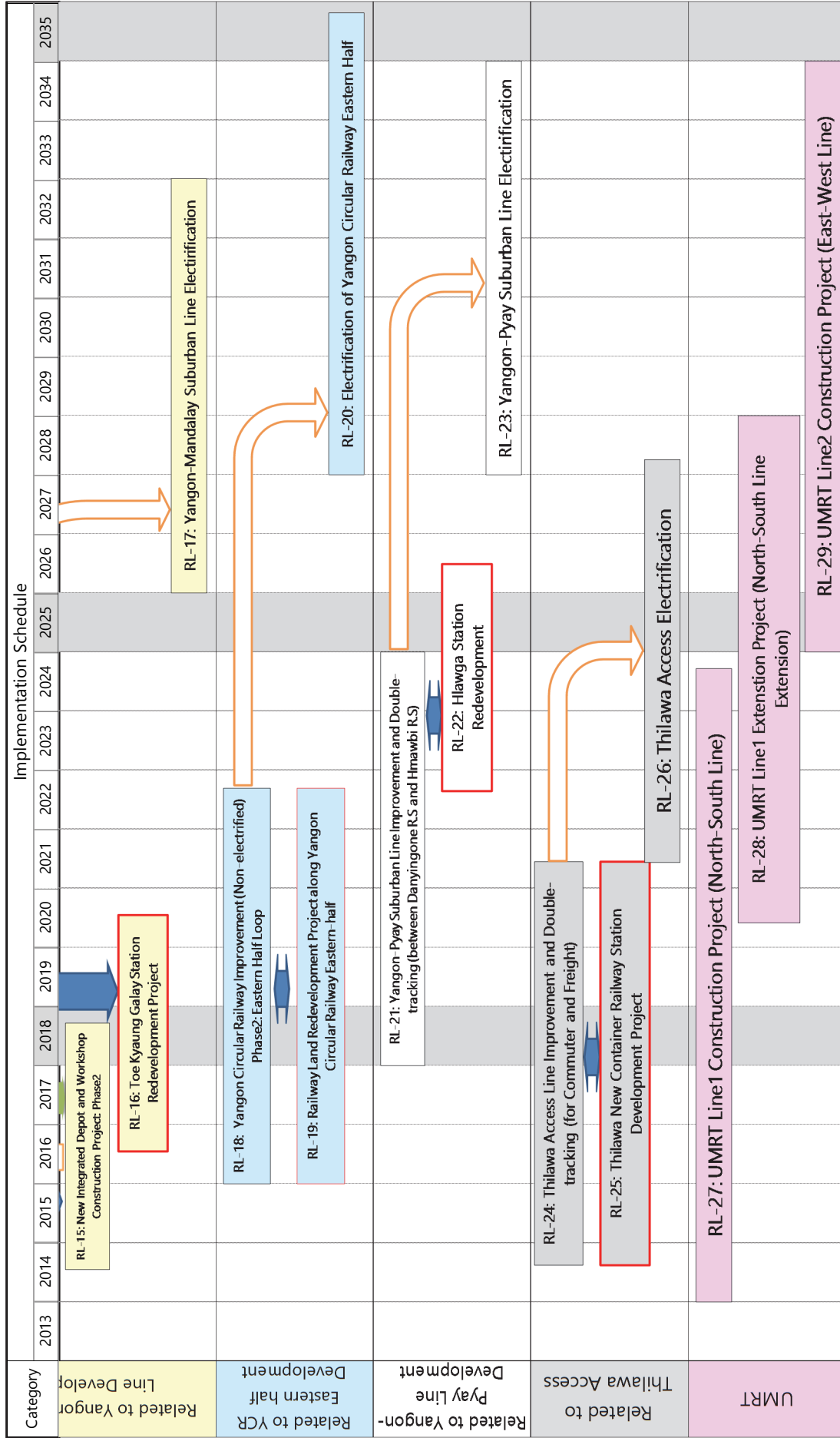


6.2 Major Master Plan Projects

6.2.1 Public Transport Projects

1) Urban Railway Development Projects

Urban Railway Projects are composed of three types of projects, i) Urban Sections of Existing Myanmar Railway, ii) Urban Railway, and iii) Transit Oriented Development (TOD). In order to enhance the project effect, these projects should be collaborated intimately. The chronological correlation diagram among proposed railway projects and proposed TOD projects including yard redevelopment projects is shown in Figure 6.2.1.1 and Figure 6.2.1.2. The study prepares a scenario to enhance reciprocal development effects among all projects.

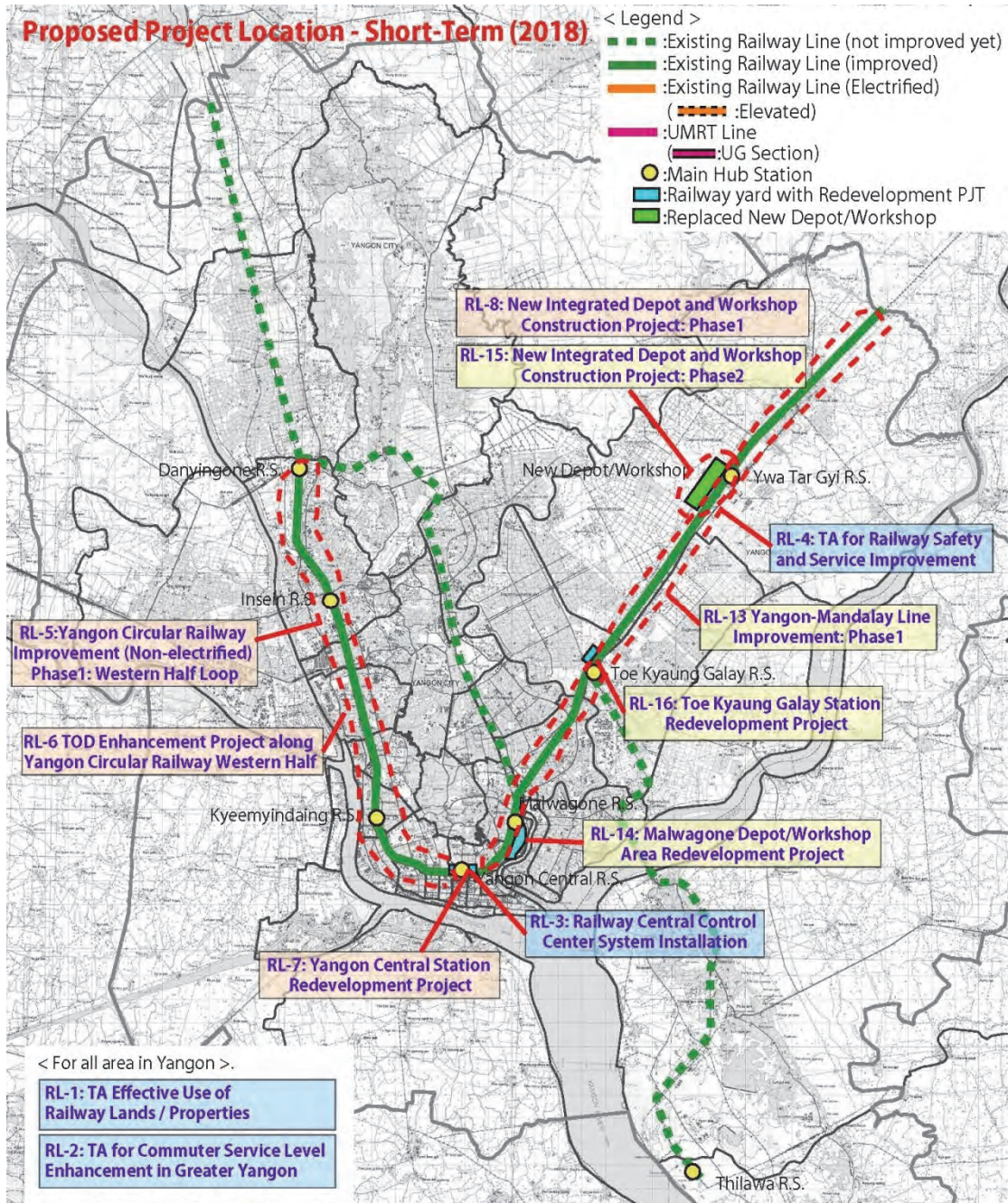


Source: YUTRA Project Team

Figure 6.2.1.2 Chronological Correlation Diagram among Railway Projects and TOD/Land Redevelopment Project (2/2)

The location maps of the proposed projects for short-term, middle-term and long-term are shown in the following three figures respectively.

For short-term, it is planned to enhance transport capacity of V shape line connecting Danyingone station with Ywa Tar Gyi station via Yangon Central station by improving Yangon Circular Railway Western Half and Yangon-Mandalay Line. In addition, yard redevelopment projects along these lines will be conducted in parallel in order to increase railway user and enhance ability to attract customers. Furthermore, relocation and integration of existing depots and workshops, which is required in connection with yard development, will be implemented simultaneously.



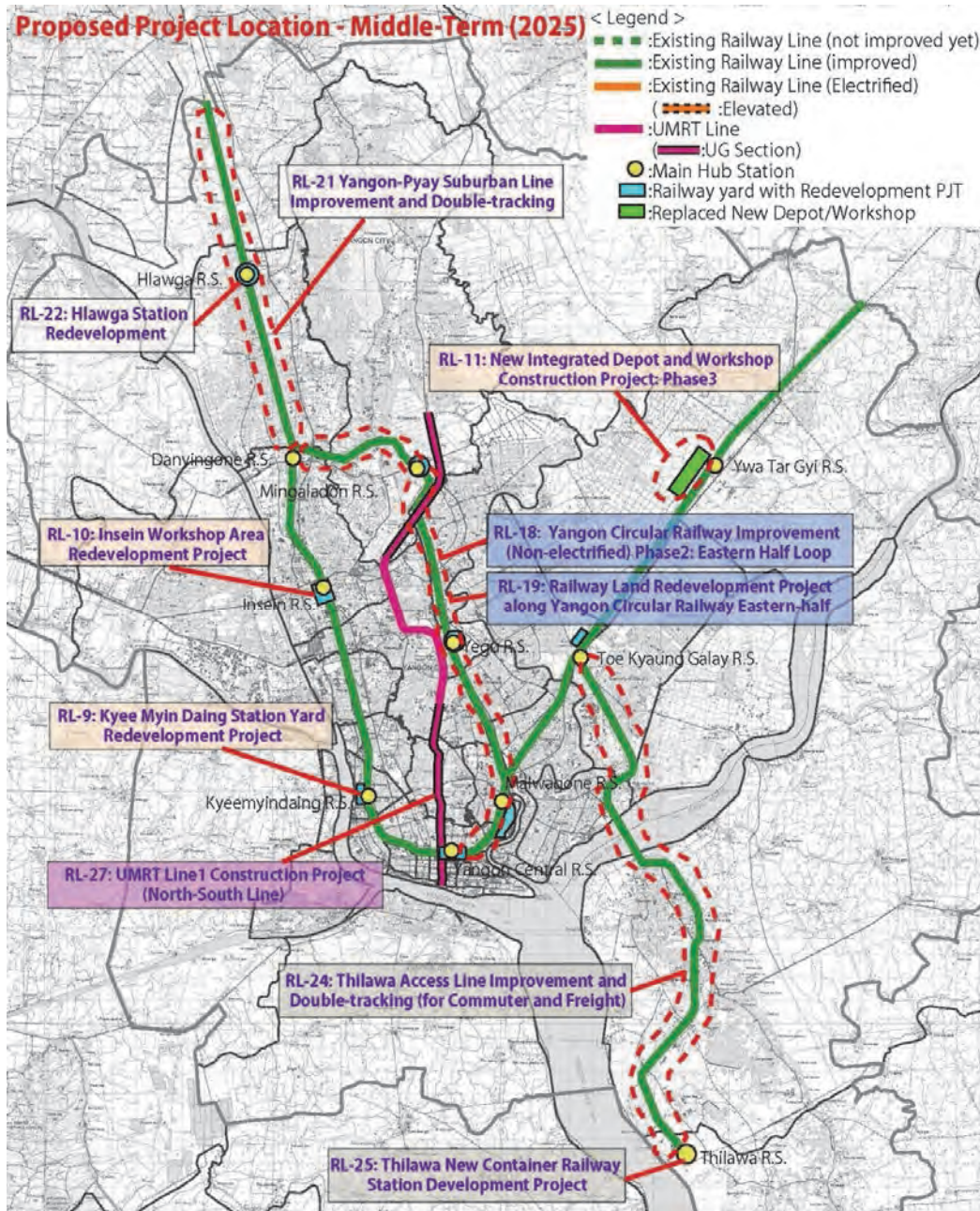
Source: YUTRA Project Team

Figure 6.2.1.3

Proposed Project Location Map for Short-term

For middle-term, it is planned to improve the remaining sections of the existing lines (Yangon Circular Railway Eastern Half, Yangon-Pyay line suburban section, Thilawa access line), and to conduct projects for yard redevelopment and land development along these lines in parallel in order to fulfill further increasing railway user and enhancing ability to attract customers. Expansion of the new integrated depot and workshop will be implemented simultaneously in connection with yard development.

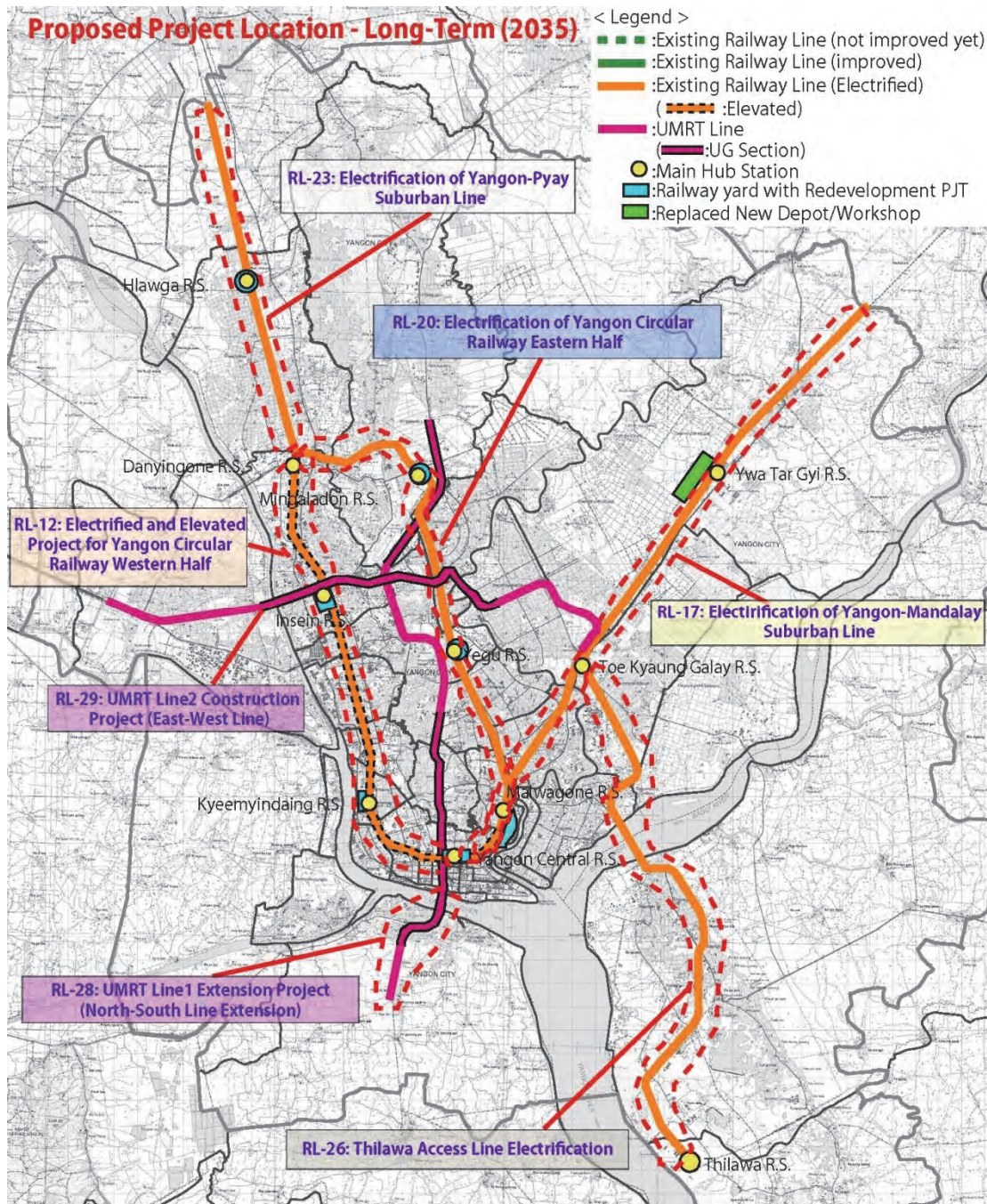
Furthermore, UMRT Line1 which is named as North-South Line connecting CBD with Yangon International Airport via Yangon Central station and Mindama sub-center will be installed as first metro in Yangon. In order to minimize initial cost, it is planned underground section is minimized as much as possible, and elevated section is applied maximally.



Source: YUTRA Project Team

Figure 6.2.1.4 Proposed Project Location Map for Middle-term

For Long-term, it is planned to electrify and partially elevate existing lines which were improved as first step in short or middle term, in order to fulfill further transport capacity enhancement and speed-up, and reducing operation cost. Regarding UMRT, extension of UMRT Line 1 and new construction of additional line will be implemented in order to expand railway network.



Source: YUTRA Project Team

Figure 6.2.1.5 Proposed Project Location Map for Long-term

List of abovementioned projects with the implementation schedule for all terms is shown in the table below.

Table 6.2.1.1 Overall Project List (1/3)

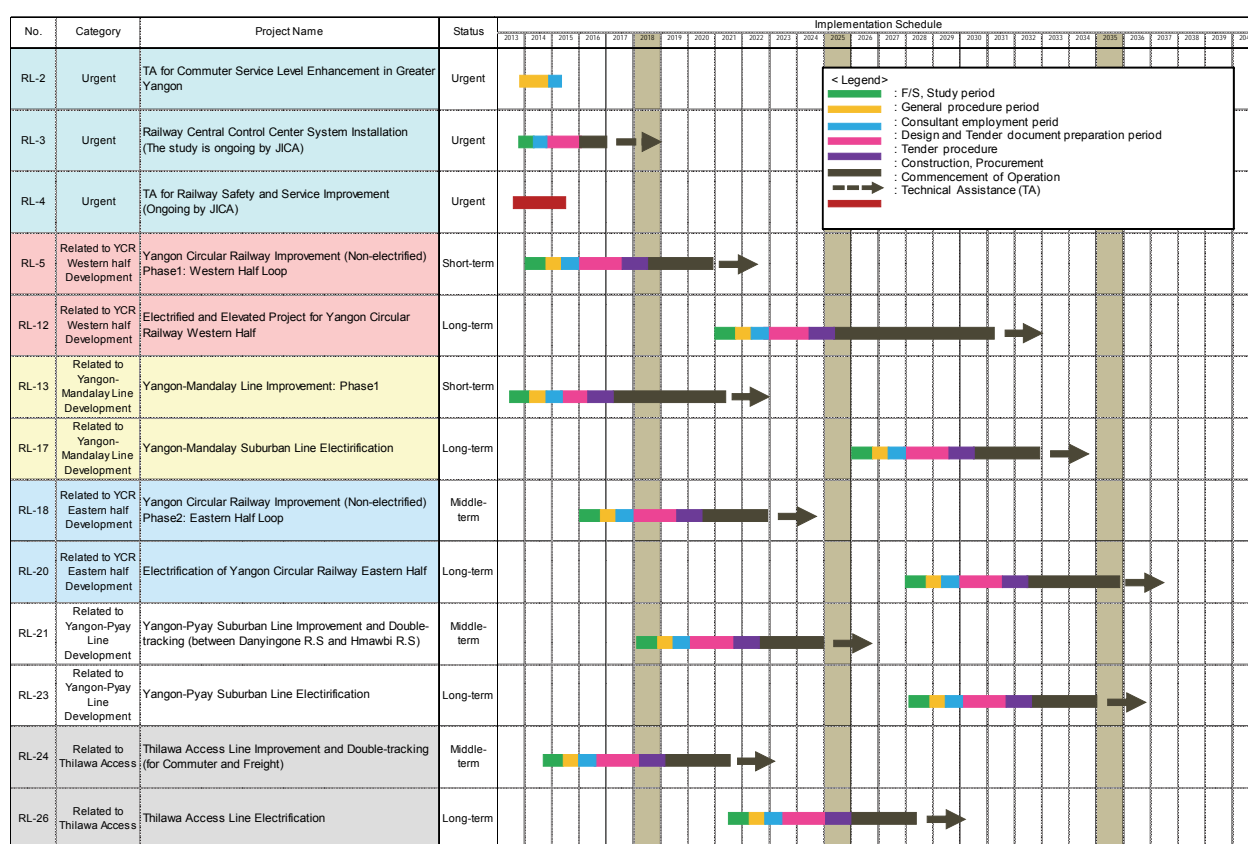
No.	Category	Project Name	Status	Implementation Schedule												Remarks	
				2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024		2025
RL-1	Urgent	TA for the Integration of Rail Transport Improvement and Station Area Urban Development in Yangon (Enhancing Transit Oriented Development)	Urgent													<ul style="list-style-type: none"> - Establish redevelopment rule/standard for railway land in which many private developers will be interested by using PPP scheme, etc. - To prepare plan and necessary documents for Yangon R.S. and Mawlaikone W.S. relocation/redevelopment, and railway infrastructure development by using the development benefit (inc. preparing demarcation between public and private, standard contract document, standard tender document/TOR) 	
RL-2	Urgent	TA for Commuter Service Level Enhancement in Greater Yangon	Urgent													<ul style="list-style-type: none"> (1) Support to establish an effective train operation plan and diagram for commuter, and (2) establishing "Commuter Service Improvement Dept.", and the capacity building, and (3) Technical Assistance for the existing passenger wagon interior upgrade work for commuter. 	
RL-3	Urgent	Railway Central Control Center System Installation (The study is ongoing by JICA)	Urgent													The study is ongoing by JICA as potential grant project	
RL-4	Urgent	TA for Railway Safety and Service Improvement (Ongoing by JICA)	Urgent													<ul style="list-style-type: none"> - Ongoing by JICA TA - Technical transfer for track maintenance skill by using Yangon-Mandalays suburban line. - Technical standard Preparation. 	
RL-5	Related to YCR Western half Development	Yangon Circular Railway Improvement (Non-electrified) Phase 1: Western Half Loop	Short-term													<ul style="list-style-type: none"> - Improvement as commuter line for app. 21km between Yangon R.S. and Danyingone R.S. - Scope is improvement of civil track, existing depot/workshop, modernization of signal, telecom, station, automatic level crossing, DEMU procurement 	
RL-6	Related to YCR Western half Development	TOD Enhancement Project along Yangon Circular Railway Western Half	Short-term													<ul style="list-style-type: none"> - conducted as additional project of Yangon Circular Railway improvement Phase 1: Western Half Loop - provide station plaza with bus stop/terminal at Kyeemyindaing R.S., Insein R.S., and Danyingone R.S. 	
RL-7	Related to YCR Western half Development	Yangon Central Station Redevelopment Project	Short-term													<ul style="list-style-type: none"> - assumed as PPP project - At first, the depot function in the yard is relocated, and the station yard is redeveloped as transport hub and business/economic center. - Developer is obliged to install the following infrastructures by the development benefit; RL-8: New Depot and Workshop Project Phase 1. 	
RL-8	Related to YCR Western half Development	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase 1	Short-term													<ul style="list-style-type: none"> - assumed as PPP. - Relocation of current depot forced by "RL-7 Yangon Central Station Redevelopment Project". The project cost should be born by RL-7's development profit. - Proposed site is the northern side of Ywa tar Gy R.S. which is owned by MR. 	
RL-9	Related to YCR Western half Development	Kyee Myn Daing Station Yard Redevelopment Project	Middle-term													<ul style="list-style-type: none"> - assumed as PPP. - At first, the depot function in the yard is relocated, and the station yard is redeveloped as transport hub and business/economic center. - Developer is obliged to install the following infrastructures by the development benefit; RL-11: New Depot and Workshop Project Phase 3. 	
RL-10	Related to YCR Western half Development	Insein Workshop Area Redevelopment Project	Middle-term													<ul style="list-style-type: none"> - assumed as PPP. - At first, the workshop function in the yard is relocated, and the yard is redeveloped as transport hub and business/economic center. - Developer is obliged to install the following infrastructures by the development benefit; RL-11: New Depot and Workshop Project Phase 3. 	

(1) Urban Sections of Existing Myanmar Railway

Improvement and modernization of urban sections of the existing MR lines becomes a basis of railway development in Yangon city. Improvement and modernization of urban sections of the existing MR lines has some merits such as i) immediate effectivity due to passing many developed areas with high population density, ii) relatively low initial cost due to existing infrastructure utilization (therefore, the implementation is easy relatively for Myanmar government, which need huge budget for many infrastructure rehabilitation.), and iii) no or little land acquisition and resettlement is required due to locating inside MR yard, etc.

The proposed projects for improvement and modernization of urban sections of the existing MR are shown in the table below.

Table 6.2.1.4 Proposed Projects for Urban Sections of Existing Myanmar Railway



Source: YUTRA Project Team

Outline of the main projects are shown below.

(i) Urgent Countermeasures

[RL-2: Urgent] TA for Commuter Service Level Enhancement in Greater Yangon

Almost current issues/problems regarding Yangon Circular Railway (western half) will be solved by "[RL-5] Yangon Circular Railway Improvement Phase1: Western Half Loop" hence the Yen Loan amount is huge. After the completion of the improvement project, Yangon Circular Railway can play a role as main axle of commuter. However, we should wait for the commencement of the operation until short-term target year at the soonest. Until then, it is necessary to conduct any temporary countermeasures in order to enhance

modal shift from road to railway, contribute traffic jam reduction, and provide better commuting service to Yangon citizens.

The objectives of the TA are below.

- At present, punctuality of trains on Yangon Circular Railway is low due to influence from delay of high-class trains on Yangon-Mandalay Main Line/Pyay Line, and it causes the tendency that commuter does not use railroad. In order to resolve the situation, to establish an effective train operation plan and diagram for commuter.
- To make MR staffs recognizing the importance of the commuter service and train them.
- To enhance modal shift from road to railway by providing better passenger wagon for commuter.

It note that the TA should be conducted as temporary countermeasures until the completion of Yangon Circular Railway Modernization Project, in order to enhance modal shift from road to railway, contribute traffic jam reduction, and provide better commuting service to Yangon citizens.

In order to fulfill the objectives, this program consists of 3 components,

- Support to establish an effective train operation plan and diagram for commuter,
- Establishing "Commuter Service Improvement Dept." and the capacity building, and
- Technical Assistance for the existing passenger wagon interior upgrade work for commuter.

[RL-3: Urgent] Railway Central Control Center System Installation

The study is ongoing by JICA. The purpose of the study is to decide the scope of grant aid for railway safety facilities.

The current railway has some problems/issues. For example, Yangon Circular Railway has installed automatic color light signal, however, the system is quite old and has many problems such as frequent malfunction with no changing signal color due to fail-safe system worked by shunt-circuited track circuit by water-soaked track in every rainy season. Therefore, all trains are in dangerous train operation depending driver's eye-checking without reliable signal and train detection system during signal malfunction. In addition, the current railway has many level crossings which are manually operated (opened and closed) by railway staff, and it brings chronic traffic congestions at all level crossing points.

In order to eliminate the problems, appropriate safety facilities such as OCC, electronic interlocking device, etc., will be installed as urgent countermeasure by JICA grant aid.

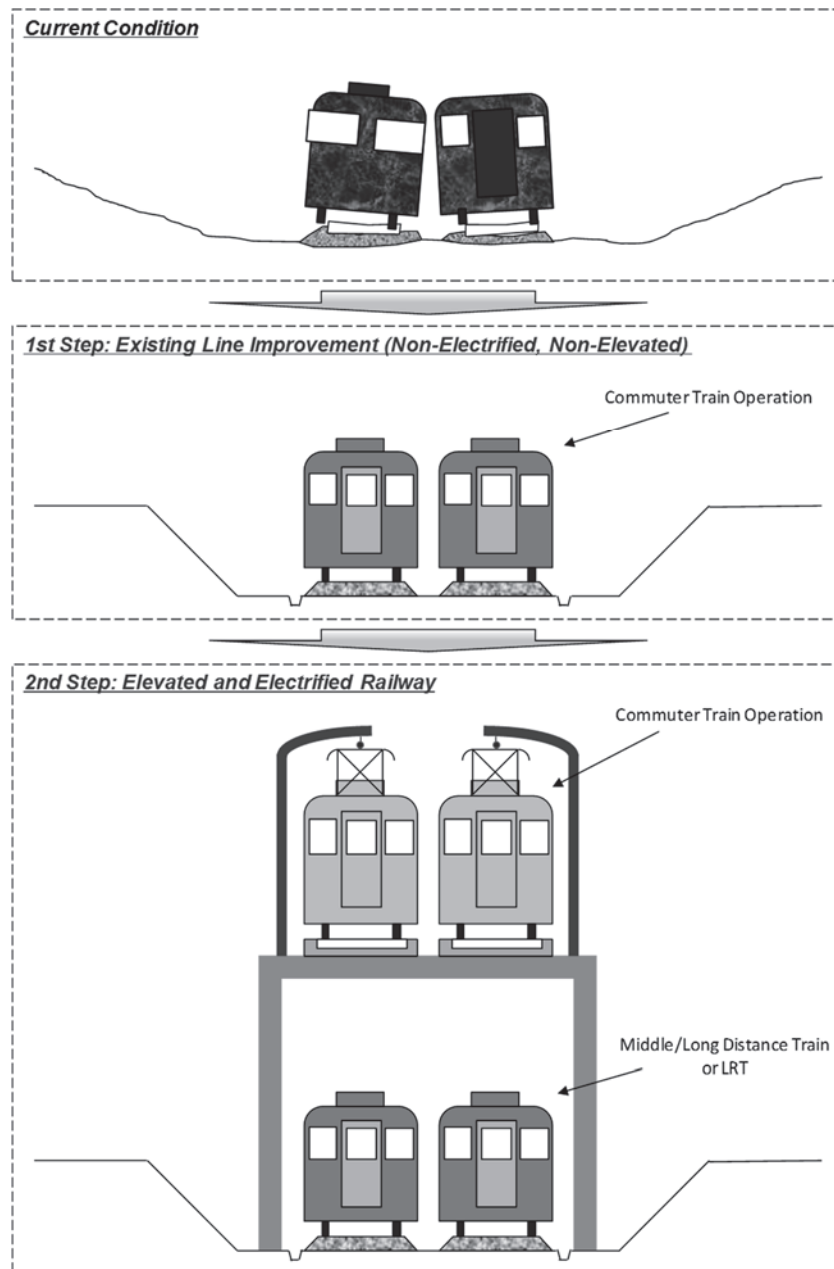
[RL-4: Urgent] TA for Railway Safety and Service Improvement

The TA is ongoing by JICA. At present, daily MR passenger is reached to approximately 200,000 and about half of them are for Yangon Circular Railway and the suburban lines. On the other hand, the current condition is quite poor and accident and delay become constantly.

