWM - To improve the efficiency of solid waste collection - To realize and execute the method and procedure of public enhancement - To share the experiences and knowledge of SWM in YCDC		
ISW-03 Project for Capacity Development of Solid Waste Management (2)	**[Current Problem]** - Final disposal sites are operated in open dumping site and may cause negative environmental impacts. - Collection rate of waste service fee is very low and deficit is very huge while tariff table exist for the service. - Material recovery activities are mainly carried out by private sector. Instruction by YCDC for this issue as not been well developed. **[Countermeasure]** - To carry out capacity development at social/institutional, organizational and individual level to solve/improve the current problems listed above **[Project Scope]** - To review and update the action plan developed in the capacity development project1 - To train personnel for improvement of operation of the existing final disposal sites and future sanitary landfill - To review, revise and monitor the tariff table and fee collection method of SWM fee - To coordinate and stimulate private sector for setting up of 3R policy and promoting their involvement for middle term **[Expected Project Effect]** - To continue the formulating and authorizing a the policy of SWM - To improve the operation of the existing final disposal sites and prevent environmental impact - To realize and acquire necessary knowledge and operation practice for sanitary landfill - To prepare development of 3R policy and enhance the awareness of private sector	Approximately US$ 6 mil.	a) Implementation of the project: mid-2017 to mid-2020 [approximately for three years]
ISW-04 Project for Sanitary Landfill Development 1) Htein Bin 2)Kyi Su	**[Current Problem]** - All existing final disposal sites of YCDC are operated in an open dumping method. - The disposed waste at the open dumping sites is causing negative environmental impact. - The sanitary waste stream cannot be achieved without an appropriate final disposal plan.	Approximately 1) US$35 mil. 2) US$ 80 mil. 3) US$ 120 mil. 4) US$ 140 mil. 5) US$ 45 mil.	a) Feasibility Study: April 2013 to October 2013 b) Loan Appraisal: December 2013 c) Selection of the consultant for detailed

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
3) Hlaing Tharyar 4)Thanlyin 5)Dala	**[Countermeasure]** − To construct a sanitary landfill. **[Project Scope]** − To construct a sanitary landfill Approximate area of the project site 1) 30 ha, 2) 100 ha, 3) 150 ha, 4) 200 ha, 5) 50 ha − To procure and install necessary equipment and facility for landfill management such as weighing scale, heavy equipment, environmental monitoring equipment, etc. **[Expected Project Effect]** − To operate a final disposal site in sanitary manner. − To prevent negative impact to the environment.		design and construction supervision: January 2014 to November 2014 d) Detailed Design, Tender Document Preparation: December 2014 to November 2015 e) Tendering: December 2015 to November 2016 f) Construction, Procurement, Installation, Commissioning: 1) December 2016 to May 2019 2) December 2016 to May 2019 3) December 2016 to November2019 4) December 2016 to November 2018 g) Commencement of Service: 1) June 2019 2) June. 2019 3) December 2019 4) December 2018
ISW-05 Project for Hazardous Waste Treatment Facility [Pilot scale]	**[Current Problem]** − No specific facility of hazardous waste treatment − Anticipated increase of hazardous waste generation as economic grows − Weak enforcement of the polluter pay principle **[Countermeasure]** − To construct hazardous waste treatment facility [incinerator]. **[Project Scope]** − To construct a incinerator for hazardous waste treatment as a pilot scale facility [treatment capacity: 100ton/day] − To procure and install necessary equipment and facility **[Expected Project Effect]** − To treat hazardous waste properly. − To prevent negative impact to the environment.	Approximately US$34 mil.	a) Feasibility Study: Apr. 2013 to Oct. 2013 b) Loan Appraisal: Dec. 2013 c) Selection of the consultant for detailed design and construction supervision: Jan. 2014 to Nov. 2014. d) Detailed Design, Tender Document Preparation: Dec. 2014 to Nov. 2015. e) Tendering: Dec 2015 to Nov. 2016 f) Construction, Procurement, Installation, Commissioning: Dec. 2016 to May. 2019 g) Commencement of Service: June. 2019

Source: JICA Study Team

(8) Telecommunication

Sub-program of telecommunication (ITC) consists of total 1 projects. The projects are shown in Table 6.3.13.

Table 6.3.13: Sub Program of Telecommunication (List of Projects)

Project Name	Project Outline	Preliminary Estimated Cost	Project Implementation Schedule
ITC-01 Construction of Next Generation Network	**[Current Problem]** − Low speed access line **[Countermeasure]** − Construction of NGN with OFC. **[Project Scope]** − Installation of 4 NGN core facilities and construction of FTTX **[Expected Project]** − Serviceable telecommunication network	Approximately US$ 276 mil.	a) Feasibility Study: April to July 2014 b) Detailed Design, Tender Document Preparation: August to January 2015 c) Tendering: February to March 2015 d) Construction, Procurement, Installation, Commissioning: April 2015 to March 2017 e) Commencement of Service: April 2017

Source: JICA Study Team

6.3.3 Economic, Environmental, and Social Considerations on the Priority Programs

(1) General

In this section, the economic consideration on the selected sector-wise priority projects based on urgency will be made, while the clarification will consist of necessary considerations in the process of project implementation in terms of environmental and social aspects.

1) Features of Economic Effect

Economic effect can be classified into stock effect and flow effect in a broad term. The stock effect can be defined as the economic effect by the stock or accumulation of facilities such as constructed infrastructure. And the stock effect can be classified into direct effect and indirect effect. Direct effect can be defined as directly benefiting the beneficiary, while the indirect effect can be defined as multiple-effect of productivity improvement on the supply-side and consumption increase on the demand-side through the direct effect. Meanwhile, flow effect can be defined as effect into macro-economic activities, e.g., job creation, increase of income, consumption, national revenue, etc., based on investment value during construction period and at the later.

The feature of stock effect has varieties of benefit items and beneficiaries based on the feature of the project by sector, Meanwhile, the feature of flow effect is measured by the value based on project investment cost.

1) Features of Stock Effect by Sector Constituting Priority Projects

The stock effect of infrastructure sector mainly consists of direct-effect and indirect-effect. For instance, the direct effect in transport sector is decrease of transport cost and time as representative examples; meanwhile, the indirect effect is difficult to calculation economic benefit, e.g., user-friendliness, locational attractiveness of production activities, creation of job opportunity, consumption rise, increase in tax revenue. etc.

The following table shows the feature of stock effect regarding the priority projects by infrastructure sector.

Table 6.3.14: Features of Stock Effect by Sector Constituting the Priority Projects

Sector	Features of Stock Effect
Feature of priority projects in Urban Development	The urban development sector consists of three sub-sector, 'Urban development Management', 'Urban landscape and Heritage', and 'Public Park and Greenery'. The Urban Development Management sub-sector is the largest investment amount. The largest project of investment amount project is 'Thirawa SEZ Class A Area Development Project' in the Urban Development Management sector, 620 million US$. Almost 80% of investment amount of Urban Development Sector is 'Thirawa SEZ Class A Area Development Project. Urban Development Sector covers broad range of objectives, e.g., income distribution adjustment, sustainable economic growth, integration of each spectral plan, efficient public finance operation, creation of job opportunity, improvement of social service, enhancement of urbanization, and etc. The priority project for Urban Development Sector convers a variety sectors according to the objectives.
Stock Effect	The stock effect of Urban Development Sector convers a variety range by the project, and the clarification of stock effects should be examined by Master Plan and Feasibility Study, etc. The sector's priority project consists mainly of the urgent projects, especially CBD area, corresponding to rapid increase population in the future. The priority projects in this sector aims mainly at improving urban circumstance of not only living but also business climate.

Sector	Features of Stock Effect
Feature of priority projects in Urban Transport	In Yangon Metropolitan area, the priority projects in city transport sector consist of public transportation system as urgent projects, e.g., improvement of shuttle bus system, installation of BRT system, traffic management system, etc., corresponding to serious traffic congestion.
Stock Effect	To maintain a smooth urban transport is a prerequisite for urban life and infrastructure. The representative stock effects of urban traffic system are as follows; - Saving of transport cost, - Saving of transport time, - Decrease of traffic accident, - Decrease of emission, and - Benefit of induced traffic. In addition, the secondary effect of the stock effect includes job creation, income growth, tax revenue increase, traffic amenity, etc.
Feature of priority projects in Road Network	The priority projects in road sector selected flyover/underpass construction, signaling system improvement, reconstruction of existing bridges, bypass-road for logistics system by large size vehicles, as urgent response projects for rapid increasing traffic volume in Yangon Metropolitan area.
Stock Effect	The stock effect of road network improvement is almost the same as urban traffic system. In addition, the secondary effect of the stock effect includes job creation, income growth, tax revenue increase, traffic amenity, etc. Priority projects in road sector includes not only restrictive regional effects by means of improvement of signaling system, flyover construction, etc., but also ripple effect in the whole metropolitan area, e.g., job creation, income increase income, increase of tax revenue, improvement of transport amenity, etc.
Feature of priority projects in Railway	In the railway sector, the priority projects as short-term project were selected based on the long-term development plan. In the middle long term, the development plan covers the role-sharing cargo handling between Thilawa international port and the river ports in the Yangon City.
Stock Effect	The stock effect of railway system improvement is almost the same as urban traffic system. The specific effect can be picked up as follows; - Mitigate the congestion of existing traffic system, - Increase the level of service by strengthening the rail transport system, - Administrative improvement of rail transport business for sustainable transport system - Creation of urban structure and support of new town development, and - Others. In railway sector, the priority projects were selected based on long-term development plan because the investment of the railway projects is huge amount. The objectives of priority projects in railway sector are increase of cargo transport capacity between major cities, enhancement of modal shift from car to railway usage. Especially, the increase of cargo transport capacity between the cities may greatly contribute to activate economy across the nation.
Feature of priority projects in Port and Logistics	The development objectives in the port and logistics sector contains 1) To make cargo handling efficient, 2) To improve operating speed of river transportation and 3) To enhance containerization. Based on the objectives, the handling capacity expansion of Yangon port, the Thilawa port development, etc., were selected as the priority projects with the aim of expansion of industrial activity in Yangon Metropolitan Area.
Stock Effect	The stock effect of port and logistic system improvement is basically the same as the other transport sector. The port development project might affect the growth of national economic and international trade depending on the development scale in particular. The selected priority projects in this study divided into two types according to economic effect; one is expansion of cargo handling capacity in quantity aspect; and another is improvement of effectiveness and safety, etc., in quality aspect. The economic effect in quality aspect is expected to contribute economic activity across the nation. Meanwhile, the economic activity in quality aspect is expected to contribute to improve port business management directly, and effectiveness of industrial activity indirectly.
Feature of priority projects in Water Supply	The development objectives in water supply sector contains 4 programs, 1) new water resource development and capacity improvement of water supply plant, 2) establishment of effective water distribution system, 3) improvement of fare collection system, and 4) Improvement of water quality management. Renewal of old water pipeline must be urgent project, however, the project needs huge investment cost and improvement of management capacity in the long term.

Sector	Features of Stock Effect
Stock Effect	The objectives of water supply project include not only provision of daily water needs but also industrial water. The feature of direct economic effect in water supply sector is easy to identify the beneficiary of water supply. The stock effect includes the cost reduction of water supply management and water leakage. In addition, the long term effects are as follows; - Environmental burden reduction, - Cost reduction of medical care, - Enhancement of tourism industry and others.
Feature of priority projects in Sewage and Drainage/Solid Waste Management	The sewerage system is mainly divided into 4 areas, 1) CBD, 2) Build-up Area, 3) New Urban Area and 4) Industrial/Port Area, and the priority projects in the sewerage and drainage sector were selected corresponding to regional feature in the Yangon Metropolitan Area. The priority projects in the solid waste management sector were selected according to one of the development strategy, "establishment of solid waste flow managed by sanitary measure" by priority.
Stock Effect	The objectives of the sewerage and drainage/solid waste management are mainly to improve urban environmental system and water quality of river and pond. In water supply sector, it has the same entity between service provider and beneficiary. But in this sector, there is a different entity between service provider and beneficiary. The specific effect can be picked up as follows; - Treatment cost reduction, - Enhancement of reuse of treated water, - Reduction of medical care cost, - Enhancement of tourism industry and others.
Feature of priority projects in Power and Telecommunication	The priority projects of power and telecommunication sector are 1) construction of next generation network and 2) construction of international terrestrial OFC. This sector is business infrastructure to cultivate business climate for FDI in while country.
Stock Effect	Public sector plays an important role in the telecommunication development because development project needs huge investment cost and a wide variety of public regulations in eliminating public penalty due to monopoly. In the long run, the telecommunication sector might change from public to private initiative, the economic evaluation as public investment is restrictive for a long term. The specific effect can be picked up as follows, - Reduction of business transaction cost, - Enhancement of FDI, - Narrowing of regional economic gap and others.

Source: JICA Study Team

2) Features of Flow Effect by Sector constituting Priority Projects

The flow effect as mentioned above might appear as the effects based on the actual investment amount. The investment amount will be expanded from the relative industrial sectors of the project as first ripple effect to the downstream industries in series. And then the ripple effect will expand furthermore through the expansion of consumption after increase in the wage and income in relative industries. Therefore, it may be expected to increase the effect more than investment amount due to the ripple effect as mentioned above. The sector with highest amount is the 'Urban Development and Management', followed by Water Supply, Urban Transport, and Railway sectors, at US$ 831.67 million, US$ 780.07 million, US$ 747.07 million, and US$ 603.0 million, respectively.

Table 6.3.15: Investment Value of Priority Projects

Sector	Investment Value (No. of Priority Projects)
Urban Development	US$ 831.6 million (26)
Urban Transport	US$ 747.0 million (21)
Road Network	US$ 236.0 million (5)
Railway	US$ 603.0 million (5)
Port and Logistics	US$ 513.0 million (6)
Water Supply	US$ 780.0 million (6)
Sewage and Drainage	US$ 109.6 million (2)
Solid Waste Management	US$ 481.0 million (5)
Telecommunication	US$ 276.0 million (1)
Total	US$ 4,577.2 million (77)

Source: JICA Study Team

2) Necessary Environmental and Social Considerations on the Priority Projects

1) Characteristics of the Priority Projects

Table 6.3.16: Characteristics of the Priority Projects

Sector	Characteristics
Urban Development and Management	Mainly the projects consist of the redevelopment plans of the existing urbanized areas including CBD and the new urban development plans at the outside of the inner ring road. The projects also contain the various capacity development plans. Those project are categorized into the software components. Therefore, the environmental impact by the projects will be considered as minimum level.
Urban Transport	Most of the proposed priority projects (22) are categorized into the software components such as restructuring of passenger bus network and modernization of traffic control and management system. Therefore, the environmental impact by the projects will be considered as minimum.
Road Network	The proposed projects are “Improvement of Signalized Intersections” and “Construction of Flyovers/Underpasses for Bottleneck Intersections”. The minimum level of land acquisition will be necessary for “Construction of Flyovers/Underpasses”.
Railway	The five (5) proposed projects will be undertaken inside of existing ROW. In addition, the project characteristics of those projects are categorized into the software components such as “Automatic Level Crossing Installation in Yangon Circular Railway”. Accordingly the environmental impact by the projects will be considered as minimum.
Port and Logistics	The proposed project is rehabilitation of the existing embankment and jetty. Therefore, the environmental impact by the projects will be considered as minimum excepting the degradation of water quality of the canal during construction.
Water Supply	Out of four(4)selected priority projects, three(3) priority projects are replacement of the existing pump/distribution pipeline and renewal of existing reservoir. Therefore, the environmental impact by the projects will be considered as minimum level. While, small scale land acquisition might be necessary for the installation of pump facilities and conduction pipeline from Ngamoeyeik and improvement of Aungtagon WTP.
Sewage and Drainage	The projects are the rehabilitation of the WWTP and transfer existing sewage collecting system to new collecting system using gravity flow. Therefore, the environmental impact by the projects will be considered as minimum level.
Solid Waste Management	The environmental impact by the two projects which are “supply of collection equipment” and “capacity development of SWM” projects will be considered as minimum level. While, involuntarily resettlement might be necessary for the four sanitary landfill development projects depending on the project location.
Telecommunication	The environmental impact by the two projects which are construction of international terrestrial optic fiber cable (OFC) and construction of next generation network will be considered as minimum level.

Source: JICA Study Team

2) Necessary Environmental and Social Considerations of the Priority Projects

Considering that most of the Priority Projects are categorized into the software components with having minimum environmental and social impacts, the necessary environmental and social considerations on Projects are proposed as follows.

a) Obtainment of Environmental Approval

At the moment, the regulations and guidelines etc., which will be necessary for implementation of the provisions including conducting EIA mentioned in the "Environment Conservation Law", are under preparation by MOECF.

It is essential to obtain appropriate environmental approval for each individual project based on the regulations to be promulgated.

b) Implementation of Appropriate Environmental Management

Basically any serious negative environmental impacts on the proposed priority projects are not expected so far. However, it is indispensable to conduct appropriate environmental management in the construction stage based on the approved Environmental Management Plan (EMP) considering various environmental impacts depending on project characteristics.

c) Confirmation of the Social Impact by Involuntarily Resettlement

Presently, no large scale involuntarily resettlement is anticipated in the proposed priority projects. In case the projects need to obtain land, it is essential to take necessary actions including establishment of appropriate resettlement action plan (RAP) with careful consideration to project affected persons (PAPs). It is noteworthy that RAP should meet with the requirement of Land Acquisition Act of Myanmar as well as those of JICA Guidelines, if the project is to be financed by JICA.

d) Consideration on Local Community

The priority projects contained the project on the improvement of transportation and intersection which may cause temporal disturbance to the local transportation and local businesses during construction. Therefore, it is necessary to establish a basic agreement with local community for the implementation of the project through the conduct of a Stakeholders Meeting (SHM).

e) Consideration on the Traditional Worth

Approximately, 40% of the heritage buildings observed in the CBD and other heritage buildings scattered in several townships have traditional values. Therefore, it is necessary to confirm the existence of these buildings in advance to take necessary consideration in the project implementation stage.

f) Consideration on Vulnerable Group

Regarding the priority projects, the involvement of specific vulnerable groups such as poor communities or minorities is not identified presently. It is necessary to conduct a socio-economic survey depending on the necessity in consideration of livelihood restoration for those people during the implementation stage.

6.3.4 Project Implementation and Management

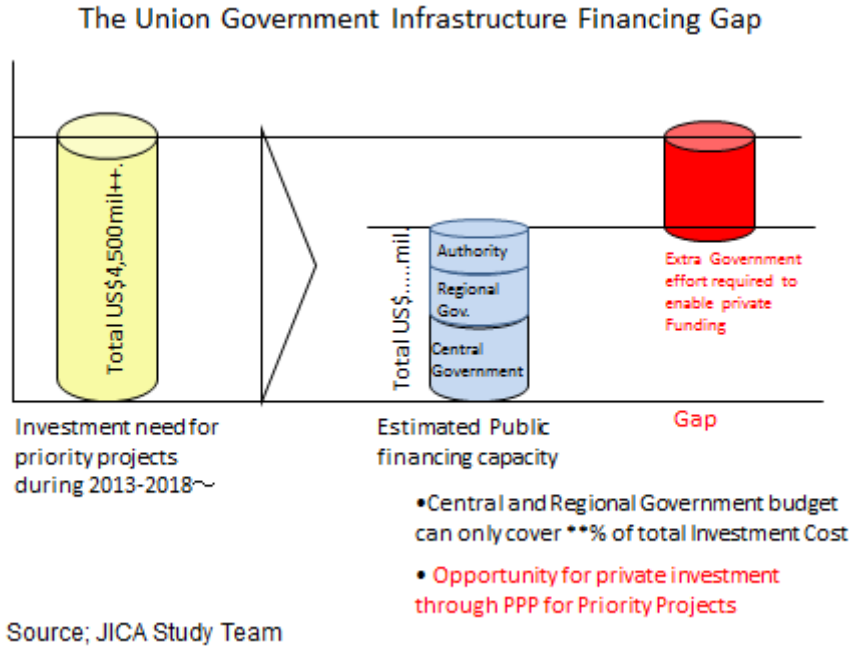
This section will cover the improvement, urban planning, and master plan (MP) of infrastructure for the nine sectors as reported in the previous chapter. The MP has suggested the necessary magnitude of infrastructures based on the forecast demand in 2040 and defined development goal and effect indicators. While the priority projects and middle to long term projects which will be operational in 2018 and afterwards, respectively, a detailed feasibility study and detailed implementation plan will be carried out after 2013 onwards. Therefore, implementation and management of priority project will be discussed qualitatively hereafter, and the optimum project modality shall be determined following the result of the future feasibility study.

(1) Background of the Application of Public Private Partnership (PPP) for the Study

1) Unbalance Demand for Infrastructure and Financial Resource in the Public Sector

Implementation methodology for infrastructure project in the Union government/YCDC has been in the form of conventional public works except for a few concessions for mining, natural gas, and power sectors. The estimated investment amount for MP may be approximately US$ 3 billion for all sectors. On the other hand, fiscal situations of according to the CIA World Fact Book is experiencing deficit; the public debt is said to be US$ 11.0 billion (2012), while public revenue is US$ 2.016 billion and expenses is US$ 4.272 billion (2011 est.) .

While some significant amount of ODA shall be necessary in order to meet the requirement for the proposed priority projects, the projects which are not covered by ODA need to find some international financial source such as the World Bank (WB) and Asian Development Bank (ADB) together with the possibility of private participation. According to Section 6.3.1 & 6.3.2 of Chapter 6 of the Final Report, all investments for priority projects totaled to 77 projects in amounting of US$ 4,500.2 million over the next 5 to 10 years.



Source: JICA Study Team

Figure 6.3.1: Union Government Infrastructure Financing Gap

Table 6.3.17: Investment Cost of Priority Project (Source: FRI-6.3)

Category	Nos. and Cost	Urban Development Sector					
		Urban Development & Management	Social Service	Urban Landscape & Heritage	Public Parks & Green	Capacity Development	Sum
Priority	Nos.	11	3	5	2	5	26
	Cost	747.6	20.0	15.2	30.8	18.0	831.6

Category	Nos. and Cost	Infrastructure Sector										Grand Total
		Urban Trans-port	Road	Rail way	Port	Water	Waste Water	Pow er	Solid Waste	Tele com	Sum	
Priority	Nos	21	5	5	6	6	2	-	5	1	51	77
	Cost	747	236	603	513	780	109.6	-	481	276	3,745.6	4,577.2

Unit＝US$ million
Source: JICA Study Team

2) General Notion of PPP as Project Implementation

Public private partnership (PPP) becomes a trend of project implementation for the construction and operation of infrastructure. Among the many definitions of PPP that exist, PPP study group of JASCIC has adopted the following notion as shown in Figure 6.3.2.