In order to improve the current condition, i) to establish plan for improvement of operation for enhancement of safety and service, and ii) technical capacity building/technical transfer for track maintenance skill by using Yangon-Mandalay suburban line, will be conducted.

(ii) Yangon Circular Railway Western Half Modernization

As explained in the previous chapter, the step-development will be applied for the existing railway modernization. Regarding Yangon Circular Railway Western Half Development, the following step-development will be applied.



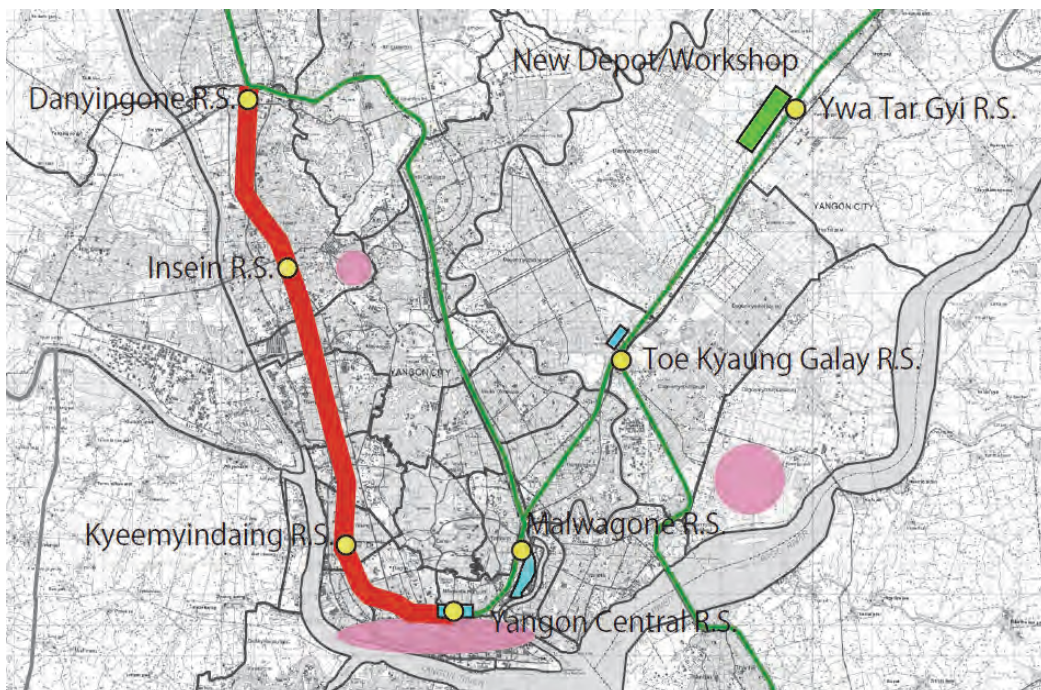
Source: YUTRA Project Team

Figure 6.2.1.6 Step-Development for Yangon Circular Railway Western Half

[RL-5] Yangon Circular Railway Improvement (Non-electrified) Phase 1: Western Half Loop (Short-term)

Yangon Circular Railway surrounds the city center by 47km length line. The line, especially the western half, has high potentiality as urban railway line due to passing high value areas such as business district, high density residential area, etc. However, the railway is inferior to the other public transport mode such as bus in terms of all aspects such as punctuality, quick-deliverability, safety, comfortability and accessibility at present due to the deteriorated infrastructures, the lack of feeder connection, etc. It causes the tendency that Yangon citizens, especially high and middle class people, do not use railway service so much.

The western half of Yangon Circular Railway (Yangon Central Station – Insein Station – Danyingone Station with 21km length) which passes high population density areas is categorized as future main transport axis linking the north with the south in the city center.



Source: YUTRA Project Team

Figure 6.2.1.7 Location Map for Yangon Circular Railway Western Half

The modernization and electrification should be conducted as first priority project. In order to fulfill speed up and high frequent operation, the following project scopes are expected.

- Civil Structure Improvement (Drainage Improvement, Embankment/Cut Improvement, Bridge Improvement, Culvert Improvement)
- Track Improvement (Replace Rail from existing 37kg/m rail to 50kg/m rail, Install New PC sleeper for 50kg/m rail, Spread new ballast)
- Signaling & Telecom System Modernization
- Station and Station Facility Improvement (High height platform, ticket selling system improvement, introduction of AFC system with IC card)

- DEMU Procurement
- Improve existing Kyeemyindaing depot and Insein workshop for new DEMU
- Installation of automatic level crossing

Note that no elevated and no electrified are applied. Improved image is shown as below. As a result of improvement, the following effects will be expected.

- To facilitate the modal shift from road to railway transport, especially the north - south direction transport.
- To reduce road traffic volume and traffic congestions.
- To improve the transport condition between the north Yangon and CBD area drastically, especially commuting condition.

The current condition and image of after improvement is shown below.



Source: YUTRA Project Team, http://nukezo.s54.xrea.com/trains/shanai/jr/j-east/kiha_e200.html

Figure 6.2.1.8 Current Condition and Image of After Improvement

[RL-12] Electrified and Elevated Project for Yangon Circular Railway Western Half (Long-term)

Enough effect will be obtained from “[RL-5] Yangon Circular Railway Improvement (Non-electrified) Phase1: Western Half Loop” as short-term project hence the speed, frequency, comfortability and safety are improved drastically. However, from the middle and long term view point, electrification and grade separation will be essential because i) high frequent operation will not be allowed due to the limitation of level crossing closing time in case of

at-grade, ii) electrified railway can save the operation cost in case of high frequent operation, iii) elevated railway ensure safety from traffic accident at level crossing, etc. Especially, along the western half of Yangon Circular Railway is high population density area and many road vehicles cross the line. Hence, the line should be elevated.

From the reasons stated above, it is proposed that the western half of Yangon Circular Railway, which runs Yangon Central Station – Insein Station – Danyingone Station with 21km length, is to be electrified and elevated as long-term project. Actual project implementation schedule should be reviewed by the possibility of stable power supply, budget allocation, etc.

Image of after improvement is shown below.



Source: <http://photodb.ttozawa.com/archives/cat27/cat43/index.html>, http://www.tripadvisor.jp/LocationsPhotos-g1021218-d1497097-Toyoko_Inn_Tsukuba_Express_Moriya_ekimae-Moriya_Ibaraki_Prefecture_Kanto.html, <http://monk777.blog2.fc2.com/blog-entry-784.html>, <http://ja.wikipedia.org/wiki/%E3%83%A9%E3%83%83%E3%82%B7%E3%83%A5%E6%99%82>

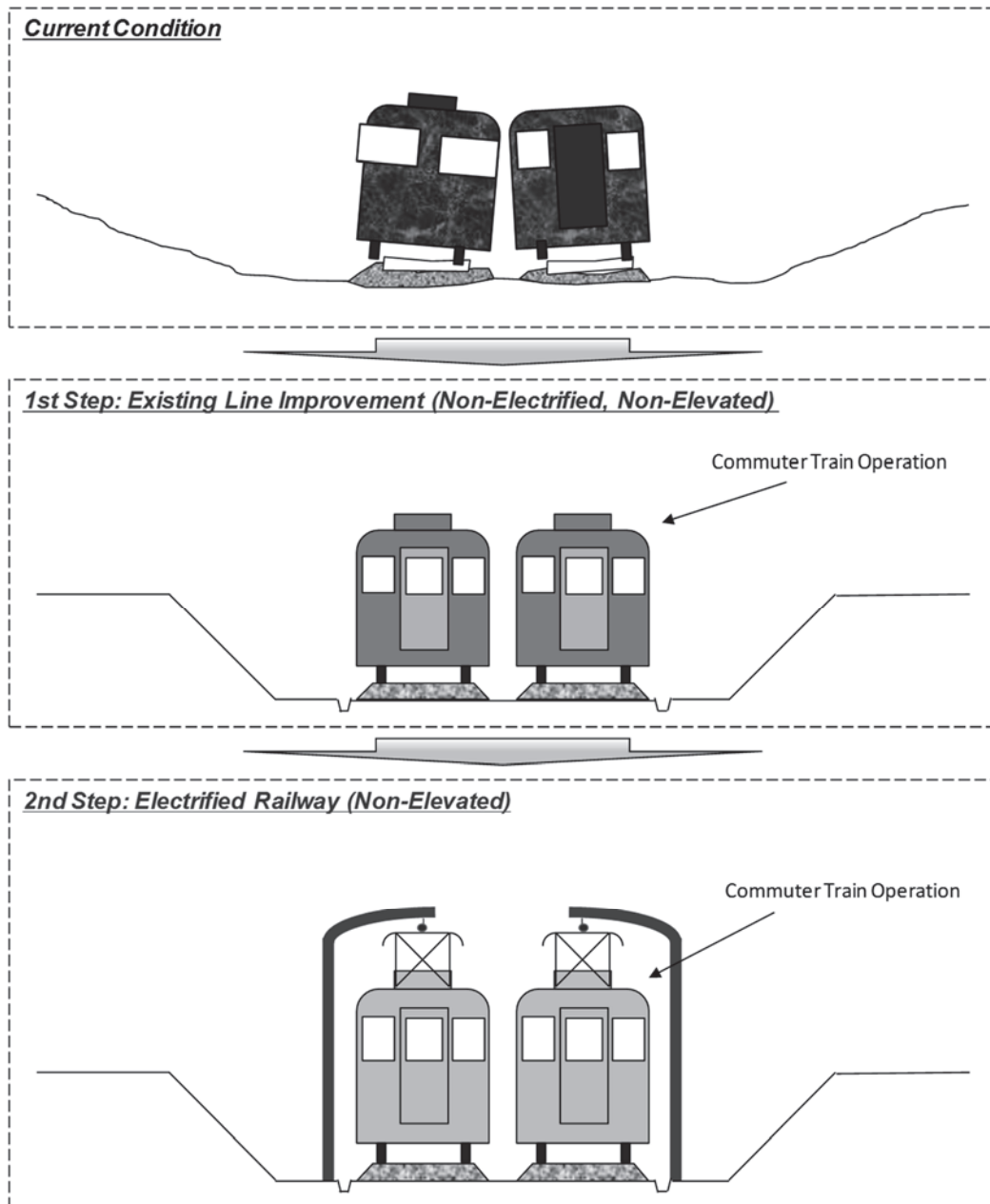
Figure 6.2.1.9 Image of After Electrified/Elevated (Example of Tokyo)

(iii) Yangon Circular Railway Eastern Half Modernization

The step-development will be also applied for the eastern half of Yangon Circular Railway. However, the line will not be elevated due to the following reasons.

- The population density along the line is lower than the western half.
- It is required to save the initial cost because of the budget envelope.

Regarding Yangon Circular Railway Eastern Half modernization, the following step-development will be applied.



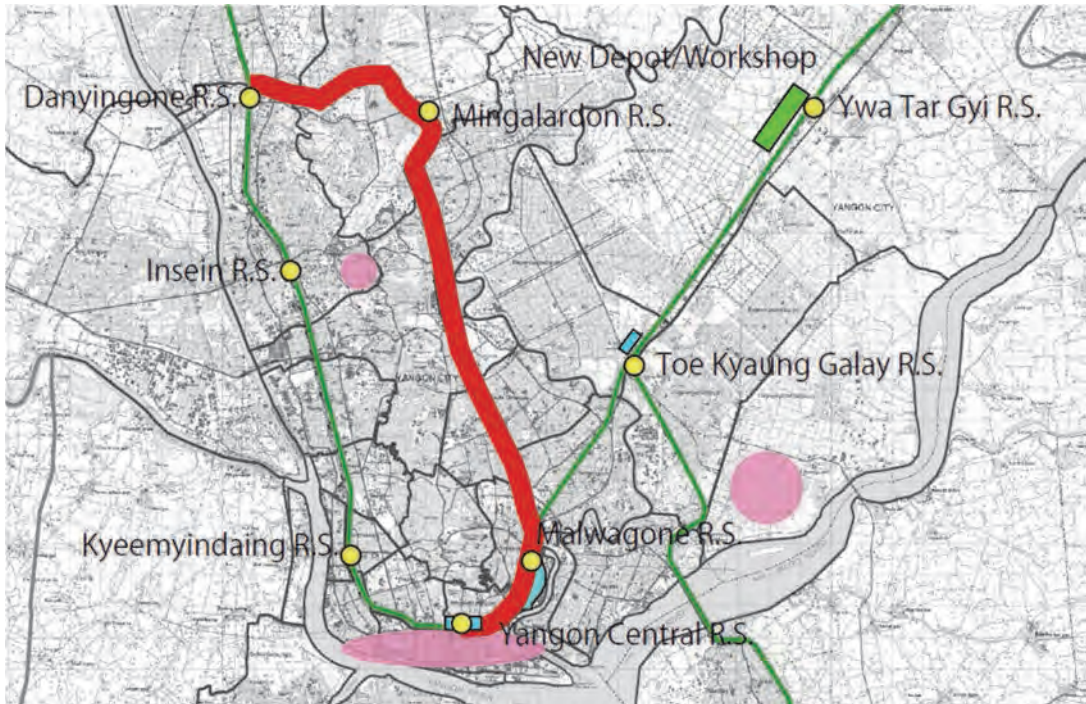
Source:YUTRA Study Team

Figure 6.2.1.10 Step-Development for Yangon Circular Railway Eastern Half

[RL-18] Yangon Circular Railway Improvement (Non-electrified) Phase2: Eastern Half Loop (Middle-term)

After the completion of “[RL-5] Yangon Circular Railway Improvement (Non-electrified) Phase1: Western Half Loop”, the remaining section, which is the eastern half of Yangon Circular Railway (Yangon Central Station – Malwagone Station – Mingalardon Station – Danyingone Station with 26km length) should be improved as Phase2 project. The project scope is the same as “[RL-5] Yangon Circular Railway Improvement (Non-electrified) Phase1: Western Half Loop”

The project location is shown in the figure below.



Source: YUTRA Project Team

Figure 6.2.1.11 Location Map for Yangon Circular Railway Eastern Half

[RL-20] Electrification of Yangon Circular Railway Eastern Half (Long-term)

After the completion of “[RL-12] Electrified and Elevated Project for Yangon Circular Railway Western Half”, the remaining section, which is the eastern half of Yangon Circular Railway (Yangon Central Station – Malwagone Station – Mingalardon Station – Danyingone Station with 26km length) should be improved. As mentioned above, the line will be electrified on at-grade basis (without elevated work).

Image of after modernization is shown below.



Source: http://himitsu86.blogspot.jp/2010/10/blog-post_07.html, http://loca.ash.jp/show/2008/d200801_kitayoshio.htm

Figure 6.2.1.12 Image of After Electrification (Example of Tokyo)

(iv) Yangon – Mandalay Line Modernization

The step-development will be also applied for Yangon – Mandalay suburban line modernization. However, the line will not be elevated due to the same reasons of Yangon Circular Railway Eastern Half.

Regarding Yangon – Mandalay line modernization, the same step-development method of the eastern half of Yangon Circular Railway will be applied.

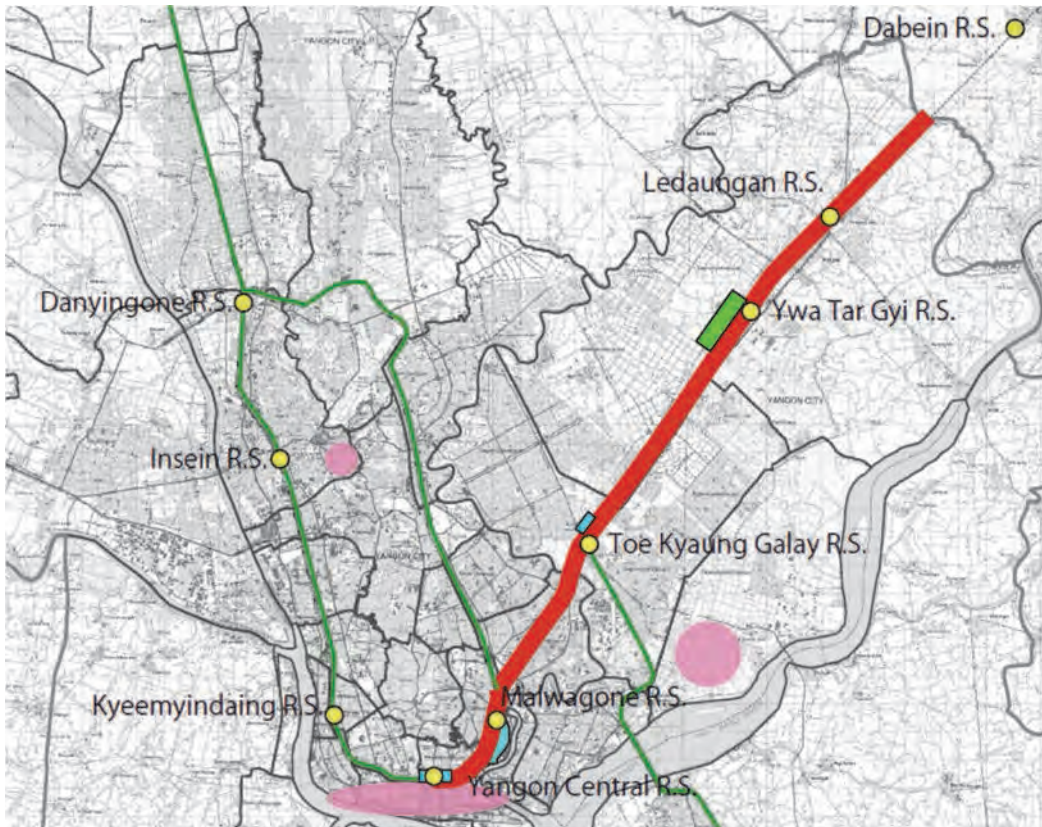
[RL-13] Yangon-Mandalay Line Improvement: Phase1 (Short-term)

The project will be conducted as a part of Yangon-Mandalay Line Improvement Project funded by JICA (Yen Loan). The project section will be 267.2km between Yangon Central Station and Toungoo Station. Although the project is for intercity railway improvement, the project section is including Yangon suburban line in Yangon-Mandalay Line, and the section will be used for commuter railway.

The project scope is composed of earthwork improvement, bridge improvement, track Improvement, other civil works, signaling & telecom system modernization including automatic level crossing installation, procurement of rolling stocks (DMU and DEMU) with maintenance facilities, and rehabilitation of two freight terminals (Satsan and Botataung)

[RL-17] Yangon-Mandalay Suburban Line Electrification

After the completion of “[RL-13] Yangon-Mandalay Line Improvement: Phase1”, the suburban section should be electrified in order to deal with the increasing demand for commuter. Note that the line will be on at-grade basis (without elevated work). The project section is 28.3km from Yangon Central Station to the border of the study area (between Ledaungan Station and Dabein Station). The project location is shown in the figure below.



Source: YUTRA Project Team

Figure 6.2.1.13 Location Map for Electrification Section for Yangon-Mandalay Suburban Line

(v) Yangon – Pyay Suburban Line Double-Tracking and Modernization

The step-development will be also applied for Yangon – Pyay suburban line modernization. However, the line will not be elevated due to the same reasons of Yangon Circular Railway Eastern Half.

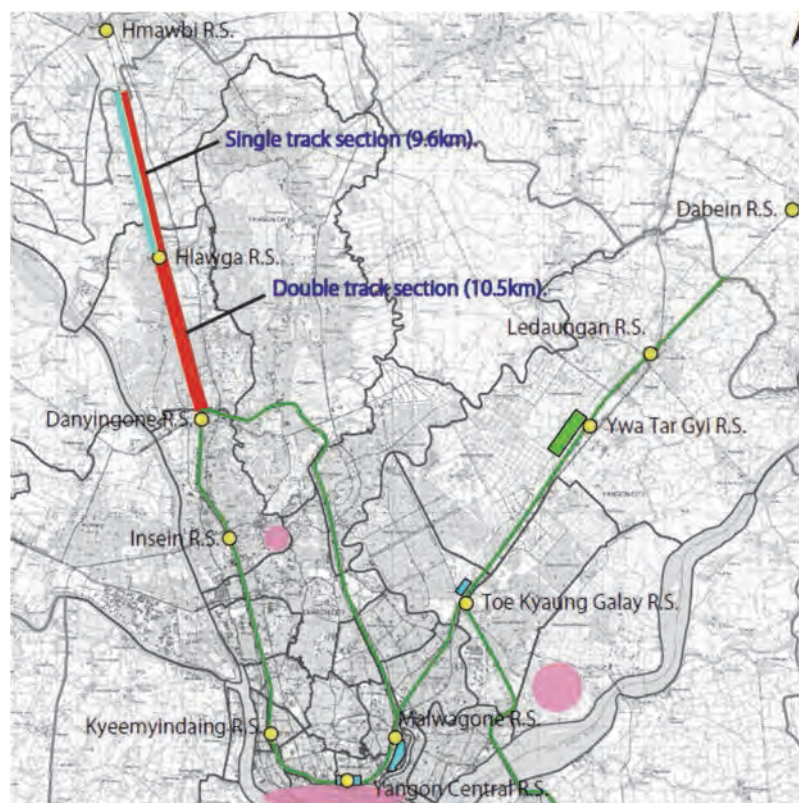
[RL-21] Yangon-Pyay Suburban Line Improvement and Double-Tracking (Middle-term)

Yangon-Pyay suburban line can be recognized as “the extension line of the western half of Yangon Circular Railway” judging from the actual location, and therefore the line should be improved in order to fulfill transport capacity enhancement and operational speed improvement.

Although the line has 20.1km from Danyingone station to the border of the Study area near Hmawbi station, the half of them (9.6km from Hlawga Station to the border of the study area near Hmawbi station) is single track. The section should be double-tracked in order to increase train operation capacity in addition to improvement of the existing track.

The other project scope will be the same as “[RL-5] Yangon Circular Railway Improvement (Non-electrified)Phase1: Western Half Loop”

The project location is shown in the figure below.



Source: YUTRA Project Team

Figure 6.2.1.14 Location Map for Yangon-Pyay Suburban Line

[RL-23] Yangon-Pyay Suburban Line Electrification (Long-term)

After the completion of “[RL-21] Yangon-Pyay Suburban Line Improvement and Double-Tracking”, the suburban section should be electrified in order to deal with the increasing demand for commuter. Note that the line will be on at-grade basis (without elevated work). The project section is 20.1km from Danyingone Station to the border of the study area (between Hlawga Station and Hmawbi Station).

(vi) Thilawa Access Line Improvement

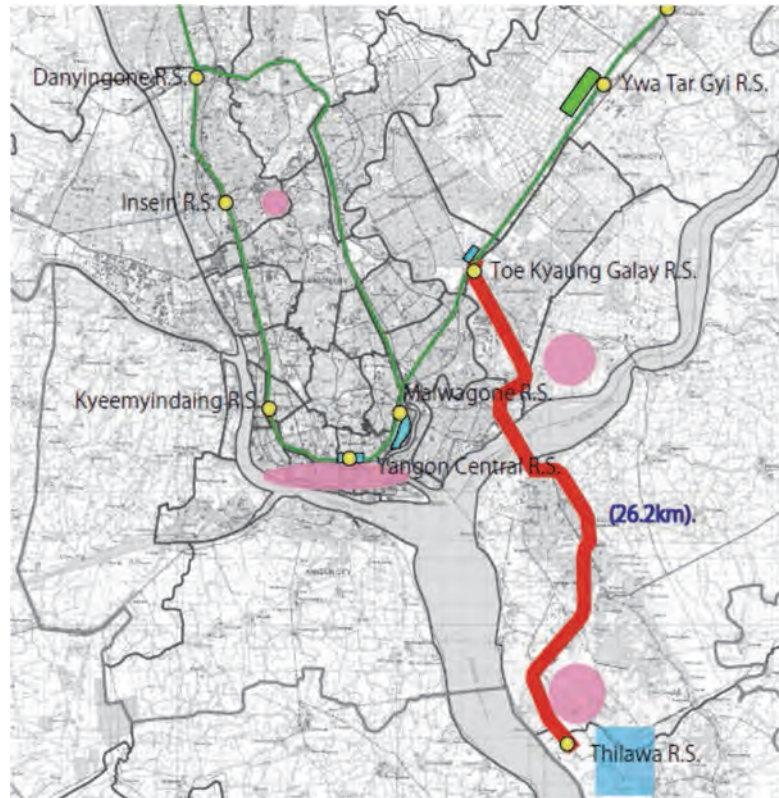
[RL-24] Thilawa Access Line Improvement and Double-tracking (Middle-term)

Thilawa access line will be the important line for both commuter and freight transport due to the future development of Thilawa area as a main port, huge SEZ, and a one of sub-center in Yangon. However, the current access railway line to Thilawa is single track and quite poor condition due to the lack of maintenance, old-fashioned safety devices, etc.

Therefore, it is proposed to improve and double-track the existing line which has 26.2km from Toe Kyaung Galay station to Thilawa station.

Regarding the double-tracking, it will be a one of main issues that how to cross Bago river due to the long length with approximately 2km. There is a problem in the existing Thanlyin bridge across Bago river that any container train cannot pass due to the small construction gauge and car gauge. Therefore, all freight container train should pass the new railway bridge, and the existing bridge will be for commuter/passenger train.

The project location is shown in the figure below.



Source: YUTRA Project Team

Figure 6.2.1.15 Location Map for Thilawa Access Line Improvement and Double-tracking

[RL-26] Thilawa Access Line Electrification (Long Term)

After the completion of “[RL-24] Thilawa Access Line Improvement and Double-tracking”, the section should be electrified in order to deal with the increasing demand for passenger. Note that the line will be on at-grade basis (without elevated work). The project section is 26.2km from Toe Kyaung Galay station to Thilawa Station.

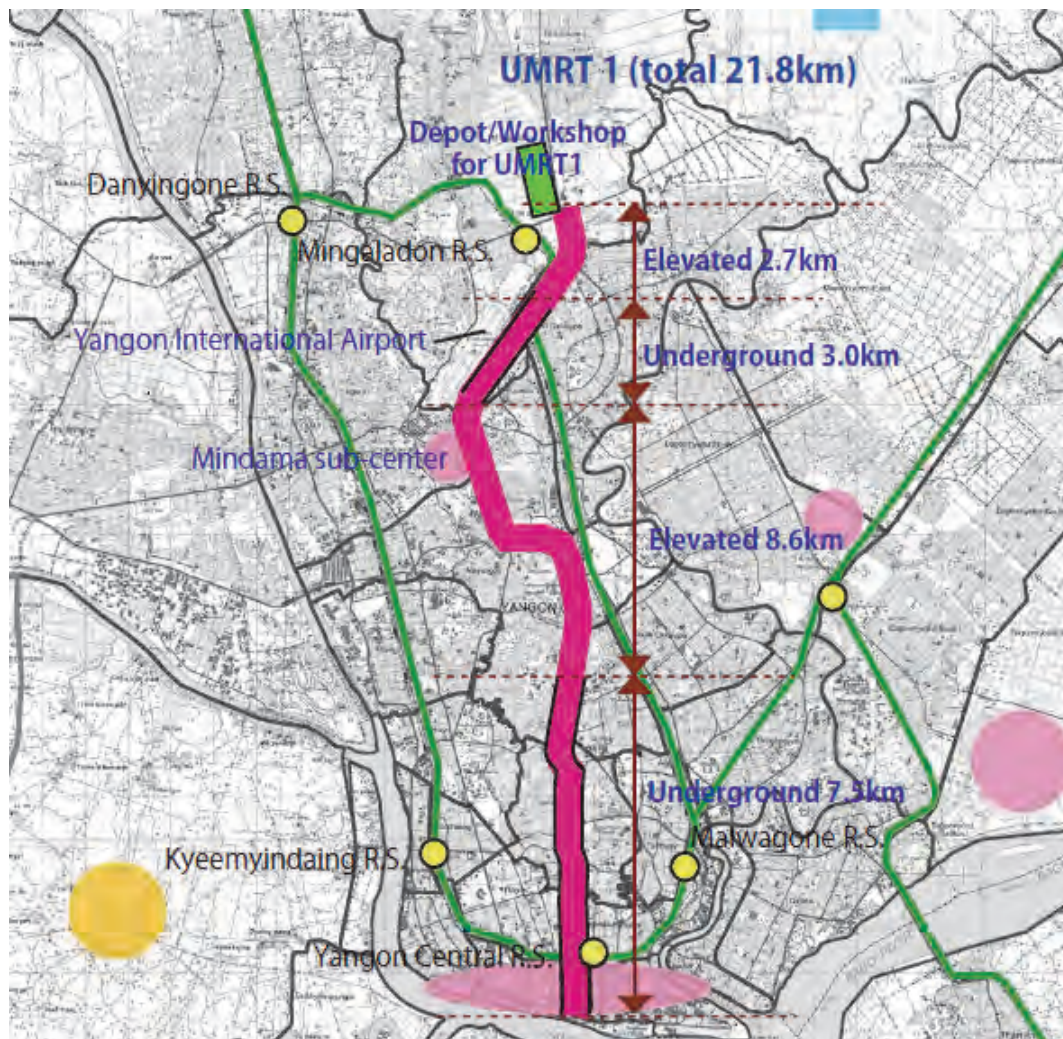
(2) Urban Railway

Judging from the future population increase with increasing the number of trip, it is essential to install Urban Mass Rapid Transit (UMRT) with high speed, high frequency, and high transport capacity, in addition to the existing railway modernization. On the other hand, the installation timing should be set properly due to requiring huge cost for both initial construction and operation and maintenance. As mentioned in Chapter4, the installation timing is decided based on the actual example of relation between UMRT opening year and GRDP in Asian major cities. Five UMRTS lines were planned by SUDP, which is upper level plan of the Study, in consideration of future trip number increase, urban area expansion, and TOD oriented plan, etc. Although the number of line has evidences and proper, the budget limitation can be shouldered by Myanmar side is not studied. In addition, sharing with the other mass transit such as BRT, etc. is not considered because it is assumed that all public mass transport is covered by railway only. From the reasons, the five lines are reviewed and narrowed, and two important lines are proposed as a result. In addition, it is emphasized that it is essential to establish an implementation and operation

for commuter. The line connecting CBD with Yangon International Airport with 21.8km length via Yangon Central Station and Mindama sub-center area, along Sule Pagoda Rd., Kaba Aye Rd., Yangon Airport Rd., and NH No.3.