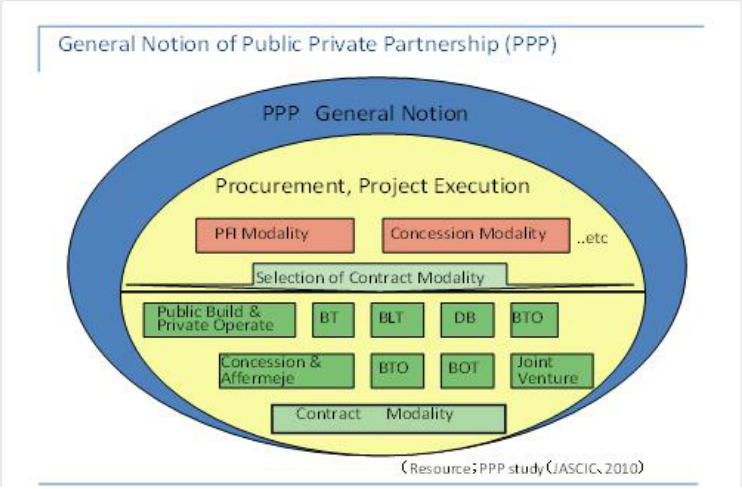


Figure 6.3.2: General Notion of PP

JASCIC has analyzed PPP project as follows:

1) What is PPP? -Background of the PPP;

- PPP has been highlighted in many countries since the later half of the 1980s.
- Government faces financial difficulty to raise sufficient budget for infrastructure development.
- Improvement of efficiency against expenditure in the development of infrastructure by the participation of private sector.
- Investment in infrastructure will be attractive for pension fund due to stable long terms as well it is linked to consumer price index.

2) What is PPP? - PPP/PFI Means;

- PPP aims at improving the efficiency of public service introducing the mechanism of marketing through private finance initiative (PFI), privatization, assignment of service to private sector and independent administration. The risks shall be borne by public and private sector.
- PFI intends to procure public services such as construction, operation, and maintenance of infrastructures in a more efficient and effective manner by introducing private finance, competence of high technology, and management skill.

The development of infrastructure for many sectors shall be implemented under a balanced arrangement, otherwise, adverse impact may cause suffocation to the livelihood and society's expectations. In this viewpoint, it is practical to assume that the investment will be a conventional publicly-build and operate modality, hybrid modality involving ODA, and private finance. Although, the concrete project implementation and management will be dependent on conduct of the study that will commence in the near future after the feasibility study for the demand forecast is completed. The universal modalities for implementation plan and management will be presented in item (4).

(2) Financial Arrangement for the Implementation of PPP

1) Situations of Private Enterprise and Financial Institutions of Union Government

1) Situations of Domestic Financial Institutions

There are five domestic banks which have more than 1500 employees according to the investigation of the JICA Study Team. CBM, Central Bank of Union Government, specified the interest rates for commercial bank as 8% per annum for deposits, 13% per annum for lending to private company while CBM lend the loan with an interest rate of 10% per annum. The loan is usually by cash basis with collateral of land and immovable properties. Lending rate is 13%＋1% (service charge), maturity band is one year and will roll-over after conclusion of the maturity. Ayeyarwaddy Bank Ltd. has MMK 156.2 billion of total asset as of second quarter of 2012, and loan balance is approximately MMK 80.0 billion. As recorded, these banks have no experience to offer loan for infrastructure project, therefore the participation to the PPP business is a matter of future consideration. Furthermore, it is not realistic consideration for local financial institutions to participate in these priority project with project finance methodology.

Thus, domestic financial institutions tend to offer only local currency financing with a maximum amount that can be borrowed at extremely low interest rate and the procedures for borrowing is complex, according to the Law Firms. Although foreign companies are not expressly prohibited from seeking financial sources from domestic commercial banks, in practice, this would be very difficult, given the restrictions on foreign ownership of land which is often required for the purpose of providing security.

2) Situation of Domestic Enterprises

The Capital Development Ltd. (CD) has begun the construction of the "Shwe Gune Dine Flyover Bridge Project". According to a hearing conducted by the JICA Study Team, the project will be categorized as "Unsolicited Proposal" where CD proposed to YCDC that this will be part of their corporate social responsibility (CSR), and accepted by YCDC. Finally, the regional government (RG) became the contracting agency and YCDC to be the supervisor. Although construction works has begun since August 2012, the contract with RG has not been signed yet which is in the modality of "Deferred Payment".

Though CD does not express to participate with the PPP projects including infrastructure sector in the future, it has been considering to work on the improvement of infrastructure in the city. For example, railway development should accommodate with the feeder transportation systems to and from suburban station. Concerning the investment to PPP project, CD has said that FIRR shall have to be higher than 18% taking into consideration the high interest rate in Union government.

The optimum PPP modality will be selected according to the progress of the project feasibility study together with the market study for domestic and foreign companies.

3) Situation of Foreign Financial Institutions

There are 17 foreign banks which have obtained the license and permit base in Union government (Refer to Table 6.3.18). These banks have been acting only as a representative office and have not commenced to extend any loans for infrastructure project yet. The representative of Bangkok Bank Public Company Ltd. in Yangon shared to the JICA Study Team that the bank could extend the loan to infrastructure projects in Union government based on their experience in providing financing for mega project infrastructure in Laos, Vietnam, and Thailand. From the information obtained from the mass media, the bank understood that several studies for infrastructure have been ongoing, and therefore, the bank will speed up in collecting information to determine what projects to participate. However, it is dispensable that the loan of foreign currency shall be repaid by foreign currency and that there is an involvement of international financial institutions such as the WB, ADB, and JICA. A Japanese bank has mentioned to the JICA Study Team that the loan business for infrastructure in Myanmar is premature while the remittance of money between Japan and Union government has just been made possible recently. Regarding project finance, it shall be essential to enact relevant laws and regulations for the loan and its repayment. The suggested project implementation modality of the Study needs a definite involvement of the international financial institutions and investors due to the current monetary situation of the Union government. Particularly, the synthesis to the Foreign Investment Law (FIL) and its rules and regulations shall be most indispensable for the assessment of risks on investment and loans as described in item (3).

Table 6.3.18: List of Foreign Bank Offices in Union Government

No.	Name of Bank	Date of License Issued	Date of Commencement
1	United Overseas Bank Ltd.	10th Nov. 1993	2nd Aug. 1994
2	Oversea Chinese Banking Corporation	8th Feb. 1994	15th Nov. 1994
3	Malayan Banking Berhad (MAYBANK)	12th Aug. 1994	11th Apr. 1995
4	Bangkok Bank Public Company Ltd.	24th Oct. 1994	18th Aug. 1995
5	National Bank Ltd.	6th Jul. 1995	16th Jul. 1996
6	Brunei Investment Bank	18th Sep. 1995	1st Jul. 1996
7	First Overseas Bank Ltd.	30th Apr. 1996	15th May. 1996
8	First Commercial Bank, Singapore Branch	20th Nov. 1997	5th May. 1998
9	Sumitomo Mitsui Banking Corporation	18th Apr. 2001	18th Apr. 2008
10	DBS Bank Ltd.	12th Sep. 2003	12th Sep. 2003
11	The Bank of Tokyo-Mitsubishi UFJ Ltd.	17th Mar. 2006	17th Mar. 2006
12	CIMB Bank Berhad	19th Feb. 2008	19th Feb. 2008
13	Bank for Investment and Development of Vietnam	1st Mar. 2010	3rd Apr. 2010
14	AB Bank Ltd.	10th Dec. 2010	
15	Industrial and Commercial Bank of China Ltd.	16th Sep. 2011	2nd Dec. 2011
16	Mizuho Corporate Bank Ltd.	18th Jan. 2012	6th Apr. 2012
17	Siam Commercial Bank Public Company Ltd.	23th Apr. 2012	

Source: JICA Study Team

2) Necessity of Foreign Donor Country

The Government of Japan (GOJ) has announced to launch a JPY 50 billion loan in January 2013. This will be the biggest amount of loan since the new civilian government was established. Project implementation modality of this Study, though detailed investigation has not been undertaken yet, can assume that the sectors of urban transport, road, railway, water supply, and solid waste management could be potentially feasible based on the private sector investment alone and/or hybrid modality to offset the lower financial feasibility. As stated in item (1) 1), there are big gaps that exist between the financial resources of the government and the demand for 2018 priority projects, the financial support coming from ODA shall be unavoidable for the implementation and execution of the Project for the Strategic Urban Development Plan of the Greater Yangon.

(3) Laws and Regulations for the Implementation of PPP Project in Union Government

1) Foreign Investment Law (FIL)

The FIL was promulgated on 2 November 2012. The law is specified as law number 21, 2012 and consists of Chapter 1 to Chapter 20. As stipulated "In implementing the provision of this law, the Ministry of National Planning and Economic Development shall, with the approval of the Union government, issue rules, regulations, and by-laws, procedures, orders, notifications, and directives as may be necessary within 90 days from the adoption of this law". The JICA Study Team considers that the Rules and Regulations (RR) is an indispensable guideline for the proper application of FIL. RR as Notification Order 11/2013 and Specified Type of Economic Activties as Notification 1/2013 have been promulgated on 31st January 2013. Contents and comments are stated in paragraph (3) 1) *(3)* **"Issues of FIL in Relation to PPP"**

1) Relative items to PPP in FIL

The following table shows some clauses stipulated in the FIL which will be of high concern for private sectors. These were extracted for easy comprehension for the investors and lenders including wordings with unclear meaning such as constraint for exit from project, apparent risk exposure, degree of the government, exemptions, reliefs, etc. Some items are further commented and suggested for amendment. As stated, coming up with the Rules and Regulations (RR) for FIL is definitely required for the investors and lenders to consider participating in any of the priority projects.

Table 6.3.19: Extraction of the Clause Relating to the Implementation of PPP

Cl.	Item	Description /Comments
3,4	Restricted Prohibited	FIL shall apply to business stipulated by the Commission, however 11 sectors of the business industry shall be restricted or prohibited. These are; the agriculture, animal husbandry, fishery, certain manufacturing activities, and so on, which involve potential risks to the Union government. [Note] "Business which can be done by the citizens of Union government regarding manufacturing and service" are not specify in details which will be described in the new rules. Thus, wide-ranged businesses may be subject to restriction or prohibited in the future.
7	Aim	Relating to the PPP and infrastructure are; to develop human resources, banking and financial business, high grade main roads, highway roads, electric and energy production, to develop respective area, communication network, transport business such as rail, ship, aircraft, etc.
9	Form of investment	Foreign investment modality is (a) 100％ foreign investment、(b) joint venture with citizen, government department, and organization, (c) in the contract which approved by both parties.
10a)		There are no regulations as to the investment ratio of foreigner, rather it is by the

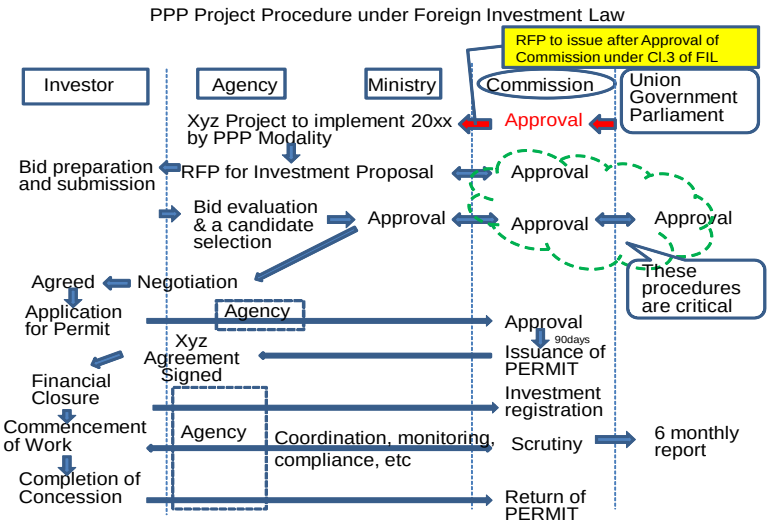
Cl.	Item	Description /Comments
		agreement of the parties concerned. Minimum investment capital is subject to the Commission's approval with the consent of the government.
12 13		The duties of the Commission is to coordinate with relevant regions or state government in respect to foreign investment…….and the powers of the Commission are accepting the proposal and issuing permit to the promoter or investor….、 [Note] The Commission is the sole authority to accept the proposal and issue the permit. Therefore, the contracting agency and implementing ministry does not have any approval rights.
17		In relation to exit from the investment, the transferring of share to any foreigner or citizen, such deal shall be subject to the permission of the Commission. Foreign company shall return the permit to the Commission.
24	Appointment staff/ workers	High skilled employee shall be employed, in principle, from the establishment of the company, 25% shall be employed within two (2) years, 50% shall be employed within four (4) years, 75% shall be employed within six (6) years. Non-skilled worker shall be all citizen. [Note] The description does not specify the sector which needs skill, so careful check and research will be required as the case maybe..
27	Incentive	Investment business under the FIL, tax exemptions and privileges, rights to remit the money are granted in items (a) to (k). The company without adoption of FIL shall not enjoy these incentives. [Note] There are no rules or guidelines which the Commission will determine whether or not to grant the above benefits, and these are understood to be granted on a case to case basis.
28,29	Guarantees	The government guarantees that a business under permit shall not be nationalized, and not to suspend any investment business and to disburse foreign currency.
43	Settlement of dispute	Dispute arises between the parties shall be settled amicably. If settlement mechanism is not stipulated in the contract, applicable laws will be followed. If settlement mechanism is stipulated in the contract, the mechanism will follow. [Note]There are no statement of settlement with the third country that has international laws and rules.

Source: JICA Study Team

While the RR, when issued as mentioned, will clarify many of the points in question in FIL 2012 as in the above table, relevant laws shall also be reviewed briefly as shown below.

2) Procedure to Apply for Investment Project under FIL

The investor comprising foreigners and citizens of Union Myanmar shall obtain the approval of the Commission stipulated in Clause 3 of FIL. The procedure is summarized in Figure 6.3.3.



Source: JICA Study Team

Figure 6.3.3: Procedure under FIL

3) Issues of FIL in Relation to PPP

Notwithstanding the aim of business, it is specified in Clause 7 of FIL, on condition that the participation to the business including infrastructure shall comply with international standards, the following important points are neither described nor referred. The PPP law and BOT law promulgated in Southeast Asian countries contained the detailed procedures and application for the procurement of SPC and implementation of the PPP project. Myanmar shall need to consider and adopt more information in providing further studies for FIL and related regulations. Two numbers of Rules and Regulations (Notification No.11/2013) and Law related to FIL (Notification No.1/2013) have been promulgated on 31st January 2013. The verification for that are described in the terms of following issues :

- Details of PPP modality are not regulated.
  - B.O.T and B.T.O are defined in Chapter (1) of Notification No.11/2013. It is improvement However there should be more detailed descriptions regarding various PPP modalities.
  - For the implementation of priority projects of YCDC Master Plan, more sophisticated modality shall be promulgated.
- Detailed procurement process for PPP investors (SPC) is not described.
  - Under Chapter (5) & (6) of Notification No.11/2013 “Submission of Proposal”, “Continuing for the Proposal” respectively may cover the process.
  - Under Notification No.1/2013, “List of business that allow to carry out by joint-venture with citizen” and “ The list of type of business that are permitted by the consideration of concerning Ministry Department” has describes the process and conditions to apply the business.
- Draft concession agreement for PPP project is not provided yet.
  - Under Chaoter (5) of Notification No.11/2013, Proposer is required to propose.

- Required contents and clauses shall be indicated in Rules and Regulations and/or FIL.

➢ There is no description for the Unsolicited Proposal.

- There are no definition for Unsolicited Proposal ,

➢ The description of Rules and Regulations generally seems to be implied to accept as unsolicited proposal. Incentives to be granted to SPC do not contain the matters other than the taxes.

- Chapter (14) of Notification No.11/2013 describe incentives.

➢ Government supports in terms of financial aspects are not stated.

- Chapter (16), (17), (18) of Notification No.11/2013 describe the management and deal for foreign capital and currency.
- No description is made on Government support to investor in terms of financial aspects.
- Since Myanmar is undeveloped country, tariff and/or charge to be paid by beneficiary of such facilities shall be restricted as relatively lower than required to recover the investment.
- Government support for PPP project shall be indispensable for expedited development of YCDC Master Plan.

➢ Settlement process of dispute is not tailored as to international standard.

- Chapter (20) and (21) of Notification No.11/2013 describe the argument.
- For the PPP project involving foreign investors, international dispute resolution mechanism shall be considered to apply.

➢ Terms and conditions for termination shall be described in details to protect the interest of both parties.

- The procedure and mechanism of termination is not clearly stated.

2) Laws and Regulations in Relation to PPP Project in Union Government

Recently, a few international sanctions imposed in Myanmar were lifted. During the time of sanctions, some market oriented economy existed but no PPP project was implemented except for some concessions for mining, natural gas pipeline, and operation of wharf, which were contracted to enterprises of China, Malaysia, and Singapore. In addition to natural resources fields, MPA had granted a 75-year concession to a Thai company for the development of Dawei Deep Sea Port.

For the purpose of understanding the situation and possible issues at a glance, reference is made to the "Union Government Investment Guide" issued in December 2012 by the Herbert Smity Freehills, a Law Firm of Australia. Some items related to implementing the PPP or the like were extracted.

Regarding the Dispute Resolution, "Disputes shall be settled by arbitration under the Arbitration Act". As a general rule, the Attorney General's Office and the Commission do not permit arbitration provisions outside Myanmar.

Regarding Bribery and Corruption, "Union government signed the 2003 UN Convention against corruption on 2 December 2005", but was not yet ratified.

Regarding the Labor Law, "Union government's labor laws governing labor relations, disputes, remuneration of workers, holiday and work rules are set out in a number of acts and orders. For instance, foreign nationals employed by foreign companies are subject to the approval of the Commission".

Regarding the Contract, "Under the Contract Act, a contract is defined as an agreement that is made by the free consent of parties competent to enter into a contract, for lawful consideration and with a lawful object, and that is not expressly declared to be void."

Regarding the Risks and Barriers to Foreign Investment, "Many of international sanctions have now been suspended or lifted altogether, following the recent political reform and the results of the April 2012 by-elections. Nevertheless, investors should be aware that the relaxations of sanctions depend on the continuation of political progress in Union government. Therefore, any reversal or abandonment of government reforms may lead to the full or partial reinstatement of these sanctions."

Regarding the Lending, "Under Section 22 of the Foreign Exchange Regulations Act of 1947, if an overseas lender makes a loan to a borrower in Union government without the approval(s) of governor of CBM and other necessary authorities, the contract or agreement will be void and the overseas lender will be subject to criminal penalties."

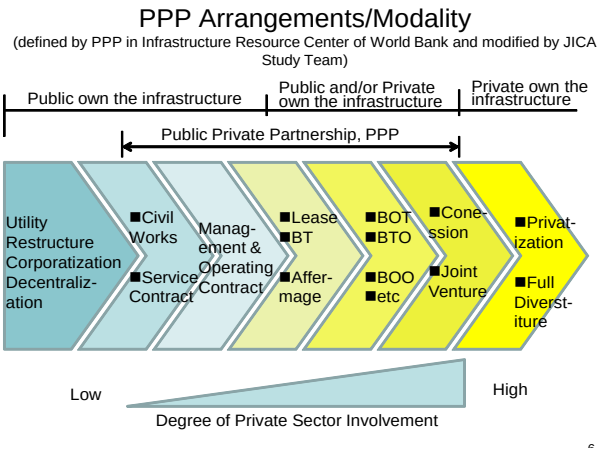
Table 6.3.20: Union Government Laws relating to PPP in General

No.	Items relating to PPP	Laws	Promulgation
1	Dispute	Judiciary Laws	2000
2		Arbitration Act (non-Union Government arbitration is not permit)	1944
3	Bribery and Corruption	Suppression Corruption Act (UN Convention against Corruption was signed but not ratified yet)	1948 Dec.2005
4	Labor	Labor Organization Law	2011
5		Statement Labor Dispute Law	28th Mar.2012
6	Contract	Contract Act	1872
7		Sale of Goods Act	1930
8		Transfer of Property Act	1882
9		Specific Relief Act	1877
10	Foreign Investment other than FIL	State-Owned Economic Enterprise Law	1989
11	Copy right	Copy Right Act	1914
12	Real Estate	Transfer of Property Act	1882
13	Lending	Moneylenders Act	1945
14		Income Tax Law	1974

Source: Herbert Smith Freehills

(4) Study for the PPP scheme which will be applicable to each infrastructure

According the PPP arrangements defined by PPP in Infrastructure Resource Center of the World Bank, PPP can take a wide range of forms varying on the degree of involvement of the private entity in a traditionally public infrastructure. A PPP is generally written in a contract or agreement to outline the responsibilities of each party and clearly allocate the risks. Figure 6.3.4 depicts the spectrum of PPP agreements.



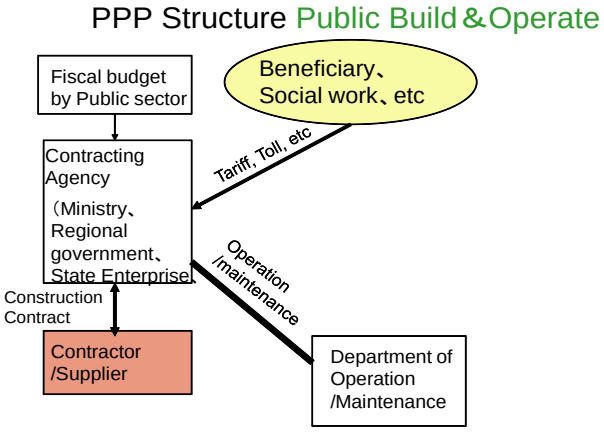
Source: World Bank & JICA Study Team

Figure 6.3.4: Spectrum of PPP Agreements

1) Classification of Project Implementation to be Applied in the Development of Infrastructure

1) Public Build and Operate

- Conventional public work
- Source of funds attribute to the central government and regional authority
- The project to apply for ODA and/or WB, ADB
- Suitable to nonprofit type infrastructure and facilities

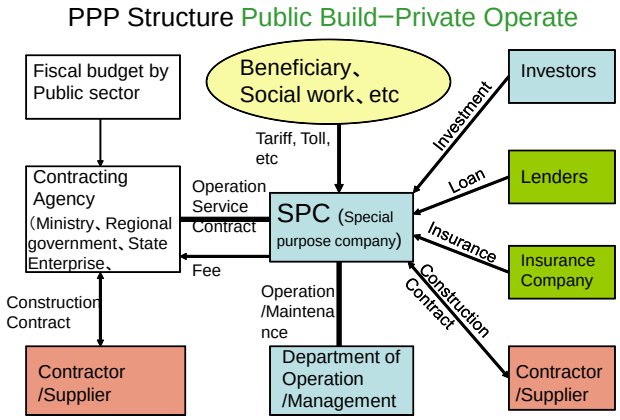


Source: JICA Study Team

Figure 6.3.5: Public build and Public Operate

2) & 3) Public Build and Private Operate (with risk of demand, or without risk of demand)

- Under the modality, the public constructs all the facilities while the private operates/maintains them.
- Under the assignment, there are two cases of demand risk allocations namely, with and without risks.
- Under the assignment, there are two cases of investment allocations namely, with and without additional investment.



Source: JICA Study Team

Figure 6.3.6: Public Build and Private Operate (With Risk of Demand, or Without Risk of Demand)

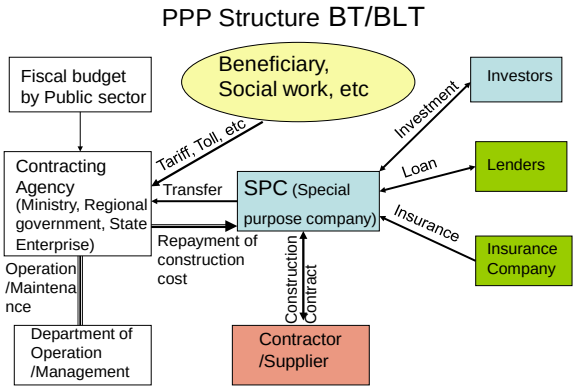
4) Affermage (refer to Figure 6.3.10)

- Affermage scheme has been applied in many countries in France and other countries it influenced.
- Affermage is a contract that involves assigning of service for public services, which is not similar to concession agreement.
- Assignee (Private) shall pay the fees to Assigner.
- Assigner requires a periodic repair to Assignee though terms is less than 20 years.
- The advantage of Affermage is to ensure delivery of better quality services by utilizing existing facilities.
- Based on the agreement, the public could intervene into the private's work, and hence, the public controls the private reasonably.
- Demerit is considered when fare/tariff is higher due to non profitability.
- The success key is the selection of the project at the beginning.

The structure of Affermage is quite similar to the (6) Concession.

5) BT and BLT

- In case of the high necessity for the project without financial resources from the public side, private sector will be required to advance the finance to deliver the infrastructure. Public shall pay the total amount in lump sum or deferred payment to the private sector.



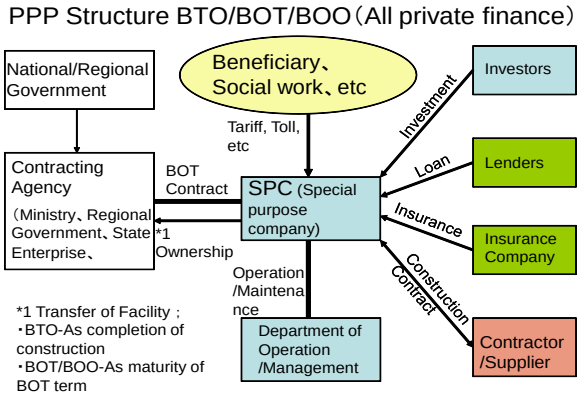
Source: JICA Study Team

Figure 6.3.7: BT/BLT

- To apply for the security facilities, environmental facilities, and non-profit related facilities.
- Private will not operate the facility as a means of lease. PFI in Japan adopts the similar scheme.

6) BTO, 7) BOT ,BOO

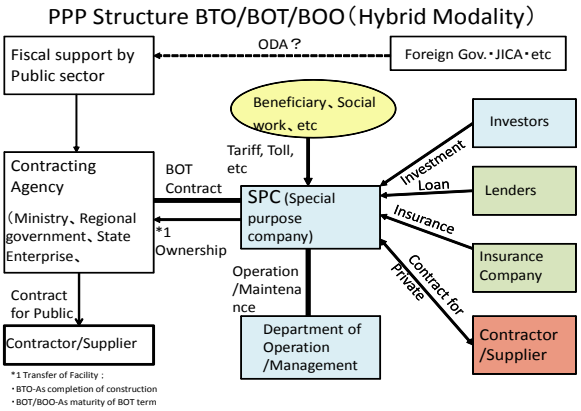
- Usually applicable to the project of Greenfield.
- Build-Transfer-Operate, Build-Operate-Transfer, Build-Own-Operate
- Modalities are different due to the timing of transfer of ownership of the facility. Private sector procures 100% finance.



Source: JICA Study Team

Figure 6.3.8: BTO, BOT and BOO

- The advantages to the public are; there will be no new burden on the balance sheet, development of infrastructure utilizing the technical and financial knowhow, and expectation of the immovable property tax revenue.
- The disadvantage to the public is; there will be the trend that private sector concentrate to generate the profit rather than providing public services to the society.



Source: JICA Study Team

Figure 6.3.9: BTO, BOT and BOO (Hybrid Modality)

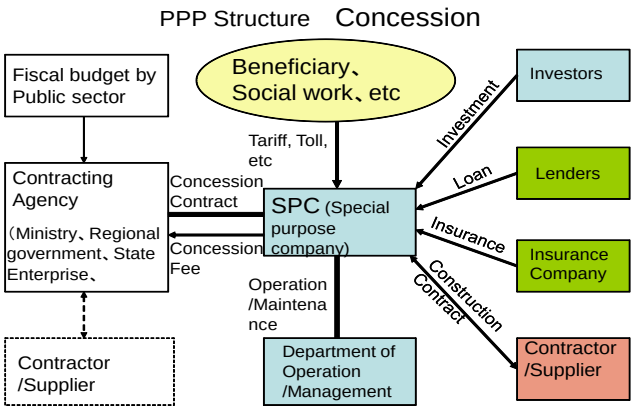
- The balanced development of infrastructure may become difficult due to the implementation order of the postponement of nonprofit generating project.

Under the aims to possibly utilize private finance to large extent, private operation knowhow and the reduction of public fiscal budget, Hybrid PPP scheme which combine the ODA and private finance can be applied.

- A infrastructure will be divided into a component by a means of functions and/or quantitative separation depending on the split methodologies, namely, horizontal split, vertical split, and surface split.
- How to decide the splitting boundary is based on the range of possibility of the participation of private investor, the balance of risk shares between public and private and the synthesis of construction program for public and private.
- The key is to achieve a win-win situation for both public and private sectors.

8) Concession

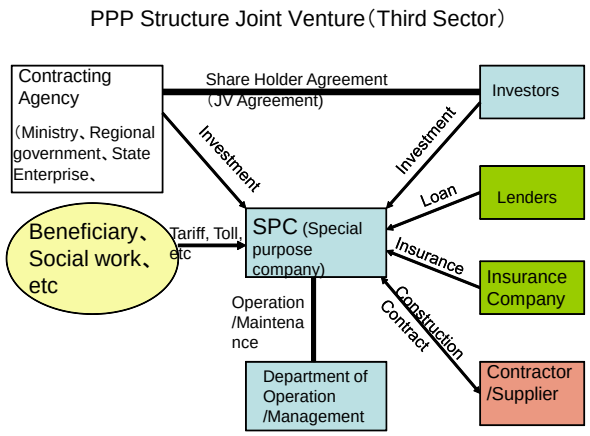
- Public will assign the operation right to private sector within the terms.
- Private sector invests for infrastructures and serves the operation within the terms.
- The facilities invested by private shall be owned by the public.
- The advantages to the public will be the fee revenue at the beginning as a consideration of concession. Project risks and severe recovery risk of investment can be put on the private sector.



Source: JICA Study Team

Figure 6.3.10: Concession

- The merits of private sector will be the opportunity for new business and the revenues linking to the achievement of the services.
- The disadvantage to the public will be the rather lower liquidity due to the fixed long term concessionaire service.



Source: JICA Study Team

Figure 6.3.11: Joint Venture

9) Joint Venture (JV)

- Under JV scheme, the services provided by an SPC would be purchased by the beneficiary and investor, who shall recover its investment from the profits of SPC.
- In case the recovery fall into negative, the public will have the horizons for financial undertaking. Thus, risk shares between public and private shall be the key.
- The public partner shall evaluate the credibility and the ability to perform the requirement of the public, thus, the risk of abandonment of business is due to the default of private sector.
- Merit and demerit lay on the modality of JV. The mitigation measures to balance the responsibility and influential impact of parties shall be established.
- The Third Sector, equal JV, in the 1980s had collapsed more than 90% in Japan.

The summary of PPP modality is shown in Table 6.3.21.

Table 6.3.21: Summary of PPP Modality

No.	Modality	Degree of Public Participation	Synthesis of Laws % Regulation	Degree of Finance by Public/Private	Probability of Private Finance	Probability of Beneficiary Payment	Main Operator
1	Public Build & Operate	100%	Existing laws	100%/ 0%	None	Possible	Public
2	Public Build & Private Operate w/risk	100% for construction	N.A.	100%/ α %	Operating capital	Beneficiary payment + Government support	Private
3	Public Build & Private Operate w/o risk	100% for construction	N.A.	100%/ α %	Operating capital	Beneficiary payment +government support	Private
4	Affermage	100% for construction	N.A.	100%/ α %	Operating capital	Beneficiary payment +government support	Private
5	BT, BLT	0% Deferred payment	N.A.	Deferred 100%/ 100%	100% advance for construction	No beneficiary payment in general	Public
6	BTO	0%	N.A.	0%/ 100%	100% + operation capital	Beneficiary payment +government support	Private
7	BOT, BOO	0% Share % with Hybrid	N.A.	0%/ 100% Share % with Hybrid	100% +Operation Capital share % w/hybrid	Beneficiary payment +government support	Private
8	Concession	100% for construction	N.A.	100%/ α %	Operation capital	Beneficiary payment +government support	Private
9	Joint Venture	Shared %	Foreign Investment Law	Shared %	Shared %	Beneficiary payment	JV co. Private/Public

Source: JICA Study Team

2) Reference Quoted from Global Case Study of PPP Modality

Numbers of the projects under Public Private Partnership have been widely implemented globally since 1980th. Depending upon the risk share and complexity of the projects, various modalities have been adopted.

1) Aspects of Modality in Europe and USA

With reference to the published report of "Case Study of Transportation Public-Private Partnerships around the World, US$epartment of Transportation, July 2007", the distribution of the PPP modality is shown on the following circle graph.

In comparison to the U.S., the use of PPPs between 1985 and 2004 has been more widespread overseas where concessions and BOT/BTO are the most widely used PPP approaches used, as shown in Figure 6.3.12. In addition, international spending on road-related PPP projects has been over six times the amount spent of these types of projects in the U.S. This reflects the greater level of responsibility and risk taken by the private partners involved in PPPs overseas, where the need for private capital financing is greater than in the United States which has traditionally relied on funding provided by motor fuel taxes paid into a trust fund intended solely for surface transportation capital and renewal projects.

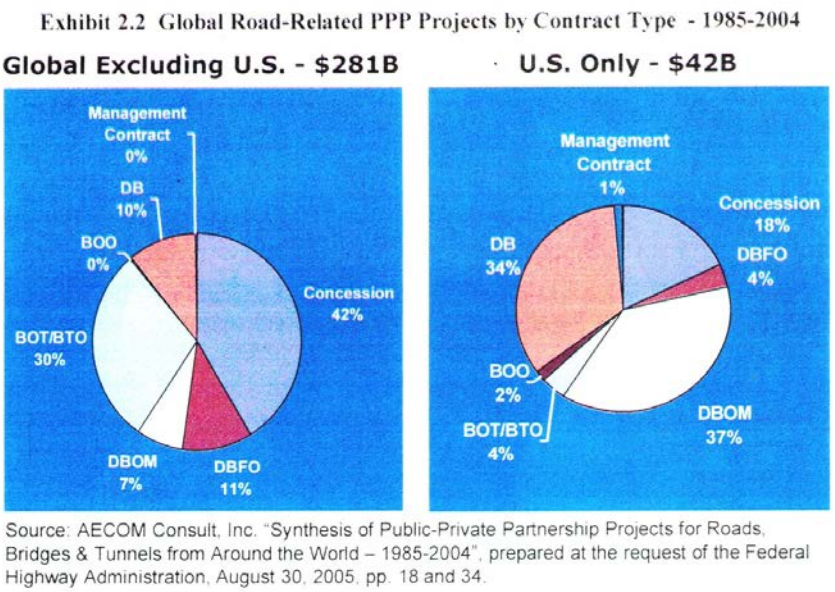


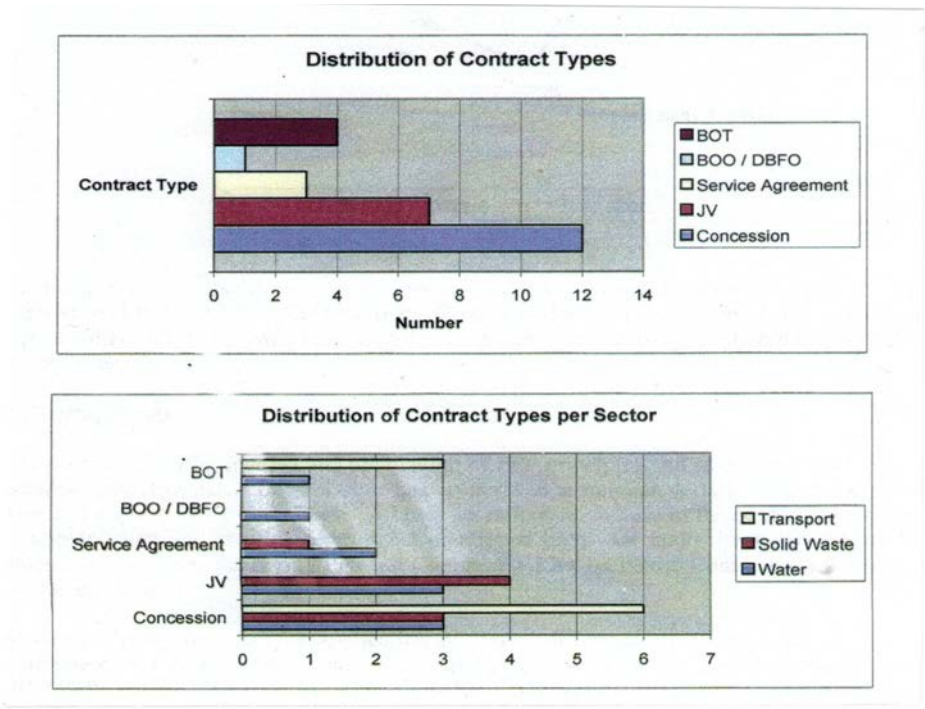
Figure 6.3.12: Global Road Related PPP Projects by Contract Type (1985-2004)

Note; Modality shall synthesize with this report as follows

- Management Contract to be read as Public build and operate
- DB(Design Build) to be read as wide range of PPPs including Public Build Private Operate, BTO, BOT, BOO, Concession and Joint Venture.
- DBOM to be read as Public Build and Private Operate.
- DBFO to be read as BTO, BOT, BOO

With reference to the published report of " Resource Book on PPP Case Studies, European Commission, June 2004", the distribution of the PPP modality on each nature of infrastructures are shown on the following bar graph.

The following diagrams demonstrate the type and frequency of contracts and structures presented. There is a strong dominance of concession and joint venture structures. This may however be due to the selection of cases and application of terminology rather than a true dominance of such structures. The research of cases found a lack of common terminology and consistency in the use of terms. This is in fact indicative of the evolving nature of PPP concepts and the lack of a commonly accepted set of terms. The Resource Book adopts the nomenclature of the Guidelines with respect to PPP structures.



Source; European Commission "Resource Book on PPP Case Study, June 2004"

Figure 6.3.13: Distribution of Contract Types

2) Issues

Case Studies of Transportation Public-Private Partnerships around the World, US$epartment of Transportation" described the issues in various aspects. Some of these issues, but not limited to, are extracted as examples for the future planning of YCDC priority projects.

Table 6.3.22: Issues in Various Aspects

Classification	Issues
Legal Issues	Lack of legal authority to enter into a PPP to develop transportation infrastructure projects at the national level was widespread in many nations, particularly in developing nations and those countries formerly part of the Soviet Union.
	Overly restrictive covenants in concession agreement that limited the concessionaire's ability to adjust toll rates in a timely manner and to introduce alternative project delivery aproaches, even if more cost-effective
	Burdensome requirements for majority participation by quasi-public company established by the government reduces flexibility and cost-effectiveness of the private sector members of the joint venture team and the potential value capture (reward) relative to the risks held by the private side of the JV
	Differences in legal authority for PPPs between sovereign nations in a region characterized by significant cross-border movements of people and goods creates the potential for incompatible PPP contracting and project delivery which may result in stalled projects that depend on several nations to agree on the nature of the project, its funding and financing approaches, and so on.
Technological Issues	Challenges of setting fixed deadlines for project start-up that is dependent on new or to-be-developed technology, which posed high risks for the public sponsor and especially for the private provider team
	Difficulty in handling expected high volume of traffic when the toll facility opened
	Lack of interoperability between tolling schemes in separate countries, especially adjacent countries which serve the same traffic, is a challenge for concessionaires competing to develop and operate toll facilities in different

	countries with different technical requirement.
Funding financial issue	Public opposition to toll highways stemming from historical examples of toll monopoly pricing and inconvenience of stopping to pay cash tolls
	Allocating financial risks among partners to PPP
	Traffic and revenue estimates not realized in early years of long-term concession
	Allocating construction risk among partners to PPP
	Traffic and revenue risks
	Allocation of windfall profits resulting from linkage to nearby roads
	Financial risk of large-scale project if using private funds
	High public sponsor financial risks of early PPP projects
	Allocating financial risks among partners to PPP
Environmental issues	Widespread public opposition to project due to broad array of environmental and community concern
Administrative issues	Challenge of resolving disputes between public and private partners to a PPP
	Quality, cost, schedule, and performance risks during concession term
	Risk of changing design standards during PPP development process
	Challenge of attracting sufficient private sector interest in PPP to ensure a competitive procurement process
	How to hold the concession team accountable for project performance according to the terms of the contract
	Start-up problems with facility operator unfamiliar with the implementation of new electronic toll collection technology
	Risk of changing design standards during PPP development process

Source: JICA Study Team

3) Summary

Although PPP project shall have to be sustainably continued a long time period, public sector shall focus on the bankruptcy and/or failure of SPC which should result in whole risks attribute on to Public sectors. Public sector shall also admit itself for the future alteration/changes of laws and taxations which may cause significant impact to Private sector. Therefore it is to be said that general concept of PPP is rather comfortable to Public and Private, however they need to recognize the necessity of the steady patient and financial risks.

3) Evaluation of the Project Implementation and Management Scheme which will be Applicable for Priority Project

1) Evaluation of Priority Project by Categories

The adoptability of priority projects out of nine sectors will be verified in the classifications in items under 1). For the methodology of verifications, No.1 to No.9 of Table 6.3.23 will be checked qualitatively. Larger public involvement shall be categorized as “A” and least public involvement shall be categorized as “E”. Reducing the public involvement will be categorized from “B” to “D” in order of magnitude. Each priority project will be adopted by plural modality classified in (i), since the characteristics of each project are ambiguous at present. The study which will be conducted individually from the middle of 2013 will reveal the concrete plan, prerequisite conditions, numbers, and FIRR as well. Then most optimum and beneficial PPP modality for the society, YCDC and the government shall be selected.

- Type-A is a necessary project to comply with the requirements of society and environment, and shall be implemented despite insufficient profitability. The project of this category will be generally constructed and operated by the public.
- Type-B project is a necessary project to comply with the requirements of society and environment, and shall be implemented despite insufficient profitability. However, the operation of the project is individually isolated; therefore the operation and maintenance will be assigned to private sector in order to reduce the financial burden of the public.

Under these conditions for the assignment, the service concentration modality and demand guaranteed modality will be adopted.

- Type-C is a necessary project to comply with the requirements of society and environment but the public will have budget shortage for the construction. The public sector will make deferred payment or lease payment within the term agreed upon, while the private sector will advance the whole construction cost. Type-C is only feasible as the verified credibility of the public. The cost for the infrastructure will be higher than Types A and B due to the financing cost such as interest, overhead, and fees associated with private business.

- Type-D project is defined as "economically viable but financially [partially] feasible." Although Type-D is a necessary project, the recovery of investment cost will be jeopardized due to the lesser demand and/or lower tariff applicable due to political reasons. An infrastructure will be divided into the component by means of functions and/or quantitative separation so that the private sector could survive as investor. The project will be operated and maintained entirely by the private sector.

- Type-E project is defined as "economically viable and financially feasible." Type-E is a necessary project with sufficient demand and appropriate chargeable tariff. The private sector will invest the whole amount of cost and operate during the term. After expiration of term, all facilities will be handed over to the public sector.