In order to save construction cost, underground section is minimized. However, 10.5km length becomes underground section due to no room for elevated viaduct construction. Two sections that i) 7.5km from the starting point which is the intersection of Strand Rd. and Sule Pagoda Rd. to the east side of Inya lake, and ii) 3.0km along the southeast side of Yangon International Airport are planned as underground section. The other sections are planned as elevated. The depot and workshop will locate at the north end of the line judging from the current plenty vacant lot.

The project location is shown in the figure below.



Source: YUTRA Project Team

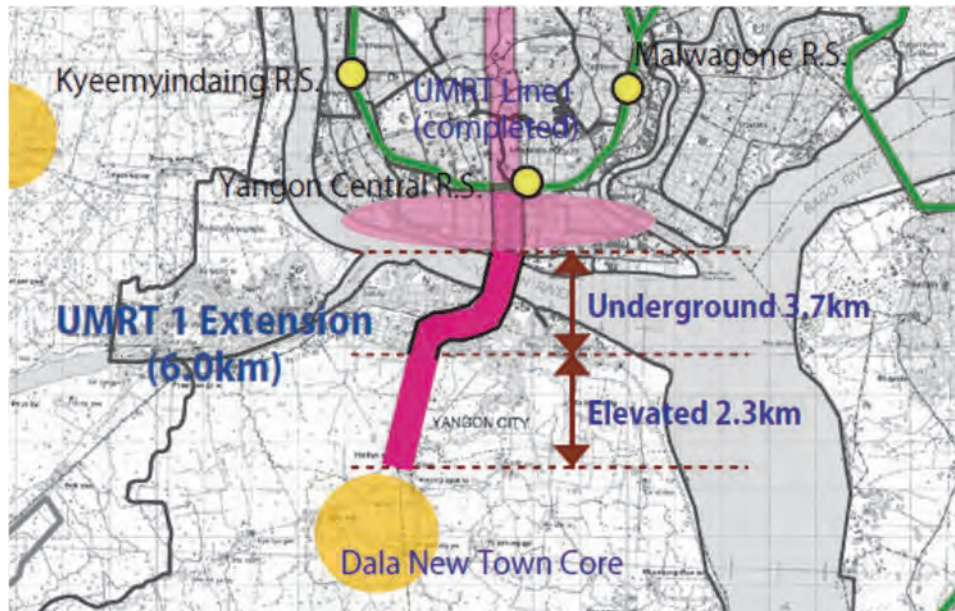
Figure 6.2.1.17 Location Map for UMRT Line1

[RL-28] UMRT Line1 Extension Project (North-South Line Extension) (Long-term)

The project is to extend UMRT Line1 from the south end to Dala with 6km length.

In order to save construction cost, underground section is minimized. However, 3.7km length becomes underground section due to across Hlaing river and no room for elevated viaduct construction around the river side of Dala.

The project location is shown in the figure below.



Source: YUTRA Study Team

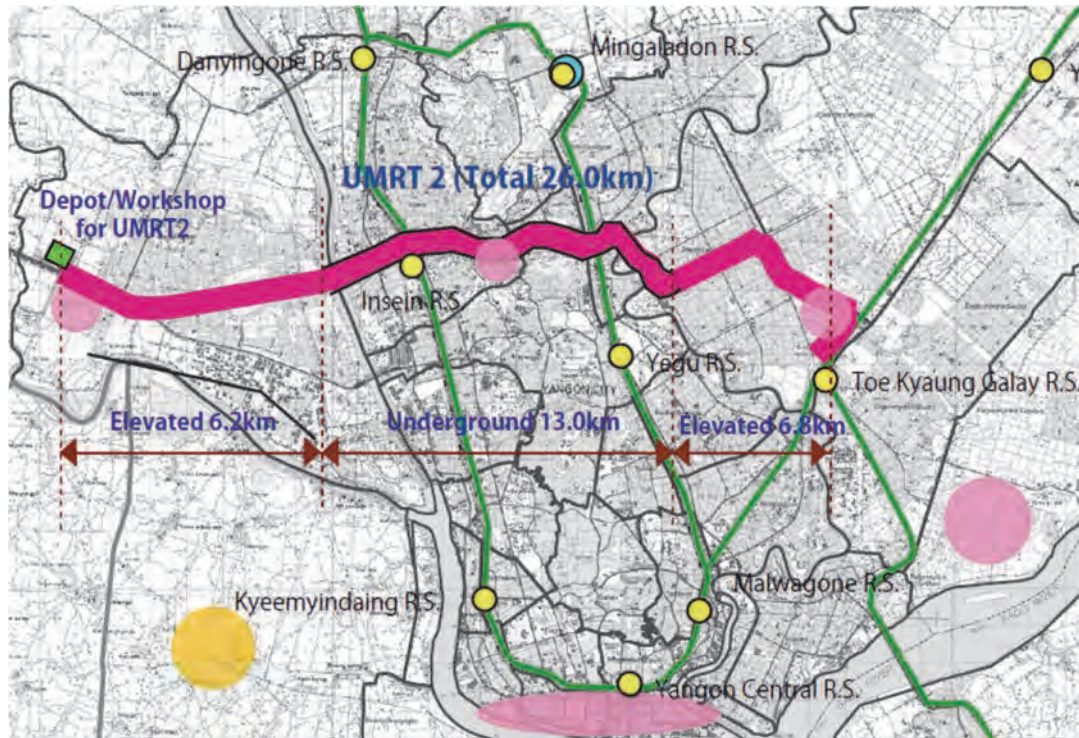
Figure 6.2.1.18 Location Map for UMRT Line1 Extension

[RL-29] UMRT Line2 Construction Project (East-West Line) (Long-term)

UMRT Line2 is installed as East-West axis with 26.0km length. The route is planned to connect sub-centers planned by SUDP, named Hlaing Tharya, Mindama, and Dagon Myothit.

In order to save construction cost, underground section is minimized. However, 13.0km length becomes underground section due to no room for elevated viaduct construction. Two sections that i) 6.2km from the starting point which is located beside Hlaing Tharya. Sub-center to the west bank side of Aung Zay Ya bridge, and ii) 6.8km from near the west end of Yarzaa Dirit Rd. to the end point beside Toe Kyaung Galay station are planned as elevated section. The other sections are planned as underground. The depot and workshop is planned to locate at the beside Hlaing Tharya sub-center judging from the current plenty vacant lot.

The project location is shown in the figure below.



Source: YUTRA Project Team

Figure 6.2.1.19 Location Map for UMRT Line2

(3) Transit Oriented Development

The key to be succeeded in railway project is to enhance ability to attract potential passengers by developing stations as business/commercial center and transport hub by yard redevelopment, land development along railway, transport hub function enhancement, feeder function enhancement, etc. In other word, it is important to conduct TOD projects, which means citizens can access everywhere in the city by public transport (mainly railway) and walking and station becomes attractive in terms of commercial and economical aspect, in harmonized with railway projects specially and timely.

The Study plans to develop railway yards and high potential vacant lots along the urban sections of the existing lines in harmonized with its improvement / modernization timely. Four yards (Yangon Central station yard, Malwagone depot and workshop yard, Insein workshop yard, and Kyeemyindaing station yard) have high development potential due to large area. Especially, it is expected that Yangon Central station yard located at the center of CBD will be developed early due to current high interest from several private developers. However, in case of private oriented development, there is a possibility to be insufficient public facilities required as basic station function to fulfill TOD such as transfer facility, pedestrian deck, impediment removal design, seamless flow line design, effective station plaza, emergency facility, etc., because private developer is apt to be development to require short-term gain. Therefore, it is important that Myanmar government side makes regulation for development from a leading position and takes appropriate right and responsibility.

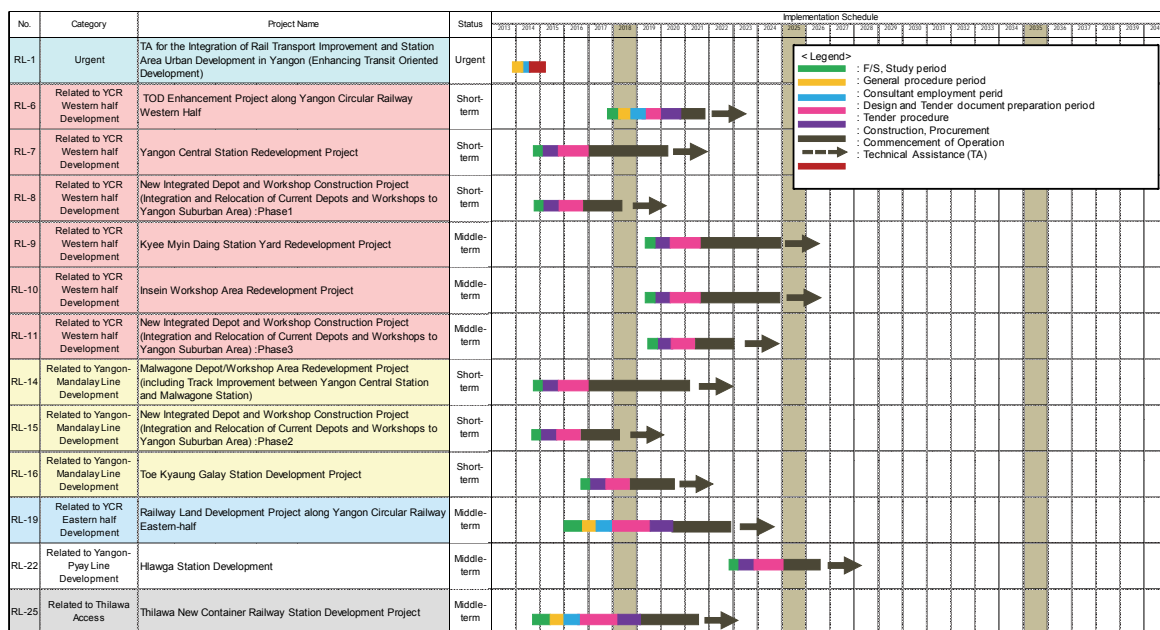
In addition, it is important to create virtuous cycle by reflowing the huge development benefits from TOD towards railway upgrades, new construction, renewals, etc. in order to

realize further service level improvement

Furthermore, in order to conduct yard redevelopment project, it is required to relocate the current function such stabling and maintaining rolling stocks, etc. to somewhere in advance. The relocation work should be conducted by using development benefit obtained from private developer, because it is recognized as a part of redevelopment project

TOD projects (railway-oriented) proposed by the study is shown in the table below.

Table 6.2.1.6 Proposed Projects for TOD



Source: YUTRA Project Team

Outline of the major projects are shown below.

(i) Urgent Issue

[RL-1: Urgent] TA for the Integration of Rail Transport Improvement and Station Area Urban Development in Yangon (Enhancing Transit Oriented Development)

MR has some lands which has high property value such as Yangon Central Station area, Malwagone Depot/Workshop Area, etc. Many foreign developers are interested in redeveloping the areas and submitted their proposals. It is the good tendency, but MR has to handle and control the development plan in order to maximize the public development benefit and divert the benefit to the transport projects such as modernization of the existing railway infrastructure and/or new urban transport system development.

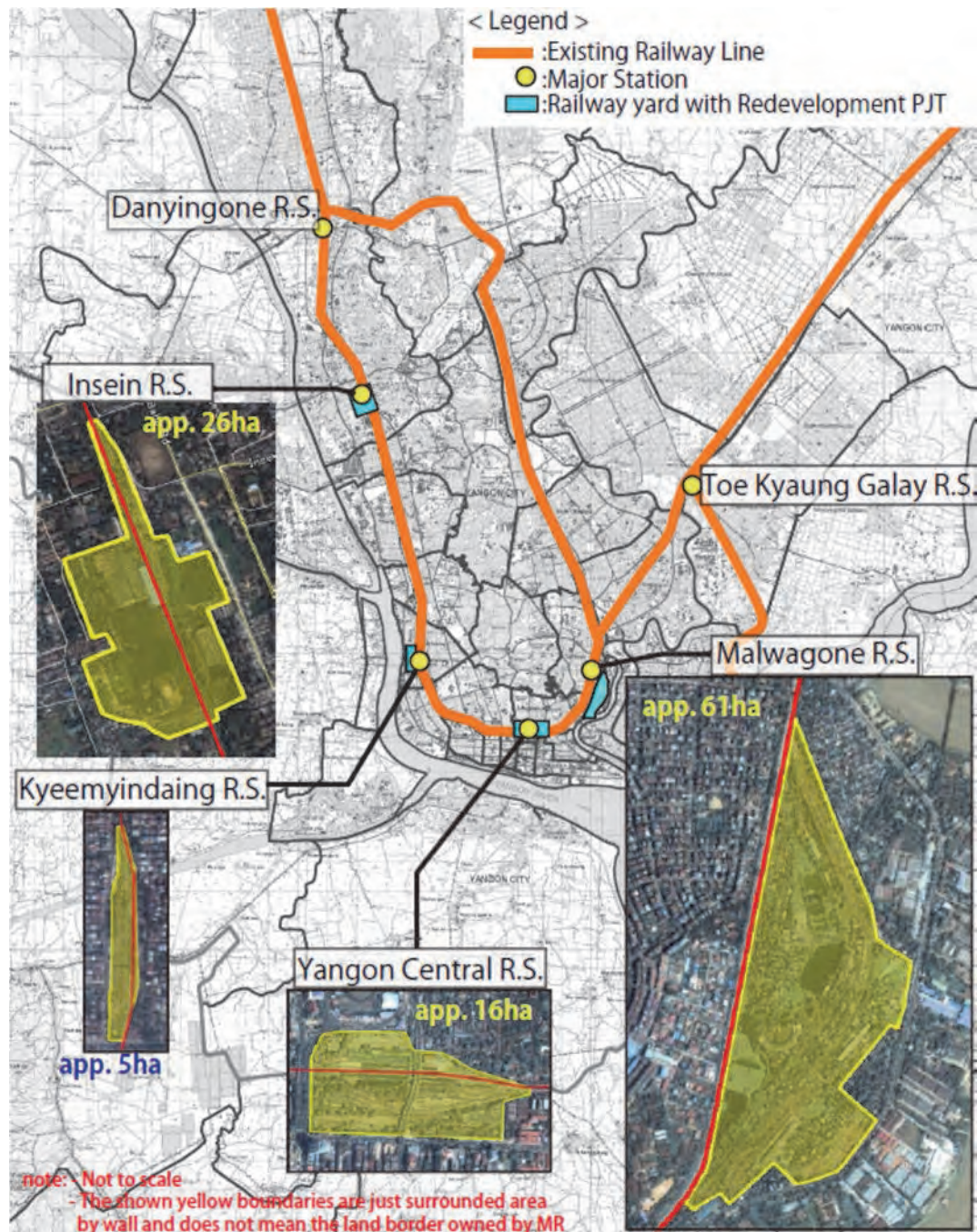
The objectives of the TA are below.

- To establish a coordination mechanism between MR. and organizations responsible for urban development along railway lines particularly in station areas
- To prepare a conceptual station area development plan including inter-modal transfer facilities and urban development which will be able to enhance usages of railway system,
- To estimate development benefit from the urban development and to prepare PPP (Public Private Partnership) guide lines for the station area development.

- In order to fulfill the objectives, following scopes to be conducted.
- To prepare conceptual station area urban development plan in the available MR. railway land.
- To prepare standard RfP and contract document for biddings for Replace/Redevelopment of railway land which will be developed by any private firms. The RfP may require developer to relocate the existing function in current yards to be developed such as stabling yard, depot, workshop, etc. and to modernize the existing railway and/or install new transit system by using their benefit obtained from the land development.

(ii) TOD for MR's Yard

MR has some large lands for station yard, depot, workshop, etc. along the railway line in the study area as shown in the figure below. These lands are appropriate for redevelopment and TOD because projects can be conducted inside railway area with no land acquisition and resettlement.



Source: YUTRA Project Team

Figure 6.2.1.20 Location Map of MR's Yard for Redevelopment/TOD

[RL-6] TOD Enhancement Project along Yangon Circular Railway Western Half (Short-term)

The project is conducted as supplemental project of Yangon Circular Railway Improvement Phase1: Western Half Loop, in order to enhance the improvement effect of the railway and increase the number of passengers. The project scope is to provide station plaza with bus stop at main stations along the line such as Kyeemyindaing R.S., Insein R.S., and Danyingone R.S. Yangon Central station is excluded from the target station because there is another project named as “[RL-7] Yangon Central Station Redevelopment Project”.

Kyeemyindaing station and Insein station will be included in the project scope, although there are another projects named as “[RL-9] Kyeemyindaing Station Yard Redevelopment Project” and “[RL-10] Insein Workshop Area Redevelopment Project” respectively, because the projects are conducted as middle-term project and minimum function should be installed as short-term countermeasure.

The image of small station plaza development is shown in the figure below.



Source: YUTRA Project Team

Figure 6.2.1.21 Example of Station Plaza

[RL-7] Yangon Central Station Redevelopment Project (Short-term)

Yangon Central station yard is the most attractive land for commercial and business use among MR’s lands, because the yard has large area and is situated at the heart of Yangon city and commercially strategic location, although MR has some lands along the railway line in the Study area. Therefore, several private developers already expressed their interests in redevelopment and the other potential developers may express their interests near future.

Yangon Central station yard surrounded by wall is approximately 16ha. (note: although actual Yangon Central station area owned by MR is 29ha, remaining 13ha is fully used by many apartments/housings for MR staffs, stops, etc.)

The redevelopment plan should be prepared by selected developer from the commercial viewpoint, although layout of business offices, commercial facilities, residential apartments, etc. are expected. However, the redevelopment area will play roles as not only commercial and business center but also transit hub because the station accept entering many transit mode including MR trains such as Yangon Circular Railway, etc., UMRTs (UMRT Line1, UMRT Line2), BRTs, buses, taxis, private vehicles, and pedestrians. In order to fulfill the function as transport hub, the following public functions and the integration should be considered.

Table 6.2.1.7 Required Public Functions for Yangon Central Station Redevelopment

Function.	Specific Name	Remarks
Public Transport Transfer	MR lines (Yangon Circular Railway, Yangon Suburban Lines, Middle and Long Distance Trains) UMRT lines stations (UMRT Line1, UMRT Line2) BRT stations (2 routes are planned) Feeder bus terminal Taxi stand	To Integrate Inter - modal facilities (Railway, BRT, Feeder Bus, Taxi, Car)
Private Vehicle Connection	Road connection including access rotary road to station entrance, bus terminal, and taxi stand, etc. Car parking for Park & Ride or commercial / business building users	
Others	Pedestrian path Green space	Separate pedestrians and vehicles Connect buildings by pedestrian deck Introduce enough green space inside development area

Source: SUDP, JICA (2013) and YUTRA Project Team

In addition, the station yard belongs to CBD area and there are some restriction about development according to land use and urban planning instructed in SUDP. The following restrictions are confirmed.

- The current station building should be preserved due to historical building.
- Building-to-land ratio (50%) and floor area ratio (800%).

A draft conceptual image of redevelopment is shown in the figure below. Note that it is just draft and the detail should be studied by any another study.



Source: YUTRA Project Team

Figure 6.2.1.22 Draft Conceptual Image of Yangon Central Station Redevelopment

It is recommended to conduct the project by PPP scheme in order to maximize use of private investor's fund. It is a one of options that public side (MR) provides their land and private side (developer) develop the area including public facilities by their own fund, and developer pay decided royalty to MR.

The redevelopment area currently has several railway functions such as depot and maintenance shed, etc. Therefore, it is necessary to relocate these existing functions in Yangon Central station yard to any substituted yard. The relocation work should be conducted by using the development benefit. In addition, it is recommended to make appropriate scheme that the development benefit can be used for upgrading and/or new installation of railway infrastructures as much as possible.

[RL-9] Kyee Myin Daing Station Yard Redevelopment Project (Middle-term)

Kyee Myin Daing station, which is the one of major stations along the western half of Yangon Circular Railway, is located at the western edge of CBD and has small depot with approximately 5ha surrounded by wall. This area has potential to be the middle-scale transit hub with commercial and business functions, therefore there is a possibility any private investors express their interest to redevelop the yard.

The redevelopment plan should be prepared by selected developer from the commercial viewpoint, although layout of business offices, commercial facilities, residential apartments, etc. are expected. However, the redevelopment area will play roles as not only commercial and business center but also transit hub because the station accept entering many transit mode including Yangon Circular Railway, UMRT Line3, feeder buses, taxis, private vehicles, and pedestrians. In order to fulfill the function as transport hub, the following public functions and the integration should be considered.

Table 6.2.1.8 Required Public Functions for Yangon Central Station Redevelopment

Function.	Specific Name	Remarks
Public Transport Transfer	MR lines (Yangon Circular Railway) UMRT lines stations (UMRT Line3) Feeder bus terminal Taxi stand	To Integrate Inter-modal facilities (Railway, Feeder Bus, Taxi, Car)
Private Vehicle Connection	Road connection including access rotary road to station entrance, bus terminal, and taxi stand, etc. Small car parking	
Others	Pedestrian path	Connect with buildings, station plaza, concourse, etc. by pedestrian deck

Source: SUDP, JICA (2013) and YUTRA Project Team

It is recommended to conduct the project by PPP scheme in order to maximize use of private investor's fund. It is a one of options that public side (MR) provides their land and private side (developer) develop the area including public facilities by their own fund, and developer pay decided royalty to MR.

The redevelopment area currently has function as depot. Therefore, it is necessary to relocate these existing functions in Kyee Myin Daing station yard to any substituted yard. The relocation work should be conducted by using the development benefit. In addition, it is recommended to make appropriate scheme that the development benefit can be used

for upgrading and/or new installation of railway infrastructures as much as possible.

[RL-10] Insein Workshop Area Redevelopment Project (Middle-term)

Insein station, which is the one of major stations along the western half of Yangon Circular Railway, is located near Mindama area which is appointed as the sub-center in SUDP. Therefore, there is a possibility that this station will be transfer station from Yangon Circular Railway to feeder transits to Mindama sub-center, etc. In addition, the one of the main workshops in MR, named as Insein Workshop, is located beside the station. The development potential of Insein workshop is quite high due to the abovementioned location and the huge yard with approximately 26ha. Therefore, there is a possibility any private investors express their interest to redevelop the yard.

The redevelopment plan should be prepared by selected developer from the commercial viewpoint, although layout of business offices, commercial facilities, residential apartments, etc. are expected. However, the redevelopment area will play roles as not only commercial and business center but also transit hub because the station accept entering many transit mode including Yangon Circular Railway, BRT, feeder buses, taxis, private vehicles, and pedestrians.

In SUDP, Insein workshop is selected as the target for TOD case study. In the study, it is proposed to apply phasing development for the area. The conceptual plan and perspective image drafted in SUDP is shown in the figure below.



Source: SUDP, JICA (2013)

Figure 6.2.1.23 Draft Conceptual Plan and Perspective Image for Insein Workshop Redevelopment

It is recommended to conduct the project by PPP scheme in order to maximize use of private investor's fund. It is a one of options that public side (MR) provides their land and private side (developer) develop the area including public facilities by their own fund, and developer pay decided royalty to MR.

The redevelopment area currently has function as workshop. Therefore, it is necessary to relocate these existing functions as workshop to any substituted yard. The relocation work should be conducted by using the development benefit. In addition, it is recommended to make appropriate scheme that the development benefit can be used for upgrading and/or new installation of railway infrastructures as much as possible.

[RL-14] Malwagone Depot/Workshop Area Redevelopment Project (including Track Improvement between Yangon Central Station and Malwagone Station) (Short-term)

Malwagone depot/workshop, which is in the southern side of section between Puzundaung station and Malwagone station along Yangon-Mandalay line, is located at the eastern edge of CBD and has the largest area surrounded by wall with approximately 61ha although it includes many apartments/housings for MR staffs, stops, etc.

This area has quite large potential to be developed as the large transport hub and commercial/business center due to the good location and large area, therefore it is expected any private investors express their interest to redevelop the yard.

The redevelopment plan should be prepared by selected developer from the commercial viewpoint, although layout of business offices, commercial facilities, residential apartments, etc. are expected. However, the redevelopment area will play roles as not only commercial and business center but also transit hub because the station accept entering many transit mode including MR trains such as Yangon Circular Railway, Yangon suburban lines, middle/long distance trains running Yangon-Mandalay line, etc., UMRT Line3, BRT, buses, taxis, private vehicles, and pedestrians. In order to fulfill the function as transport hub, the following public functions and the integration should be considered.

Table 6.2.1.9 Required Public Functions for Yangon Central Station Redevelopment

Function.	Specific Name	Remarks
Public Transport Transfer	MR lines (Yangon Circular Railway, Yangon Suburban Lines, Middle and Long Distance Trains) UMRT lines stations (UMRT Line3) BRT station Feeder bus terminal Taxi stand	To Integrate Inter-modal facilities (Railway, BRT, Feeder Bus, Taxi, Car)
Private Vehicle Connection	Road connection including access rotary road to station entrance, bus terminal, and taxi stand, etc. Car parking for Park & Ride or commercial / business building users	
Others	Pedestrian path Green space	Separate pedestrians and vehicles Connect buildings by pedestrian deck Introduce enough green space inside development area

Source: SUDP, JICA (2013) and YUTRA Project Team

It is recommended to conduct the project by PPP scheme in order to maximize use of private investor's fund. It is one of options that public side (MR) provides their land and private side (developer) develop the area including public facilities by their own fund, and developer pay decided royalty to MR.

The redevelopment area currently has function as depot and workshop. Therefore, it is necessary to relocate these existing functions in the yard to any substituted yard. The relocation work should be conducted by using the development benefit. In addition, it is recommended to make appropriate scheme that the development benefit can be used for upgrading and/or new installation of railway infrastructures as much as possible.

(iii) Depot and Workshop Relocation and Integration related to MR Yard Redevelopment Projects

According to a series of the railway yard redevelopments projects mentioned above, these existing functions as depot and/or workshop should be relocated to any substituted yard. because these depot/workshop areas are also redeveloped to commercial and business area. From the above reasons, it is planned to establish a new integrated depot and workshop at the ourshirt of Yangon city.

There is a huge land which is owned by MR at the northern side of Ywa Tar Gyi station along Yangon-Mandalay line. Therefore, it is proposed to use the yard for the project.

The development cost should be born from the development benefit of each yards.

The integrated new depot and workshop will be established by phasing development due to the difference of timing to redevelop each yards.

A series of the projects are named as below.

- [RL-8] New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase1 (Short-term)
- [RL-15] New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase2 (Short-term)
- [RL-11] New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase3 (Middle-term)

(iv) TOD for Land not owned by MR

There are many potential lands for TOD along the existing railway, which do not belong to MR. These lands have many vacant lots currently due to far from CBD and having few bus services. However, the situation will be changed drastically after the modernization of the existing railways .because many trains for commuter are operated with high frequency, large transport capacity and high travel speed, high comfortability. Especially, Toe Kyaung Galay station along Yangon-Mandalay line, and Hlawga station along Yangon-Pyay line are selected as the target stations in consideration of i) distance from CBD, ii) current vacant lots around station, and iii) future land use.

Toe Kyaung Galay station is approximately 10km to 15km far from CBD, is transfer station

to Thilawa, is located at the southern side of Dagon Myothit sub-center, and has plenty vacant land at the northern side.

On the other hand Hlawga station is located near new town core and new industrial zone planned in SUDP and has plenty vacant land, although the distance from/to CBD is approximately 30km.

The projects are named as below

- [RL-16] Toe Kyaung Galay Station Development Project (Short-term)
- [RL-22] Hlawga Station Development (Middle-term)

(4) Rough Construction and Procurement Cost Estimate (MR, UMRT and TOD)

The rough cost estimate result for construction and procurement work related to railway is shown in the table below. The cost is estimated based on the unit cost per km, per ha, etc. calculated based on the actual project data, related documents, etc. The cost is for initial construction and procurement cost only and does not include the other costs such as engineering service cost, land acquisition and resettlement cost, price escalation, tax, etc.