Table 6.3.23: Type-A: Public Work

No.	Evaluation Category	Conformity			Applicable Scheme
		High	Mid	Low	
1	Degree of financial burden of the public sector	✓			Public Build & Operate Public Build & Private Operate
2	Magnitude of economical impact to society	✓			
3	Magnitude of contribution to GDP growth for YCDC/Government		✓	✓	
4	Probability of beneficiary payment			✓	
5	Probability of participation of private finance			✓	
6	Difficulty to acquire the right of way		✓		
7	Importance of EIA and degree of compulsory relocation		✓		
8	Magnitude of project cost	✓	✓		
9	Degree of accomplishment of the project	✓	✓		

Source: JICA Study Team

Table 6.3.24: Type-B: Assignment of Service

No.	Evaluation Category	Conformity			Applicable Scheme
		High	Mid	Low	
1	Degree of financial burden of the public sector	✓			Public Build & Private Operate Affermage Concession
2	Magnitude of economical impact to society	✓			
3	Magnitude of contribution to GDP growth for YCDC/Government		✓		
4	Probability of beneficiary payment			✓	
5	Probability of participation of private finance			✓	
6	Difficulty to acquire the right of way		✓		
7	Importance of EIA and degree of compulsory relocation		✓		
8	Magnitude of project cost	✓	✓		
9	Degree of accomplishment of the project	✓			

Source: JICA Study Team

Table 6.3.25: Type-C: Construction with advanced finance by Private

No.	Evaluation Category	Conformity			Applicable Scheme
		High	Mid	Low	
1	Degree of financial burden of the public			✓	BT BLT
2	Magnitude of economical impact to society		✓		
3	Magnitude of contribution to GDP growth for YCDC/Government		✓		
4	Probability of beneficiary payment			✓	
5	Probability of participation of private finance			✓	
6	Difficulty to acquire the right of way		✓		
7	Importance of EIA and degree of compulsory relocation		✓		
8	Magnitude of project cost		✓	✓	
9	Degree of accomplishment of the project		✓		

Source: JICA Study Team

Table 6.3.26: Type-D: Hybrid PPP

No.	Evaluation Category	Conformity			Applicable Scheme
		High	Mid	Low	
1	Degree of financial burden of the public sector		✓		BOT BTO JV
2	Magnitude of economical impact to society	✓			
3	Magnitude of contribution to GDP growth for YCDC/Government	✓			
4	Probability of beneficiary payment	✓			
5	Probability of participation of private finance	✓			
6	Difficulty to acquire the right of way			✓	
7	Importance of EIA and degree of compulsory relocation		✓	✓	
8	Magnitude of project cost	✓	✓		
9	Degree of accomplishment of the project	✓			

Source: JICA Study Team

Table 6.3.27: Type-E: Private Initiative PPP

No	Evaluation Category	Conformity			Applicable Scheme
		High	Mid	Low	
1	Degree of financial burden of the public			✓	BOT BOO
2	Magnitude of economical impact to society		✓		
3	Magnitude of contribution to GDP growth for YCDC/Government	✓			
4	Probability of beneficiary payment	✓			
5	Probability of participation of private finance	✓			
6	Difficulty to acquire the right of way			✓	
7	Importance of EIA and degree of compulsory relocation			✓	
8	Magnitude of project cost	✓	✓		
9	Degree of accomplishment of the project	✓			

Source: JICA Study Team

2) Summary of Project Implementation and Management

Table 6.3.28: Summary of Project Implementation and Management (Priority Project)

Sector	No	Program/Project Name	Cost	Type	Modality
Urban Development and Management	UD-01	Mindama secondary CBD development project	20.0	B/D/E	BTO, BOT, BOO, JV
	UD-02	Thilawa SEZ Class-A area development project	620.0	D/E	BTO, BOT, BOO, JV
	UD-03	Bago Riverside sub-center development project	29.0	B/D/E	BTO, BOT, BOO, JV
	UD-04	Dagon Myothit sub-center development project	29.0	B/D/E	BTO, BOT, BOO, JV
	UD-05	Public facilities and buildings in CBD transfer and renovation project	39.0	B/D/E	BTO, BOT, BOO, JV
	UD-06	Formulation of CBD renewal scheme project	1.0	A/B	Public Build & Operate/Private Operate, Concession
	UD-07	Prioritized CBD renewal and redevelopment project	0.5	A	Public Build &Public Operate、
	UD-08	A survey and utilization plan for unused lands project	0.8	A	Ditto
	UD-09	Prioritized unused lands development project	0.3	A	Ditto
	UD-10	Statistics system elaboration project	4.0	A	Ditto
	UD-11	Household database management system development project	4.0	A	Ditto
	Sum		747.6		
Social Service	US-01	Barrier-free for persons with disabilities (PwD) project	6.0	A	Public Build & Public Operate
	US-02	Education system strengthening project	8.0	A	Ditto
	US-03	Urban poor assistance project	6.0	A	Ditto
		Sum	20.0		
Urban Landscape and Heritage	UL-01	Establishment of the guideline and promotion of the management for heritage conservation project	0.5	A	Public Build & Public Operate
	UL-02	Yangon tourism action plan project	0.5	A	Ditto
	UL-03	Tourism & heritage promotion area/street development project	13.0	A/B	Public Build & Public Operate/Private Operate, Concession
	UL04	Holding technical workshop for the conservation management and construction technique project	0.7	A	Public Build & Public Operate
	UL-05	Establishment of the mechanism for the realization of heritage buildings project	0.5-	A	Ditto
		Sum	15.2		
Public Parks and Greenery	UP-01	Formulation for guideline and standard for construction of new public parks project	0.8	A	Public Build & Public Operate
	UP-02	New public parks construction in new towns project	30.0	A	Ditto
		Sum	30.8		
Capacity Development	UC-01	Preparation of manual for urban planning and implementation	2.0	A	Public Build & Public Operat
	UC-02	Urban spatial control management	3.5	A	Ditto
	UC-03	Formulation of detail spatial plan	5.5	A	Ditto
	UC-04	Establishment of information management system for urban planning	4.0	A	Ditto
	UC-05	Assistance for possible acceleration measures for urban planning project	3.0	A	Ditto
		Sum	18.0		
Total (26 numbers)			831.6		

Note: “A” is “Public Work”, “B” is “Assignment of Service”, “C” is “Construction with advanced finance by Private”, “D” is “Hybrid PPP”, and “E” is “Private Initiative PPP”.
Cost Unit: US$ million
Source: JICA Study Team

Table 6.3.29: Summary of Project Implementation and Management (Priority Project)

Sector	No	Program/Project Name	Cost	Type	Modality
Urban Transport	IT-01	Restructuring of passenger bus network	3.0	A	Public Build & Public Operate
	IT-02	Modernization of the passenger bus services	50.0	B/D/ E	Public Build & Private Operateconcession, BOT,BTO,BOO,JV
	IT-03	Prioritization of passenger bus transportation	15.0	A	Public Build & Public Operate
	IT-04	Development of bus interchanges	20.0	A	Ditto
	IT-05	BRT system development	20.0	A	Ditto
	IT-06	BRT system development	200.0	/B/D/ E	Public Build & Public Operate/Private Operate, Concession BOT,BTO,BOO,JV
	IT-07	Development of public transportation system in the CBD	100.0	B/D/ E	Ditto
	IT-08	Traffic congestion mitigation project	20.0	A	Public Build & Operate
	IT-09	Intersection grade-separation project	150.0	A/C	Public Build & Public Operate, BT, BLT
	IT-10	Modernization of traffic control and management system	50.0	A/C	Ditto
	IT-11	Improvement of traffic safety facility	20.0	A	Public Build & Public Operate
	IT-12	Improvement of pedestrian environment in the CBD	5.0	A	Ditto
	IT-13	Traffic safety education and propaganda	3.0	A	Ditto
	IT-14	Enhancement of traffic enforcement	20.0	A	Ditto
	IT-15	Development of traffic accident database and traffic safety audit system	5.0	A	Ditto
	IT-16	Computerization of vehicle and license registration	5.0	B/D/ E	Public Build & Private Operate Concession, BTO, BOT, BOO, JV
	IT-17	Transport demand control in the CBD	20.0	A	Public Build & Operate
	IT-18	Development of public parking and guidance system in CBD	30.0	B/D/ E	Public Build & Private Operate Concession, BTO, BOT, BOO, JV
	IT-19	Reform of law and regulation on traffic management and transport demand management	1.0	A	Public Build & Public Operate
	IT-20	Yangon Urban Traffic Planning Unit	5.0	A	Ditto
	IT-21	PTA (Public Transport Authority)	5.0	A	Ditto
	Total (except 10&22 mid-term)		747.0		
Road	IR-01	Improvement of signalized intersections	13.0	A	Public Build & Public Operate
	IR-02	Construction of flyovers/underpasses for bottleneck intersections	50.0	A/C	Public Build & Public Operate, BT,BLT
	IR-03		35.0	A	Public Build & Public Operate
	IR-04	Improvement of Road No.2	60.0	A/C	Public Build & Public Operate, BT,BLT
	IR-05	Outer Ring Road (Section-1)] Upgrading of Road No.7	78.0	A/C/ D	Public Build & Public Operate, BT,BLT BOT, BTO, JV
	Total		236.0		
Railway	IRW-01	Automatic level crossing installation in Yangon Circular Railway	13.0	A	Public Build & Public Operate

Sector	No	Program/Project Name	Cost	Type	Modality
	IRW-02	Bottleneck elimination of Yangon Circular Railway between Yangon Central Station and Puzundung Station	13.0	A	Ditto
	IRW-03	Urgent installation of radio-typed train detection system in Yangon Circular Railway	13.0	A	Ditto
	IRW-04	Installation of radio-typed telecommunication system for Yangon Circular Line (Malwagone–Yangon–Danyingone Section)	4.0	A	Ditto
	IRW-05	Yangon circular railway modernization (Improvement and electrification) Phase1: Western Half Loop	560.0	B/D/ E	Public Build & Private Operate 、 concession, BTO, BOT, BOO, JV
	Total		603.0		
Port & Logistic	IP-01	Twante Canal Rehabilitation	10.0	A	Public Build & Public Operate
	IP-02	Waterfront Development	50.0	D/E	BOT,BTO,BOO,JV
	IP-03	Yangon Main Port Expansion	100.0	D/E	Ditto
	IP-04	Installation of Safety Navigation Facilities	50.0	A/C	Public Build & Public Operate, BT, BLT
	IP-05	Thilawa Area Port Project Phase I	291.0	D/E	BOT,BTO,BOO,JV
	IP-06	Replacement of Dala Ferry Ships	12.0	D/E	BOT,BTO,BOO,JV
	Total		513.0		
Water Supply	IW-01	Renewal of Pump Station of Nyaunghnapin WTP	20.0	A	Public Build & Public Operate
	IW-02	Renewal of Distribution Pipeline in Yankin Township		A	Ditto
	IW-03	Construction of Kokkowa WTP	520.0	B/D/ E	Public Build &Private Operate, Concession, concession, BTO, BOT, BOO, JV
	IW-04	Construction of Lagunpyin WTP	145.0	B/D/ E	Ditto
	IW-05	Renewal of Distribution Pipe Network of Zone 1	75.0	A	Public Build & Public Operate
	IW-06	Installation of Disinfection Facility	20.0	A	Ditto
	Total		780.0		
Sewerage and Drainage	IS-01	Improvement of water quality of Kan Dow Gyi Lake	4.6	A	Public Build & Public Operate
	IS-02	Installation of Sewerage System	105.0	A/C	Public Build & Public Operate, BT,BLT
	Total		109.6		
Solid Waste Management	ISW-01	Supply of Collection Equipment for Solid Waste Management	16.0	A	Public Build & Public Operate
	ISW-02	Capacity Development of Solid Waste Management (1)	5.0	A	Ditto
	ISW-03	Capacity Development of Solid Waste Management (2)	6.0	A	Ditto
	ISW-04	Sanitary Landfill Development	420.0	B/C	Public Build & Private Operate, BT, BLT, concession
	ISW-05	Hazardous Waste Treatment Facility	34	A	Public Build & Public Operate
	Total		481.0		
Telecommunication	ITC-01	Construction of next generation network	276.0	D/E	BOT, BTO, JV, BOO
	Total		276.0		
Total Investment Cost (8 categories of infrastructure)			3,745.6		

Note: “A” is “Public Work”, “B” is “Assignment of Service”, “C” is “Construction with advanced finance by Private”, “D” is “Hybrid PPP”, and “E” is “Private Initiative PPP”. Cost Unit: US$ million
Source: JICA Study Team

Tables 6.3.28 and 6.3.29 are summarized on Table 6.3.30 to understand the magnitude of.

Table 6.3.30: Summary for Categories and Prospective Fund Source

Type	Urban Infrastructure Development Sector					Urban Development Sector				
	No.	Amount US$ million	Source of Finance and Amount			No	Amount US$ million	Source of Finance and Amount		
			Public	Hybrid	Private			Public	Hybrid	Private
A	29	450.6	450.6			19	80.6	80.6		
A/C &A/B	7	465.0	465.0			2	14.0	14.0		
A/C/D	1	78.0		78.0			-			
B/C	1	413.0		413.0			-			
B/D/E	8	1610.0		1610.0		4	117.0-		117.0	
D/E	5	729.0			729.0	1	620.0			620.0
Total	51	3,745.6	915.6	2,101.0	729.0	26	831.6	94.6	117.0	620.0

Note; The amount of private column includes a certain amount of the public portion which will be defined later stage.
Source: JICA Study Team

(5) Issues of the Union Government/YCDC in the Project Implementation and Management

1) Issues Concerning the Laws and Regulations

Rules and Regulations (Notification No.11/2013) and Specifying the Type of Economic Activities (Notification No.1/2013) have been promulgated on 31st of January 2013. The issues stated in item (3) 1) *(3)* were verified therein. Both FIL 2012 and indispensable Notification No.1&11 2013 are still need to clarify as *(3)* above. Other regulations such as taxation for foreign business, work permit, visa, and custom are not clarified, either. The priority projects need a magnitude of investments and loans from foreign companies who wish to evade the exchange risk. Foreign companies also wish to build up a consensus with YCDC in accepting foreign investors in participating in YCDC infrastructure projects together with the participation of the local investors. All these points shall be scrutinized as soon as possible.

Maximize the foreign investment for the priority projects will be dependent on the coordination between YCDC and the Ministry of National Planning & Economic Development (MNPED) which are the secretariats of the Commission. Therefore, the YCDC shall produce a synthesized development plan with the same subjects of MNPED who is the planner and implementing agency.

FIL does not guarantee any financial support from the Union government. For the continued expansion of PPP modality, statement of WB is quoted as shown below;

Government support in financing PPPs by PPP in Infrastructure Resource Center of World Bank says, "The government may decide to provide direct support for the project for example through subsidies/grants, equity investment and/or debt. These mechanisms are particularly useful where the project does not in its own merit achieve bankability, financial viability, or is otherwise subject to specific risks that the private investors or lenders are not well placed to manage. In developing countries where private finance is most needed, these constraints may necessitate more government support than would be required in more developed countries. Funded support involves the government committing financial support to a project

Few PPP projects are viable without some form of government technical or financial support. Efficient financing of PPP projects can involve the use of government support, to ensure that the government bears risks, which it can manage better than private investors and to supplement projects which are economically viable but not financially viable."

2) Issues Concerning Financing

This Study covers the priority project and a medium to long term project. The methodology of conventional public work with fiscal government budget will be common modality since there are many concerned stakeholders and relatively large scale projects. However, the Union government is still under development with difficulty to provide the entire budget. Should the financial procurement fails, balanced development among different sectors cannot be achieved. Namely, infrastructure projects cannot be delivered for use or expected development goal be unachievable. Thus, the application of ODA shall be indispensable to provide the sufficient finance resource. On the other hand, the key to financial closure for PPP modality depends on the execution of the countermeasures for risks which can be envisaged during the project implementation. The application for ODA will be a complicated procedure and take a long time. The issue is for Union government and YCDC to execute the feasibility study for the application of ODA based on this Study without delay.

Table 6.3.31: Composition of Project Finance- Extraction of Risks

Item	Risk before completion	Risk after completion
Extraction of Risks as time series	1) Investment Risk；Fulfillment of equity contribution by Investor 2) Completion Risk；Completion of construction/comissioning 3) Delay Risk；Time Overrun, Cost Overrun	1) Latent Defect Risk；Adverse impact on Revenue due to Latent Defect 2) Operation Capacity Risk; No enough capability of management, technical, skill, maintenance, etc 3) Market Risk; Fluctuation of demand, economy, etc.
Common Risks througho-ut term	1) Fluctuation of interest/exchange Risk; During construction and repayment term of debt. 2) Environmental Risk; Adverse impact due to the project and unforeseen incidents in future. 3) Force majeure Risk; War, Riot, Revolution, etc 4) Country Risk; Change of laws, Nationalization, etc	

Source: JICA Study Team

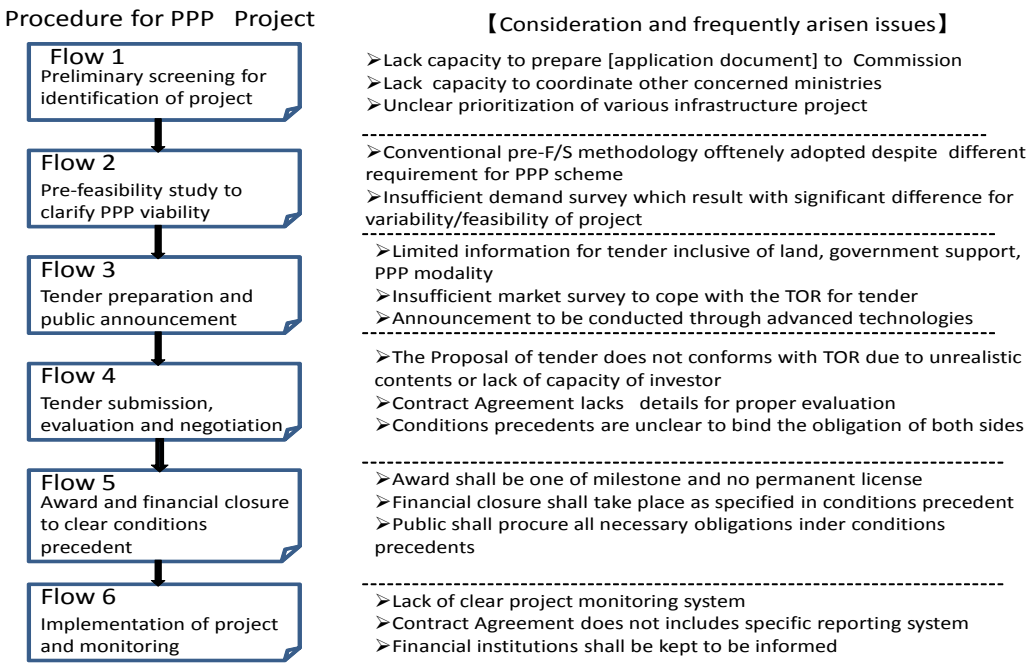
3) Issues Concerning Technical Domain

The capability to evaluate the technical abilities of the proposer for PPP project is essential to carry out the project successfully. In addition to the physical matters, the technical ability for operation and management which is usually not required for conventional public works is essential for PPP project. The standard specifications and requirements in the operation of various infrastructures shall be established in the manner that public safety and conveniences are fully maintained throughout the project term

4) Issues Concerning the Organization/Staff

YCDC and implementing authority of PPP projects shall proceed the proper process in order to achieve the development goal specified in this Study. Figure 6.3.14 shows the typical flow chart of procedure for PPP project.

For upgrading the capacity of department/procedure/staff, “Capacity Building” will be introduced. Appropriate preparation for RFP/TOR documents, proper evaluation competence of the project and investors, and the ability to carry out right monitoring are to be improved.



Source: JICA Study Team

Figure 6.3.14: Procedure for PPP Project

5) Alternative Measures when PPP Modality Fails to Implement

In case the application of the PPP modality 2)-9) of (4) (i) fails, namely neither private investors nor financial institutions participate in the Tender or Request for Proposal, the public sector can no longer postpone the project due to the necessity of the society. This situation may be unavoidable in the meantime, as a consequence of actual private financial market and the immature synthesis of legal framework. Under these circumstances, infrastructure shall be constructed under the modality of Public Build and Operate of classification 1) or 2) & 8). After certain period in operation, when the economy and market in relation to these projects have matured, the public has the option to reduce the accumulated investment burden. The public may invite private sector to make an offer to purchase the infrastructure for operation. The public will be able to recover a part, or whole, of the initial investment cost and any associated cost during its own operation period. Depending on the nature of the project, the public may be able to obtain the capital gains as well. For example, the Department of Defense of the United States of America established privatization program for their utilities since 2000 and the utility market becomes an interesting business for investors and operators.

6.3.5 Summary of Projects for Priority Programs

Table 6.3.32: Summary of Projects for Priority Programs

Code	Project Name	Schedule		Preliminary Estimated Cost (US$)	Project Component			PPP Type
		Urgent (-2015)	Short (-2018)		Survey & Plan	Construction	Management	
Urban Development Sector								
UD-01	Mindama Secondary CBD Development Project	■		20 mil.	○	◎	○	B/D/E
UD-02	Thilawa SEZ Class-A Area Development Project	■		620 mil.	○	◎	○	D/E
UD-03	Bago Riverside Sub-center Development Project		■	29 mil.	○	◎	○	B/D/E
UD-04	Dagon Myothit Sub-center Development Project		■	29 mil.	○	◎	○	B/D/E
UD-05	Public Facilities and Buildings in CBD Transfer and Renovation Project		■	39 mil.	○	○	◎	B/D/EA /B
UD-06	Formulation of CBD Renewal Scheme Project	■		1 mil.	◎		○	A
UD-07	Prioritized CBD Renewal and Redevelopment Project		■	0.5 mil.	◎		○	A
UD-08	A Survey and Utilization Plan for Unused Lands Project	■		0.8 mil.	◎			A
UD-09	Prioritized Unused Lands Development Project		■	0.3 mil.	◎			A
UD-10	Statistics System Elaboration Project	■		4 mil.	◎		○	A
UD-11	Household Database Management System Development Project		■	4 mil.	◎		○	A
US-01	Barrier-free for Persons with Disabilities (PwD) Project	■		6 mil.	○		◎	A
US-02	Education System Strengthening Project		■	8 mil.	○		◎	A
US-03	Urban Poor Assistance Project		■	6 mil.	○		◎	A
UL-01	Establishment of the Guideline and Promotion of the Management for Heritage Conservation Project	■		0.5 mil.	◎		○	A
UL-02	Yangon Tourism Action Plan Project		■	0.5 mil.	◎	○	○	A
UL-03	Tourism and Heritage Promotion Area/Street Development Project		■	13 mil.	○	○	◎	A/B
UL-04	Holding Technical Workshop for the Conservation Management and Construction Technique Project		■	0.7 mil.	◎			A
UL-05	Establishment of the Mechanism for the Realization of Heritage Buildings Project	■		0.5 mil.	◎		○	A
UP-01	Formulation for Guideline and Standard for Construction of New Public Parks Project		■	0.8 mil.	◎		○	A
UP-02	New Public Parks Construction in New Towns Project		■	30 mil.	◎	○	○	A
UC-01	Preparation of Manual for Urban Planning and Implementation		■	2 mil.	○		◎	A
UC-02	Urban Spatial Control Management	■		3.5 mil.	○		◎	A
UC-03	Formulation of Detailed Spatial Plan	■		5.5 mil.	○		◎	A
UC-04	Establishment of Information Management System for Urban Planning		■	4 mil.	○		◎	A
UC-05	Assistance for Possible Acceleration Measures for Urban Planning Project		■	3 mil.	○		◎	A

Code	Project Name	Schedule		Preliminary Estimated Cost (US$)	Project Component			PPP Type
		Urgent (-2015)	Short (-2018)		Survey & Plan	Construction	Management	
Urban Infrastructure Development Sector								
IT-01	Restructuring of Passenger Bus Network		■	3 mil.	○	○	◎	A
IT-02	Modernization of the Passenger Bus Services		■	50 mil.	○	○	◎	B/D/E
IT-03	Prioritization of Passenger Bus Transportation		■	15 mil.	○	◎	○	A
IT-04	Development of Bus Interchanges		■	20 mil.	○	◎	○	A
IT-05	Development of Bus Terminals		■	20 mil.	○	◎	○	A
IT-06	BRT System Development		■	200 mil.	○	◎	○	B/D/E
IT-07	Development of Public Transportation System in the CBD		■	100 mil.	○	◎	○	B/D/E
IT-08	Traffic Congestion Mitigation Project	■		20 mil.	○	○	◎	A
IT-09	Intersection Grade-separation Project	■		150 mil.	○	○	◎	A/C
IT-10	Modernization of Traffic Control and Management System		■	50 mil.	○	○	◎	A/C
IT-11	Improvement of Traffic Safety Facility	■		20 mil.	○	○	◎	A
IT-12	Improvement of Pedestrian Environment in the CBD		■	5 mil.	○	○	◎	A
IT-13	Traffic Safety Education and Propaganda	■		3 mil.	○		◎	A
IT-14	Enhancement of Traffic Enforcement	■		20 mil.	○	○	◎	A
IT-15	Development of Traffic Accident Database and Traffic Safety Audit System		■	5 mil.	○		◎	A
IT-16	Computerization of Vehicle and License Registration		■	5 mil.	○	○	◎	B/D/E
IT-17	Transport Demand Control in the CBD	■		20 mil.	○		◎	A
IT-18	Development of Public Parking and Guidance System in the CBD	■		30 mil.	○	◎	○	B/D/E
IT-19	Reform of Law and Regulation on Traffic Management and Transport Demand Management	■		1 mil.	◎		○	A
IT-20	Yangon Urban Traffic Planning Unit	■		5 mil.	◎		○	A
IT-21	PTA (Public Transport Authority)		■	5 mil.			◎	A
IR-01	Improvement of Signalized Intersections	■		13 mil.	○	◎	○	A
IR-02	Construction of Flyovers/Underpasses for Bottleneck Intersections	■		50 mil.	○	◎	○	A/C
IR-03	Re-construction of Old Bridge (i.e.Thaketa Bridge)	■		35 mil.	○	◎	○	A
IR-04	Improvement of Road No.2		■	60 mil.	○	◎	○	A/C
IR-05	[Outer Ring Road (Section-1)] Upgrading of Road No.7		■	78 mil.	○	◎	○	A/C/D
IRW-01	Automatic Level Crossing Installation in Yangon Circular Railway	■		13 mil.	○	◎	○	A
IRW-02	Bottleneck Elimination of Yangon Circular Railway between Yangon Central Station and Pazundaung Station	■		13 mil.	○	◎	○	A
IRW-03	Urgent Installation of Radio-typed Train Detection System in Yangon Circular	■		13 mil.	○	◎	○	A

	Railway							
IRW-04	Installation of Radio-typed Telecommunication System for Yangon Circular Line (Malwagone- Yangon-Danyingone Section)			4 mil.	○	◎	○	A
IRW-05	Yangon Circular Railway Modernization (Improvement and Electrification) Phase1: Western Half Loop			560 mil.	○	◎	○	B/D/E
IP-01	Twante Canal Rehabilitation Project			10 mil.	○	◎	○	A
IP-02	Waterfront Development			50 mil.	○	◎	○	D/E
IP-03	Yangon Main Port Expansion			100 mil.	○	◎	○	D/E
IP-04	Installation of Safety Navigation Facilities (VTMS, AIS) & Navigation Aid			50 mil.	○	◎	○	A/C
IP-05	Thilawa Area Port Project Phase I			291 mil.	○	◎	○	D/E
IP-06	Replacement of Dala Ferry Ships			12 mil.	○	◎	○	D/E
IW-01	Renewal of Pump Station of Nyaunghnapin WTP			20 mil.	○	◎	○	A
IW-02	Renewal of Distribution Pipeline in Yankin Township				○	◎	○	A
IW-03	Construction of Kokkowa WTP and transfer/distribution pipeline			520mil.	○	◎	○	B/D/E
IW-04	Construction of Lagunpyin WTP and transfer/distribution pipeline			145mil	○	◎	○	B/D/E
IW-05	Renewal of Distribution Pipe Network of Zone 1			75mil.	○	◎	○	A
IW-06	Installation of Disinfection Facility			20mil.	○	◎	○	A
IS-01	Improvement of water quality of Kan Dow Gyi Lake			4.6 mil	○	○	◎	A
IS-02	Installation of Sewerage System			105 mil	○	◎	○	A/C
ISW-01	Project for Supply of Collection Equipment for Solid Waste Management			16 mil.	○	◎	○	A
ISW-02	Project for Capacity Development of Solid Waste Management (1)			5 mil.	○		◎	A
ISW-03	Project for Capacity Development of Solid Waste Management (2)			6 mil.	○		◎	A
ISW-04	Project for Sanitary Landfill Development			420 mil.	○	◎	○	B/C
ISW-05	Hazardous Waste Treatment Facility			34 mil.	○	◎	○	A
ITC-01	Construction of Next Generation Network			276 mil.	○	◎	○	D/E

Note: "◎" means main scope of the project, "○" is also scope of the project.
"A" is "Public Work", "B" is "Assignment of Service", "C" is "Construction with advanced finance by Private", "D" is "Hybrid PPP", and "E" is "Private Initiative PPP"
Source: JICA Study Team

CHAPTER 7

Strategic Environmental Assessment (SEA)

< Part-II: The Master Plan >

CHAPTER 7: STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA)

7.1 General

JICA requested the Project proponents to provide an appropriate environmental and social considerations when implementing an ODA project, based on the "JICA Guidelines for Environmental and Social Considerations (April 2010) (hereinafter referred to as the JICA Guidelines)".

According to the JICA Guidelines, SEA will be applied in conducting a master plan study to integrate appropriate environmental and social considerations at an early stage up to monitoring stage of the proposed project.

The SEA was carried out in this Plan as an examination of the development vision and basic policy for development in the future. The result of SEA will be incorporated in the development master plan of Greater Yangon.

7.2 System of Environmental and Social Considerations in Myanmar

7.2.1 Legislation related to Environmental and Social Considerations

The Environment Conservation Law of Union of Myanmar was promulgated on 30th March 2012. The law consists of the objectives, formation of the environmental conservation committee, environmental conservation functions and powers of the Ministry of Environment Conservation and Forestry (MOECF), environmental emergency, and so on.

The summary of the objectives are as follows:

- To implement the Myanmar National Environment Policy;
- To provide the basic principles and give guidance on the systematic integration of environmental conservation matters in a sustainable development process;
- To promote a good and clean environment and to conserve the natural and cultural heritage for the benefit of both present and future generations;
- To reclaim the ecosystems that are at the early stages of degradation as soon as possible;
- To manage the prevention of natural resources degradation and to enable its sustainable use;
- To implement the promotion of public understanding and dissemination of educational program on environmental awareness;
- To promote the international, regional, and bilateral cooperation in environmental affairs; and

- To enable the cooperation among government departments, government organizations, international organizations, non-governmental organizations, and individuals in matters of environmental conservation.

It is noteworthy that Myanmar laws do not contain any descriptions related to the system of environmental impact assessment (EIA) for development projects as well as to SEA. Moreover, the systems of public involvement in the decision-making process are not also prescribed in the law. This is considered as a significant gap between the Myanmar laws and JICA Guidelines.

As of November 2012, the regulations and guidelines necessary for the implementation of the provisions including conduct of an EIA mentioned in this law are still under preparation by MOECF.

7.2.2 Land Management in Myanmar

In the development project, land acquisition tends to be a serious issue, and sometimes projects have been suspended due to this problem in some cases. The land management issues in Myanmar in terms of land ownership and land acquisition will be discussed below based on the "Guidance Notes on Land Issues,2010" prepared by UNHABITAT and UNHCR.

(1) Legislation Related to Land Acquisition

According to the State Constitution (2008), 'The Union is the ultimate owner of all lands and all natural resources above and below the ground, above and beneath the water and in the atmosphere in the Union'. Although the socialist system was abolished in 1988, the existing land law and directions are still in effect today without formal revision.

There are many significant laws which govern land issues, land administration, and land ownership in Myanmar such as Land Nationalization Act (1953), Disposal of Tenancies Law(1963), Land Acquisition Act(1894), Forest Law(1992), Farm Land Law (2012), and so on.

(2) Types and Classes of Land

From an administrative point of view, land can be classified into the following eleven categories.

1) Freehold Land

Freehold land can be interpreted as "ancestral land". It is transferable in accordance with the "Land Acquisition Act".

2) Grant Land

"Grant land" is owned by the government. Land of the government may be disposed by grant or lease to any person or entity for a stipulated period. The lease period could range from 10 years, to 30 years or even up to 90 years, etc.

3) Agricultural Land

"Agricultural land" is defined as "land being utilized or kept in possession for agriculture purposes". All agricultural lands became under exclusive state-ownership with the enactment of the "Land Nationalization Act" in 1953. Agricultural land is not transferable in accordance with the act.

4) Garden Land

"Garden land" is a kind of "agricultural land", but the type of crop(s) grown in the garden land is different from those usually grown in the agricultural land.

5) Grazing Land

Grazing land is stipulated in the Nationalization Act (1953) as grazing of cattle and no revenue is expected from the levy.

6) Cultivable Land, Fallow Land, and Waste Land

This is a land which the right to cultivate/utilize may be granted by the government to state-owned economic organizations etc. A maximum period of 30 years may be granted to cultivate/utilize the land.

7) Forest Land

"Forest land" is declared and administered in accordance with the "Forest Law". Permission is required from the ministry in extracting timber, cutting fire-wood, producing charcoal, etc.

8) Town Land

In most cases it could be classified under either "freehold land" or "grant land". However, the land belongs to a specific categorization because the town is the owner of the land.

9) Village Land

Village land also belongs to a specific categorization like "town land" because the village is the owner of the land.

10) Cantonments

"Cantonments" is a specific type of land acquired by the government for exclusive use by the military. The land will be acquired under the "Land Acquisition Act" and exempted from land tax.

11) Monastery Land

The land which the Ministry of Home Affairs may declare as "monastery land" and it is obtained based on the "Land Acquisition Act".

(2) Land Acquisition for Development Project under the Master Plan

There are possibilities that the agricultural land in the rural areas of Greater Yangon would be subject to land acquisition for urban development in the implementation stage of the Master plan in the future. Agricultural land is not transferable as stated in the Land Nationalization Act (1953), and whoever uses agricultural land for other purposes could be evicted and punished under the Disposal of Tenancies Law, 1963.

It is noteworthy, however, that in reality agricultural land could be used for other purposes such as for building houses under special arrangement. According to "Article 39 of the Land Nationalization Act (1953), the decision of such can be given by the concerned State/Division Peace and Development

Council based on the approval of the Ministry of Agriculture and Irrigation, and then, the State/Division Peace and Development Council may issue an official document called "La Na 39" based on the said decision. This 'La Na 39' type of land is transferable.

7.3 Strategic Environmental Assessment (SEA)

7.3.1 Definition[1] of the "SEA"

SEA is an environmental impact assessment on the "three P's", namely, "policy", "plan", and "program". SEA is understood as a tool for integrating appropriate environmental and social considerations based on sufficient environmental and social information into the process of PPPs development.

"Policy" is considered as administrative policies of the government that shows the basic principle of plans and/or projects in the whole policy system but does not decide on the necessities and/or concrete contents of the each project. Therefore, policies are generally abstract not concrete.

"Plan and Program" show the scenario which explains the methodologies and schedule for the project to be implement systematically, but details of the project are not decided. In this sense, "Plan and Program" are more concrete than policy and more abstract than projects.

The "Project for the Strategic Urban Development Plan of the Greater Yangon" is considered belonging to the category of the "Plan and Program.

7.3.2 Significance of SEA

In relation to the national development and environmental context, SEA is said to have two significant roles, as given below.

(i) To integrate appropriate environmental and social considerations into the process of decision making.

(ii) To supplement the limitation of conventional environmental impact assessment that will be carried out in the implementation stage.

7.3.3 Methodologies

At the moment, no single "best" SEA process has been established. Different techniques or methodologies have been applied in various stages and activities of SEA. The choice of techniques depends on a whole range of factors, including the purpose of the SEA, the availability of data, local environmental assessment capacity, decision-making structure and culture, and resource constraint[2].

SEA for the Project was carried out before the process of establishing the development visions and structure plans for Greater Yangon. Regarding the detailed description of the vision and structure plans, refer to "*Chapter 3 Development Visions and a Structure Plan, 3.1 Draft of Development Vision and 3.4 A Structure Plan for Greater Yangon "*.

The detailed methodologies for SEA are as follows:

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1 Cited from the report prepared by the Study Group for SEA under the Ministry of Environment of Japan, August 2000.

2 Cited from the "Strategic Environmental Assessment in the World Bank Operations, May 2002".

(1) Review the Process of the Preparation of Draft Structure Plans (three alternatives)

At first, three draft structure plans were reviewed carefully. In the review, confirmation was made on the contents of each structure plan as well as the process of establishing development visions.

(2) Discussion on the Present Environmental Issues in Greater Yangon

The present environmental issues in Greater Yangon were discussed in the course of SEA study preparation. The Master Plan has a target year of 2040, therefore, it will be useful to discuss the present environmental issues in Greater Yangon considering the future environmental issues.

(3) Preliminary Stakeholder Meeting Through Interviews to Related Townships

It is essential in SEA to incorporate opinions of related stakeholders into the plan formulation as early as possible. Therefore, the interviews to all 39 related townships were carried out as a preliminary stakeholders meeting to ask their preferences on the proposed structure plans. At the same time, their opinions on various topics such as environmental concerns and socioeconomic issues were discussed between the chief of townships and the JICA Study Team.

(4) Environmental Scoping

Anticipated actions necessary to realize the proposed four development visions were clarified first. Then, the environmental impact items considered in the realization of the development visions were selected using environmental checklist. In the process, the results of the discussion on the present environmental issues in Greater Yangon and opinions obtained in the preliminary stakeholders meeting with related townships were considered.

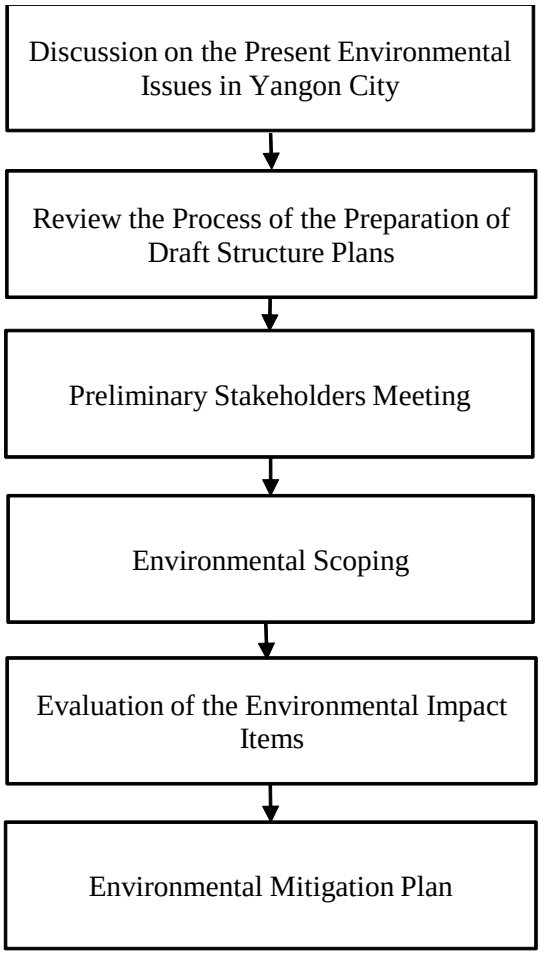
(5) Evaluation of the Environmental Impact Items

Anticipated environmental impacts caused by each of the alternatives were evaluated using the matrix.

(6) Establishment of an Environmental Mitigation Plan

An environmental mitigation plan necessary in the implementation stage was prepared to select the optimal alternative based on the evaluation of the environmental impact items.

The work flow for SEA is shown in Figure 7.3.1.



Source: JICA Study Team

Figure 7.3.1: Work Flow for SEA

7.3.4 Present Environmental Issues in Yangon City

(1) Water Pollution

The service coverage of YCDC water supply system was approximately 42% in 2010 and the remaining 58% unserviced population sourced their water needs from either private well/pond or rainwater. Although there is no data on the water quality of private wells, access to safe drinking water is not secured, except for those who uses deep wells.

Of the six periphery townships in Greater Yangon, four townships, namely, Hlegu, Hmawbi Htantabin, and Twantay have no available water supply system. People of these townships source their water through private wells/ponds or utilize rainwater. Therefore, these townships are under similar condition in terms of no access to safe drinking water.

Existing sewerage system covers only a small part of the CBD area. The sewerage system was constructed in 1888 and the service area was expanded in 1929. Recently, a new wastewater treatment plant (WWTP) was completed in January 2005.

People living outside the sewerage service area employ on-site disposal systems such as septic tank. The degradation of water quality is high concern as human waste sewage often flows into the drainage directly without appropriate treatment.

Habitual flooding by tidal backwater occur in lowland areas without any flood protection. Flooding causes accumulation of floating debris in the drainage. Waste water without proper treatment results to poor water quality and offensive odor. Consequently, this waste water may flow directly to the Yangon River and it is a great concern that waste water causes degradation of the river's water quality.

The solid waste disposal in Greater Yangon is being operated in an open dump site. Therefore, there is a concern that untreated leachate might cause water quality degradation, including ground water.

(2) Air Pollution and Noise

More than 25,000 vehicles have been reportedly added to the number of vehicles plying on the city roads in the first half of the year after the government approved the import permit in 2012. Therefore, air pollution and noise are major concerns due to the increasing number of vehicles as well as the traffic jam.

The polluted level is unknown because no monitoring data on air pollution and noise is available, but there is a high possibility of serious environmental issues caused by air pollution and noise with rapid economic growth in the future.

Also, air pollution and noise from the industrial zones developed in the west and east suburbs of the city in the last two decades may cause environmental problem as a result of industrial growth.

The open dumping system for solid waste disposal may cause air contamination by open burning of solid waste.

(3) Solid Waste Management

Solid waste in Yangon City comes from waste generators such as residents, business owners, and retailers. Waste is being collected by the Pollution Control and Cleansing Department (PCCD) of Yangon City Development Committee. It is then transported to seven final disposal sites (FDSs) including large scale FDS such as Htantabin FDS and Htawe Chaung FDS, operating as open dump sites.

The waste collection system in Yangon City is a combination of primary waste collection method, waste temporary storage, and secondary waste collection. Supposedly, waste is transported directly to final disposal sites after the secondary waste collection. However, waste transportation is not always done immediately after the secondary collection, leaving the fully-loaded garbage trucks parked along the street even at the day-time . Wastes kept in trucks emit bad smell in the area.

Hazardous waste generated in the hospitals in Yangon City is separately collected by PCCD's compactor trucks and incinerated at the cemetery furnace located nearby Htantabin FDS. Given that responsibility of treatment and disposal, as well as the method for treatment is not clear because hazardous wastes have not been regulated by a legislation in Myanmar. It is a very urgent issue to establish a management system on hazardous waste based on appropriate law and/or regulations.

(4) Urban Amenity

The Hlawga Protected Area in Mingalardon Township is considered as one of the main natural environments, and is designated in Yangon City as a wildlife park in 1989. Yangon City has long and narrow spur projecting from the low hills of the central area running almost in the north-south direction with an average height of 30 m.

In the low hills, several lakes and marshes remain in the urbanized area. Of those, Kan Daw Gyi Lake and Inya Lake are protected as public parks. Other lakes and marshes should also be given more

attention in terms of conservation, because these water areas are very important and needed for flood control and mitigation of environmental pollution.

In YCDC, a total of 139 ha is allotted for public park area which seems to be quite small, considering the population of approximately 5.14 million. If the public park area is divided by the number of population, the parameter of park area per person in YCDC, results to 0.27 m^2 which is a small figure compared with other cities in the world, such as 29.3 m^2 in New York and 4.5 m^2 in Tokyo,

Therefore, it is important to introduce urban greenery actively in the city for the mitigation of "Heat Island Phenomenon" and also to increase the quality of urban amenity.

Public safety and pedestrian space is not secured in the city due to inappropriate use of pedestrians. These pedestrians lack proper maintenance, which are being illegally occupied by street stalls and used for parking. It is important to consider increasing the quality of pedestrian space in order to realize a comfortable and attractive city.

(5) Lack of Environmental Management System for Development Project

Until early part of 2012, there has been no law or regulation that enforces environmental impact assessment and environmental management plan to development project in Myanmar. Many infrastructures and industrial zones were constructed during the 1990s and 2010s without any proper environmental management system. Therefore, these factories located inside these zones tend to generate foul odor, noise, polluted air, and waste water.

7.3.5 Review of the Development Visions and a Structure Plan

The development visions and basic policy were proposed in a form of structure plans. The process used in the establishment of structure plans is as follows.

(1) Scoping in the Process of the Establishment of Development Visions

The scoping on development visions were conducted through the following discussions.

1) Discussion on the Development Vision with YCDC

In December 2011, a workshop was held for two days to discuss the Yangon Concept Plan (Vision 2040) participated by YCDC, Department of Human Settlement and Housing Development, and other relevant organizations. Through the discussion workshop, the following roles of Yangon City are expected in the future.

- To be the Main Economic Hub of the Nation.
- To develop a City of Inland and International Port Integration.
- To be a Green and Healthy City.
- To be a Multi Ethnical City of Heritage, Culture and Tourism.
- To be a City of Education and Knowledge.

2) Discussion on the Development Vision in the Workshop Held by YCDC (Urban Planning Division)

A workshop was held in the course of the Master Plan Study to discuss visions among the staff of Urban Planning Division, YCDC on 11th September 2012. In the workshop, discussion on the future development visions for Yangon City was carried out.

According to the result, some key themes were clarified as follows:

- Governance and Law Enforcement

(Keywords: Good Governance, System, Control, Rule, etc.)

- Economy Growth

(Keywords: Development Economy, Employment Opportunity, etc.)

- Green and Culture

(Keywords: Green, Clean, Public Park, Historical, Heritage, Culture, etc.)

- Urban Infrastructure

(Keywords: Transportation, Port and Airport, Water, Electricity, Waste, Telecom, etc.)

- Living Environment

(Keywords: Living Standard, Health-care, Education, Disaster Risk, Social, etc.)

(2) First Draft of Development Visions of Greater Yangon for 2040

In consideration of the past discussion among YCDC, Ministry of Construction (MOC), and other relevant organizations, as well as the outputs from the workshop conducted by the Urban Planning Division of YCDC, the first draft of development visions of Greater Yangon for 2040 was established, as follows: .

(i) To be an international hub city;

(ii) To be a comfortable city;

(iii) To be a well-managed infrastructure city; and

(iv) To be a city of good-governance.

(3) Socioeconomic Framework

Various socioeconomic development alternatives for Greater Yangon from the viewpoint of different development scenarios were examined. As for the preliminary demographic framework, the population projection was calculated based on the three different scenarios. As a result, it was revealed that for every scenario the population of Greater Yangon will be more than 10 million in 2040.

The future GDP per capita corresponding to the three scenarios was examined as preliminary economic framework. The examination showed that the GDP per capita of Yangon City would reach to the current GDP's level of Thailand in 2040 even in the low scenario.

(4) Basic Strategy for Economic Development

The preliminary basic strategies and measures for economic development in the manufacturing sector were formulated based on the forecast made by thePlanning Department Yangon Regional Office, as follows;

- To attract more foreign investment;
- To upgrade the existing manufacturing industry;
- To encourage new industrial businesses; and
- To make a mechanism for effective utilization of labor.