Table 6.2.1.10 Rough Construction and Procurement Cost Estimate (MR, UMRT and TOD)

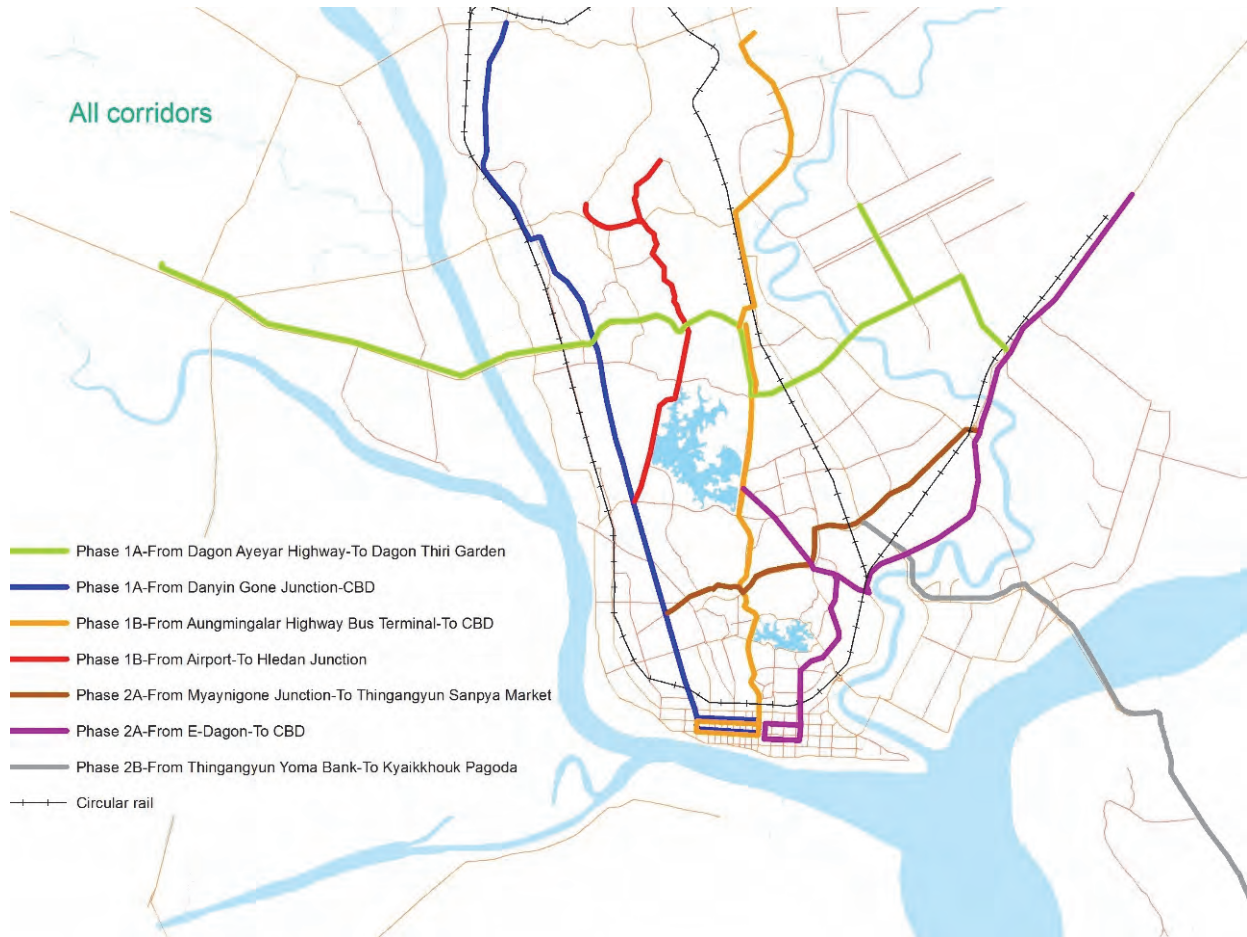
No.	Category	Project Name	Status	Construction Cost (USD)	Railway			TOD			Others			
					Short-term	Middle-term	Long-term	Short-term	Middle-term	Long-term	Short-term	Middle-term	Long-term	
RL-1	Urgent	TA for the Integration of Rail Transport Improvement and Station Area Urban Development in Yangon (Enhancing Transit Oriented Development)	Urgent	1										
RL-2	Urgent	TA for Commuter Service Level Enhancement in Greater Yangon	Urgent	2										
RL-3	Urgent	Railway Central Control Center System Installation (The study is ongoing by JICA)	Urgent	-										
RL-4	Urgent	TA for Railway Safety and Service Improvement (Ongoing by JICA)	Urgent	-										
RL-5	Related to YCR Western half Development	Yangon Circular Railway Improvement (Non-electrified) Phase1: Western Half Loop	Short-term	485	485									
RL-6	Related to YCR Western half Development	TOD Enhancement Project along Yangon Circular Railway Western Half	Short-term	6				6						
RL-7	Related to YCR Western half Development	Yangon Central Station Redevelopment Project	Short-term	704				704						
RL-8	Related to YCR Western half Development	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase1	Short-term	64								64		
RL-9	Related to YCR Western half Development	Kyee Myin Daing Station Yard Redevelopment Project	Middle-term	220						220				
RL-10	Related to YCR Western half Development	Insein Workshop Area Redevelopment Project	Middle-term	1,144						1,144				
RL-11	Related to YCR Western half Development	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase3	Middle-term	104									104	
RL-12	Related to YCR Western half Development	Electrified and Elevated Project for Yangon Circular Railway Western Half	Long-term	1,260				1,260						
RL-13	Related to Yangon-Mandalay Line Development	Yangon-Mandalay Line Improvement: Phase1 (Partial operation)	Short-term	144	144									
RL-14	Related to Yangon-Mandalay Line Development	Malwagone Depot/Workshop Area Redevelopment Project (including Track Improvement between Yangon Central Station and Malwagone Station)	Short-term	2,684				2,684						
RL-15	Related to Yangon-Mandalay Line Development	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase2	Short-term	244									244	
RL-16	Related to Yangon-Mandalay Line Development	Toe Kyaung Galay Station Development Project	Short-term	220						220				
RL-17	Related to Yangon-Mandalay Line Development	Yangon-Mandalay Suburban Line Electrification	Long-term	425				425						
RL-18	Related to YCR Eastern half Development	Yangon Circular Railway Improvement (Non-electrified) Phase2: Eastern Half Loop	Middle-term	568				568						
RL-19	Related to YCR Eastern half Development	Railway Land Redevelopment Project along Yangon Circular Railway Eastern-half	Middle-term	1,100						1,100				
RL-20	Related to YCR Eastern half Development	Electrification of Yangon Circular Railway Eastern Half	Long-term	398				398						
RL-21	Related to Yangon-Pyay Line Development	Yangon-Pyay Suburban Line Improvement and Double-tracking (between Danyingone R.S and Hnawbi R.S)	Middle-term	500				500						
RL-22	Related to Yangon-Pyay Line Development	Hlawga Station Development	Middle-term	220						220				
RL-23	Related to Yangon-Pyay Line Development	Yangon-Pyay Suburban Line Electrification	Long-term	302				302						
RL-24	Related to Thilawa Access	Thilawa Access Line Improvement and Double-tracking (for Commuter and Freight)	Middle-term	766				766						
RL-25	Related to Thilawa Access	Thilawa New Container Railway Station Development Project	Middle-term	40									40	
RL-26	Related to Thilawa Access	Thilawa Access Line Electrification	Long-term	393				393						
RL-27	UMRT	UMRT Line1 Construction Project (North-South Line)	Middle-term	2,253				2,253						
RL-28	UMRT	UMRT Line1 Extension Project (North-South Line Extension)	Long-term	693				693						
RL-29	UMRT	UMRT Line2 Construction Project (East-West Line)	Long-term	2,730				2,730						
				sum	628	4,067	6,201	3,614	2,684	0	412	40	0	
				sub-total			10,917			6,298			452	
				total										17,667

Source: YUTRA Project Team

2) Other Mass Transit Systems including BRT

(1) BRT network for Yangon and Construction Stage

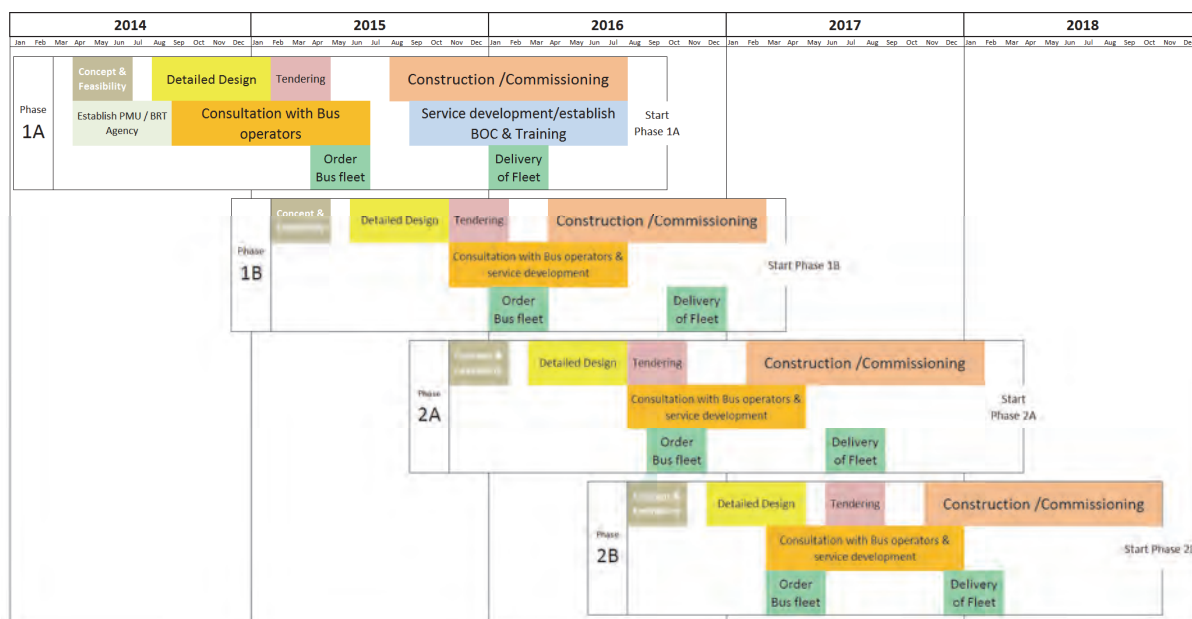
There are 11 BRT routes, however, some of them have overlapping sections and the corridors for construction can be categorized as shown in Figure 6.2.1.24. The build stages are designed to create an early and maximum impact to maximise the opportunity for motorists to use BRT during its early stages and prior to the full network being complete.



Source: YUTRA Project Team

Figure 6.2.1.24 BRT Corridors for Construction

Figure 6.2.1.25 and Table 6.2.1.11 show the phases of construction and length of busway construction required for each stage.



Source: YUTRA Project Team

Figure 6.2.1.25 BRT Implementation Schedule by Phase

Table 6.2.1.11 BRT Route and Construction Length (per phase) and Cost

	Corridor Construction (Km)		BRT Route Length (Km)		Project Cost (USD Mill.)
Phase 1A	Blue Line	22.4	BRT 1 (Red)	24.6	153
	Green Line	27.5	BRT 2 (Blue)	22.5	
			BRT 3 (L/Green)	25.0	
	Subtotal	49.9	Subtotal	72.1	
Phase 1B	Orange Line Section North	8.5	BRT 4 (Light Blue)	18.7	139
	Orange Line Section South	11.4	BRT 5 (Orange)	22.7	
	Red Line	11.2	BRT 6 (Pink)	25.6	
	Subtotal	31.1	Subtotal	67.0	
Phase 2A	Purple Line	20.3	BRT 7 (Dark Green)	19.5	111
	Brown Line	9.7	BRT 8 (Aqua Blue)	20.3	
			BRT 9 (Brown)	21.4	
	Subtotal	30.0	Subtotal	61.2	
Phase 2B	Grey Line	16.9	BRT 10A (Yellow)	23.5	69
			BRT 10B (Purple)	21.1	
	Subtotal	16.9	Subtotal	44.6	
TOTAL	127.9	TOTAL	244.9	472	

Source: YUTRA Project Team

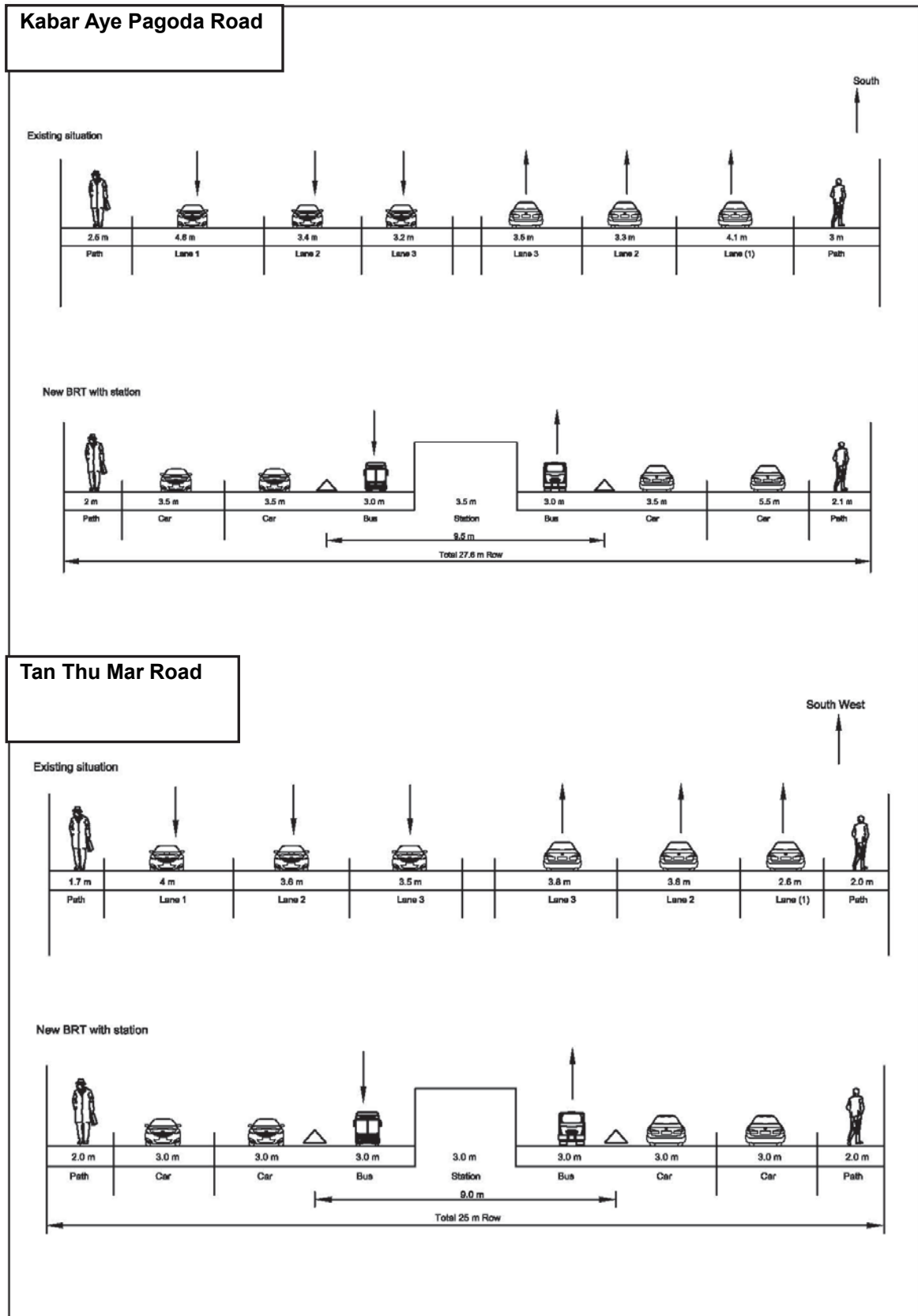
(2) Specific Design Guidelines for Yangon BRT

(i) Busway Design

The busway shall use the median lanes of the existing roadway. Most present ROW's are sufficient to allow the two centre laneways to be used for a BRT. Figure 6.2.1.26 illustrates examples of the typical cross-section of the proposed BRT. This includes the possible reassignment of road space and a BRT station accommodated on the ROW for illustrative purposes.

A concrete barrier shall separate the bus lane from mixed traffic lanes. In narrow or constrained areas a soft barrier shall allow other traffic to enter the bus lane if necessary. Existing road surface can be used where they are in good condition, or if not, will need to be resurfaced.

The introduction of a BRT can be used to reorganise the corridor, increasing walking path spaces, removing car parking and reordering road space accordingly.



Source: YUTRA Study Team

Figure 6.2.1.26 Typical Cross-section of BRT (example)

(ii) BRT stations

The location of BRT stations shall be approximately 800m apart along the BRT route. BRT stations shall be designed as a high platform (90cm) to suit a high floor bus. In almost all cases are 3.5m wide and according to bus demand be 2 or 3 berth long. In some cases where space is constrained, a 3m wide station is permitted, but the station length should be increased to accommodate passenger numbers. Passing lanes for express buses at bus stations are considered unnecessary, as bi-articulated buses will operate, offering large capacity. Stations will be staffed with a marshall at each platform and have a ticket office on or near the platform.

Stations shall operate as closed stations, meaning that entry to the station is only possible with payment at the ticket barrier.

Pedestrian entry shall be at-grade (using a 200mm raised crossing design) and signalised to ensure safe road crossings. A 1:10 incline ramp to the station platform will provide universal access.

A bus guide-wheel will be used at station platforms to minimise the BRT lane width at stations and allow predictable and safe docking of the bus, and avoid any collision with the platform. All stations will be a straight platform design for long buses to enter without requiring any turning movement.

The capacity of stations to accommodate buses is a major constraint to the system capacity, and therefore accurate scheduling of buses is needed to avoid station platform overcrowding (through bus bunching). For this reason good intersection management is required.

(iii) Intersection management

The BRT shall operate at-grade wherever possible, however where there is a traffic flyover, the BRT would operate in the median lanes of the flyover. Flyover construction on BRT routes should be avoided, as it restricts turning movements of BRT buses onto cross streets (where BRT lines intersect). A BRT bus by-passing a flyover can be allowed, but there is traffic conflict at the approach and exit of the flyover as mixed traffic and buses need to cross-over.

The main objective for intersection control is to reduce the amount of red-light interference to buses so that buses do not bunch up and overcrowd the next station. The most suitable approach is to synchronise the bus movement to the natural green phase of the traffic lights, by signalling the bus at the platform to depart at a time that will coincide with arriving at the next signal intersection at the cyclical green phase.

Where BRT traffic is heavy, buses can be platooned into a convoy. This will increase the gap between services to allow cross-traffic movements. Up to 4 buses in a platoon can operate, as a two berth station can service a four bus platoon (in a 2+2) configuration. Such an intensive BRT movement needs to be modelled carefully and building one additional platform at certain risk prone stations will allow space for a bus that drops out from the platoon.

(iv) Bus Fleet

The recommended option for Yangon, due to the high level of travel demand, is the use of

25m long bi-articulated buses (double bendy) combined with some low-density routes operating 12 metre rigid body city bus. The decision for the 25m long bus design also provides financial benefit as this is the only option that allows a profitable operation at current bus fares.

The high floor design is recommended as buses are easier to maintain, and if CNG tanks need to be stored, they can be positioned under floor. The other advantage of a high floor design is less interference in the bus interior with wheel arches obstructing passenger movement. The space inside the bus must allow free access so that there is no obstruction or delay during boarding and alighting.

The issue of energy propulsion has been evaluated, with the conclusion that CNG is a feasible option for the Yangon Bus fleet, and that the various operational issues can be managed. CNG offers an overall 14% cost saving.

However the best financial performer over the life of the bus is the electric trolley system, as buses have a service life of 20-30 years (Diesel or CNG buses will be replaced after 1 million km after 10-15 years) and energy cost is cheaper. The lower cost of vehicle maintenance is an advantage, but is partly offset by additional overhead power grid maintenance. Emissions and energy wise however, it is also a favoured option, providing clean, quiet and smooth operation, highly suited to a mass transit system. The concern on electricity supply will be overcome by each bus being equipped by an APU back-up power unit (for use up to 10km), and for longer outages a number of backup generators for the system are used.

An electric articulated trolley bus is very similar to an LRT type service, and Yangon's decision makers should evaluate this option during the Concept and Feasibility Design of Phase 1A. Suppliers of trolleybus system should be contacted to explore possibilities and also ODA financing opportunities.

(3) Operation Plan

The Operation Plan defines the service plan and the financial feasibility of the BRT system.

The operational modelling has tested five scenarios, against bus size and alternative propulsion systems. The base case is a mostly articulated bus fleet operating on diesel fuel. A bi-articulated bus option was then tested and both scenarios tested with CNG fuel. Finally a bi-articulated bus option was tested with electric propulsion.

(i) Travel demand

The scenarios of the Operational Plan are based on existing demand levels. During the feasibility study and design of each corridor to be conducted in the near future, the line volume will need to be confirmed. The model counts all existing truck-bus, small bus and large bus passengers in the BRT travel demand.

Infrastructure design needs to consider building for maximum (future) capacity; however at the time of the feasibility study for each corridor the level of existing demand (and early growth) will be assessed to determine the required fleet strength for start-up.

(ii) Physical Infrastructure and travel efficiency

Operational modelling informs the business plan and financial feasibility, and the level of

fare and whether subsidy support is needed. A key objective is to design for efficiency so that operational subsidy can be avoided.

In this regard, the physical infrastructure needs to be designed to deliver 1) efficient operating speed and 2) adequate space at BRT station platforms to avoid bus congestion and 3) managed intersections to regulate buses along the busway.

The operational model indicates buses will need to maintain an average operating speed of 20 to 25kph in order to be viable. As speeds reduce, financial losses increase.

Maintaining good commercial speeds also requires good management of intersections so that 1) buses can avoid red-light interference and 2) buses avoid bunching; causing congestion and delays at the next station. Management of bus priority signalling and bus movements has been discussed earlier. Busway design also needs to be well-segregated from mixed traffic, and stations need to be sufficiently sized so that they can manage the capacity (numbers of buses) adequately.

(iii) Affordability

A major issue for Yangon is that passengers are very sensitive with bus fares currently at 20% below comparable developing cities. Typically, due to better efficiency, BRT systems can operate at present fare levels (usually about US\$ 0.30) and be able to cover costs; however in Yangon this is not so. The following box outlines the situation.

<p><i>What are passengers paying now, and what is affordable?</i></p> <p>Affordability is gauged by looking at what passengers are presently paying for a single journey.</p> <p>While the official fare level is set at K 50 flagfall and K 6 per km, the Household Interview Survey (HIS) shows that actual fare paid is K 156 and 31 per km (see Table 4.4.2.2) taking into account that transporters may be charging a higher fare, and when passengers transfer, they incur a second fare.</p>	<p>Household Interview Survey (HIS) (SUDP, JICA, 2013)</p> <p>(what passengers are actually paying for journeys)</p> <table style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th>Flagfall</th> <th>Per km</th> </tr> </thead> <tbody> <tr> <td>Para-bus</td> <td>82</td> <td>40</td> </tr> <tr> <td>Large bus</td> <td>179</td> <td>27</td> </tr> <tr> <td>All bus</td> <td>156</td> <td>31</td> </tr> </tbody> </table>		Flagfall	Per km	Para-bus	82	40	Large bus	179	27	All bus	156	31
	Flagfall	Per km											
Para-bus	82	40											
Large bus	179	27											
All bus	156	31											

(iv) Operation Scenario Test

Table 6.2.1.12 shows the result of operation scenario test for the full network being a typical BRT design using 18 metre articulated buses (using diesel and CNG fuel) on the most dense routes, but on lighter routes (where bus frequency would exceed 5 minutes) use of a standard 12 metre citybus is assumed. All scenarios have adopted the existing fare level.

The result shows that losses are incurred of US\$ -11.6M (Diesel) and US\$ -4.9M (CNG) which would either require operational subsidy support or a fare increase of 14% and 7% respectively. It is uncertain if a fare increase of this size would be feasible given the price sensitivity. While this level of fare may be justified by the level of service improvement some accommodation of the lowest affordability sector may need to be made.

Table 6.2.1.12 also shows the result of employing larger buses, being double articulated design with 24-25 metres long. This has the advantages of reducing the volume of bus traffic on the busway (by 20-25%) solving some potential congestion, and also reducing the

fleet requirement by 35%; (from 703 buses to 454 buses) significantly reducing fleet and operating costs and bringing the system into profit.

Table 6.2.1.12 Operating Results for Five Tested Scenarios

Scenario:	(1) Base Case		(2) Base Case using CNG		(3) Larger bus Diesel		(4) Larger bus using CNG		(5) Trolleybus	
Fare Level:	Current fares		Current fares		Current fares		Current fares		Current fares	
Fuel Type:	Diesel		CNG		Diesel		CNG		Electric	
Bus Type:	Articulated and Citybus		Articulated and Citybus		Bi- Articulated and Citybus		Bi-Articulated and Citybus		Bi- Articulated Trolley and Citybus	
Total Fleet (all bus types)	707		707		462		462		465	
% energy cost of bus operating costs	49%		31%		49%		33%		42%	
Occupancy	80%		80%		80%		80%		80%	
Operating Results	US\$000		US\$000		US\$000		US\$000		US\$000	
Gross Profit	\$73,498		\$73,498		\$73,106		\$73,106		\$73,111	
Management Costs (A)	\$5,112	6%	\$5,112	6%	\$5,112	7%	\$5,112	8%	\$5,112	5%
Fleet Cost (B)	\$28,700	34%	\$35,412	45%	\$26,891	39%	\$31,277	49%	\$60,299	64%
Bus Operations Cost (C)	\$51,851	61%	\$38,391	49%	\$36,405	53%	\$28,098	44%	\$28,264	30%
Total Costs	\$85,663		\$78,916		\$68,408		\$64,487		\$93,676	
Year 1-5 Profit/Loss (000)	-12,165		-\$5,418		\$4,698		\$8,618		-\$20,565	
% cost recovery	86%		93%		107%		113%		78%	
Fare increase for full cost recovery	16.0%		7.0%		---		---		23.0%	

Source: YUTRA Project Team

The above table also demonstrates the impact of using different fuel and propulsion technologies. Under a diesel fuel scenario energy cost represents almost 50% of total bus operating costs whereas using CNG this reduces to 31-33%. Scenario 2 shows a US\$6.7M improvement by switching to CNG fuel and Scenario 4 a US\$3.9M improvement for larger buses. Electric propulsion (trolleybuses) has energy costs at 42% of total bus operating costs. While Scenario 5 Electric Propulsion has a larger early year loss (US\$-19M p. a. for first 5 years), it has an overall profit over a 20 year lifespan as the trolleybuses have double the life of diesel or CNG buses.

Note: The cost of energy in the trolleybus scenario has been modelled at K100/KWh which is 25% above the present rate.¹

The 20 year 'whole of life scenario is shown in Table 6.2.1.13 indicating that the most profitable option is the electric trolleybus. Mainly because the trolleybus has double the life span of diesel or CNG buses, with less mechanised parts.

¹ Note: the present (2012) cost of Electricity per KWh is MMK 75. Calculations in the model have used MMK 100 as the tariff being sustainable rate recommended by ADB report: 'Electricity Demand and Supply in Myanmar' December 2012

<http://www.ash.harvard.edu/Home/Programs/Institute-for-Asia/Publications/Occasional-Papers>

Table 6.2.1.13 20 Year Result for All Scenarios

<i>(Present Fares & Costs at 2013 \$ value)</i>					
Year 1-5 Profit/Loss (000)	-11,670	-\$4,904	\$5,780	\$9,671	-\$19,299
Year 6-10 Profit/Loss (000)	-\$10,897	-\$3,947	\$5,780	\$10,515	-\$17,658
	<i>Buy new fleet (+30%)</i>	<i>Buy new fleet (+30%)</i>	<i>Buy new fleet (+30%)</i>	<i>Buy new fleet (+30%)</i>	<i>Refurbish Bus (\$100K ea)</i>
Year 10-15 Profit/Loss (000)	-\$20,051	-\$15,288	-\$1,648	\$515	\$28,232
Year 16-20 Profit/Loss (000)	-\$19,047	-\$14,044	-\$1,648	\$1,612	\$40,042
Average 20 year Profit/Loss (p.a)	-\$15,416	-\$9,546	\$2,066	\$5,578	\$7,829

Source: YUTRA Project Team

3) Conventional Bus

Poorly planned current bus system resulted in bus route overlapping, worsening traffic congestion, and reducing the capacity of public bus transport system. Therefore, restructuring of bus network is required to improve the efficiency of bus operation. This restructuring, however, should be done according to the following principles:

1. A new business model that enables investment on clean and efficient fleet and other modern facilities should be introduced.
2. Rerouting of buses should be conducted as MRTs and BRTs are constructed. Conventional bus should shift step-wise from trunk services to feeder services. In this case, major railway/BRT stations or terminals should provide buses with enough space for the convenience of transferring passengers.

This is, in one word, a systematic and coordinated approach as the entire public transport system of Yangon. Bus operation is required to change gradually as BRTs and urban railways start operation. This change will be represented by major two movements; 1) modernization of fleet and passenger facilities including bus stops and terminals, and 2) shift from trunk service to feeder service.

In the light of the above, the following project is proposed:

- A. Project Title: Improvement of Existing Public Bus Transport Services in Yangon Region
- B. Project Outline:
 - Restructuring of bus network
 - Modernization of bus services
 - Development of bus terminals and interchanges
 - Prioritization of urban bus transport

The total cost of this project is about US\$ 108 million. Refer to the project profile in the Appendix of this report for details.

6.2.2 Road Development Projects

1) Geometric Standards

An important factor in the development of road hierarchy is road design standards. Unfortunately, road design standards in Myanmar are incomplete. Road classification by function involves applying standards on key design elements, such as design speed, speed limits, access control, treatment of intersections and others. The draft of road geometric standards is considered as below.

(1) Design Standards

a) Design speed

The design speed must be appropriate for road level and function, in addition to traffic volume, area topography, and economic considerations. Design speed specifications differ among the various regulations in use in the world. Table 6.2.2.1 shows standards by AASHTO and MOC (PW). In case of MOC, design speeds are mainly specified by topographical features, such as flat, rolling and mountainous. Therefore, in Yangon urban area, design speed of AASHTO seems suitable to apply by each road classifications, such as major arterial roads, secondary arterial roads, collector roads and local roads.