(5) Structure Plans for Greater Yangon

Alternative urban structure plans of Greater Yangon were examined for the achievement of above development visions in consideration of the socioeconomic framework and economic strategy.

Alternative urban structure plans were prepared taking into account the following factors;

- Urbanization Pattern (decentralization or concentration of the city center)
- Main Urban Function Distribution (As the city center, industrial area, residential area, etc.)
- Green Conservation (Public Park, protected area, high productive agricultural area, etc.)
- Transportation Network (Radial and ring trunk road, railway, etc.)

The summary of the three alternatives are as follows.

1) Sub-center System (Decentralized Urban Pattern)

This urban structure aims mainly at decentralizing the city center. Several “sub-centers” will be created as new business, commercial, industrial and/or residential centers with high-rise buildings. These sub-centers will be located around 10-15 km radius area from the CBD. Led by the sub-centers development, urbanization will be promoted around 10-15 km radius areas, which will be named a “Sub-center Growth Belt”. Outside of the sub-center growth belt, urbanization will be followed by market demands without any strict urban control measures. Green areas will be conserved properly.

2) Sub-center with Green Isle System (Decentralized Urban Pattern)

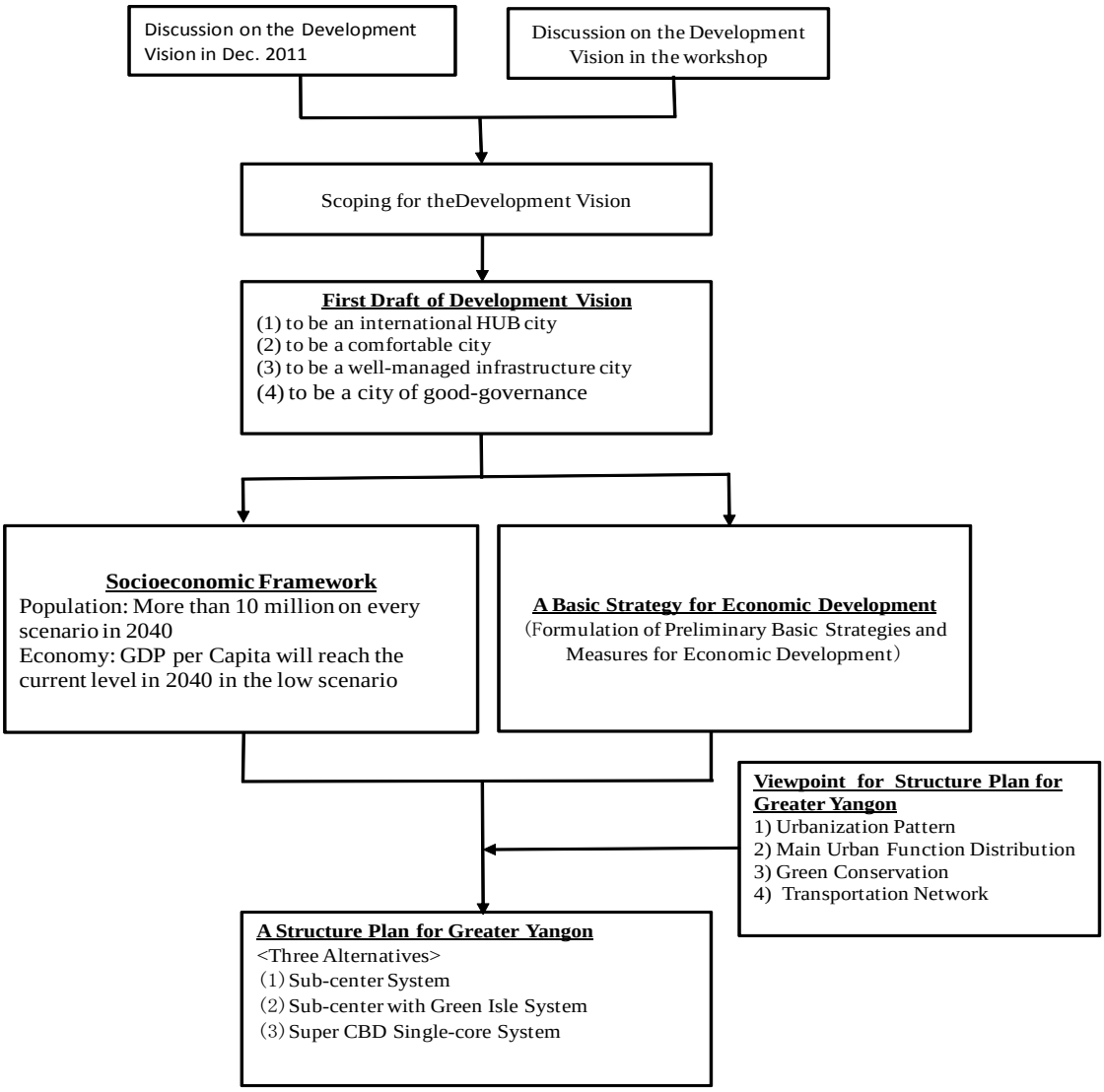
This urban structure also aims at decentralizing the urban center. A few sub-centers will be created around 10-15 km radius area from the CBD. Additionally, an outer ring road will be provided, and future urbanization along the outer ring road as the next step of development of the sub-centers growth belt will be promoted, which will be called an “Outer Ring Growth Belt”. This urban structure aims at controlling urban expansion by means of creating outer green belt in order to avoid continuous and extensive urban expansion with low density and to supply urban infrastructures efficiently and effectively. Green areas including high productive agricultural areas will be conserved as “Green Isles” as much as possible.

3) Super CBD Single-core System (Centralized Urban Pattern)

This urban structure follows the natural market demands of urbanization, which probably will occur along the main radial roads, such as No.5, No. 4, No.1, No.2, and No.6 roads. Urban

functions shall continue to concentrate in the current CBD, and this will let the CBD expand larger and rise higher as "Super CBD". On the other hand, suburban development will have minimum intervention. Green and agricultural area will not be given much attention due to less market demands for urbanization outside of the city's main roads.

The flowchart on the drafting of the development vision down to the preparation of the alternative urban structure plans is shown in Figure 7.3.2.



Source: JICA Study Team

Figure 7.3.2: Flowchart from the Drafting of the Development Vision Down to the Preparation of the Structure Plans

7.3.6 Preliminary Stakeholder Meeting

The SEA facilitates in information disclosure as early as possible. Therefore, interviews to all 39 related townships in Greater Yangon were carried out as a preliminary stakeholders meeting to ask about their preferences on the proposed structure plans. At the same time, opinions on various topics such as environmental concerns and social-economic issues were exchanged between the chief of townships and JICA Study Team. Consequently, the results of the interviews reinforced the contents of the "present environmental issues in Yangon City".

(1) Methodologies

Three alternatives of the structure plans, namely, "Sub-center System", "Sub-center with Green Isle System", and "Super CBD Single-core System", were explained to obtain the preference of the chief of the townships. Then, the interview was conducted on the township-wise environmental issues using questionnaires. The summary of the questionnaires is presented below.

<Infrastructures>

- Issues related to transportation system (traffic jam, traffic accident, air pollution, noise, vibration etc.)
- Road security
- Water supply/sewage system
- Solid waste management
- Distribution of indigenous people, religion-based tribes/minorities
- Presence/absence of child care centers, problems in children
- Present/absence of tourism resources
- Security problems like numbers and types of crimes in the township
- Green areas in the township
- Presence/absence of recreation areas
- Public toilets/bathrooms
- Religious areas

<Social issues>

- Minority issues
- Squatters issues
- Sufficiency of vehicle parking
- Presence or absence of platforms/ways or path for pedestrians
- Other social conflict in the township

<Others>

- Increasing land price etc.
- Local rules and regulations

(2) Schedule

15t^{h} October 2012 - 26th October 2012

(3) Results

1) Preferences on the Structure Plans

As per the question on their preferences among the three alternatives, 29 out of the 39 township-respondents preferred the plan of "Sub-centers with Green Isle System", while eight respondents preferred the "Sub-center System" and 2 respondents did not answer.

The reasons on choosing the "Sub-centers with Green Isle System", which was supported by the majority are as follows:

- The plan aims for the conservation of the natural environment and sustainable urban development.
- The plan could reduce the traffic jams and traffic accidents if the construction of inner and outer ring road will be implemented.
- The plan can accommodate the future population properly.
- The plan seems to meet the international standard.

The reasons on choosing the "Sub-center System" are as follows;

- The plan can help on the series of steps that will lead to urban expansion.
- The plan has less impact on the environment.
- The plan is suitable for appropriate urban expansion.

2) Summary of Comments on the Environmental Issues for Townships

- In all, 28 township-respondents mentioned that traffic jam is a serious problem of the Yangon Region. The traffic accident is the second serious problem as mentioned by 22 township-respondents. Traffic jams occur on the main road, at road junctions, and in market places. Given that illegal parking is one of the main reasons for traffic jam, the shortage of parking space is a problem.
- No respondent mentioned a problem on pedestrian space .
- Presently, air pollution, noise, and vibration are not considered as serious environmental problems among related townships.
- As for public facilities, 22 respondents pointed out that public toilet system is insufficient within their township areas.
- Regarding squatting issue, 22 respondents noted that problems on squatters still exist in their townships. These squatters areas are located mainly along the railway.
- Safety measures for school children are also important in urban planning, as 24 respondents mentioned that the safety for school children has been considered by way putting a zebra-crossing system, traffic light system, and teachers lead the children in crossing, however, these are not enough.
- Among the 39 township respondents, 20 respondents mentioned that land prices are increasing. It was revealed that land and building prices are increasing at the outer urban zone. While, among the seven townships in the CBD area of Yangon City, only one respondent mentioned that the land price within the township is increasing.

- There is no specific complain on medical, welfare, and education facilities among the townships.
- As for the power supply, 21 respondents pointed out that power failure is usually between once a month and five times a month. The duration of power failure is between five minutes as the minimum to one hour as the maximum based on this year's experience.
- Most of the respondents observed a trend of urban development in progress at their peripheral areas, and thought that conservation of natural environment is essential.


Figure 7.3.3: Interviews to the Chief of Townships

7.3.7 Environmental Scoping

Anticipated actions for realizing the proposed four development visions were clarified first. Then, the environmental impact items that will be considered in the realization of development visions were selected using an environmental checklist.

(1) Anticipated Actions Necessary to Realize the Proposed Development Visions

Anticipated actions necessary to realize the proposed four development visions were considered as follows:

1) To be an International Hub City

- Introduction of a large scale development project such as development of "Thilawa Area" in terms of special economic zone and improvement of port facility, etc.
- Establishment of large scale commercial facilities in the periphery area.
- Establishment of a new airport, if necessary.
- Establishment of a convention hall which can hold international congress sessions.
- Enhancement of tourism by realizing an "attractive city".
- Others

2) To be a Comfortable City

- Secure an ample greenery in the city.
- Improvement of pedestrian space in the city.

- Awareness on environmental conservation lifestyle through environmental education
- Conservation of historical architectural areas.

3) To be a Well-managed Infrastructure City

- Establishment of a road network synchronized with the development of public transportation.
- Establishment of road network that does not involved involuntary resettlement, as much as possible
- Establishment of a comprehensive public transportation system consisting possibly of heavy railways and/or middle capacity transit such as LRT and monorail LRT.
- Expansion of the service area as well as improvement of service quality of water supply, sewage and drainage systems in the city.
- Establishment of an effective and efficient power supply system.
- Provision of solid waste collection services in the city.

4) To be a City of Good-governance

- Establishment of legislations which are necessary for the conservation of natural environment.
- Establishment a system addressing the alteration of land use which will produce new and appropriate development projects.
- Establishment of an EIA system for an appropriate environmental management.

(2) Environmental Scoping

The environmental scoping was conducted considering the relationship between the environmental impact items and anticipated actions in each development vision using an environmental impact check matrix. It is noteworthy that the 30 general environmental impact items were prepared referring to the environmental check list of the JICA Guidelines. As a result, 18 environmental impact items, namely, nine items under social environmental issues, four items under natural environmental issues and five items under pollution issues, were selected, as shown in Table 7.3.1.

Table 7.3.1: Environmental Impact Matrix for the Master Plan

Environmental Parameters	No.	Development Vision		International HUB City					Comfortable City				Well-managed Infrastructure City						City of good-governance		
		Actions / Environmental Imapact Items	Identified Environemntnal Impact Item	Introducing large scale development such as the Development in "Thilawa Area"	Establishment of large scale commercial facilities in periphery area	Establishment of new airport	Establishment of convention hall	Enhancement of tourism by construction of the "attractive City"	Active greenery in the city	Improvement of urban ppedestrian space	Enlightenment of environmental conservation lifestyle	Conservation of historical building area	Road network synchronized with the development of public transportation	Road network avoiding involuntarily resettlement	Establishment of comprehensive railway-wise public transportation system	Increasing the service area of water supply, sewage and drainage system	Establishment of effective power supply	Provision of solid waste collection service to all population	legislations necessary for conservation of natural environment	System for addressing the alteration of land use properly	Establishment of EIA system
Social Environment	1	Involuntary Resettlement	✔	✔	✔								✔	✔	✔						
	2	Local economy such as employment and livelihood, etc	✔	✔	✔	✔		✔				✔	✔	✔	✔		✔				
	3	Land use and utilization of local resources	✔	✔	✔	✔							✔	✔	✔					✔	
	4	Social institutions such as social infrastructureand local decision-making institutions																			
	5	Existing social infrastructures and services	✔										✔	✔	✔						
	6	The poor, indigenous and ethnic people	✔										✔	✔	✔						
	7	Misdistribution of benefit and damage	✔										✔	✔	✔						
	8	Cultural heritage	✔					✔			✔	✔	✔	✔	✔						
	9	Local conflict of interests																			
	10	Water Usage or Water Rights and Rights ofCommon																			
	11	Sanitation	✔	✔												✔		✔			
	12	Hazards (Risk)Infectious diseases such as HIV/AIDS	✔										✔	✔	✔						
Natural Environment	13	Topography and Geographical features																			
	14	Soil Erosion																			
	15	Groundwater	✔	✔												✔					
	16	Hydrological Situation																			
	17	Coastal Zone																			
	18	Flora, Fauna and Biodiversity	✔						✔										✔		
	19	Meteorology																			
	20	Landscape	✔						✔			✔	✔	✔	✔						
	21	Global Warming	✔						✔		✔				✔						
Pollution	22	Air Pollution	✔										✔	✔	✔						
	23	Water Pollution	✔													✔		✔			
	24	Soil Contamination																			
	25	Waste	✔															✔			
	26	Noise and Vibration	✔										✔	✔	✔						
	27	Ground Subsidence																			
	28	Offensive Odor																			
	29	Bottom sediment																			
	30	Accidents	✔							✔			✔	✔	✔						

Note: "✔" shows the relationship between environmental impact items and the action by the Development Visions

Source: JICA Study Team

7.3.8 Evaluation Matrix of the Environmental Impact for Each Alternative

Anticipated environmental impacts that would be caused by the three alternatives for urban structures were evaluated in a matrix system, as presented below.

- Sub-center System(hereinafter referred to as "Plan A")

- Sub-center with Green-Isle System (referred to as "Plan B")
- Super CBD Single-core System (referred to as "Plan C")

(1) Evaluation Methodology

The evaluation categories are divided into social environment, natural environment, and pollution control. The environmental impacts were evaluated into positive and negative aspects. The magnitude of environmental impact is considered following the three levels, namely, A, B, and C for the positive impact; and X,Y, and Z for the negative impact. Therefore, "A" mark shows that the environmental impact item has the most positive impact, while "Z"mark shows that it has the most negative impact.

(2) Evaluation on the Positive Impacts

The evaluation for positive impacts were undertaken focusing on the following 12 environmental parameters consisting of five social environment, three natural environment, and four pollution control. These 12 parameters were selected from the 18 parameters in the environmental scoping.

- Social environment parameters are as follows; (i) Local economy such as employment and livelihood, etc. (ii)Poor, indigenous and ethnic people, (iii)Misdistribution of benefit and damage, (iv)Cultural heritage, and (v)Sanitation.
- Natural environment parameters are as follows: (i)Ground water, (ii)Flora, fauna, and biodiversity, and (iii)Global warming.
- Pollution control parameters are as follows: (i)Water pollution, (ii)Waste, (iii)Noise and vibration, and (iv)Accident.

1) Social Environment

Regarding "Plan A" and "Plan B", the following positive impacts on social environment are expected because these plans have more systematic infrastructure development compared with "Plan C". For item (i), job opportunities will be increased with the construction of sub-centers and infrastructures, and consequently, it will lead to activation of local economy. (ii)The establishment of the railway-type public transportation will enable people to move to distant areas in shorter time compared before. It will lead to an increase in opportunity to enter schools and get more jobs. Consequently, an increase in the number of "middle class" and distribution of benefit to wider areas will be expected. (iii)The conservation of historical buildings in the CBD will contribute to an increase in the level of tourism resources with systematic infrastructure development. (iv)Appropriate social services such as access to safe drinking water will be provided and secured through the establishment of an effective infrastructure of water supply and sewage system.

"Plan B" proposes to set a city framework with the creation of an outer green belt. It will contribute to the realization of a "compact city". Consequently, this plan has the most appropriate social service among the three alternatives such as access to safe drinking water will be provided and secured through the establishment of an effective infrastructure of water supply and sewage system.

"Plan C" with no specific development plan, is considered to have minimum positive impact in terms of activation of local economy, opportunity of going to schools and getting more jobs and provision of appropriate social services such as access to safe drinking water.

Based on the above discussion, "Plan B" was evaluated as the most positive plan in terms of social environmental considerations followed by "Plan A" and "Plan C".

2) Natural Environment

"Plan A" and "Plan B" could alleviate the degradation of ground water if appropriate water supply, sewerage and solid waste management systems are provided. Also these plans could reduce the impact of global warming if railway-type public transportation system which emits less CO_2 and has highly energy efficient system is introduced.

"Plan A" will conserve the green areas inside of the inner green belt such as "Hlawga Protected Area", "Inya Lake", etc. properly. While, "Plan B" which will be established in the outer ring road will conserve the greenery systematically not only the green areas inside of the inner green belt but also the area toward outer ring road.

"Plan A" will contribute to alleviate the "Urban Heat Island Phenomena" for the city located inside the inner green belt through conservation of the green areas. And "Plan B" will conserve the green wide areas on a systematic way. Plan B is evaluated to have higher potential to alleviate "Urban Heat Island Phenomena" than "Plan A". "Plan C" has low effectiveness in terms of infrastructure development because it has no specific development plan. Therefore, "Plan C" is considered to have limited positive impact in terms of alleviating the degradation of ground water through appropriate water supply, sewerage, and solid waste management systems.

Based on the above discussion, "Plan B" was evaluated as the most positive plan from in terms of natural environmental considerations followed by "Plan A" and "Plan C".

3) Pollution

Regarding "Plan A" and "Plan B" which both have systematic infrastructure development, the following positive impacts on pollution are expected. (i)The water pollution could be reduced with appropriate water supply, sewerage and solid waste management systems. (ii)The activation of the modal-shift to railway system through the establishment of a railway-type public transportation will alleviate the traffic jam and accident. And it is expected that there will be a reduction of air pollution caused by exhaust gas, noise, and vibration due to the decreasing number of vehicles. (iii)The traffic jam and accident will be reduced due to construction of the inner ring road.

In addition to this, "Plan B" aims at providing appropriate water supply, sewerage and solid waste management systems for the whole area. Also Plan B could alleviate traffic jam and accident through the construction of the inner ring road and the outer ring road. "Plan C" has low effectiveness of infrastructure development because it has no specific development plan. Therefore, "Plan C" is considered to have limited positive impact in terms of alleviation of water pollution and solid waste management.

Based on the above discussion, "Plan B" was evaluated as the most positive plan in terms of pollution followed by "Plan A" and "Plan C".

(3) Evaluation on the Negative Impacts

The evaluation on the negative impacts were conducted focusing on the following ten environmental parameters, consisting of five social environment, two natural environment, and three causes of pollution. These 10 environmental parameters were selected out of the 18 items in the environmental scoping.

- Social environment, namely: (i)Involuntary resettlement, (ii)Land use and utilization of local resources, (iii)Existing social infrastructures and services, (iv)Cultural heritage, and (v)Hazardous and (Risk) infectious diseases such as HIV/AIDS.

- Natural environment, namely: (i)Flora, fauna, and biodiversity and (ii)Landscape
- Pollution, namely:(i) Water pollution, (ii)Air pollution, and (iii)Noise and vibration.

1) Social Environment

Three alternatives have similar negative impacts on the construction of railway-type public transportation system. This construction might divide the community, in case the railway will be built on the ground unless its an underground or viaduct railway. Furthermore, this can induce the spread of infectious diseases such as HIV/AIDS because a large number of laborers from the outside will come to the construction areas at the implementation stage.

Regarding "Plan A" and "Plan B" ,the following three negative impacts on social environment are anticipated, as follows; (i)There is a possibility to cause involuntary resettlement due to land acquisition for the construction of the ring road and railway. (ii)Some negative impact on existing land use might accrue due to the construction of new infrastructures. (iii) Private owner's pickup truck and taxi businesses will be affected by the introduction of a new public transportation. Therefore, there is a concern that drivers of these private entities may lose their jobs, consequently.

As for the negative impact caused by involuntarily resettlement, "Plan B" which has wide target areas in terms of infrastructure development will create more serious impact than those of "Plan A".

"Plan C" might induce the disappearance of historical buildings inside the CBD due to uncontrolled development and this will lead to decrease in tourism resources, consequently.

Based on the above discussion, it was concluded that "Plan B" will have the most negative impact from the viewpoint of social environmental considerations mainly due to the involuntarily resettlement followed by "Plan C" then "Plan A".

2) Natural Environment

All the alternatives exhibit negative impact on urban landscape due to the construction of viaduct for roads and railway.

"Plan C" might show the worst pattern in the disappearance of greenery environment due to uncontrolled urban sprawl. For "Plan A", the green areas outside of the inner ring road might disappear due to development based on market demand. To some extent, the decreasing green areas toward the outer ring road might be inevitable with "Plan B".

Based on the above discussion, it was considered that "Plan C" will have the most negative impact from the viewpoint of natural environmental considerations mainly due to the green areas disappearance followed by "Plan B" and "Plan A".

3) Pollution

All the alternatives may cause air pollution, noise, and vibration due to the increasing number of vehicles plying on the road. In case of "Plan A", the environmental degradation in terms of flood, water pollution, offensive odor, etc. might occur due to ineffective water supply, sewage, and solid waste management systems outside of the inner ring road.

Based on the discussion above, it was concluded that "Plan A" will have the most negative impact from the viewpoint of pollution control followed by "Plan B" and "Plan C" which both have similar negative impact levels.

4) Evaluation Analysis and Conclusion

Regarding positive impact, "Plan B" was evaluated as the most positive plan in all three evaluation categories, i.e., social environment, natural environment, and pollution control. As for the negative impact, "Plan A" was the most negative plan followed by "Plan B" and "Plan C" which were evaluated on the same level.

Based on the comprehensive consideration of the evaluation results mentioned above,"Plan B" (Sub-center with Green-Isle System) was selected as the most recommendable structure plan for the "Master Plan for Yangon City".

The evaluation matrix of the environmental impact for each alternative is shown in Table 7.3.2.

It should be noted that the results of the comparative evaluation mentioned above are reflected in the alternatives' evaluation in terms of environmental and social considerations described in "*Chap*ter 3 Development Visions and a Structure Plan, 3.4.2 Concept of Urban Structure".

Table 7.3.2: Evaluation Matrix of the Environmental Impact

Items		"Sub-center System"	"Sub-center with Green-Isle System	"Super CBD Single-core System
Positive Impact	**Social Environment** (Involuntary resettlement/Local economy /Land use /Existing infrastructure/Poverty/Misdistribution of benefit/ Cultural heritage/Sanitation/HIV)	● Job opportunities will be increased with the construction of infrastructures and it will lead to the activation of local economy consequently. ● The establishment of the railway-type public transportation will enable people to move to distant areas in shorter time than before. It will lead to an increase in opportunity to enter schools and get more jobs. Consequently, an increase in the number of "middle class" and distribution of benefit to wider areas will be expected. ● The conservation of historical buildings in the CBD will contribute to high level of tourism resources. ● Appropriate social services such as access to safe drinking water will be provided and secured through the establishment of an effective water supply and sewage system.	● Job opportunities will be increased with the construction of infrastructures and it will lead to the activation of local economy consequently. ● The establishment of the railway-type public transportation will enable people to move to distant areas in shorter time than before. It will lead to an increase in opportunity to enter schools and get more jobs. Consequently, an increase in the number of "middle class" and distribution of benefit to wider areas will be expected. ● The conservation of historical buildings in the CBD will contribute to high level of tourism resources. ● This plan proposes to set a city framework with the creation of an outer green belt. It will contribute to the realization of a "compact city". Consequently, the most appropriate social service among the three alternatives such as access to safe drinking water will be provided and secured through the establishment of an effective water supply and sewage system.	● A public transportation mainly based on a railway-type system will be established due to the increasing population without even considering the efficient way. People will be able to move to distant areas in shorter time than before. It will lead to an increase in opportunity to enter schools and get more jobs. Consequently, the increase in the number of "middle class" and the distribution of benefit to wider areas will be expected. ● Public health condition will be improved at a minimum level because infrastructure on water supply, sewage, and solid waste management systems will be established even without considering the desired results.

Items		"Sub-center System"	"Sub-center with Green-Isle System	"Super CBD Single-core System
	Evaluation	**B**	**A**	**C**
	Natural Environment （Ground water/ Flora, fauna and biodiversity/ Landscape/ Global warming）	● The degradation of ground water will be alleviated through appropriate water supply, sewerage, and solid waste management systems. ● The green areas inside the inner green belt such as "Hlawga Protected Area", "Inya Lake", etc. will be conserved properly. ● The conservation of the green areas will contribute to alleviate the "Urban Heat Island Phenomena" for the city located inside the inner green belt. ● The impact of global warming might be reduced through the introduction of the railway-type public transportation system which emits less CO2 and has a high energy efficient system.	● The degradation of ground water will be alleviated through appropriate water supply, sewerage and solid waste management systems. ● Not only the green areas inside of the inner green belt such as "Hlawga Protected Area", "Inya Lake", etc., but also the area toward the outer ring road will be conserved systematically. (For example, a law will imposed the developer to remain and maintain green areas in certain portion of the development area) ● The systematic conservation of green-wide area will contribute in alleviating "Urban Heat Island Phenomena" for the entire city area. ● The impact of global warming might be reduced through the introduction of the railway-type public transportation system which emits less CO2 and has a high energy efficient system.	● The degradation of ground water will be alleviated because infrastructure on water supply, sewerage, and solid waste management system will be established even done in unsafe or improper way. ● There is a possibility to increase the green rate inside super CBD with a systematic urban greenery plan.
	Evaluation	**B**	**A**	**C**
	Pollution (Water pollution/Air pollution/ Waste/ Noise and vibration/Accident）	● The water pollution could be reduced with appropriate water supply, sewerage, and solid waste management systems. ● An appropriate solid waste management system could be possible inside of the inner green belt. ● The activation of the modal-shift to railway system through the establishment of the railway-type public transportation will alleviate the traffic jam and accident on the road. And it is expected that there will be a reduction of air pollution caused by exhaust gas, noise and vibration due to the reduction of vehicles. ● Traffic jam and accident will be reduced due to the construction of the inner ring road.	● The water pollution could be reduced with appropriate water supply, sewerage and solid waste management systems for the entire area. ● An area-wide and appropriate solid waste management may be possible to implement. ● The activation of the modal-shift to railway system through the establishment of the railway-type public transportation will alleviate the traffic jam and accident. And it is expected that there will be a reduction of air pollution caused by exhaust gas, noise, and vibration due to decreasing number of vehicles. ● Traffic jam and accident could be reduced if the construction of the inner ring road and the outer ring road is implemented.	● The reduction of water pollution, solid waste management will be achieved because infrastructure on water supply, sewerage, and solid waste management systems will be the established even done in unsafe and ineffective way. ● There is a possibility that the air pollution and noise in suburban area will be decreased as compared with other two alternatives due to the concentration of urban function into the CBD.

Items		"Sub-center System"	"Sub-center with Green-Isle System	"Super CBD Single-core System
	Evaluation	**B**	**A**	**C**
Negative Impact	Social Environment (Involuntary resettlement/Local economy /Land use /Existing infrastructure/Poverty/Misdistribution of benefit/ Cultural heritage/Sanitation/HIV)	● There is a possibility of involuntary resettlement due to land acquisition for the construction of the inner ring road and railway. ● Some negative impact on the existing land use might accrue due to the construction of new infrastructures. ● The private owner's pickup truck and taxi services might be affected by the introduction of the new public transportation. Therefore, it is a concern that drivers of these private entities might lose their jobs. ● The construction of railway-type public transportation might divide the community, in case the railway will be built on the ground, unless its an underground or viaduct railway. ● In the implementation stage, a large number of laborers from outside will come to the construction areas. This might induce the spread of infectious diseases such as HIV/AIDS.	● There is a possibility of involuntary resettlement due to land acquisition for the construction of the inner ring road, the outer ring road, and railway. ● Some negative impact on the existing land use might accrue due to the construction of new infrastructures. ● The private owner's pickup truck and taxi businesses might be affected by the introduction of the new public transportation. Therefore, it is a concern that drivers of these private entities might lose their jobs consequently. ● The construction of railway-type public transportation might divide the community, in case the railway will be built on the ground, unless its an underground or viaduct railway. ● In the implementation stage, a large number of laborers from outside will come to the construction areas. This might induce the spread of infectious diseases such as HIV/AIDS.	● There is a possibility that historical buildings inside CBD will disappear due to uncontrolled development and this will lead to decrease in tourism resources consequently. ● The construction of railway-type public transportation might divide the community in case railway will be built on the ground, unless its an underground or viaduct railway. ● In the implementation stage, a large number of laborers from outside will come to the construction areas. This might induce the spread of infectious diseases such as HIV/AIDS.
	Evaluation	**Y**	**Z**	**X**
	Natural Environment （Ground water/ Flora, fauna and biodiversity/ Landscape/ Global warming）	● The green areas outside of the inner ring road might disappear due to development based on market demand. ● The might be a negative impact on urban landscape due to the construction of viaducts for road and railway.	● To some extent, the disappearance of green areas toward the outer ring road might be inevitable. ● The might be a negative impact on urban landscape due to the construction of viaducts for road and railway.	● This plan might be the worst pattern in terms of green areas disappearance due to uncontrolled urban sprawl. ● There is a possibility of accelerating the "Urban Heat Island Phenomena" due to green areas disappearance, especially in the super CBD. ● There might be a negative impact on urban landscape due to construction of viaduct for road and railway.
	Evaluation	**Y**	**X**	**X**
	Pollution (Water pollution/Air pollution/ Waste/ Noise and vibration/Accident)	● The increase in number of vehicles might cause air pollution, noise, and vibration. ● Environmental degradation in terms of flood, water pollution, offensive odor,	● The increase in the number of vehicles might cause air pollution, noise, and vibration.	● The increase in the number of vehicles, especially inside super CBD might cause serious air pollution, noise, and vibration.

Items		"Sub-center System"	"Sub-center with Green-Isle System	"Super CBD Single-core System
		etc., might occur due to ineffective water supply, sewage, and solid waste management systems outside of the inner ring road.		
	Evaluation	**Z**	**Y**	**Y**
Comprehensive Evaluation		Recommendable	**Most Recommendable**	Not Recommendable

Source: JICA Study Team

7.3.9 Environmental Mitigation Plan

For the optimal structure plan, mitigation measures for the identified negative impact are proposed as follows:

＜Involuntary Resettlement＞

- To minimize the number of affected persons in the process of planning and designing.
- To prepare the Resettlement Action Plan (RAP) if a large number of the affected persons are identified in order to minimize the impact of land acquisition

＜Land Use＞

- To minimize the impact on the existing land use through careful investigation in the planning process.
- To investigate the status of land ownership for appropriate alteration of land use in the planning process.

＜Conservation of Vegetation＞

- To establish necessary arrangement of legislation to minimize the vegetation loss and degradation in the process of urban development.
- To undertake and conduct urban greenery preservation actively to increase the rate of greenery covered-areas in the urban area not only through the conduct of systematic vegetation conservation.

＜Landscape＞

- To carefully design railway structure so as to minimize negative effects on the landscape in strategically important areas.

＜Air pollution, Noise and Vibration＞

- To avoid building road alignment near the hospital, school, etc. to reduce the impact of air pollution, noise, and vibration.

7.3.10 Environmental Monitoring Plan

The overall environmental monitoring plan for urban development in the selected structure plans for the "Master Plan for Yangon City" is proposed as follows.

As described earlier, the "Environment Conservation Law of Union of Myanmar" was promulgated last year and the regulations including the environmental standards which are necessary for implementation of the provisions mentioned in this law are still under preparation by the MOECF. Therefore, the proposed monitoring plan is supposed to be conducted based on the environmental standard of the World Health Organization (WHO) for the time being.

The environmental parameters used for monitoring have to be decided based on the characteristics of the individual development project. The proposed environmental monitoring plan consists of general environmental parameters focusing mainly on pollution control such as water quality, air quality, and noise. In case the project includes a large scale involuntarily resettlement, additional social environmental parameters such as appropriateness of compensation system, livelihood restoration program, and so on should be included as monitoring parameters.

The monitoring location and monitoring frequency will be decided and incorporated as part of the environmental management plan for individual project. The responsible agencies for implementation of environmental monitoring activities should be decided in all stages, e.g., design stage (obtaining baseline data), construction stage, and operation stage. Table 7.3.3 shows the proposed overall environmental monitoring plan.

Table 7.3.3: Overall Environmental Monitoring Plan

Items	Parameters
Water quality	pH, EC, DO, BOD, COD, SS, nitrate, phosphate, chloride, oil/grease, zinc, lead, total coliform, E. coliform, etc.
Air quality/Dust	● Carbon monoxide ● Sulphur dioxide ● Nitrogen dioxide ● Ground level ozone ● PM10 etc.
Noise	● Mean sound level (Leq (24)) ● Day-night sound level (Ldn)

Source: JICA Study Team

7.4 Stakeholder Meeting

Information disclosure and transparency are two of the most essential factors in the SEA process. Accordingly, the results of the SEA were explained and discussed at the Stakeholder Meeting (SHM) for the purpose of information disclosure and transparency.

The first SHM was held with the objectives, as follows;

- To share information related to the process of establishing Development Visions of Greater Yangon for 2040
- To exchange opinions on the prepared structure plans based on the development visions and alternatives of structure plans.

7.4.1 First Stakeholder Meeting

(1) Outline

Information of the first SHM is presented below. (Invitation letter for the SHM is presented in Appendix 5.1)

The objectives of the SHM were explained by the JICA Study Team prior to the presentation of YCDC. It should be noted that questions and/or comments from the attendees were accepted in the form of

question sheets to facilitate opinion sharing of the attendees who are hesitant to talk in front of many people. The question sheets were collected during the coffee break after presentation of YCDC. The YCDC replied after reading each question sheet, additional comments were received after the responses.

Date and Time : 18th January 2013（09:30-12:00）
Venue : Meeting Hall of YCDC
Agenda :

1) Opening Remark
2) Presentation of the Project by YCDC
    i) Explanation of the Strategic Environmental Assessment (SEA) for Development Visions and the Structure Plans for Greater Yangon
    ii) Explanation of Infrastructure Development
    iii) Explanation of Land Use Plan
3) Coffee Break
4) Question and Answer Session
5) Closing Remarks

(2) Attendees

A total of 169 people attended the first SHM as shown in Table 7.4.1. (The attendee list is presented in Appendix 5.2)

Table 7.4.1: Numbers of Attendees for Each Organization

Organization	Numbers
Regional Parliament	23
Government Office	49
YCDC	31
Media	66
Total	169

Source: JICA Study Team

Source: JICA Study Team

Figure 7.4.1: Stakeholder Meeting

(3) Question and Answer

A summary of the question and answer session is shown in Table 7.4.2. (The minutes of discussion is attached in Appendix 5.3)

Table 7.4.2: Summary of Question and Answer Session

No	Questions/Comments	Response（YCDC）
1	• Do you have any plans to maintain and preserve the center of Yangon (CBD)? • What is the major problem of Yangon? (Tin Aung Kyaw, BBC Burmese)	• To maintain and preserve the CBD is very delicate and complex because the area is too crowded but we are trying our best. • Housing/sheltering and transportation are the major problems of Yangon City.
2	• Will the project provide reasonable amount of building for low income class? (Kaung Myat Phyo,Myit MaKha News Agency)	• The low-cost housing project is going to be carried out by the Department of Human Settlement and Housing Development (DHSHD).
3	• How will you carry out land acquisition to obtain necessary land for the project? • Is there any possibility that land price will increase due to the project? (Zaw Wai,The Farmer Media)	• The land acquisition will be conducted based on the "Land Law" and compensation will be carried out based on the market price. • We agree with your concern. We should try to exclude any factor which will cause land price increase, therefore we need your cooperation in addressing this issue.
4	• Which one will you take as a priority in the establishment of new cities or improvement of existing cities in urban development project? • How will you manage the people who are living at the housing project area? (no information on the commenter)	• We have to improve the current urban structure in Yangon first and then a new town would be developed. • Basically, the housing development project in the Master Plan is planned at the vacant lots.
5	• How will you absorb the suggestions provided by the local people? • How do you grasp the opinions of low income class? (Ye Linn Htut, The Trade Times)	• We would like to conduct public relations through media to collect public opinion. • The household interview survey was conducted to collect the opinions and comments of the people so these information will be reflected in the project.
6	• Are there any plans being prepared for the affected farmers whose land will be acquired due to the project such as development of road and railway. Will they provide job opportunities as compensation alternatives? (Daw Ei Ei Khaing, , Administrator)	• Although there are no plans of land acquisition of farm lands for the project, the compensation will be conducted based on the market price, and we are going to consider creating job opportunities for them depending on the necessity. But we are not make sure if everyone is going to get a job.
7	• Are there any restrictions being prepared for the development of high rise buildings in township areas? • Are there any countermeasures for illegal throwing of garbage in the backstreet? (Dr. Win Ko Hla, Regional Parliament Representative)	• There are many historical and cultural heritages buildings in Yangon City especially in the CBD area. To maintain these buildings we have some limitation on the building height. Concerning this issue, we are drafting a certain height restricted manuals and methods. • For illegal dumping of trash in the backstreet, we are creating awareness and measures on throwing garbage illegally in the backstreets.
8	• At the downtown area, illegal parking due to shortage of car parking areas causes traffic congestion. Do you have any idea to manage the parking areas to avoid these inconveniences? (U Tint Aung, Administrative Officer)	• We are coping with these problems through collaboration with the Engineering Department (Roads and Bridges). Considering the recent increase in the number of vehicles, we understand that securing sufficient parking space is very urgent issue to address traffic congestion.
9	• How do you plan to share information about urgent urban planning projects to people, these projects are to be implemented in the fiscal year 2013 – 2014? (Dr Saw Hla Htun, Yangon Regional Government Hluttaw Representative)	• We want the media to announce our projects' activities to the public. We want to propose that the local people will visit our office to give us their opinions. We have already got the instructions from our government, rules and regulations have been promulgated to address our activities to the public.
10	• It is better to conduct the short-term projects first before the long-term project? • (Daw Kyi Kyi Mar, Regional Hluttaw Representative,)	• Supposedly, short-term projects have to start prior to long-term projects. But, some project activities might cause delay if rules and regulations are not yet complete.

Source: JICA Study Team

(4) Discussion

Regarding the preparation of the SHM, necessary action for the SHM such as sending invitation letters, arrangement of a meeting room, and so on, were conducted by YCDC to show full ownership of the project. Especially, YCDC gives attention to the representatives from related townships by sending YCDC staff in person to present the notice for the SHM.

The presentations including explanations on the "Strategic Environmental Assessment (SEA) for Development Visions and the Structure Plans for Greater Yangon" were carried out appropriately by YCDC personnel. Accordingly, the SHM was successfully conducted with 169 attendees.

The discussion in the question and answer session was considered to be active and constructive because the comments from the attendees were received in the form of question sheet prior to the session. The arrangement of providing question sheet seemed to be appropriate in eliminating attendee's hesitation in terms of expressing their opinions in front of many people. Although there were less number of questions and comments related to the SEA itself, the high interests of the attendees to the Master Plan were observed in the SHM.

7.5 Conclusion and Recommendation

The SEA was carried out in this Plan as an examination of the development vision and basic policy for development in the future. The "Plan B" (Sub-center with Green-Isle System) was selected as the most recommendable structure plan for the "Master Plan for Yangon City" resulting from the SEA, The mitigation plan and the monitoring plan were prepared for the Plan.

The rationales for conducting of the SEA for the Plan and the explanation on the appropriateness of the applied methodologies for the SEA are mentioned as follows. In addition, the issue how to address the environmental and social considerations for individual projects is described as well.

7.5.1 Rationales for Conducting SEA for the Project

The Environment Conservation Law of Union of Myanmar do not contain any descriptions related to the system of environmental impact assessment (EIA) for development projects as well as to SEA.

According to the JICA Guidelines, SEA ought to be applied in conducting a master plan study to integrate appropriate environmental and social considerations at an early stage up to monitoring stage of the proposed project. The SEA was carried out in this Plan as an examination of the development vision and basic policy for development in the future.

As mentioned earlier in relation to the national development and environmental context, SEA is said to have two significant roles, as given below.

(i) To integrate appropriate environmental and social considerations into the process of decision making.

(ii) To supplement the limitation of conventional environmental impact assessment that will be carried out in the implementation stage.

7.5.2 Appropriateness of the Methodologies for the SEA

The methodologies for the SEA applied in the Plan satisfied necessary conditions properly as follows.

(1) Environmental and Social Considerations at Strategic Level

The environmental and social considerations at strategic level were carried out through the examination of the development vision and basic policy for development in the future in the Master Plan.

(2) Discussion of the Alternatives including “No action”

The discussion of the alternatives including "Super CBD Single-core System" which is a plan of “No action” for the development vision and basic policy for development in the future was carried out.

(3) Comparative Analysis for the Alternatives in terms of Social and Natural Environment

The environmental scoping was conducted considering the relationship between the environmental impact items and anticipated actions in each development vision using an environmental impact check matrix. And anticipated environmental impacts caused by each of the alternatives were evaluated.

(4) Information Disclosures and Transparency of the Process of the SEA

Information disclosures and transparency in the process of the SEA were ensured through the interviews to the related townships and the explanation and exchange of opinions on the process of preparation of the alternatives at stakeholders meeting.

7.5.3 The Environmental and Social Considerations for Individual Projects

The Plan will be followed by the sector-wise master plans and individual projects under the master plans in the future.

Given that the Myanmar laws do not contain any descriptions related to the system of environmental impact assessment (EIA) for development projects, the establishment of the mechanism for ensuring the appropriate environmental and social considerations for individual projects will be critical. The discussions on this issue will be conducted in the Phase II to propose appropriate solutions.

CHAPTER 8

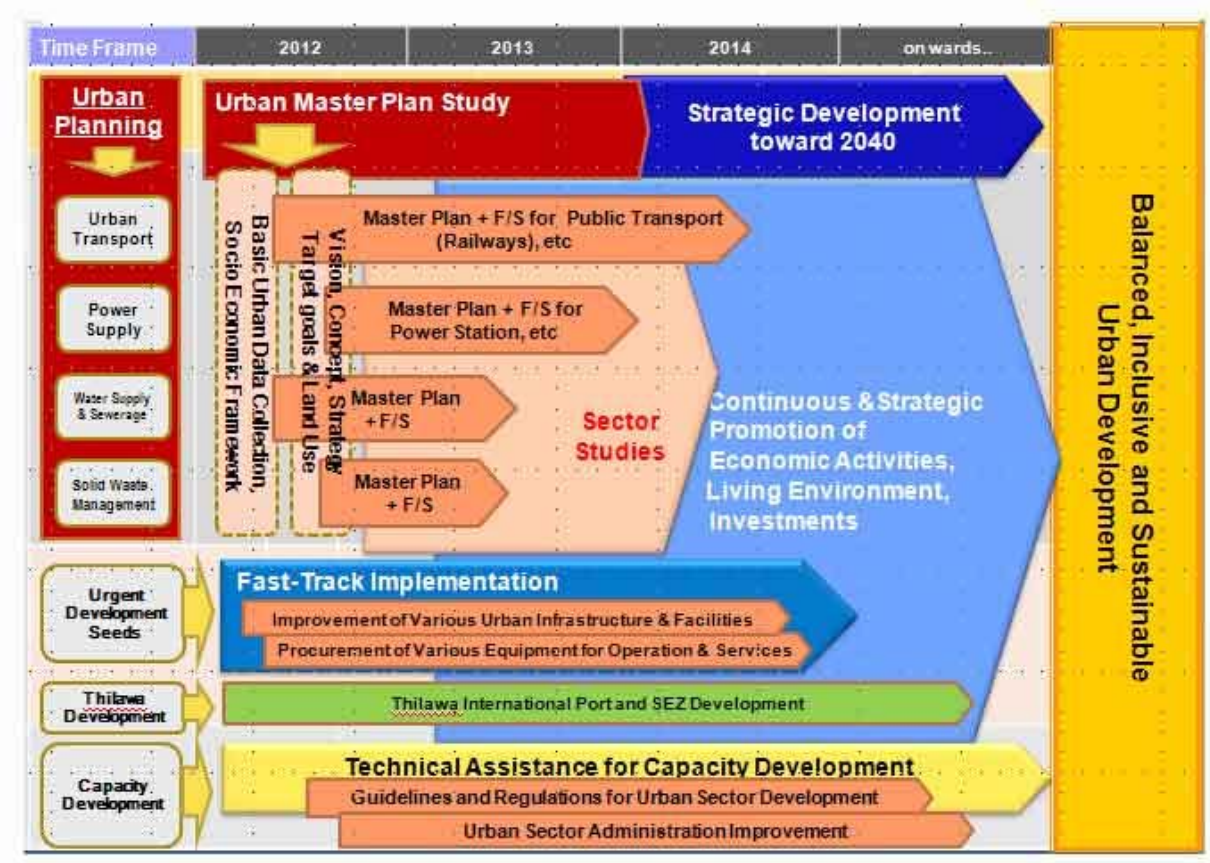
Conclusions, Recommendations and Way Forward

< Part-II: The Master Plan >

CHAPTER 8: CONCLUSIONS, RECOMMENDATIONS AND WAY FORWARD

8.1 Current Status of the Project

This undertaking is the pioneer project under the Urban Development Program for Greater Yangon toward Balance, Inclusive and Sustainable Growth, which was discussed and agreed upon by the Yangon Region Government and Japan International Cooperation Agency (JICA) on 1st May, 2012. The program is composed of elements as shown in Figure 8.1.1. While the urban master plan in the topmost bar is in progress, various sector studies and projects followed this project with shortly, including the Water Supply and Sewerage Sector Master Plan. A few other sector master plans and urgent projects are in preparation. This Project for Strategic Urban Development shall serve as the basis for sector master plans and urgent improvement projects.