**Table 6.2.2.1 Design Speed Specifications
 - AASHTO**

Area	Road Class	Speed(km/h)	
		Minimum	Desired
Urban	Local	30	40
	Collector	40	60
	Secondary Arterial	60	80
	Main Arterial	80	100

- MOC (PW)

Design Class		D-VI	D-V	D-IV	D-III	D-II		D-I
		Single Lane		2 lanes		4 lanes		Divided(2)
Annual Average Daily Traffic		Under 50	50-200	200-500	500-2,500	Over 2,500		
Design Speed (km/h)	Flat	80	80	60	60	113	113	
	Rolling	64	64	80	80	97	97	
	Mountainous	48	48	64	64	80	80	

Source: AASHTO, PW

b) Lane width

Lane width has a direct impact on road capacity and the safety and comfort of users. Narrow lanes force the driver to move close to the other vehicles which affects negatively the smoothness traffic flow. Safety increases with increase of lane width to 3.60 meters. This width provides sufficient side clearance for trucks moving on the roads. Sometimes the location forces the designer to make the lane width less than 3.6 meters, but it must not be less than 3 meters. In special cases like populated areas roads of low traffic, lane width can be 2.75 meters. While using additional lanes for speed change, the width of these lanes have to be equal to the width of main lanes i.e. not less than 3 meters. The number of lane is determined by capacity and design traffic volume as illustrated in the part concerned with

traffic studies. In industrial zones where the number of trucks is high, lane width can increase to 4 meters. The lane widths proposed for the Project are shown in the typical cross sections proposed for the projects.

c) Median

The median is the separating section between the two directions of divided road. The main aim of the median is to separate the two traffic directions and provide a width that gives the high speed vehicle driver the chance to regain control over his vehicle in emergency and gives width for making different speed lanes or u -turn lanes as well as future road expansions. The median reduces the effect of lights coming from opposite direction cars. The width of the median should cope with the other dimensions of the road. Its level can be high (mostly in urban roads) or low (mostly in rural roads) than the level of the middle of the road. The median must be clearly seen day and night. The width of the median is also associated to road classification as illustrated in Table 6.2.2.2.

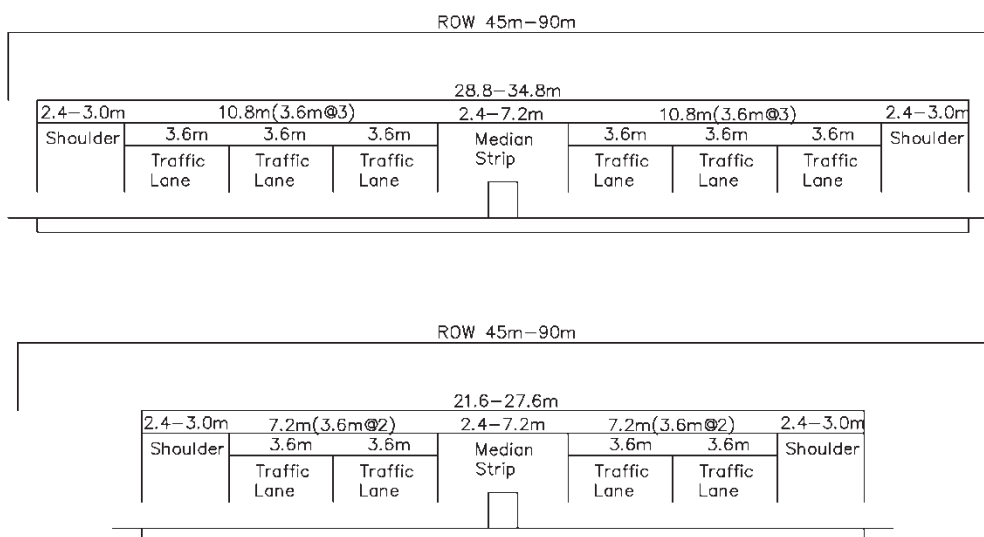
Table 6.2.2.2 Median Specification (AASHTO)

Road Class	Minimum Lane Width (m)	Minimum Median Width (m)
Local	2.70	-
Collector	3.30	0.6
Secondary Arterial	3.60	3.6
Major Arterial	3.60	3.6 - 15

Source: AASHTO

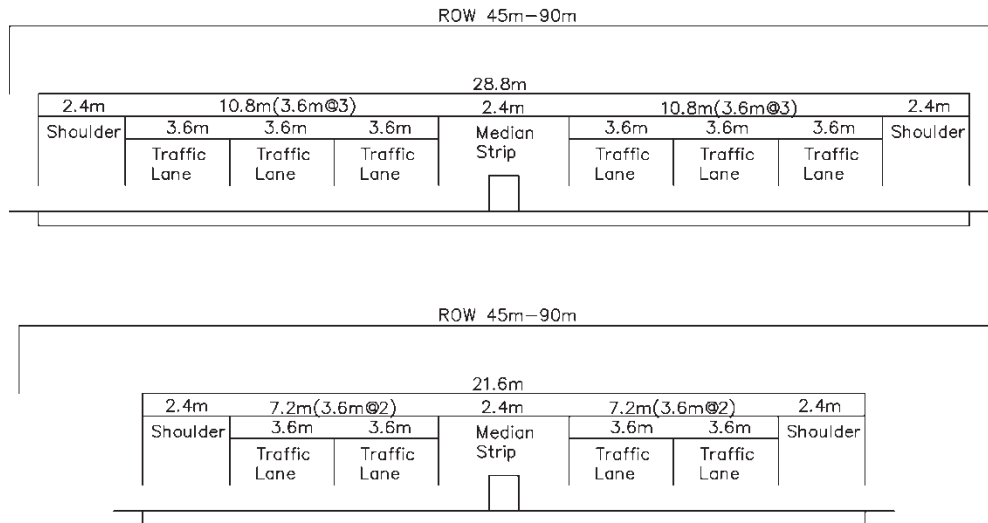
(2) Cross Sections

Based on the proposed road classification in previous Chapter 4.5.3 (Table 4.5.3.2), typical cross sections for expressways and major roads have been prepared as shown in Figure 6.2.2.1 to Figure 6.2.2.6.



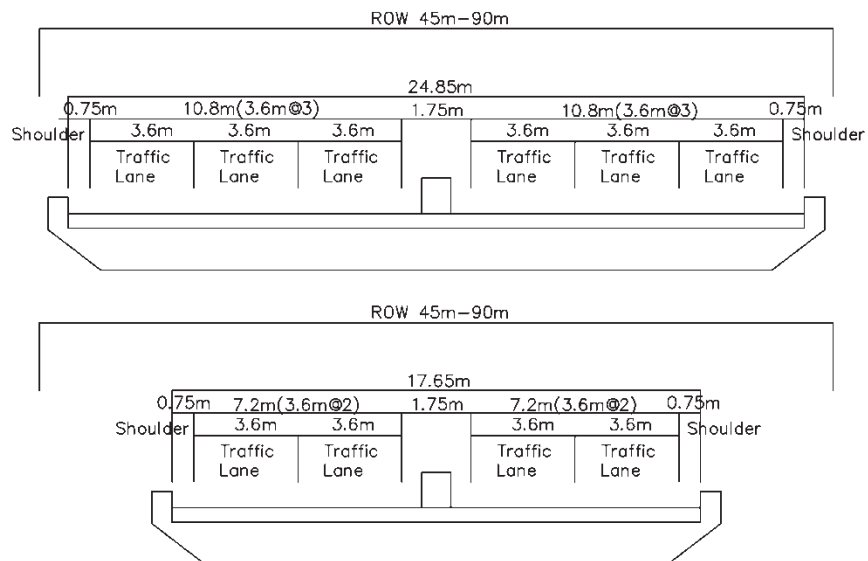
Source: YUTRA Project Team

Figure 6.2.2.1 Typical Cross Section for Inter Urban Expressway



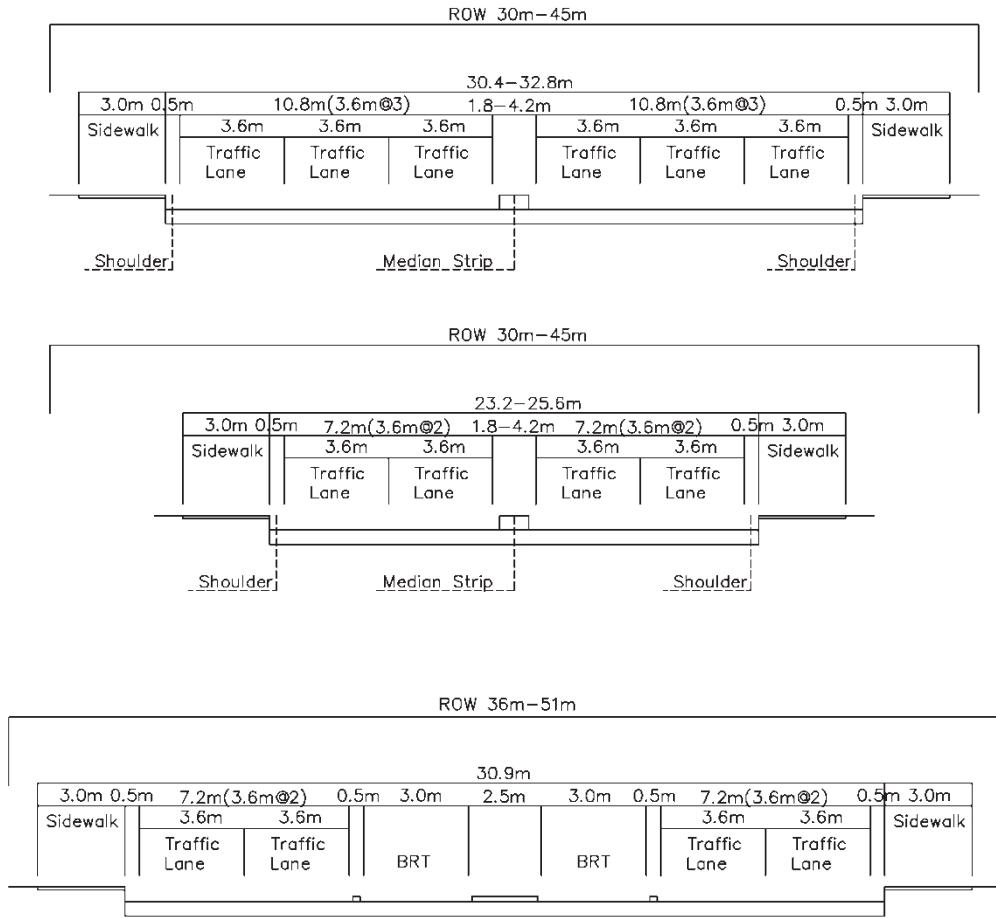
Source: YUTRA Project Team

Figure 6.2.2.2 Typical Cross Section for Intra Urban Expressway (at Grade)



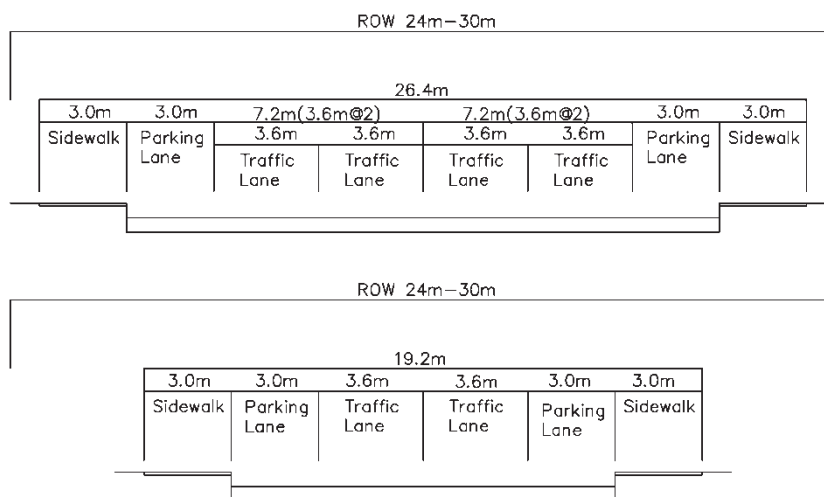
Source: YUTRA Project Team

Figure 6.2.2.3 Typical Cross Section for Intra Urban Expressway (Bridge)



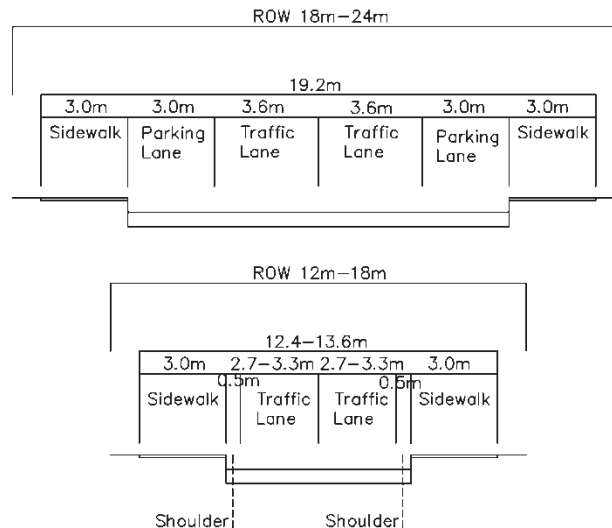
Source: YUTRA Project Team

Figure 6.2.2.4 Typical Cross Section for Major Arterial Roads



Source: YUTRA Project Team

Figure 6.2.2.5 Typical Cross Section for Secondly Arterial Roads



Source: YUTRA Project Team

Figure 6.2.2.6 Typical Cross Section for Collector and Local Streets

2) Arterial Road Network Plan

Major features of arterial road network plan are the followings;

Network Layout

- Main frame of arterial roads network consist central zone (CBD and developed area), outer ring road and radial lines by major arterial roads.
- Grid roads by secondary arterial roads shall be arranged in the area surrounded by major arterial roads.
- Network layout shall be accommodated with the urban development plan proposed by SUDP.

CBD Area

- Construction new road at grade and widening are difficult because of high density area.
- Existing road capacity can be improved by prohibition on-road parking, installation of parking facility, introduction TOD (Transit Oriented Development) and ITS, and others.

Urban Developed Area

- Construction new road at grade and widening are difficult because of density area.
- Existing road capacity can be improved by minimum widening, installation of BRT system, pavement repairing, signal improvement, introduction ITS, and others.
- Designated truck route for heavy logistic vehicles from/to Yangon port shall be avoided to pass through developed area.

Urban Developing Area

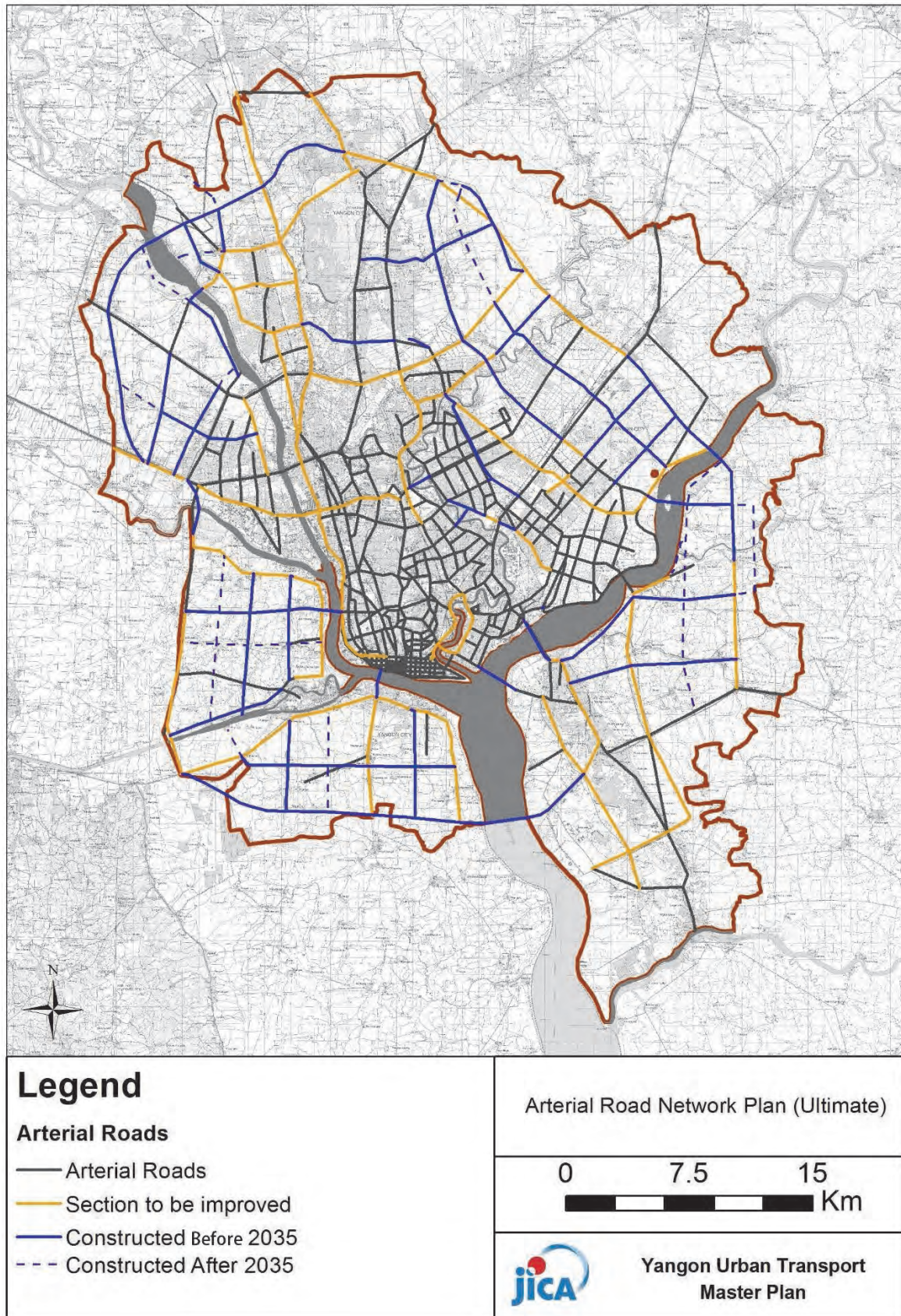
- New major arterial roads are required to accelerate an urban development.
- Part of existing major roads can be widened.

- Secondary arterial roads are required to complement major roads.
- Existing road capacity can be improved by maximum widening, pavement repairing, introduction ITS, and others.

Suburban Area

- New major arterial roads are required to accelerate development.
- Most existing major roads can be widened.
- Secondary arterial roads are required to complement major roads.
- Existing road capacity can be improved by maximum widening, pavement repairing, and others.
- For major river crossing to access suburban area, long span bridges are required.

According to the results of traffic demand forecast analysis in previous section 4.4.4, arterial road network plan in the ultimate stage is shown as Figure 6.2.2.7.



Source: YUTRA Project Team

Figure 6.2.2.7 Arterial Road Network Plan (Ultimate)

3) Expressway Network Plan

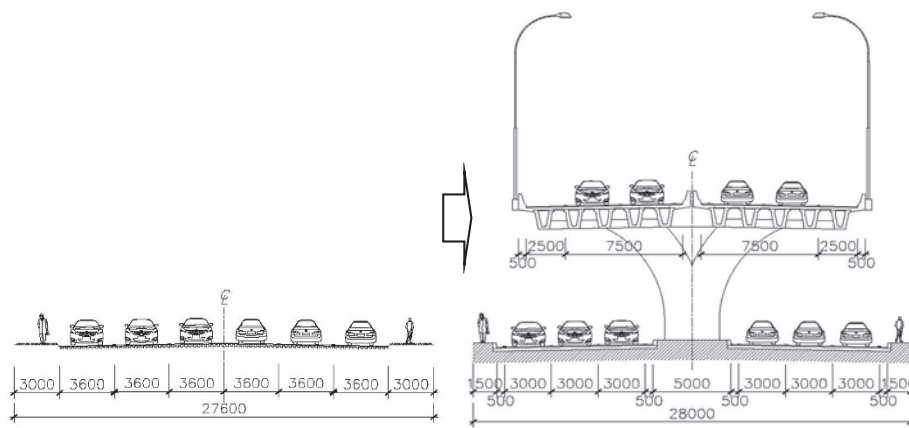
Major features of expressway network plan are the followings;

Network Layout

- Main frame of Urban Expressway Network consist inner ring road, outer ring road and radial lines.
- At main access point to major arterial roads, interchange shall be installed.
- Route alignment of expressway is basically along major arterial roads especially in developed and developing area.
- Existing expressway from Yangon to Mandalay shall be connected directly to Urban Expressway.
- Network layout shall be accommodated with arterial road's network and the urban development plan proposed by SUDP.

Inner Ring Expressway

- Inner Ring Expressway can be constructed above existing major arterial roads in developed area as elevated viaducts with 4 lanes.
- Typical cross section of 4 lanes Inner Ring Expressway is shown in Figure 6.2.2.8. Width of traffic lane of existing arterial road shall be narrowed from 3.6 m to 3.0 m, and pier of viaduct is located medium strip.
- North section of Inner Ring Expressway can be constructed as embankment.



Existing Road

Existing Road + Inner Ring Expressway



**Image of Inner Ring Expressway
 (Wai Za Yan Tar Road)**



**Route Alignment of Inner Ring
 Expressway**

Source: YUTRA Project Team

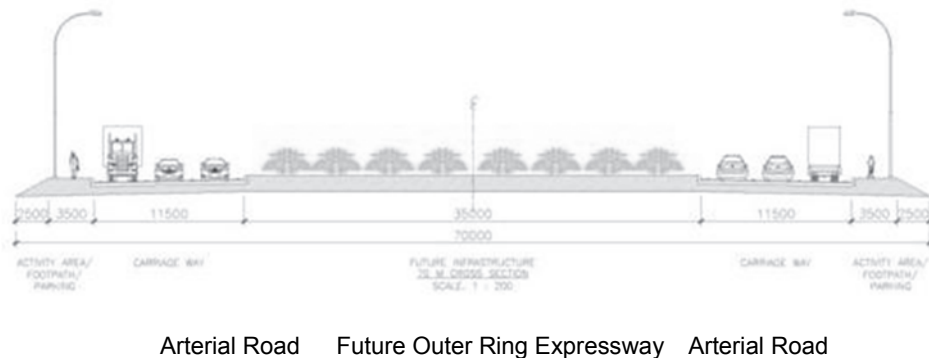
Figure 6.2.2.8 Typical Cross Section and Image of Inner Ring Expressway

Radial Line Expressway

- Route alignment of Radial Line Expressway is basically along existing major arterial roads.
- In developed and developing area, if there is no available land along the existing road, expressway shall be constructed viaduct as the same as Inner Ring Road.
- In suburban area or part of developing area, expressway can be constructed as embankment separated to existing road.
- For major river crossing, long span bridges are required.

Outer Ring Expressway

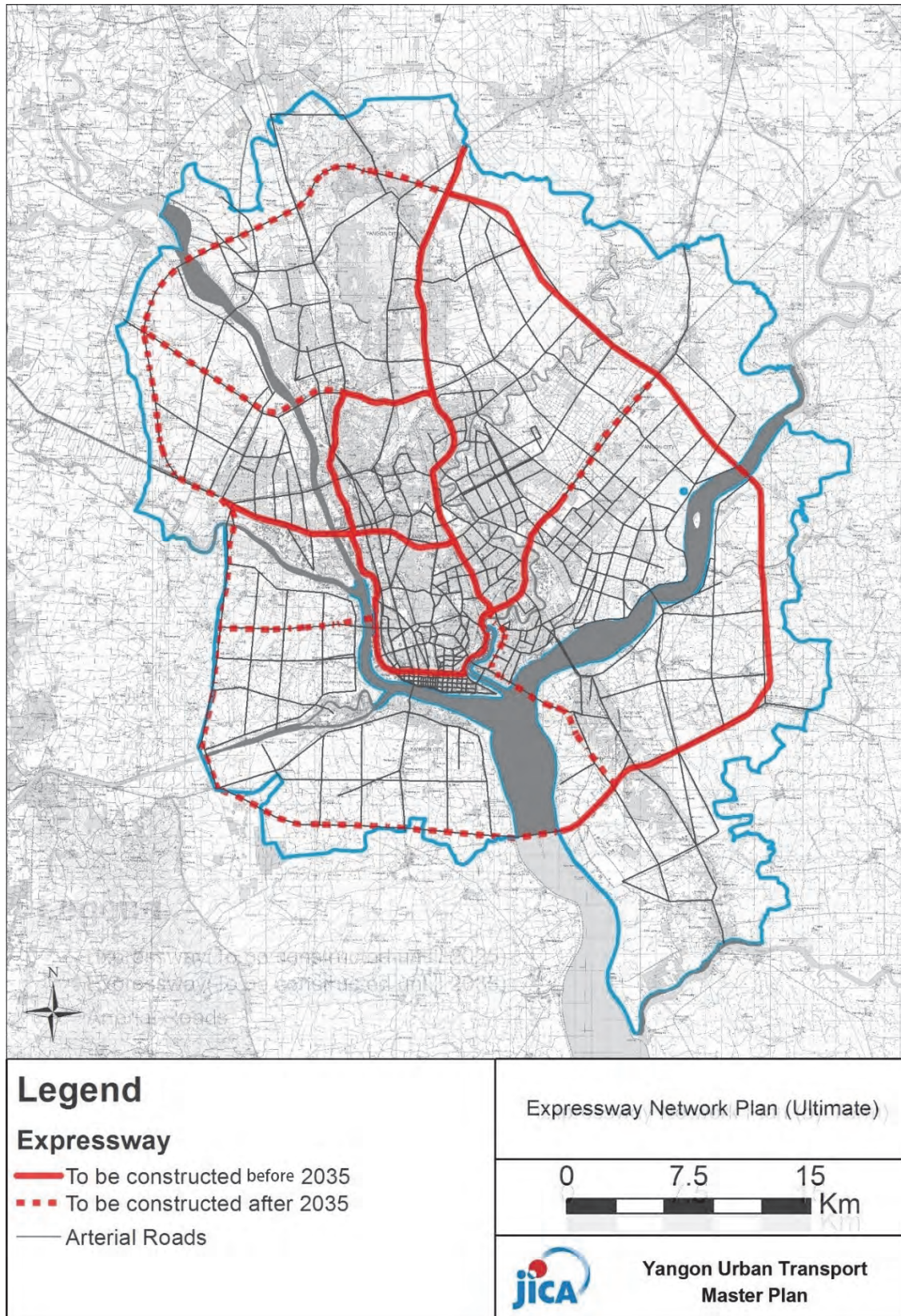
- Route alignment of Outer Ring Expressway is basically along major arterial roads to be constructed.
- Eastern section of Outer Ring Expressway shall be constructed until 2035 to connect national transport to Thilawa SEZ.
- Other sections of Outer Ring Expressway will be required after 2035, however early land acquisition is recommendable before the development along outer ring arterial road.
- Typical cross section of Outer Ring Expressway is shown in Figure 6.2.2.9.



Source: YUTRA Project Team

Figure 6.2.2.9 Typical Cross Section of Outer Ring Expressway (Reference)

According to the results of traffic assignment analysis in previous chapter 4.4.4, expressway network plan in the ultimate stage is shown as Figure 6.2.2.10.



Source: YUTRA Project Team

Figure 6.2.2.10 Expressway Network Plan (Ultimate)

4) Road Development Projects for Each Target Year

Short Term Projects (2018)

The target year for the short term plan is 2018 and the objectives are listed below and highlighted in Figure 6.2.2.11.

- Connectivity with national transport
- Decentralization to northern and eastern area to accelerate the development of Mindama, Thilawa and Bago Riverside sub-senter.
- Connectivity to Thilawa SEZ
- Diversion of truck route

Middle Term Projects (2025)

The target year for the short term plan is 2025 and the objectives are listed below and highlighted in Figure 6.2.2.12.

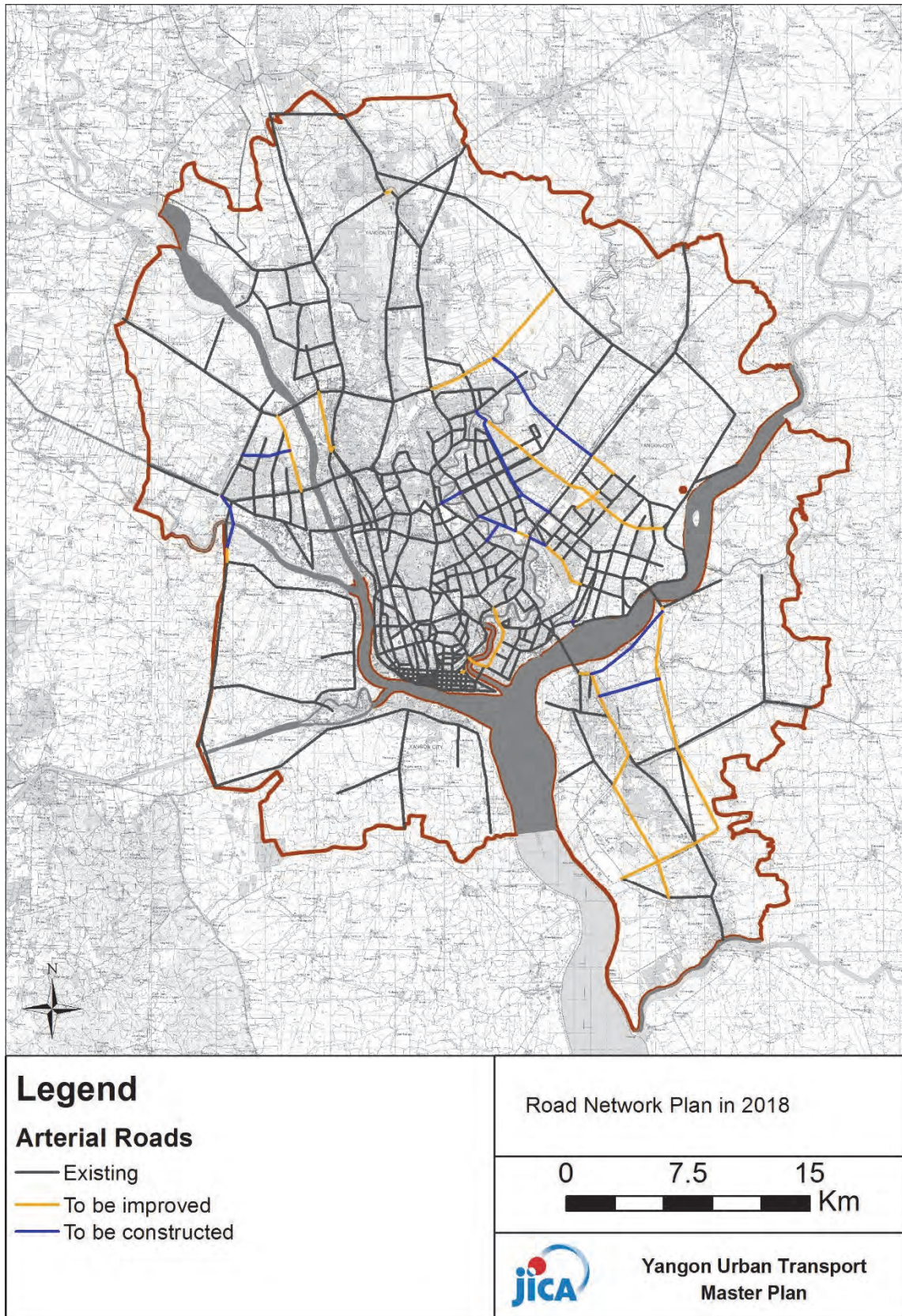
- Decentralization to northern and eastern area to accelerate the development of Thilawa, Dagon Myothit and Hlaing Tharaya sub-senter.
- Extension to road network to Hlegu, Hmawbi and East Dagon New Town Cores.
- Build north-south Urban Expressway axis.
- Build Outer Ring Expressway to connect national transport to Thilawa SEZ

Long Term Projects (2035)

The target year for the short term plan is 2035 and the objectives are listed below and highlighted in Figure 6.2.2.13.