Source: JICA Preparatory Study Team

Figure 8.1.1: Urban Development Program for Greater Yangon toward Balance, Inclusive and Sustainable Growth (Image)

The implementation of this project was agreed upon by the Yangon Region Government and JICA on 10th May 2012. JICA organized a Study Team composed of experts in urban planning and other relevant fields, which were dispatched to Myanmar to carry out the Project execution.

On 14th August 2012, the first steering committee meeting was held in Yangon with U Hla Myint, Mayor of Yangon and Development Affairs Minister of Yangon Region, who acted as the chairperson. In this Committee, the JICA Study Team explained the essence of the Inception Report, which was basically accepted by the mayor and other members of the steering committee.

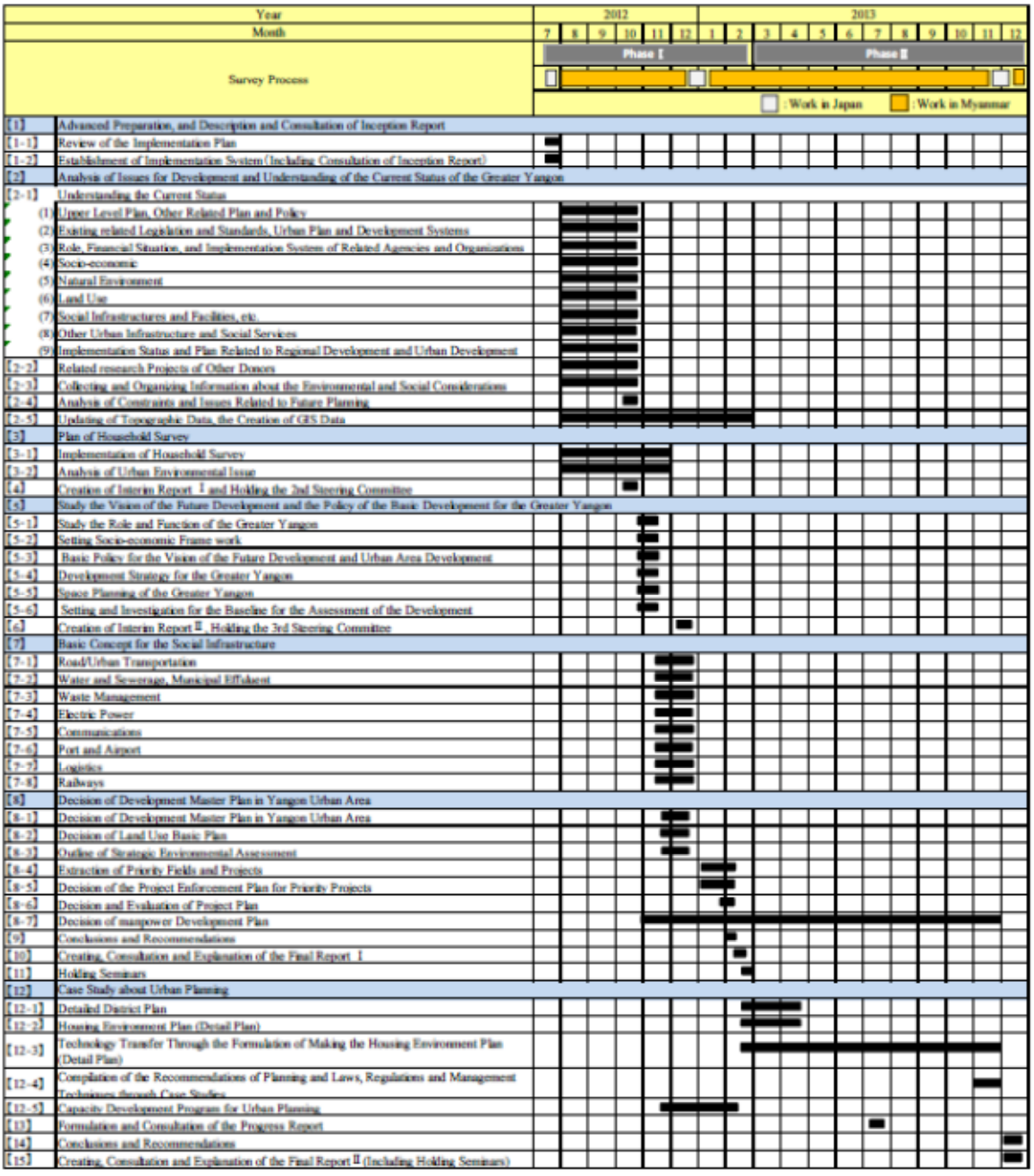
Subsequently, on 2nd November 2012, the second Steering Committee was held in Yangon with U Hla Myint, Mayor of Yangon City and Development Affairs Minister of Yangon Region as the chair. In this Committee, JICA Study Team explained the essence of the Interim Report I, and the report was basically accepted by mayor and other members of the steering committee. Some of the comments and opinion expressed in this meeting includes concern about the traffic problems of Yangon City and acceptance of the proposed alternative structure plan for the future of Greater Yangon with Multi-center structure with Green Isle. For the former concern, this report partly tries to answer the basic concept and directions for transport sector improvement with priority projects, including the road and railway.

Then, on 18th January 2013, the third Steering Committee was held in Yangon. The chairperson was U Hla Myint as well. In this Committee, JICA Study Team explained the essence of the Interim report II, and the report was basically accepted by mayor and other members of the steering committee. With the Interim report II, urban structure plan and urban infrastructure development strategy for the future of Greater Yangon was confirmed in general.

Based on the above, JICA Study Team created Draft Final Report I which compiled this master plan, and the fourth Steering Committee was held in Yangon chaired by U Hla Myint on 6th March 2013. In this Committee, JICA Study Team explained the essence of the Final Report I which include a proposal of the priority program, and the report was basically accepted by mayor and other members of the steering committee.

Besides, on 21st March 2013, a seminar was held at Tokyo in order to explain and announce this master plan in Greater Yangon for Japanese relevant government agencies, companies interested in and the media, inviting guests from Myanmar including U Hla Myint, Mayor of Yangon City and Development Affairs Minister of Yangon Region. In parallel with the seminars, this Final Report I was finalized, and the master plan was completed in April 2013.

Table 8.1.1: Detailed Work Schedule



Source: JICA Study Team

The status and progress of the Project are as scheduled so far. This Final Report I, summarizes the findings and analyses in the Phase 1, commencing in August 2012 through April 2013. This report focuses mainly on the formulation of an urban development master plan and strategies for urban infrastructures.

8.2 Conclusions and Recommendations

The following are the findings and recommendations for the Phase 1 of this Study:

8.2.1 Conclusions in Urban Development and Planning

- Historically, the presence of the Shwe Dagon Pagoda has always been the anchor of the city, and which has to be maintained in the future. In the 19th century, the city was transformed to a modern city with a port under the British colonial rule, and prospered as a regional hub. There are numbers of historical buildings within the existing CBD that need to be preserved.
- Although one of the main ideas under the British rule was to allow a wide open space along the Yangon River strand. Consequently, the open space in the strand had dissipated due to the port development along the river. At least part of the open space along the Yangon River strand has to be recovered.
- Today, Yangon is the largest and most active urban center of Myanmar. Yangon has a population of 5,142,000 in 2011. The population of the Planning Area, which includes all the 33 townships of Yangon City and parts of six peripheral townships, is 5,572,000 in the same year.
- As the urbanization is assumed to progress steadily in Myanmar, and Yangon continues to serve as the major urban center. Therefore, the future population of Yangon is projected to increase to 11,730,000 in 2040 in Greater Yangon, including peripheral townships in the same year.
- Currently, most of urban central functions including administration, banking, business and commerce are located in CBD, which has high density houses and shops that causes traffic jam and environmental problems. Some of these functions, which are concentrated in CBD should be transferred outward in the future to relieve congestion. For this purpose, Secondary CBD and sub-centers need to be introduced for prioritized urbanization areas to accommodate some central functions that are now concentrated in CBD.
- While urbanization proceeds in the Greater Yangon, green areas such as agricultural and forest areas tend to be converted to urban areas. Considering existence of most valuable green areas, such as marshes, riversides, and high productive agricultural areas, these should be protected and utilized for sustainable urban management and comfortable urban life.
- A household interview survey (HIS) was conducted by JICA Study Team for a sample of 10,000 households. The result of HIS can be utilized not only as an essential database for acquiring existing condition of urban development, but also as an important resource for understanding present evaluations and opinions of people on the existing living environment.
- Acceding to HIS, 15 % of people live in a housing unit of less than 251 sq. ft (23 m^2), indicating that there are quite a few people that live in unfavorable housing conditions. Slums and squatters are distributed near the Hlaing River, the Pazundaung Creek and the Yangon River.
- In YCDC, there are only 58 public parks, which have a total area of 188 ha (470 acre). This corresponds to 0.37 m^2 of park space per person. Such area seems to be too small for a city, and needs to be increased drastically in the future.
- Wide ranges of data and information have been collected from government agencies and relevant organizations intended for this study. Meanwhile, a variety of data has been developed by means of satellite imageries and site surveys by JICA Study Team. These collected data and information are compiled and integrated in the GIS format.

- In parallel with the analyses above and discussion with the counterpart, the future vision for the Greater Yangon was set with four pillars; namely, 1) To be an international HUB city, 2) To be a Comfortable City, 3) To be a well-managed Infrastructure city, and 4) To be a city with Good Governance.

- As the future structure plan of the Greater Yangon, three alternatives are discussed in various meetings and committees to obtain various opinions from stake holders. The three alternatives are 1) Sub-Center System, 2) Sub-Center with Green Isles System, and 3) Super-CBD Single Core System Consequently, Sub-Center with Green Isles System was adopted as most suitable for Greater Yangon.

- Based on an analysis of land evaluation and projection of future demographic and socio economic frameworks, future land use plans are formulated for 2025 and 2040, which are presented in Section 4.2. The infrastructure development strategies mentioned below are in line with these land use plans.

- With respect to the legal framework, there is no law on town planning in Myanmar, although its preparation is said to be in progress. Also, there is a draft for what will be called the Uniform Building Code, but a part pertaining to urban planning is said to be still under consideration and not yet complete. Thus, there is no workable national legal framework for urban planning presently in Myanmar.

- Institutionally, urban planning in Myanmar has been carried out by DHSHD of MOC for a long time, including the planning and implementation of urban and industrial developments in Yangon area. Under the new constitution, it is natural to think that large part of such undertakings should be devolved to local governments such as Yangon Region and/or YCDC.

- YCDC has established the City Planning Division to carry out the urban planning of Yangon staffed and manned mainly with newly recruited junior staff. As most of the staff lacks actual experience in urban planning, the need for their capacity development is high and thus, should not be further prolonged.

- Strategic Environmental Assessment (SEA) facilitates to conduct information disclosure as early as possible and interviews to all the related 39 townships of the Greater Yangon were carried out as a preliminary stakeholders meeting to ask about their preferences on the proposed structure plans. Towards the end of Phase 1, the results of the SEA were explained and discussed at the stakeholders meeting (SHM) as feedback to the stakeholders for the purpose of information disclosure and transparency. In total, 169 stakeholders attended the SHM.

8.2.2 Conclusions in Urban Infrastructure Development

- Yangon's economy is driven mainly by the services of industries and manufacturing industries. Yangon is thus considered a commercial city as well as an industrial city, which is supported broadly by gateway facilities such as the international seaport/airport and connecting domestic network where Yangon stands as the hub.

- Today, Yangon Main Port, located just south of the CBD along the Yangon River, is the main port of Yangon. Thilawa Area Port located downstream of the Yangon River is progressing rapidly as some functions of Yangon Main Port will be shifted to Thilawa Area Port in the near future. Moreover, some parts of Yangon Main Port need to be redeveloped and regenerated for a water-front that provides citizen's access to the river.

- Yangon International Airport located in the northern part of Yangon shall be saturated soon with a rapid growth of air travel demands. As the present site has little room for expansion, the Government of Union of Myanmar is preparing for a new international airport near Bago City in

the north of Yangon. In the future, the two airports will serve as the main air travel demands for Yangon as well as for the entire nation.

- Thilawa SEZ Project is a mega project in Thanlyin and Kyauktan townships in Yangon Region, which is intended to be developed as SEZ composed of areas for manufacturing, residential, commercial, logistic, and so forth. Its location is near Thilawa Area Port and convenient for transportation of raw materials as well as the products. The total development area is approximate 2,400 ha.

- More than four million people from the suburb of Yangon City commute daily to CBD. At present, there are five modes of transport such as the bus, state-owned circular railway, state riverine crafts, taxi and the private automobile. At present, 84 % of all travel is by bus, while only 3 % is by railway and 6 % by private car.

- Yangon is served by so-called Main Roads with labeled as Road No. 2 through 6, with Bayint Naung and Strand Roads as a trunk network. Feeder roads connect to either one of the main roads. In general, areas alongside the main roads are heavily built-up with houses and shops, and expansion of main roads for a wider section seems difficult in most parts of the city. As the number of cars are increasing rapidly, causing continuous traffic jam mostly in the fringe of the central area, such scenario must also be considered in the master planning.

- The current railway network in the Study area is composed of three main lines and five branches lines. Despite the large potential for public transport, the current condition and service level of the railway is low, and the share of railway in transportation is thus low. Improvement of the existing railway lines need to be considered urgently. As the current fare is set significantly low, the improvement shall not be commercially feasible, and thus continuing public sector initiative will be essential.

- Inland water transportation is a supplementary, but essential mode of transportation both for passengers and cargoes, as Yangon is basically a riverine city by nature, and the nation is dependent on the inland water transport network. For Yangon, water transport is quite important for the low income communities living across the river from CBD, particularly Dala area.

- With respect to water supply, the service coverage of YCDC water supply system is still pegged at 42 % in year 2010, and the remaining 58 % of the people get their water supply from private wells, ponds or utilize rainwater. Un-accounted for water (UFW) rate in Yangon City is very high (approx. 50 %) and needs to be reduced to make up for the potential water demand. The existing facilities are generally aged and needs rehabilitation. With respect to quality of water, the ratio of chlorination is only 25 % in volume of supply, and there was a report that harmful bacteria were detected from all samples of tap water. Thus, improvement in terms of quality and quantity of supply will be necessary.

- With regards to sewerage sector, the service ratio is only less than 10% covering only part of CBD, and this needs to be expanded in future. In Yangon, people are commonly used on-site disposal system like the pour flush type toilet and need to be replaced by septic tank systems. Also, several sludge treatment plants should be provided as soon as possible to treat the sludge from septic tanks. The expansion of sewerage services to cover wider area is necessary, and improvement of the on-site disposal system is urgently needed to maintain the environmental quality of Yangon.

- For stormwater drainage system, the existing capacity is limited, and the maintenance and improvement works of existing drainage channels is often delayed. Institutional re-structuring might be required such as strengthening the number of staff for the drainage works.

- For the electric power supply, as there is a current shortage of electrical supply to Yangon City area, it is important and urgent to increase power supply capacity in consideration of the

increasing electrical demands in the future. Rehabilitation of deteriorated existing power stations, and development of new hydro power and gas turbine power stations, shall be necessary. Also the problems of a high rate of loss in transmission/distribution and a large fluctuation of voltage in distribution must be solved by the improvement or replacement of the related facilities.

- With regard to the solid waste management (SWM), final disposal sites are in operation in the manner of open dumping, and leachate from dumped waste to the sites flows out and permeates into ground without any treatment. Sanitary final disposal site must be developed as basic infrastructure for the city so that waste can be properly disposed through sanitary means. Also, most vehicles for waste collection and transportation are very old and need to be replaced for efficient and stable performances in collecting wastes. At present, there are neither short-term nor long term plans for SWM. For continuous and sustainable improvement in SWM, formulation of a master plan for SWM is necessary.

- As for telecommunication network, the traffic of international communication lines should be increased sizably. At present satellite lines, submarine cable lines and terrestrial OFC lines are used for international connection of Myanmar. Satellite line is high-cost and submarine cable line is difficult to increase in a short period, so terrestrial OFC line to Thailand should be increased as soon as possible. Transmission facilities for submarine cable lines must be increased at the same time. Presently, as there are only three Internet Service Providers (ISPs) in Yangon, new ISPs should be permitted and internet facilities have to be improved.

8.2.3 Recommendations

- This report presents the future land use plans for 2025 and 2040. In order to realize them, detail zoning plans need to be prepared. For each zone, rules and regulations will have to be established clearly. For this purpose, YCDC should conduct a series of meetings with the involvement of relevant stakeholders, including DHSHD, to discuss and establish such zoning scheme and rules and regulations thereof. YCDC should also consider how to implement them first locally in YCDC area with their by-laws and rules and regulations properly in harmony with the national framework in progress such as the Town Planning Law and Uniform Building Code.

- One of the key tasks in achieving the proposed land use plans is the promotion of Secondary CBD and Sub-Center projects. To accelerate urban development in these areas, proper promotional land use zoning framework should be established so that the private developers would find investment in urban development in these zones attractive. In Phase 2 of this project, more detailed planning will be done for these zones with the Study Team and YCDC in collaboration.

- Yangon has, on the lowland hills, several lakes and marshes such as Kan Daw Gyi Lake and Inya Lake. These lakes with green areas alongside shall be protected as public parks properly. Other lakes and marshes should also be paid more attention for conservation, because these water areas are very important and precious for flood control and mitigating environmental pollution.

- Yangon City is a historic city which possesses hundreds of historical and religious monuments such as pagodas, temples, churches and mosques, and old buildings from British Colonial-Rule, built between 19th and 20th centuries. With the passage of time, there are some dilapidated buildings that require repairing and improvement, and others that may as well be changed for a new use. In order to utilize the heritage buildings toward sustainable urban development, a new direction for upgraded conservation and planning shall be require so that the heritage buildings would be a source of tourist attractions of Yangon in the future. In this conjunction, YCDC needs to work with Yangon Heritage Trust and international donors including JICA may take active assistance in this direction.

- In this regard, a number of former Union Government buildings that exist in CBD area are now either underutilized or misused. Positive use of these buildings with proper precautions for conservation needs to be promoted.

- In Myanmar, public sector has been an active player in housing supply. By 2040, about one million housing units need to be provided. Some units should be catered to the poor; however, private developers may not cover such demand. If YCDC should take over the public housing responsibilities which had been borne by DHSHD, proper budgetary arrangement needs to be made, and capacity development for this purpose needs to be done. In `Phase 2, a case study of suburban residential area shall be done which will provide some basic training for this purpose. YCDC should discuss how this transition of responsibilities could be made smoothly with DHSHD.

- With regard to the legal framework, Town Planning Law or another separate basic law should be enacted in the Union of Republic of Myanmar. Also, a national policy for urban planning should be considered. As they relate to the national framework for urban planning, it should be undertaken by Ministry of Construction. Donors or international development partners should positively assist this implementation.

- On the local government level, while the Yangon City Development Law and some of the by-laws provide a general framework for the building control and urban planning to be implemented locally, the actual regulations are not well-established, nor well-publicized to the general public. The regulation for building control and permissions should be clearly established and widely publicized to the general citizen to follow in harmony with the national legal framework and policy for urban planning above.

- With regard to urban transport, a separate JICA Study for Urban Transport Master Plan for Yangon was started in January 2013 under the Urban Development Program for Greater Yangon toward Balance, Inclusive and Sustainable Growth, which is also the parent program of this Study. YCDC should actively take part in this project. The priority projects for urban transport, road, network, railway and port and logistics are presented in Section 6.1. Priorities for implementation and need for international assistance should be discussed among the relevant organizations.

- For water supply and sewerage, the Study on Improvement of Water Supply, Sewerage and Drainage System in Yangon City is also in progress. This is also a separate JICA project under the Urban Development Program for Greater Yangon toward Balance, Inclusive and Sustainable Growth. With regards to the proposed priority projects for water supply, sewerage and drainage, priorities for implementation and need for international assistance should be discussed among the relevant organizations.

- With respect to the electric power supply and solid waste management, separate sector studies have not yet started. In preparation for this, YCDC should proceed with its own analysis and planning for implementation of the priority projects.

- For telecommunication sector, JICA has already dispatched a team to improve the national telecommunication network, which will also have effects on the condition in Yangon. The progress of improvement work in effect should be closely monitored.

- For the implementation of priority projects for urban development and urban infrastructures, coordination is needed to accelerate the project and reduce duplication among international donors.

- In order to fill the gap between the necessary and available funding for the urban development and urban infrastructure projects, active use of PPP needs to be promoted. Union Government needs to establish necessary legal framework for PPP in Myanmar, and prepare institutions for the

launching of PPP projects in Myanmar. International donor and development partners are encouraged to assist positively.

8.3 Upcoming Events

With the conclusion for Phase 1, this study will start as Phase 2 scheduled to start after the Water Festival in April 2013 and it is to be completed in December 2013. In June 2013, seminars at Yangon and Nay Pyi Taw will be held for each public people and administrative agencies in Myanmar.