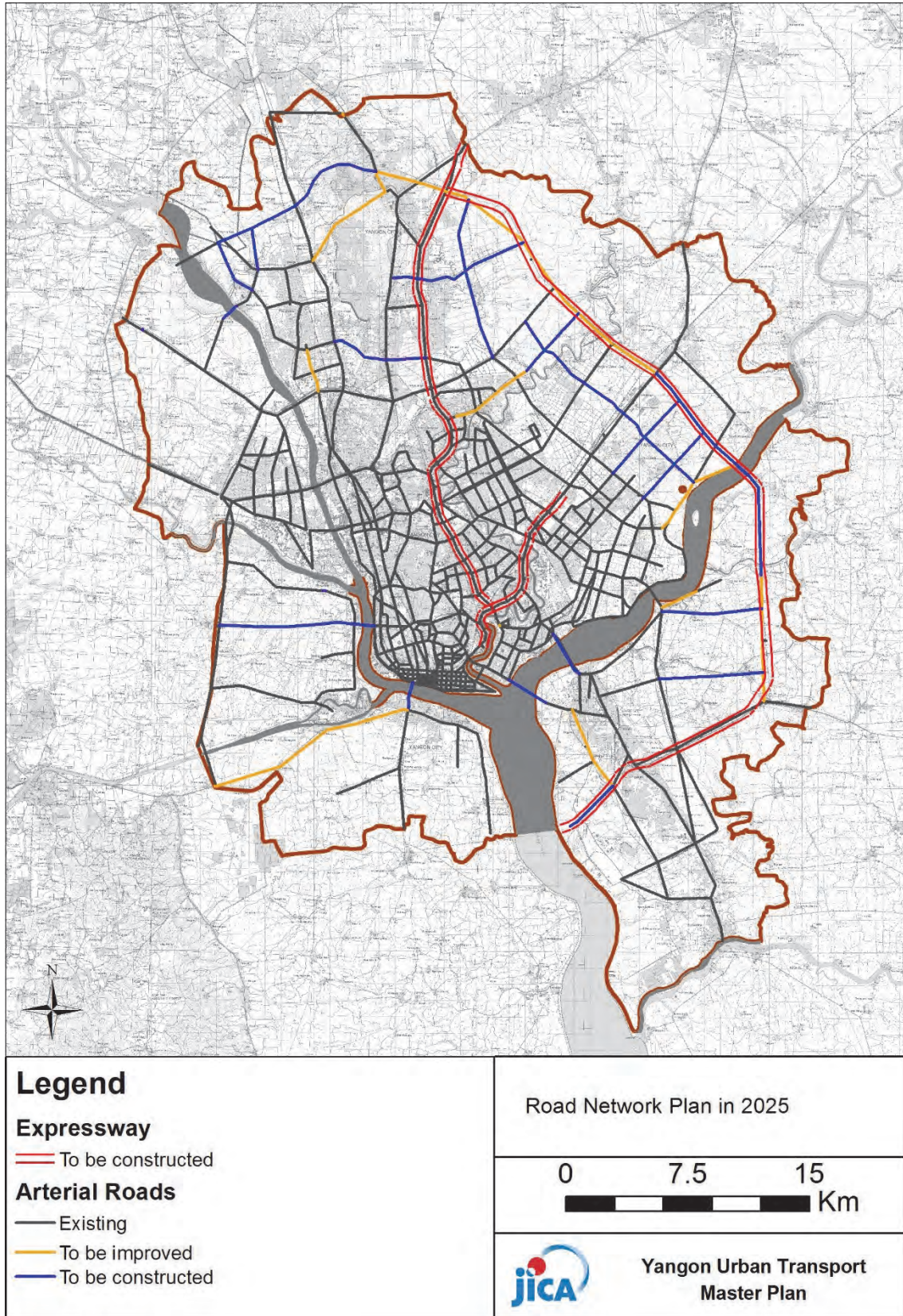
- Development of western and southern area.
- Extension to road network to Thanlyin, Dala, Twantay and Htantabin New Town Core.
- Closing of Inner Ring Expressway and outer ring arterial road.

As reference, road development projects after long term are shown in Figure 6.2.2.14.



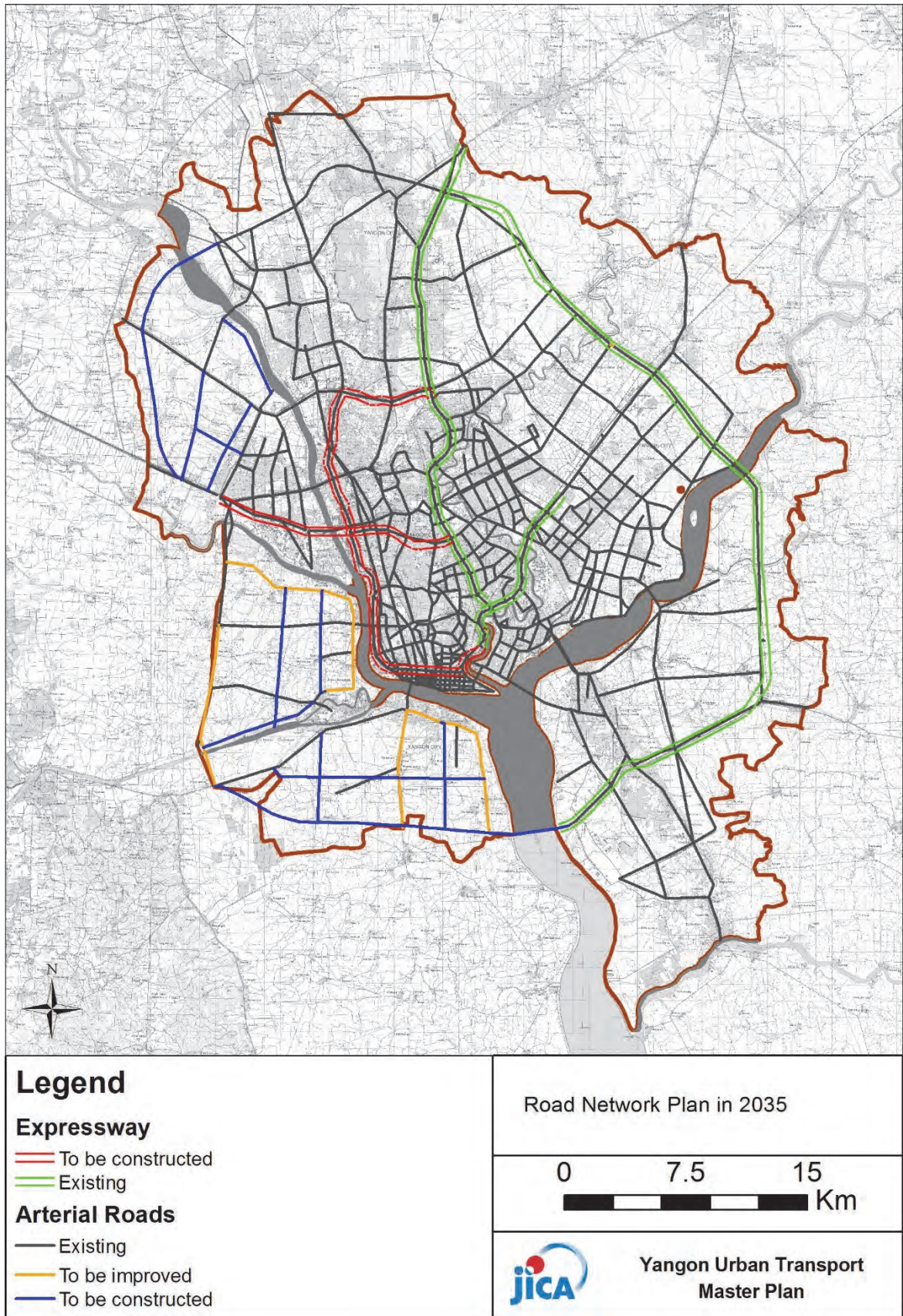
Source: YUTRA Project Team

Figure 6.2.2.11 Short Term Projects (2018)



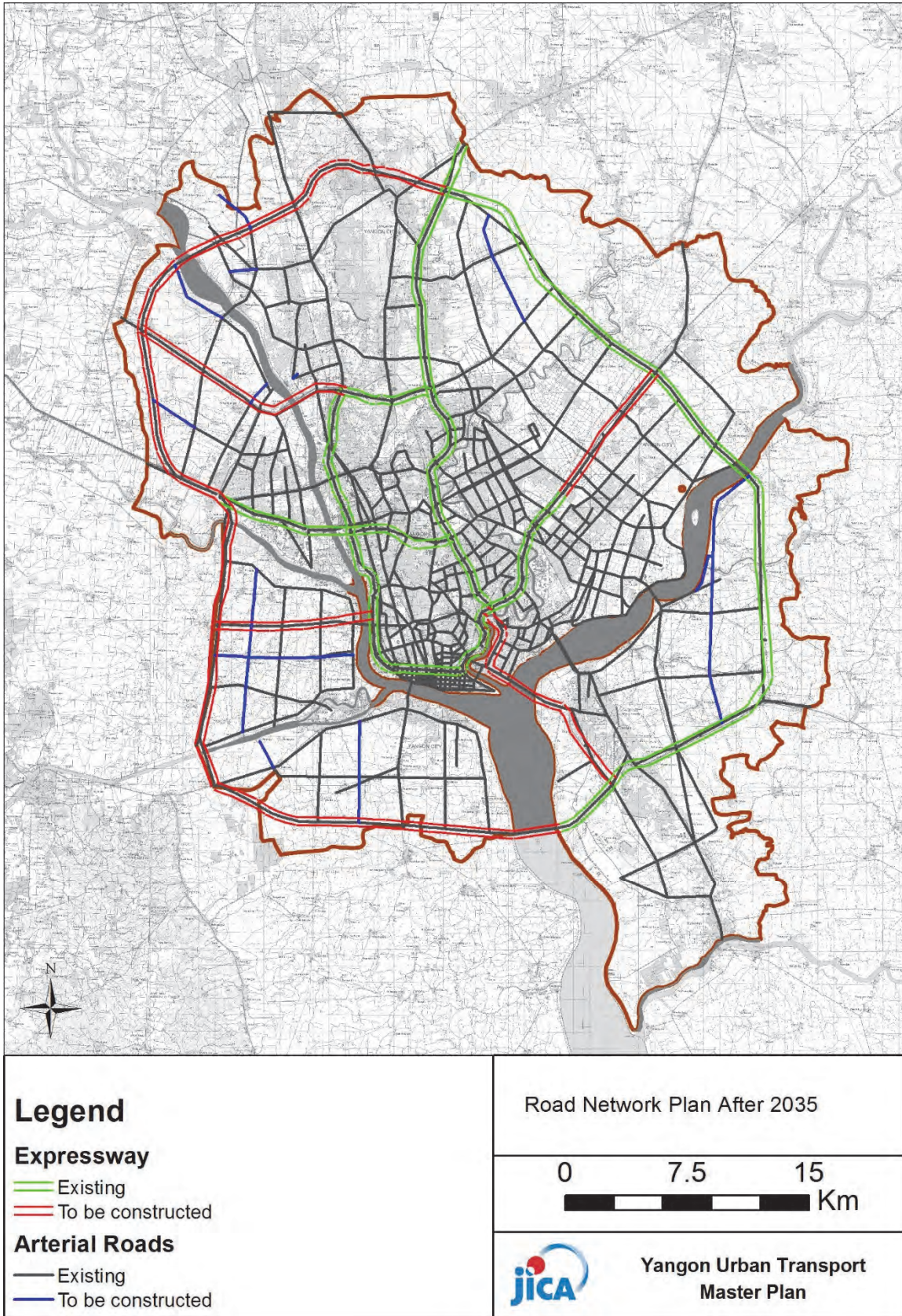
Source: YUTRA Project Team

Figure 6.2.2.12 Middle Term Projects (2025)



Source: YUTRA Project Team

Figure 6.2.2.13 Long Term Projects (2035)



Source: YUTRA Project Team

Figure 6.2.2.14 Road Development Projects (after 2035) <Reference>

5) Term-wise Road Development Project List

Term-wise road development projects are listed in Table 6.2.2.3.

Table 6.2.2.3 List of Road Development Projects

- Short Term: 2018 (including urgent)

Category	Project Name
Arterial Road	Construction of New Thaketa Bridge (Urgent)
Arterial Road(New Construction)	Construction of Arterial Roads based on the proposed road network by YUTRA
Arterial Road(Widening)	Improvement of Existing Arterial Roads based on the proposed road network by YUTRA
Traffic Control	Installation of Advanced Traffic Management System (ATMS), Phase 1 (Urgent)
Traffic Control	Installation of Advanced Traffic Management System (ATMS), Phase 2
ITS	Formulation of ITS Master Plan

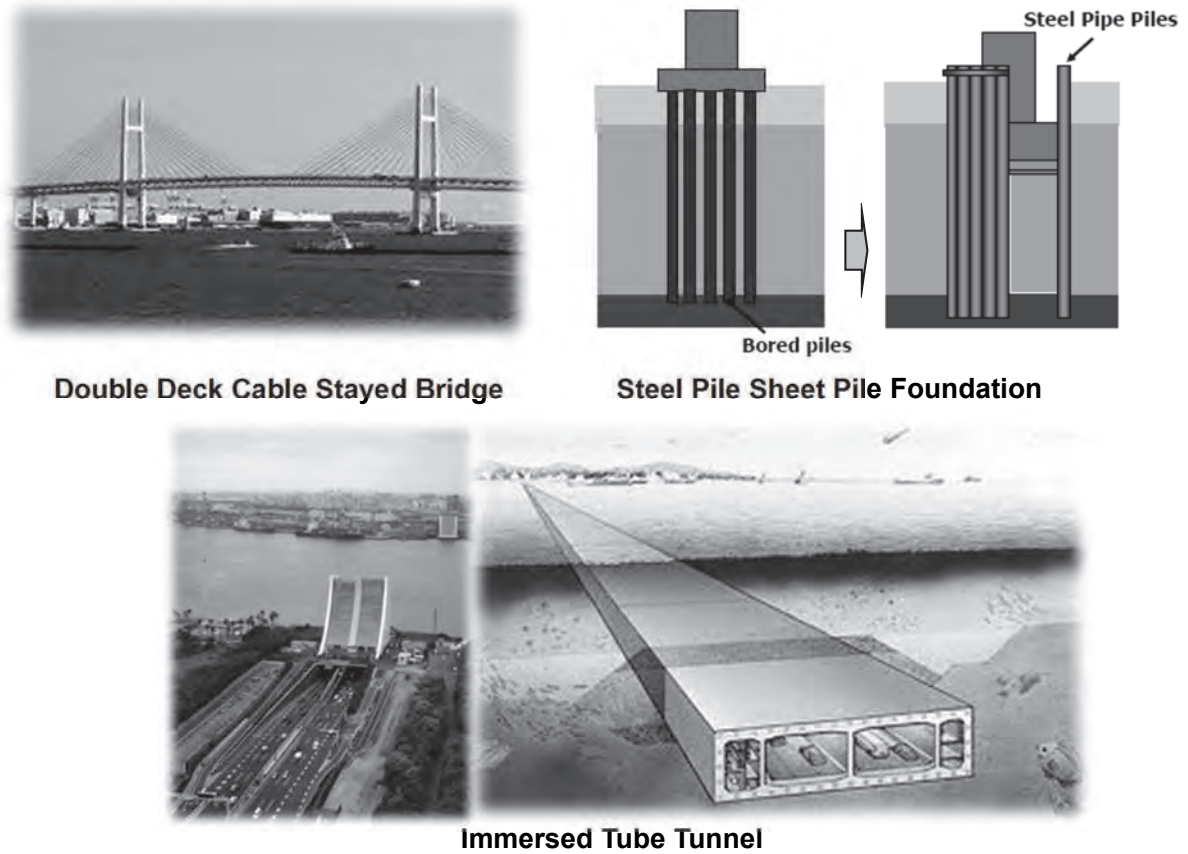
- Middle Term: 2025

Category	Project Name
Expressway(Inner Urban)	Construction of Yangon Urban Expressway North Radial Section
Expressway(Inner Urban)	Construction of Yangon Urban Expressway Inner Ring Section, Phase 1
Expressway(Inner Urban)	Construction of Yangon Urban Expressway Inner Ring Section, Phase 2
Expressway(Inner Urban)	Construction of Yangon Urban Expressway East Radial Section
Expressway(Outer Ring)	Construction of Yangon Outer Ring Expressway Eastern Section
Arterial Road(Outer Ring Road)	Arterial Road of Outer Ring Road (along Road No. 7)
Arterial Road(Outer Ring Road)	Arterial Road of Outer Ring Road (Twantay Section)
Arterial Road(New Construction)	Construction of Arterial Roads based on the proposed road network by YUTRA
Arterial Road(Widening)	Improvement of Existing Arterial Roads based on the proposed road network by YUTRA
Arterial Road	Construction of Bago Bridge
Arterial Road	Construction of Dala Bridge
ITS	ITS Implementation Program

- Long Term: 2035

Category	Project Name
Expressway(Inner Urban)	Construction of Yangon Urban Expressway West Radial Section
Expressway(Inner Urban)	Construction of Yangon Urban Expressway Inner Ring Section, Phase 3
Expressway(Inner Urban)	Construction of Yangon Urban Expressway Inner Ring Section, Phase 4
Expressway(Inner Urban)	Construction of Yangon Urban Expressway East-West Link Section
Arterial Road(Outer Ring Road)	Arterial Road of Outer Ring Road (Thanlyin TS)
Arterial Road(Outer Ring Road)	Arterial Road of Outer Ring Road (Hmawbi -Hlaintthayar Section)
Arterial Road(Outer Ring Road)	Arterial Road of Outer Ring Road (Dala Section)
Arterial Road(New Construction)	Construction of Arterial Roads based on the proposed road network by YUTRA
Arterial Road(Widening)	Improvement of Existing Arterial Roads based on the proposed road network by YUTRA
ITS	ITS Implementation Program

Source: YUTRA Project Team



Double Deck Cable Stayed Bridge

Steel Pile Sheet Pile Foundation

Immersed Tube Tunnel

Source: from Internet

Figure 6.2.2.16 Japanese Technology for River Crossing (Example)

7) Rough Cost Estimates

Rough construction cost estimates for each road development project in short, middle and long term plans are shown in Table 6.2.2.4.

Table 6.2.2.4 Rough Cost Estimates of Road Development Projects

Sector	Category	Estimated Cost (USD Mill.)		
		Short-term 2014-2018	Med-term 2019-2025	Long-term 2026-2035
Road	Arterial Roads and Bridges	253	1,516	1,049
	Expressways	0	1,591	1,700
	Traffic Control/ITS, etc.	33	26	26
	Sub-Total	286	3,133	2,776

Source: YUTRA Project Team

8) Implementation Schedule

Implementation schedule for each road development project in short, middle and long term plans are shown in Table 6.2.2.5.

Table 6.2.2.5 Implementation Schedule of Road Development Projects (1/3)

No.	Category	Project Name	Status	Implementation Schedule																	Remarks						
				2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029		2030	2031	2032	2033	2034	2035
RD-1	Arterial Road	Construction of New Thaketa Bridge	Urgent																		For replacement of the existing Thaketa Bridge in future, a new bridge (2 lanes) will be constructed. Basic Design is on-going under JICA scheme.						
RD-2	Traffic Control	Installation of Advanced Traffic Management System (ATMS), Phase 1	Urgent																		<ul style="list-style-type: none"> - To install advanced traffic signal systems at tentatively 20 bottleneck intersections with "flexible" cycle-time based on real-time traffic data - To install traffic surveillance system such as Ultra Sonic Detector - To introduce traffic information system such as Variable Message Signs (VMS) - Construction of Traffic Control Center (TCC) to control the traffic control devices 						
RD-3	ITS	Formulation of ITS Master Plan and ITS Implementation Program	Short to Long-term																		<ul style="list-style-type: none"> - To clarify existing ITS facilities and administrative functions of related authorities - To clarify effective ITS menus for sustainable development of Yangon City - To establish overall ITS Master Plan proposing short/middle/long-term projects - Implementation of ITS projects based on ITS Master Plan 						
RD-4	Traffic Control	Installation of Advanced Traffic Management System (ATMS), Phase 2	Short-term																		Refer to RD-2.						
RD-5	Arterial Road (Outer Ring)	Arterial Road of Outer Ring Road (along Road No.7)	Middle-term																		<ul style="list-style-type: none"> - Arterial Road of Outer Ring Road along Road No.7 - To construct 18 km length of the arterial roads with total 4 (2+2) lanes 						
RD-6	Expressway (Inner Urban)	Construction of Yanon Urban Expressway North Radial Section	Middle-term																		<ul style="list-style-type: none"> - Section along Road No.2 to strengthen logistic network by extension from Yangon-Naypyitaw Expressway - To construct 17 km length of the expressway with 4 (2+2) lanes - To construct 17 km length of the arterial roads along the expressway with total 4 (2+2) lanes 						
RD-7	Expressway (Inner Urban)	Construction of Yangon Urban Expressway Inner Ring Section (Phase-1)	Middle-term																		<ul style="list-style-type: none"> - Inner Ring Elevated Expressway of north-south route on Waiza Yan Thar Rd - To construct 15 km length of the expressway with 4 (2+2) lanes - To construct 15 km length of the arterial roads along the expressway with total 6 (3+3) lanes 						
RD-8	Expressway (Inner Urban)	Construction of Yangon Urban Expressway Inner Ring Section (Phase-2)	Middle-term																		<ul style="list-style-type: none"> - Inner Ring Elevated Expressway of north-south route on Kyea Myindaling Kanner Rd - To construct 7.5 km length of the expressway with 4 (2+2) lanes - To construct 7.5 km length of the arterial roads along the expressway with total 6 (3+3) lanes 						

Source: YUTRA Project Team

6.2.3 Traffic Management Projects

Traffic management and traffic safety developments may not require huge amount of investment such as road and railroad infrastructure development. Issue for the traffic management and safety master plan is how to provide appropriate measures responding to the changing social needs. In the short-term, it is required to tackle to the existing traffic problems including traffic congestions and traffic accident, while in the long-term more radical countermeasures which will be able to change peoples' behavioural habit and to meet global environment requirement. How to stop the motorization and how to make people stay on the public transport system will be radical issues in the traffic management sector. Traffic safety also has to focus on how to reduce traffic accident happened today or tomorrow in the short-term. But for the long-term measures, we have to look at behavioural culture in the traffic society.

In twentieth century, many metropolis invested huge amount of budget on developing urban road network system to meet rapid motorization. However, in twenty first century, the policy has shifted to control motorization and promote public transport system in order to against global warming. Even so, in Yangon transport network is still not sufficient enough to encourage further economic development in the country. Thus it is important to take a balance between development and control. For the traffic safety, we have to remember large number of traffic accident victims caused by the traffic accidents happened in the initial stage of the motorization, which is experienced in not only developing countries but also developed countries including Japan.

In the complicate circumstances, we propose the projects aiming to mitigate existing traffic issues as well as to strengthen various administrative function for traffic management and safety. They are;

- (1) Yangon CBD Traffic Congestion Mitigation Project
- (2) Yangon Main Road Traffic Congestion Mitigation Project
- (3) Capacity Development Project On Traffic Planning and Management
- (4) Yangon Parking Development Project
- (5) Five-Year Traffic Safety Program

1) Traffic Congestion Mitigation Project in CBD

Congestion mitigation measures for the existing traffic congestion are examined for the CBD and other urbanized areas separately. The measures in CBD are discussed in this section and measures for the other urbanized areas will be discussed in the following section.

As discussed above, the present condition of congested traffic situations cannot anymore allow traditional practices on the roads spaces such as street markets, vendor activities and street vehicle parking, particularly on the major roads in the CBD. Thus, how to control the traditional practice and how to increase the effectiveness of the existing infrastructure will be the main issues to be addressed and will be the short term congestion mitigation measures in the CBD. The following six issues are identified, including the main issue:

- (1) Over-saturating on-street parking

- (2) Street Market/street vendors occupying busy carriageway and sidewalk
- (3) Insufficient traffic management and signal operations
- (4) Insufficient management of the public passenger bus operations and taxis
- (5) How to change peoples' traditional road use practice (behaviour)
- (6) Improvement of efficiency of traffic control and enforcement activities

Table 6.2.3.1 summarizes possible short term traffic congestion mitigation measures for each issue.

Table 6.2.3.1 Short-Term Traffic Congestion Mitigation Measure in Yangon CBD (Proposed)

Issues on the Congestions	Outline of the Congestions	Proposed Short Tem Measure and its major components	
Over-saturating on-street parking	Most of the roads both main and local roads have on-street parking facilities, then smooth traffic flows interrupted or influenced by the vehicles in/out of the space, and also vehicles looking for vacant space	Review of on-street parking regulation	· Prioritization of the traffic bottlenecks and congested road sections
			· Analysis of the on-street parking behavior
			· Development of new regulation for on-street parking
		Provision of off-street parking	· Study on the land availability for off-street parking in CBD
			· Prepare parking facilities in the land identified
			· Promotion of utilization of the off-street parking
Review of parking charges	· Introduction of new parking fee system		
	· Establishment of parking management organization		
	· Implementation of the new parking management activities		
Development of Parking Master plan	· Study on the master plan development		
Pilot Project	Development of a small parking lot and strengthened parking control/ enforcement in the surrounding area (in a selected township in the CBD)		
Street Market/Street Vendors occupying busy carriageway and sidewalk	There are many street vendors occupying side walk, and street night market is opened every day from evening peak hours. The have businesses since long time ago and become a down town culture. However, nowadays, one of major cause of the serious traffic congestions in CBD	Review of Street Market Regulation	· Review of the rules and regulations on the street Vendor business
			· Study on the vendor activities on the congested road sections
			· Study on the relocation of the vendors
			· Consensus building with the vendors involved
Improvement of Pedestrian Environment	· improvement of side walk including prohibition of the street vendors	· improvement in the major bus stops and their surroundings	
			· Establishment of new rules and regulations for enforcement
Enforcement on illegal street vendors	· Implementation of the enforcement		
Insufficient traffic management and signal operation	Many roads in CBD (streets and alleys) are introduced one-way system, many traffic are concentrating to the narrow alleys to avoid congested main roads inducing another bottleneck. Traffic signal is not efficiently controlled and long signal cycle is causing long	Review of one way system, examination of the traffic-cell method	· Study on the exiting traffic flows
			· Review of the existing traffic rules including one-way system
			· Examination of a new traffic circulation system (traffic cell)
			· Review of the existing traffic signal system

Issues on the Congestions	Outline of the Congestions	Proposed Short Tem Measure and its major components	
	waiting queue extending adjacent intersection.	Improvement of signal control system	· Design and installation of new traffic signal system
Insufficient management of the public passenger bus operation and taxis	So many buses are operating on the same route and many buses do not stop properly at the designated bus stop for passenger boarding and alighting, sometimes they stop in the middle of the road. Taxis park illegally at the congested area where easy to get customers.	Review of bus networks system in CBD	· Study on exiting bus operation in CBD
		Improvement of bus stops and interchange	· Reorganize bus network and operation system in CBD
			· Preparation of improvement and relocation of bus stops
		Provision of taxi bays	· Development of bus interchange in CBD (for transfer) · Construction of the proposed facilities
How to change peoples' traditional practice (behavior)	Many causes of the congestion are peoples' behavior or habits what they obtained in the old time before expansion of the motorization, such as parking behavior, walking on the carriageway, loading and unloading of goods, boarding and alighting behavior of public transport users and so forth. To reduce the usages of the private vehicle is also much depending upon peoples' awareness. How to change the peoples' traffic habit is a significant issue for today as well as future.	Raising awareness on existing urban traffic problems	· Establishment of an appropriate organization for the activities · Seminar, Workshops, Community Activities
		Modal shift from private to public transport	· Study on the situation of the usages of private vehicles in CBD · Implementation of MM activities in the working places
		Managing road side activities	· Promote MM activities in local merchants' association
		· Provision of traffic information	· Coordination with broadcasting organization · Collection and provision of the traffic information
Improvement of efficiency of traffic control and enforcement	In order to use effectively limited road sections and areas, all road users have to follow the traffic rules and regulations and traffic manners as well. Besides strengthen the drivers education, traffic enforcement activities will be indispensable. Of cause, beforehand, it is necessary to update the traffic rules and regulations according to the current traffic situations.	Monitoring of the congestions by CCTV	· Installation of CCTV at congested intersections and road sections
			· Establishment monitoring center in Police Office
			· Training on the monitoring and instruction
		Traffic enforcement for illegal parking	· Review of illegal parking penalties · Develop a new traffic violation ticket and its management
Enforcement on illegal/dangerous bus operation	· Review of enforcement method for illegal bus operation · Establishment of a new bus operation management system		

Source: YUTRA Project Team

Except for the traffic signal improvement, most of the measures shall involve daily activities of the residential and traffic participants directly. Thus it will induce a social dilemma where there will be general agreements but no compromise on the details. However, we have to understand that those are unavoidable issues not only in the short-term but also for long-term, particularly for the street market/ vendors. They have been conducting their business for a long time and have become part of the CBD's culture which makes it harder to just remove. This will require a very careful examination from various perspectives, and the development of new rules and regulation for the vendor business in CBD. And it is indispensable that a consensus be sought among the relevant stakeholders.

Another social issue is the parking problem. Many drivers are complaining about the

difficulty of finding a parking space in the CBD. As discussed before, basically there is no parking space inside of the old buildings, thus vehicles owners have no choice but to use on-street parking or just vacant space even on the narrow alley. There was a time that YCDC controlled on-street parking and collected parking fees in the centre of CBD. At present however, there is no parking fee being charged. YCDC should introduce proper parking management system including parking fee charges to reduce number of on-street parking lots from the congested road sections. Instead, YCDC should make an effort to find space for the off-street parking using vacant government lands and unused lands. At the same time, through Mobility Management activities, it is necessary to discourage private car use and encourage the use of public transport so as to reduce demand for parking spaces.

Taking into account the feasible difficulty to solve this parking problem, a pilot project should be implemented. This is basically a combination of small parking lot development and strengthened parking control/ enforcement in a township of the CBD.

Public passenger bus routes are concentrated on Maha Bandoola Streets where very active street markets can be seen in the evening causing serious traffic congestions. Proposed short-term countermeasure will include a review of the number of bus operations and its reduction to the optimum number of lines. At the congested bus stops where people are waiting for their buses on the roads, street vendors and on-street parking and other disturbance around the bus stops should be cleared. On the examination of reorganization of bus network, if bus interchange would be developed in the strategic place in the CBD, bus operations will be divided into inner-CBD and intra-CBD so that number of bus operations on the busy roads can be optimized. Another alternative examination will be the introduction of transit mall on the Maha Bandoola Street. To choose an optimum countermeasure for the bus operation in CBD, further detail and comparative analysis is required to clarify the complex situation and to get consent of various stakeholders.

As short-term traffic congestion mitigation measures, various projects are proposed. These have less investment cost but will require close cooperation and collaboration with relevant organizations and communities. In addition, these countermeasures should be implemented comprehensively.

2) Traffic Congestion Mitigation Project on the Major Roads (outside CBD Area)

This section will discuss congestion mitigation measures in the other urbanized areas in Yangon. The congested road sections and intersections are mentioned in Figure 6.2.3.1. Main congestions outside of CBD are observed at the major intersections between north-south and east-west main roads because of the large volume of traffic demand and insufficient signal operation. Even though insufficient signal control is the main problem, there are also other numerous issues associated with the congestions as discussed above where various countermeasures shall be implemented accordingly. Proposed short-term congestion mitigation measures outside of the CBD are shown in Table 6.2.3.3 including 15 types of the measures as follows:

- a. Install or Upgrade Traffic Signal Control System
- b. Improvement of Intersection Geometrics
- c. Installation of Traffic Management Facilities such as Median and Guardrail, etc.

- d. Road Signs and Pavement Markings
- e. Prohibition of On-Street Parking and its Enforcement
- f. Traffic Monitoring System
- g. Provision of Traffic Information
- h. Provision of appropriate Sidewalk Environment
- i. Provision of Pedestrian Bridge
- j. Improvement of Bus Stops Facilities
- k. Development of Bus Interchanges/Bus Terminal for the City Buses
- l. Enhanced Traffic Rules and Safety education
- m. Development of Off-Street Parking
- n. Development of effective Road Drainage System
- o. Appropriate Traffic Management and Maintenance on Road Work Sections/Areas

Table 6.2.3.3 examines countermeasures for each congestion point or section along the lines of major roads such as Kabar Aye Pagoda Road, Pyay Road, etc. Examination along the major lines may be useful to further explain how to provide smooth traffic flows on the main directions particularly for north-south bound and east-west bound. But it is also important to examine from the perspective of areas or local regional features. Figure 6.2.3.1 shows the areas bundled on congestion points in a specific group which will be examined on the same table and implemented comprehensively. Four areas are proposed as follows:

- (1) Urban Center adjacent to CBD (subdivided into (a) Shwe Dagon Pagoda area and (b) Tarmwe Township area)
- (2) Inya Lake South area (subdivided into (a) Hledan area and (b) Yankin area)
- (3) Inya Lake North area, and
- (4) North-south Satellite Town Corridor

Table 6.2.3.2 is showing area-wide basic implementation strategies for the short-term measures. Traffic control and management measures in CBD and adjacent urban area should take into consideration the future integration system as a whole with appropriate operational organization. The roundabouts located in this area are already saturated and requires control on the inflow traffic by traffic signal. On-street parking is one of the issues not only in the CBD but also in other commercial areas. This is therefore the opportune time for the Government to establish a series of proper parking policies.

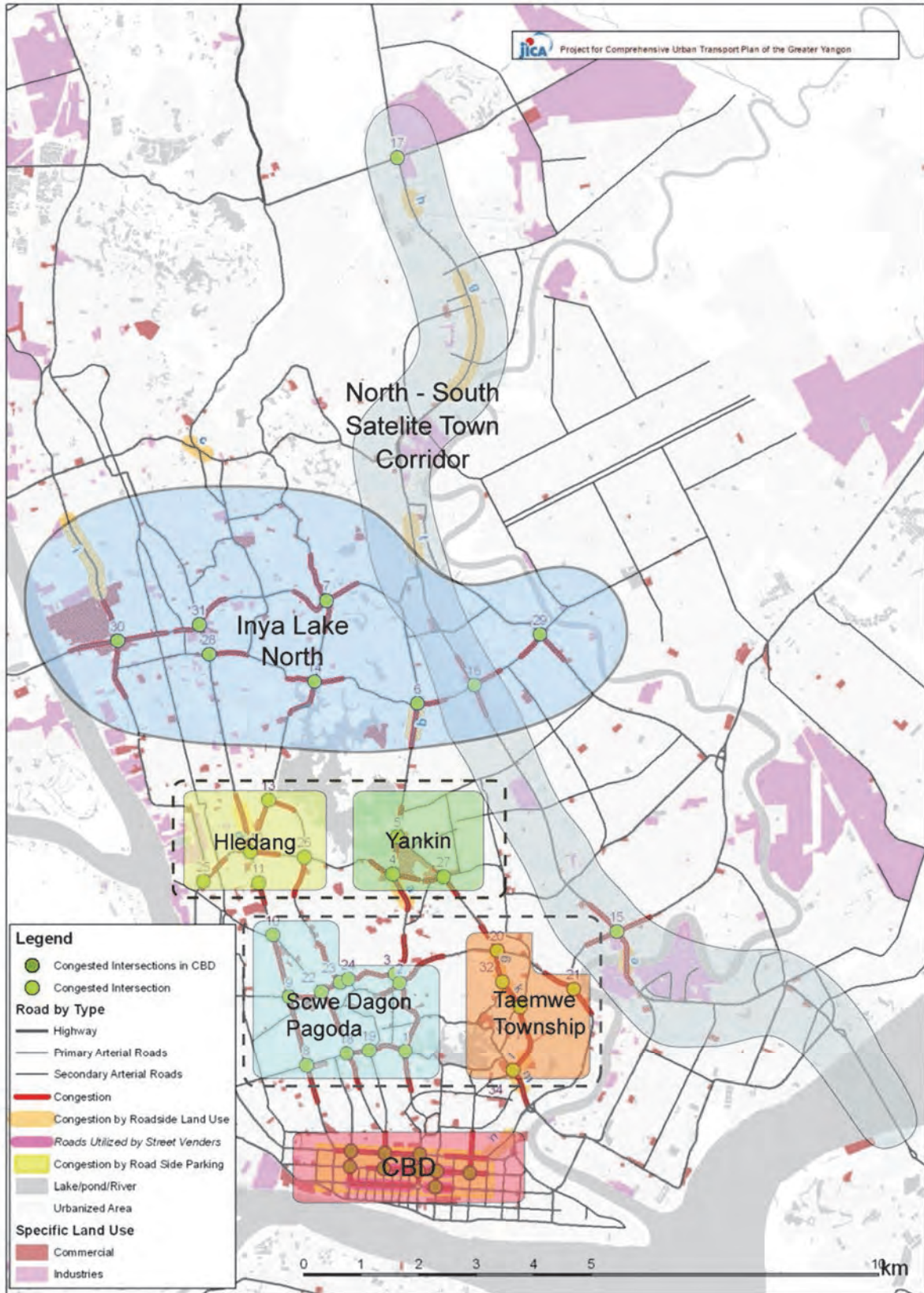
Table 6.2.3.2 Basic Implementation Strategy

Area		Basic Implementation Strategies
CBD		- Coordination and collaboration with relevant organizations and local communities to tackle complex cause of congestions
Urban Center adjacent to CBD	Shwe Dagon Pagoda area	- Control traffic flows as a whole - Coordinate with CBD traffic management
	Tarmwe Township Area	- Coordination and collaboration with local community - Comprehensive activities
Inya Lake South	Hledan area	- Control and adjust traffic flows among the intersections
	Yankin area	- Control and adjust traffic flows among the intersections
Inya Lake North		- Measures can be implemented individually, but due to the large traffic demand, the congestions will be transferred from improved intersection to unimproved intersections.
North-south Satellite Town Corridor		- Residential areas are located along the corridors, not only congestion, also safety will be taken into consideration

Source: YUTRA Project Team

Besides traffic control and management measures, improvement of the public transport system and facilities is also one of the significant issues which have to be tackled as a short-term measure. Public passenger bus service is the predominant mode of transport for the people in Yangon, with more than 80% of total modal share. Duplicated bus operations are causing traffic congestions and poor operational management are causing high risk of traffic accident. Moreover, it is also important to reduce the congestions in the buses and at the bus stops as well in order to develop a public transport oriented society in Yangon.

Congestion by road works is another issue even though their impacts are periodic. There are no information and guidance to avoid the sections where road works are ongoing. And it gives less priority on traffic flows; for example, number of traffic lane and width are reduced to assure the sufficient work space. In addition, the pavement conditions on the limited traffic lanes are very poor thus traffic has to avoid potholes and rutted areas. Therefore, traffic control and management rules and regulations for road works should be prepared and implemented for future projects.

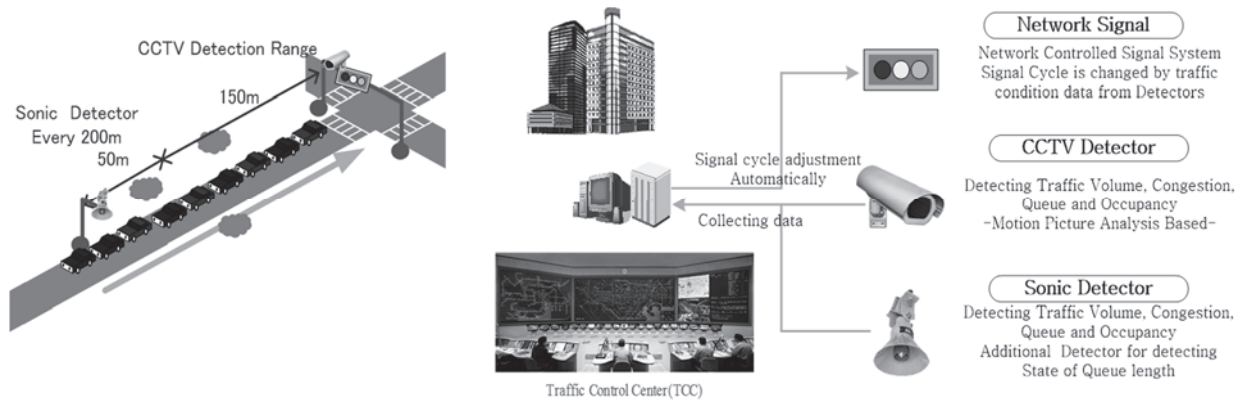


Source: YUTRA Project Team

Figure 6.2.3.1 Areas Bundled on Congestion Points in a Specific Group

(Improvement of Bottleneck Intersections)

As mentioned in the previous section, it is essential to facilitate the traffic congestion at the bottleneck intersections under the short-term development plan. The proposed infrastructures to enhance the capacity of the intersections are summarized in Figure 6.2.3.2, Figure 6.2.3.3 and Table 6.2.3.4.



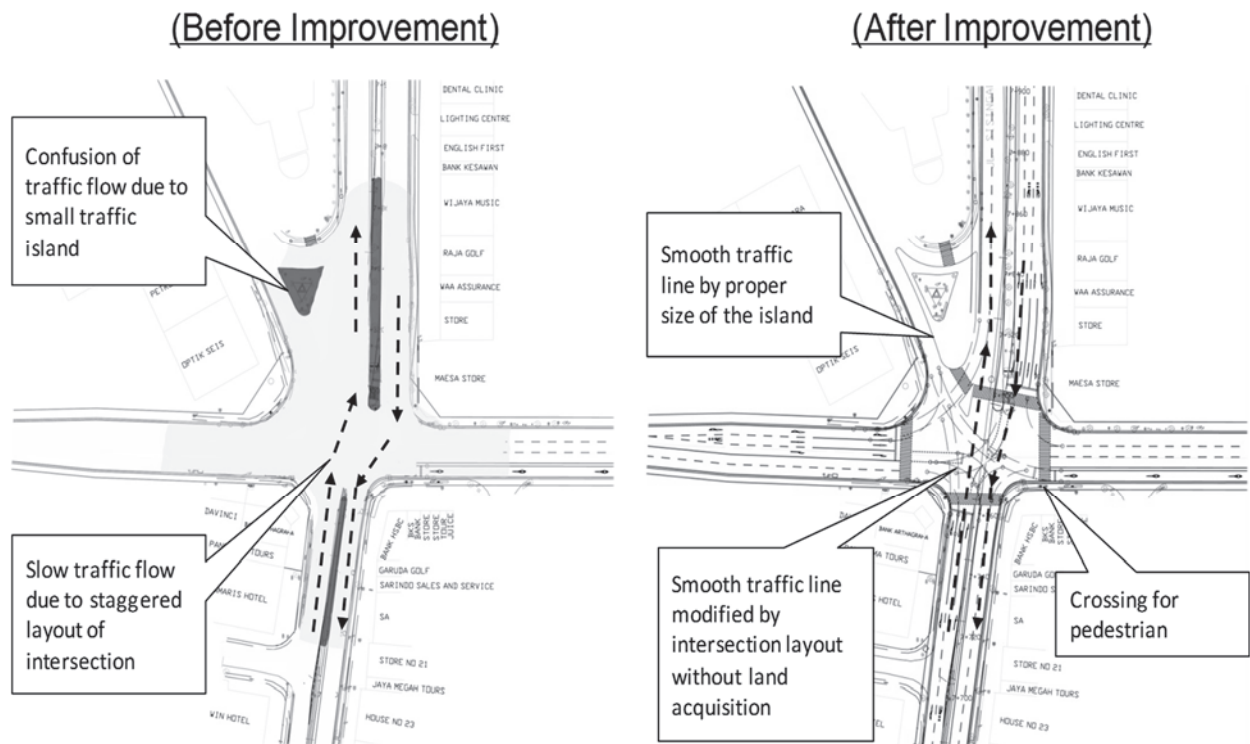
Source: YUTRA Project Team

Figure 6.2.3.2 Proposed Improvement for Bottleneck Intersections

Table 6.2.3.4 Issues and Measures to be taken for Improving Intersections

Items	Current Conditions	Possible Measures	Expected Effects
Traffic Control Devices	<ul style="list-style-type: none"> - Old signal system with "fixed" cycle-time - No synchronization with adjacent intersections - Lack of real-time traffic data - No traffic information to road users 	<ul style="list-style-type: none"> - Advanced signal system with "flexible" cycle-time based on the real-time traffic data - Advanced system for the synchronization and "Traffic Control Center (TCC)" controlling every devices - Traffic surveyance system such as Ultra Sonic Detector - Traffic information system such as Variable Message Signs (VMS), real-time information to radio station through TCC 	<ul style="list-style-type: none"> - To facilitate traffic congestion by maximization of the capacity of intersections - Proper distribution of the traffic by the synchronization of adjacent signals - To supply real-time traffic data for proper setting of cycle time, and to provide cummulative data for city/transportation planning - Real-time information to road users
Geometric Layout	<ul style="list-style-type: none"> - Improper layout of intersection such as staggered intersections, etc) - Lack of additional lanes, traffic islands 	<ul style="list-style-type: none"> - Reconfiguration of shape of intersections with minor civil works as explained below Figure 3.4.3 without or none of land acquisition 	<ul style="list-style-type: none"> - To ease traffic congestion in parallel with the advanced traffic control devices
Safety Devices	<ul style="list-style-type: none"> - Lack of safety facilities for pedestrian - Lack of enforcement devices such as CCTV 	<ul style="list-style-type: none"> - To provide safety facilities such as pedestrian crossing, median fence, etc. - To provide real-time CCTVs monitoring system 	<ul style="list-style-type: none"> - To reduce traffic accidents - To encourage traffic safety

Source: YUTRA Project Team



Source: YUTRA Project Team

Figure 6.2.3.3 Image of Minor Modification of intersection

3) Capacity Development on Traffic Planning and Management

Traffic management is one of the significant urban transport policies to enhance the efficiency of road network system and to control traffic demand; nowadays role of the traffic management is increased to meet the requirement from global climate changes as well as economic losses induced by the traditional automobile oriented development. Then to build public oriented urban development becomes a common target in major cities in the world. Traffic demand management is indispensable component to build public transport oriented society. However, there is no specialized organization responsible for the traffic management in Yangon. This project is aiming to establish 'Traffic Planning and Management Unit' under Engineering Department YCDC as shown in Figure 6.2.3.4. Outline of the Project is as follows;

Objective of the Project:

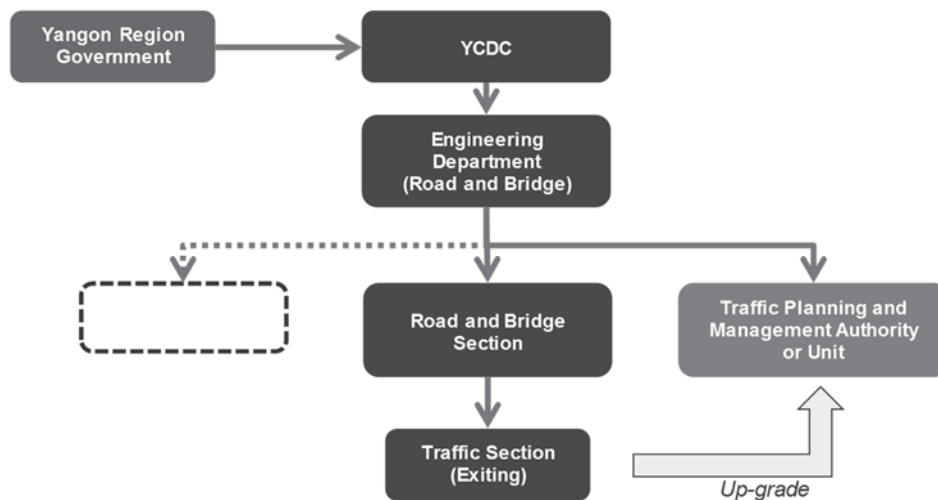
- Improve transport planning capability including traffic survey and analysis
- Enhancement of intersection traffic management skill
- Improve implementation capacity on Transport Demand Management Measures including parking policy

Activities:

- i. Training (lecture) on transport planning, intersection planning, TDM, parking measures and other traffic management issues

- ii. Implementation of pilot projects (intersection improvement, parking management and propaganda activities, and some traffic safety measures)
- iii. Counterpart training in Japan and third countries
- iv. Seminars and workshops
- v. Preparation of five year traffic congestion improvement plan (including ODA project (Yen loan or grant project))

In addition, this program shall be implemented in corroboration with the proposed traffic mitigation projects so that the proposed organization will have practical experiment mutually facilitating each other.



Source: YUTRA Project Team

Figure 6.2.3.4 Organizational Structure for the Traffic Planning and Management Unit

4) Yangon Parking Development Project

The result of traffic demand forecast indicates that the regulation of street parking could help to relieve traffic congestion considerably. Parking development project as a measure against street parking is urgently required to cope with a serious traffic congestion in the CBD.

The strategy for parking control should be introduced step-by-step as discussed in Chap 4.5.2. There are many residents using car in the CBD. Besides typical of city centre business such as retailing and financial service, there are also wholesaler and transportation companies in the CBD which relies heavily truck transport system. It makes difficult to introduce parking regulations in a very short time.

The parking development project devices roughly 2 phases. The former phase is planning stage which examines a location planning for public parking and its management scheme based on the traffic demand control policy, with estimating parking demand forecast by each district. The latter is construction stage in which starts to construct public parking.

The following issues need to be clarified in the planning stage.

(1) Parking restricted area and applicable regulations

The area which has serious traffic congestion due to the street parking should be defined at first. Applicable regulations against street parking and how to put the controls to practical use should be examined for the restriction area.

(2) Parking needs for residents and parking lot development plan

How to control private car parking in the parking restricted area should be considered whether to have the resident to install garage on their own responsibility or to park their cars at the public parking area charging monthly fee. The car parking regulation and system needs to be built on the consensus by the residents and car owners.

(3) Parking space outside of the restricted area and sufficient service of public transport

To decline car flow into the city centre, commuters and visitors from outside of the parking restricted area are encouraged to use public transportation to access to the city centre. The other drivers should be required to park at the public parking lot located in the fringe of the parking restricted area.

The public parking lot outside the parking restricted area needs to be arranged strategically. 500 m is one of the rough standard distance between parking lot and people's destination such as public facilities and shopping centres. In addition, the pedestrian walkway should be developed.

Public transport with sufficient service is essential to promote the parking control above. People should use public transportation instead of private car between the parking lot outside of the city centre and the destination in the parking restricted area.

(4) Parking charge policy based on beneficiary charge

Parking lot business should secure profitability. Parking lot inside the parking restricted area and at the fringe area should be charged. The department of the parking lot business aims to be profitable. In case of financial shortage, the parking lot outside the parking restricted should also be imposed and diverted the department as well parking fine.

(5) Installation of parking lot guidance system

Parking lot guidance system and related facilities should be introduced in the CBD to guide drivers to the appropriate parking lot. Parking space would be limited as the parking restricted area installed in the CBD. Drivers would get into difficulties in finding parking space rather than before they could park on the street except for some arterial roads. The drivers searching and waiting for the parking space might promote the traffic congestion in the CBD.

(6) Parking management and Parking violation system

Various institutions and systems should be developed to conduct parking management works effectively such as parking lot maintenance, collecting parking charge, crackdown on parking violation, and collection parking penalty.

(7) Procurement of financial source and repayment planning

Procurement of financial source for public parking development and maintenance cost should be considered along with the repayment planning. The profitability of the project should be examined by the financial analysis.

After the issues above clarified, parking business institutions and sectors would be established and could start to carry out actual plans in construction stage. Parking demand and required capacity of public parking space are estimated as follows from the result of YUTRA person trip survey.

(8) Example of parking control in the CBD

Parking demand and the capacity of existing on-road parking facility are roughly estimated by township in the CBD to clarify the actual congestion of the parking lots. The result of estimation in Table 6.2.3.5 indicates that the parking facilities reaches saturation point in Pagedan T/S, Kyauktada T/S and Latha T/S. It causes the illegal parking on the street. Furthermore, many cars looking for, parking and going from parking lot are supposed to prevent traffic flow and could worsen the traffic congestion.

As a consequence of this estimate, parking restricted area is proposed as shown in Figure 6.2.3.5 which includes both the 3 townships and immediate townships. Parking regulation around intersections and long-time parking control should also be applied to the parking restricted area.

The required capacity of public parking is approximately 100,000 m² for 5,000 cars supposing public parking area set as off-road parking and 30 – 40 % of street parking are cleared.

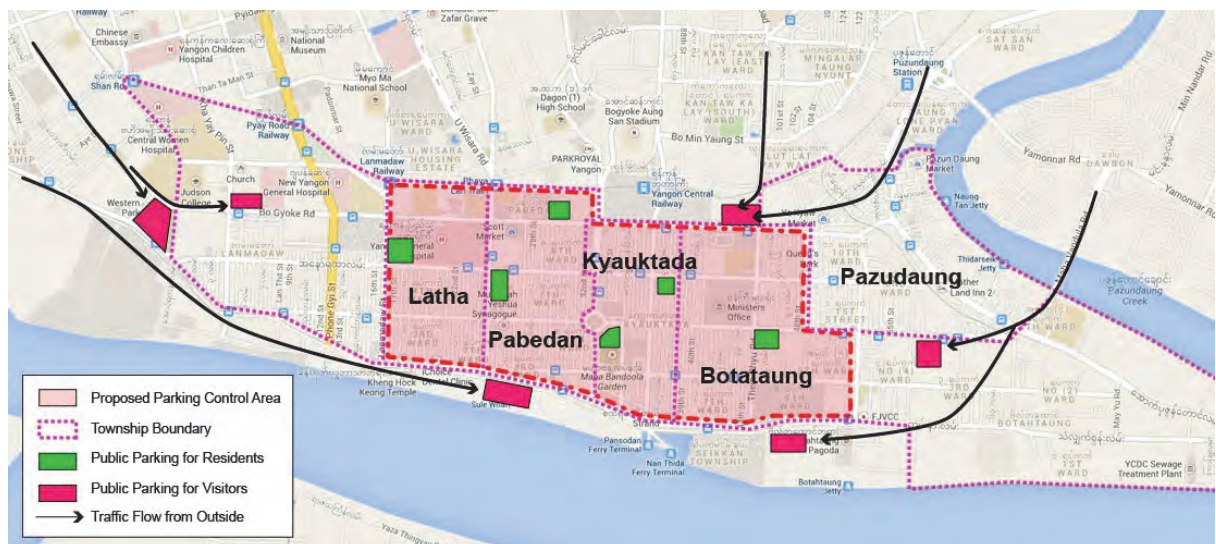
As comprehensive parking development, the public parking for resident should be developed inside the parking districted area and the parking for visitors are in the fringe of the parking districted area. One example is given in Figure 6.2.3.5 which includes the western part of Botataung T/S next to Kyauktada T/S. The overflowed parking demand is expected to be accepted on the western part of Botataung T/S which does not have serious traffic congestion so far.

Table 6.2.3.5 Study of parking demand and in the CBD and required off-road parking space

Name of Township in CBD	Area (ha)	Road Length (m)	No. of on-street parking Lots (veh)	No. of registered vehicles (veh)	Inflow No. of vehicle (veh)	On-street parking demand (veh)	On-street parking capacity (veh/day)	Saturation Rate on on-street parking
Latha	61.2	10,041	2,572	2,480	1,982	3,570	3,858	0.93
Lanma-daw	131.8	22,693	5,939	4,419	3,869	4,144	8,909	0.47
Panbet-an	62.2	13,378	3,452	1,667	4,650	5,054	5,178	0.98
Kyauk-tada	69.8	16,448	4,445	3,866	4,975	7,073	6,668	1.06
Botata-ung(west)	82.6	12,619	3,234	1,224	3,456	1,361	4,851	0.28
Botata-ung(East)	179.3	20,555	5,771	444	1,613	492	8,657	0.06
Pazun-daung	117.8	24,162	7,089	3,194	1,054	2,124	10,634	0.20
total	643.5	109,855	29,930	14,814	19,617	20,247	44,895	0.45

Name of Township in CBD	Rate of reduction on-street parking space	Reduction on-street parking space	Saturation Rate after the reduction	Off-street parking demand (veh/day)	Off-street parking space (m ²)	Remarks
Latha	0.30	2,701	1.32	869	17,380	The overflowed parking demand from Kyauktada T/S is to be accepted on the western part of Botataung T/S
Lanma-daw	0.00	8,909	0.47	0	0	
Panbet-an	0.40	3,107	1.63	1,947	38,936	
Kyauk-tada	0.40	4,001	1.77	3,072	61,446	
Botata-ung(west)	0.00	4,851	0.28	0	0	
Botata-ung(East)	0.00	8,657	0.06	0	0	
Pazun-daung	0.00	10,634	0.20	0	0	
total		40,157	4.40	5,019	100,382	

Source: YUTRA Project Team



Source: YUTRA Project Team

Figure 6.2.3.5 Example of the parking restricted area in the CBD and proposed location of off-road parking

(i) Estimation of the total road length and parking capacity in the CBD

Figure 6.2.3.6 shows the road network in the CBD and the parking prohibited section. The high-standard one-way road which runs in the east-west direction and the narrow road in the north-south direction form blocks in the CBD.



Source: GIS data by Asia Air Survey Co., Ltd.

Figure 6.2.3.6 No. of lanes and parking prohibited section in the CBD

The capacity of on-road parking in the CBD is estimated from the total length of the road network except for the parking prohibited section. Following assumptions are applied to the estimation.

- i) All road section are regarded to be used for parking space both sides. The parking on the both sides of the street are common sight even on very narrow road.
- ii) All parking cars are parked in parallel and 1 car occupies 5 m for parking. (See Figure 6.2.3.7) Some cars are parked by back-in parking style in high-standard trunk road. (See Figure 6.2.3.8)
- iii) The occupancies of street parking are 60% of trunk road, 75 % of collector road, and 90 % of the other roads.



Figure 6.2.3.7 Parallel parking on narrow roads in the CBD



Figure 6.2.3.8 Back-in style parking on the high-standard trunk road in the CBD

The estimation of on-road parking capacity is shown in Table 6.2.3.6. It indicates approximately 32,500 cars could park in the CBD.

Table 6.2.3.6 Estimation of the on-road parking capacity in the CBD

Direction	No. of Lanes	Total length of the road except for parking prohibited section (m)		
		Trunk Road	Collector road	Other roads
One way	2	0	837	32,370
	4	0 (13,703)	557 (1,089)	279
Two way	2 (1 lane * 2 direction)	14 (345)	3,798	41,106
	4 (2 lane * 2 direction)	4,690 (9,499)	6,146 (8,335)	1,453
	6 (3 lane * 2 direction)	2,755 (6,304)	777	0
Assumed parking occupancy (%)		60%	75%	90%
No. of on-road parking car Total Length(m)*2*parking occupancy(%) / 5(m/car)		1,790	3,634	27,075
Total No. of parking car (cars)		32,499		

Note: The figures in parentheses are the total length with the parking prohibited section

Source: GIS data by Asia Air Survey Co., Ltd.

(ii) Estimated number of private cars in the CBD

Number of private cars in the CBD is estimated with expanding the result of car ownership by YUTRA person trip survey and approximately 18,000 cars are supposed to be in the CBD.

5) Yangon Traffic Safety Five-Year Program

Traffic accident in Yangon Region has been increased according to the rapid expansion of motorization. In the suburbs where usages of two wheels vehicles are allowed, accidents involving the two wheels are predominant, while in the urban areas where two wheels vehicles are not allowed, many accidents causes of reckless driving of buses and jaywalking of pedestrians are reported. Currently, as mentioned in Chapter 2, there is no proper organizational setup for the comprehensive traffic safety intervention; just traffic police are playing major roles through ad-hoc enforcement activities.

In the initial stage of the motorization, most of the developing counties are facing the issues on the large number of traffic accident victims, due to the old behavior habit they obtained before the motorization came. Japan also went through that kind of period from 1960s to 1970s, recoding highest number of fatalities of 17,000 in Japan, in 1970. Under such circumstances, traffic safety measures will be required to focus on how to change peoples' behaviour. Traffic accident between bus and pedestrian often happed in the urban area will not be solved just providing pedestrian over bridges, because pedestrians may not use the bridges excusing that the bridge is far from and it is not so dangerous to cross the road, we are get used to and so forth. Bus driver will complain that cause of the accident is jaywalking of pedestrian ignoring their reckless driving.

Enhancement of peoples' awareness therefore will be significant to change the circumstances radically. In order to enhance the awareness, it is necessary to approach from all angles and to repeat many times until they can get safe behaviour habit. The all

angles include (1) improvement of road infrastructure, (2) enhancement of enforcement and (3) dissemination of traffic safety education; referred to as 3Es (Engineering, Enforcement and Education). In addition, in order to implement the 3Es comprehensive traffic safety measures, a series of rule and regulations, coordination among stakeholders and human resources in the respective organization, as well as social monitoring system involving communities and organizations will be indispensable. Traffic Safety Committee both in central and local level will play significant role not only to develop comprehensive traffic safety policies and also to coordinate relevant ministries and departments for smooth and effective implementation of the safety policies. Besides, there is another issue to analyse causes of traffic accidents to develop effective countermeasures, thus traffic accident database shall be formulated.

In Japan, Traffic Safety Five-Year Plan was started in 1970, to mitigate the serious traffic accident in Japan. Since then, after 40 years, now Ninth Traffic Safety Program is in place. The proposed traffic safety project will include those various issues for the sustainable traffic safety in Yangon, which will be the First Five-Year Traffic Safety Program in Yangon.

The proposed Five-Year Safety Program will include;

- (a) preparation of traffic safety projects for five years including 3Es (Engineering, Enforcement and Education)
- (b) Establishment Traffic Safety Committee
- (c) Development of Traffic Accident Database
- (d) implementation of the traffic safety projects
- (e) Capacity Development for Traffic Police Force and other stakeholder involved in traffic safety activities

6.2.4 Freight Traffic Management Projects

1) New MR ICD and Relocation of Highway Truck Terminal

The development of rail based Inland Container Depot (ICD) is recommended by the Myanmar National Transport Master Plan (JICA) in conjunction with the development of Thilawa port. The container throughput at the exiting Yangon ports and the Thilawa port will sharply increase in the next twenty years, reaching more than 6 times of the current level (about 500,000 TEU in 2013).

The candidate area for the MR ICD and other associated facilities is located at about 20 km east along the Main Road No. 2, near the intersection with the Main Road No.7. This ICD should have a custom clearance facility including customs, inspection, quarantine in the site.

Referring to the Lat Krabang ICD (80 ha) in Thailand of which design capacity is around 1.5 million TEU, an indicative size of the ICD at East Dagon can be about 100ha in the initial stage. (See Figure 6.2.4.1 and Figure 6.2.4.2)

The existing highway truck terminal at Bayint Naung can be relocated to the MR ICD's neighbour, and a new highway bus terminal which serve the residents in the East Dagon Township and surrounding areas can also be developed near the intersection of main road No. 2 and No. 7. (See Figure 6.2.4.3)



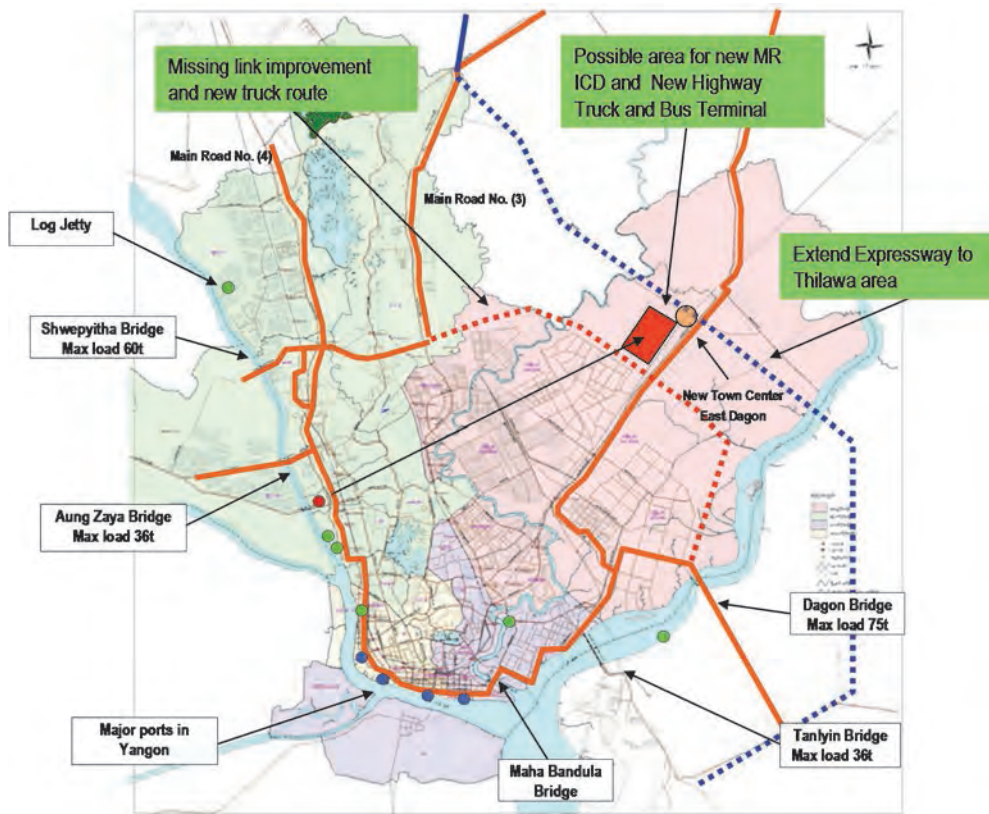
Source: YUTRA Project Team

Figure 6.2.4.1 Lat Krabang ICD, Thailand



Source: YUTRA Project Team

Figure 6.2.4.2 Lat Krabang ICD, Thailand



Source: YUTRA Project Team

Figure 6.2.4.3 Freight Management related projects

2) New Highway Truck Routes

Yangon regional government designates routes (roads) for container trailers, log trucks and heavy trucks. Container trucks using the road paralleling Strand Road and Bayint Naung road will remain because of the port activities of existing Yangon ports. While the eastern truck route running north to south from the main road No.(3) main road, passing through the Mingaladon Industrial Park, and further down to south along Thanthumar road can be removed after completion of the upgrading work of main road No. 7.

The missing link section between the main road No. 3 (near Mingalardon Garden City) and the main road No. 2 (at the East Dagon Industrial area) will be widened by 2018. The link from the East Dagon to the Dagon Bridge will also be improved by 2020.

Relocation of the existing truck terminal to the MR ICD site can be made in line with this road improvement schedule.

3) Construction schedule and cost

The development of new MR ICD should happen in line with the expansion of the Thilawa port and associated road improvement. The extension of the expressway to Thilawa and the improvement of the MR freight related facilities are the keys for the success of this ICD development. The existing Yangon – Mandalay railway will be improved by 2023, so the development opportunity of MR ICD will be around this time.

It should be noted that the extension of the expressway is scheduled by 2033 (YUTRA),

which can be made earlier if possible in order to accelerate the ICD development.

The cost of ICD and truck terminal (about 150 ha in the initial stage) can be estimated at around USD 150 million.

6.2.5 Projects Summary

The major master plan projects in each sector are summarized as below. The detailed information is shown in Appendix 1.

Table 6.2.5.1 Summary of Master Plan Projects

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
RD-1	Road	Construction of New Thaketa Bridge	Ministry of Construction	<ul style="list-style-type: none"> - To construct a new bridge (4lanes) beside existing bridge (2 lanes) - Bridge type of river crossing is PC Extradosed bridge and PC Box girder bridge (Total 253m) - To widen the access road to total 4 lanes 	<ul style="list-style-type: none"> - To reduce traffic congestion inside Yangon city developed area - To improve accessibility from central Yangon To Thanlyin TS
RD-2	Road	Installation of Advanced Traffic Management System (ATMS), Phase 1	YCDC and Traffic Police	<ul style="list-style-type: none"> - To install advanced traffic signal systems at tentatively 20 bottleneck intersections with "flexible" cycle-time based on real-time traffic data - To install traffic surveillance system such as Ultra Sonic Detector - To introduce traffic information system such as Variable Message Signs (VMS) - Construction of Traffic Control Center (TCC) to control the traffic control devices 	<ul style="list-style-type: none"> - Capacity enhancement of existing infrastructure (intersections) prior to Middle/Long-term measures - To facilitate traffic congestion inside the city - To supply cumulative traffic volume data for future city/transport planning
RD-3	Road	Formulation of ITS Master Plan and ITS Implementation Program	YCDC , Traffic Police, Yangon Region, other related agencies	<ul style="list-style-type: none"> - To clarify existing ITS facilities and administrative functions of related authorities - To clarify effective ITS menus for sustainable development of Yangon City - To establish overall ITS Master Plan proposing short/middle/long-term projects - To install facilities of ITS according to Master Plan 	<ul style="list-style-type: none"> - To facilitate traffic congestion - Synergic effects of ITS facilities - Reduction of traffic accidents - To improve environmental pollution - To obtain real-time cumulative traffic information
RD-4	Road	Installation of Advanced Traffic Management System (ATMS), Phase 2	YCDC and Traffic Police	<ul style="list-style-type: none"> - To install advanced traffic signal systems at tentatively 20 bottleneck intersections with "flexible" cycle-time based on real-time traffic data - To install traffic surveillance system such as Ultra Sonic Detector - To introduce traffic information system such as Variable 	<ul style="list-style-type: none"> - Capacity enhancement of existing infrastructure (intersections) prior to Middle/Long-term measures - To facilitate traffic congestion inside the city - To supply cumulative traffic volume data for future city/transport planning

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
				<p>Message Signs (VMS)</p> <ul style="list-style-type: none"> - Construction of Traffic Control Center (TCC) to control the traffic control devices 	
RD-5	Road	Arterial Road of Outer Ring Road (along Road No.7)	Ministry of Construction	<p>Arterial Road of Outer Ring Road along Road No.7</p> <ul style="list-style-type: none"> - To construct 18 km length of the arterial roads with total 4 (2+2) lanes 	<ul style="list-style-type: none"> - To reduce traffic congestion inside the city providing a diversion route from Thilawa - To enhance urban development of Eastern suburban area of Yangon region - To cater for productivity increase of industrial estates
RD-6	Road	Construction of Yangon Urban Expressway - North Radial Section	Ministry of Construction	<p>Section along Road No.2 to strengthen logistic network by extension from Yangon-Naypyitaw Expressway</p> <ul style="list-style-type: none"> - To construct 17 km length of the expressway with 4 (2+2) lanes - To construct 17 km length of the arterial roads along the expressway with total 4 (2+2) lanes 	<ul style="list-style-type: none"> - To reduce traffic congestion inside the city providing a diversion route from existing highway - To enhance urban development of northern suburban area of Yangon region - To cater for productivity increase of industrial estates
RD-7	Road	Construction of Yangon Urban Expressway - Inner Ring Section (Phase-1)	Ministry of Construction	<p>Inner Ring Elevated Expressway of north-south route on Waiza Yan Thar Rd</p> <ul style="list-style-type: none"> - To construct 15 km length of the expressway with 4 (2+2) lanes - To construct 15 km length of the arterial roads along the expressway with total 6 (3+3) lanes 	<ul style="list-style-type: none"> - To reduce traffic congestion inside the city providing a diversion route from existing highway - To enhance urban development of northern and eastern area of Yangon region - To improve environmental situation in Yangon urban area
RD-8	Road	Construction of Yangon Urban Expressway - Inner Ring Section (Phase-2)	Ministry of Construction	<p>Inner Ring Elevated Expressway of north-south route on Kye Myindaing Kanner Rd</p> <ul style="list-style-type: none"> - To construct 7.5 km length of the expressway with 4 (2+2) lanes - To construct 7.5 km length of the arterial roads along the expressway with total 6 (3+3) lanes 	<ul style="list-style-type: none"> - To reduce traffic congestion inside the city providing a diversion route from existing highway - To enhance urban development of northern and eastern area of Yangon region - To improve environmental situation in Yangon urban area
RD-9	Road	Construction of Yangon Urban Expressway - East Radial Section	Ministry of Construction	<p>Connection between YUEX (Inner Ring) and YORR along Road No.2</p> <ul style="list-style-type: none"> - To construct 9.5 km length of the expressway with 4 (2+2) lanes - To construct 9.5 km length of the arterial roads along the 	<ul style="list-style-type: none"> - To reduce traffic congestion inside the city providing a diversion route from existing highway - To enhance urban development of eastern suburban area of Yangon region - To cater for productivity increase of industrial

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
		(Phase-2)		expressway with total 6 (3+3) lanes	estates
RD-10	Road	Construction of Yangon Urban Expressway - West Radial Section	Ministry of Construction	Elevated expressway along Road No.5 connecting between YUEX and YORR - To construct 9.0 km length of the expressway with 4 (2+2) lanes - To construct 9.0 km length of the arterial roads along the expressway with total 6 (3+3) lanes	- To reduce traffic congestion inside the city providing a diversion route from existing highway - To enhance urban development of western suburban area of Yangon region - To cater for productivity increase of industrial estates
RD-11	Road	Construction of Yangon Urban Expressway - Inner Ring Section (Phase-3)	Ministry of Construction	Inner Ring Elevated Expressway on the major arterial roads (Byintnaung Rd-Khayae Pin Rd) - To construct 14.5 km length of the expressway with 4 (2+2) lanes - To construct 14.5 km length of the arterial roads along the expressway with total 6 (3+3) lanes	- To reduce traffic congestion inside the city providing a diversion route from existing highway - To enhance urban development of northern and western area of Yangon region - To improve environmental situation in Yangon urban area
RD-12	Road	Construction of Yangon Urban Expressway - Inner Ring section (Phase-4)	Ministry of Construction	Elevated expressway along Bo Gyoke Rd - To construct 11 km length of the expressway with 4 (2+2) lanes - To construct 11 km length of the arterial roads along the expressway with total 6 (3+3) lanes	- To reduce traffic congestion inside the city providing a diversion route from existing highway - To improve environmental situation in Yangon urban area
RD-13	Road	Construction of Yangon Urban Expressway - E-W Link Section	Ministry of Construction	East-West connection route inside YUEX Ring Road on Parami Rd - To construct 6.7 km length of the expressway with 4 (2+2) lanes - To construct 6.7 km length of the arterial roads along the expressway with total 6 (3+3) lanes	- To reduce traffic congestion inside the city providing a diversion route from existing highway - To improve environmental situation in Yangon urban area
RD-14	Road	Arterial Road of Outer Ring Road (Thanlyin TS)	Ministry of Construction	Arterial Road of Outer Ring Road in Thanlyin Township connecting with Thilawa Area - To construct 37 km length of the arterial roads with total 4 (2+2) lanes	- To reduce traffic congestion inside the city providing a diversion route from Thilawa - To enhance urban development of eastern and southern suburban area of Yangon region - To cater for productivity increase of industrial estates

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
RD-15	Road	Arterial Road of Outer Ring Road (Twantay Section)	Ministry of Construction	Arterial Road of Outer Ring Road in Twantay Section - To construct 14 km length of the arterial roads with total 4 (2+2) lanes	- To reduce traffic congestion inside the city providing a diversion route from existing road - To enhance urban development of western and southern suburban area of Yangon region - To cater for productivity increase of industrial estates
RD-16	Road	Arterial Road of Outer Ring Road (Hmawbi-Hlaingthayar Section)	Ministry of Construction	Arterial Road of Outer Ring Road Hmawbi-Hlaingthayar Section - To construct 40 km length of the arterial roads with total 4 (2+2) lanes	- To reduce traffic congestion inside the city providing a diversion route from existing road - To enhance urban development of western and southern suburban area of Yangon region - To cater for productivity increase of industrial estates
RD-18	Road	Construction of Arterial Roads based on the proposed road network by YUTRA (Short-term)	Ministry of Construction	Major Arterial Road based on Network Plan by YUTRA - To construct 35 km length of the arterial roads with total 4 (2+2) lanes	- To reduce traffic congestion inside the city providing a diversion route from existing roads - To enhance urban development of Yangon urban area - To improve environmental situation in Yangon City.
RD-19	Road	Construction of Arterial Roads based on the proposed road network by YUTRA (Middle-term)	Ministry of Construction	Major Arterial Road based on Network Plan by YUTRA - To construct 90 km length of the arterial roads with total 4 (2+2) lanes - To construct Bago River Mouth Bridge 2.5 km length of the long span bridge with total 4 (2+2) lanes - To construct Twantay Bridge 1.0 km length of the long span bridge with total 4 (2+2) lanes	- To reduce traffic congestion inside the city providing a diversion route from existing roads - To enhance urban development of Yangon urban area - To improve environmental situation in Yangon City.
RD-20	Road	Construction of Arterial Roads based on the proposed road network by YUTRA (Long-term)	Ministry of Construction	Major Arterial Road based on Network Plan by YUTRA - To construct 70 km length of the arterial roads with total 4 (2+2) lanes	- To reduce traffic congestion inside the city providing a diversion route from existing roads - To enhance urban development of Yangon urban area - To improve environmental situation in Yangon City.

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
RD-21	Road	Improvement of Existing Arterial Roads based on the proposed road network by YUTRA (Short-term)	Ministry of Construction	Major Arterial Road based on Network Plan by YUTRA - To widen 80 km length of the arterial roads with additional 2 (1+1) lanes	- To reduce traffic congestion inside the city by improvement road capacity of existing road - To enhance urban development of Yangon urban area - To improve environmental situation in Yangon City.
RD-22	Road	Improvement of Existing Arterial Roads based on the proposed road network by YUTRA (Middle-term)	Ministry of Construction	Major Arterial Road based on Network Plan by YUTRA - To widen 60 km length of the arterial roads with additional 2 (1+1) lanes	- To reduce traffic congestion inside the city by improvement road capacity of existing road - To enhance urban development of Yangon urban area - To improve environmental situation in Yangon City.
RD-23	Road	Improvement of Existing Arterial Roads based on the proposed road network by YUTRA (Long-term)	Ministry of Construction	Major Arterial Road based on Network Plan by YUTRA - To widen 35 km length of the arterial roads with additional 2 (1+1) lanes	- To reduce traffic congestion inside the city by improvement road capacity of existing road - To enhance urban development of Yangon urban area - To improve environmental situation in Yangon City.
RD-24	Road	Construction of Bago River Bridge	Ministry of Construction	Major Arterial Road based on Network Plan by YUTRA - To construct 1.9 km length of the long span bridge with total 4 (2+2) lanes	- To reduce traffic congestion inside the city by improvement road capacity of existing road - To enhance urban development of Yangon urban area - To improve environmental situation in Yangon City.
RD-25	Road	Construction of Dala Bridge	Ministry of Construction	Major Arterial Road based on Network Plan by YUTRA - To construct 1.8 km length of the long span bridge with total 4 (2+2) lanes	- To enhance urban development of Dala area - To cater for productivity increase of industrial estates
BRT-1A	Bus Rapid Transit	Phase 1A BRT Green Line and Blue Line - Construction and Implementation	YCDC	-To construct Phase 1A Blue Line and Green Line totalling 49.9 Km of BRT busway and BRT stations - To establish a BRT Agency and BRT Control Centre - To implement a synchronised intersection control along the two busway corridors.	To improve public transport along two intersecting BRT lines to create an initial public transport network and an East-West corridor.

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
				<ul style="list-style-type: none"> - To install an integrated fare collection and smart-card E-ticketing system - To establish BRT operating companies to provide bus services to the system under performance-based contract. - Acquire bus fleet of 110 bi-articulated CNG buses and build 1 main bus depot and one sub-depot. - Implement BRT routes 1,2,3. 	
BRT -1B	Bus Rapid Transit	Phase 1B BRT Orange Line and Red Line - Construction and Implementation	YCDC	<ul style="list-style-type: none"> -To construct Phase 1B the Red Line and Orange Line totalling 31.1 Km of BRT busway and BRTstations and one bus depot- To implement a synchronised intersection control along the two busway corridors. - To rationalise bus routes and establish BRT operating companies to provide bus services to the system under performance-based contract. - Acquire bus fleet of 160 bi-articulated buses. - Implement BRT routes 4,5,6. 	To add to the previous Phase 1A BRT project to expand the network , connecting the Airport and the Northern Intercity bus station to the CBD.
BRT -2A	Bus Rapid Transit	Phase 2A BRT Purple Line and Brown Line - Construction and Implementation	YCDC	<ul style="list-style-type: none"> -To construct Phase 2A the Purple Line and Brown Line totalling 30.0 Km of BRT busway and BRTstations and one bus depot - To implement a synchronised intersection control along the two busway corridors. - To rationalise bus routes and establish BRT operating companies to provide bus services to the system under performance-based contract. - Acquire bus fleet of 96 CNG bi-articulated CNG buses (25m) and 21 CNG citybuses (12m) - Implement BRT Routes 7,8,9. 	To expand the BRT network of Phase 1 to the Eastern Arterial roads and provide an east west connection.
BRT -2B	Bus Rapid Transit	Phase 2B BRT Grey Line - Construction and Implementation	YCDC	<ul style="list-style-type: none"> -To construct Phase 2B Grey Line totalling 16.9 Km of BRT busway and BRTstations and one bus depot - To implement a synchronised intersection control along the two busway corridors. - To rationalise bus routes and establish BRT operating 	To expand the BRT network over the Bago Bridge to Thanlyin Township.

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
BT-1	Bus Transport	Improvement of Existing Public Bus Transport Services in Yangon Region	Yangon Region, MOT, Transport Planning Department, Ma-hta-tha-Central, YCDC	<p>companies to provide bus services to the system under performance-based contract.</p> <ul style="list-style-type: none"> - Acquire bus fleet of 56 CNG bi-articulated (25m) buses and 26 CNG Citybus(12m) - Implement BRT Routes 10A & 10B - Restructuring of bus network - Modernization of bus services - Development of bus terminals and interchanges - Prioritization of urban bus transport 	<ul style="list-style-type: none"> - To improve the efficiency of bus operation - To provide better level of public bus transport services - To reduce traffic congestion
RL-1	Railway	TA for the Integration of Rail Transport Improvement and Station Area Urban Development in Yangon (Enhancing Transit Oriented Development)	MORT/MR	<ul style="list-style-type: none"> • To prepare conceptual station area urban development plan in the available MR, railway land. • To prepare standard RfP and contract document for biddings for Replace/Redevelopment of railway land which will be developed by any private firms. The RfP may require developer to relocate the existing function in current yards to be developed such as stabling yard, depot, workshop, etc. and to modernize the existing railway and/or install new transit system by using their benefit obtained from the land development. 	<ul style="list-style-type: none"> • To establish a coordination mechanism between MR. and organizations responsible for urban development along railway lines particularly in station areas • To prepare a conceptual station area development plan including inter-modal transfer facilities and urban development which will be able to enhance usages of railway system, • To estimate development benefit from the urban development and to prepare PPP (Public Private Partnership) guide lines for the station area development.
RL-2	Railway	TA for Commuter Service Level Enhancement in Greater Yangon	MORT/MR	<ul style="list-style-type: none"> • Support to establish an effective train operation plan and diagram for commuter, • Establishing "Commuter Service Improvement Dept." and the capacity building, and • Technical Assistance for the existing passenger wagon interior upgrade work for commuter. 	<ul style="list-style-type: none"> • At present, punctuality of trains on Yangon Circular Railway is low due to influence from delay of high-class trains on Yangon-Mandalay Main Line/Pyay Line, and it causes the tendency that commuter does not use railroad. After the TA, to establish an effective train operation plan and diagram for commuter.

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
RL-3	Railway	Railway Central Control Center System Installation (Ongoing by JICA)	MORT/MR	In order to eliminate the problems, appropriate safety facilities such as OCC, electronic interlocking device, etc., will be installed as urgent countermeasure by JICA grant aid.	<ul style="list-style-type: none"> To make MR staffs recognizing the importance of the commuter service and train them. To enhance modal shift from road to railway by providing better passenger wagon for commuter. <p>To improve reliability of train operation and safety condition in Yangon Central station and suburban section of Yangon-Mandalay line.</p>
RL-4	Railway	TA for Railway Safety and Service Improvement - (Ongoing by JICA)	MORT/MR	<ul style="list-style-type: none"> i) to establish plan for improvement of operation for enhancement of safety and service, and ii) technical capacity building/technical transfer for track maintenance skill by using Yangon-Mandalay suburban line. 	To reduce railway accident.
RL-5	Railway	Yangon Circular Railway Improvement (Non-electrified) - Phase 1: Western Half Loop	MORT/MR	<ul style="list-style-type: none"> Civil Structure Improvement (Drainage Improvement, Embankment/Cut Improvement, Bridge Improvement, Culvert Improvement) Track Improvement (Replace Rail from existing 37kg/m rail to 50kg/m rail, Install New PC sleeper for 50kg/m rail, Spread new ballast) Signaling & Telecom System Modernization Station and Station Facility Improvement (High height platform, ticket selling system improvement, introduction of AFC system with IC card) DEMU Procurement Improve existing Kyeemyindaing depot and Insein workshop for new DEMU Installation of automatic level crossing <p>Note that no elevated and no electrified are applied.</p>	<ul style="list-style-type: none"> To facilitate the modal shift from road to railway transport, especially the north - south direction transport. To reduce road traffic volume and traffic congestions. To improve the transport condition between the north Yangon and CBD area drastically, especially commuting condition.
RL-6	Railway	TOD Enhancement Project along Yangon Circular Railway Western Half	MORT/MR	The project scope is to provide station plaza with bus stop at main stations along the line such as Kyeemyindaing R.S., Insein R.S., and Danyingone R.S. Yangon Central station is excluded from the target station	<ul style="list-style-type: none"> To improve transport hub function of each stations. To improve feeder access condition from/to station.

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
RL-7	Railway	Yangon Central Station Redevelopment Project	MORT/MR	<p>because there is another project named as "[RL-7] Yangon Central Station Redevelopment Project". Kyeemyindaing station and Insein station will be included in the project scope, although there are another projects named as "[RL-9] Kyeemyindaing Station Redevelopment Project" and "[RL-10] Insein Workshop Area Redevelopment Project" respectively, because the projects are conducted as middle-term project and minimum function should be installed as short-term countermeasure.</p> <p>The redevelopment plan should be prepared by selected developer from the commercial viewpoint, although layout of business offices, commercial facilities, residential apartments, etc. are expected. However, the redevelopment area will play roles as not only commercial and business center but also transit hub because the station accept entering many transit mode and pedestrians. In order to fulfill the function as transport hub, the following public functions and the integration should be considered.</p> <p>< Public Transport Transfer >: MR lines (Yangon Circular Railway, Yangon Suburban Lines, Middle and Long Distance Trains), UMRT Line1, BRT stations (2 routes are planned), Feeder bus terminal, Taxi stand < Private Vehicle Connection >: Road connection including access rotary road to station entrance, bus terminal, and taxi stand, etc., Car parking for Park & Ride or commercial / business building users < Others >: Pedestrian path, Green space</p> <p>It is recommended to conduct the project by PPP scheme in order to maximize use of private investor's fund. It is a one of options that public side (MR) provides their land and private side (developer) develop the area including public facilities by their own fund, and developer pay</p>	<p>To increase the passenger number and enhance convenience of Yangon Circular Railway.</p> <p>The number of railway users including business/commercial area will be increased due to high ability to attract users and having high transport hub function.</p>

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
RL-8	Railway	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase1	MORT/MR	<p>There is a huge land which is owned by MR at the northern side of Ywa Tar Gyi station along Yangon-Mandalay line. Therefore, it is proposed to use the yard for the project.</p> <p>The whole integrated new depot and workshop will be established by phasing development due to the difference of timing to redevelop each yards, and this project will be the first phase for relocation of the existing function (depot and maintenance shed) in Yangon Central station yard. 16ha of Yangon Central station yard to be redeveloped, the required substitute land area is assumed as 16ha.</p> <p>The relocation cost to be born from the development benefit of Yangon central station yards.</p>	<p>Yard redevelopment projects can be implemented.</p> <p>Depot and workshop equipments and buildings are renewed.</p>
RL-9	Railway	Kyee Myin Daing Station Yard Redevelopment Project	MORT/MR	<p>The redevelopment plan should be prepared by selected developer from the commercial viewpoint, although layout of business offices, commercial facilities, residential apartments, etc. are expected. However, the redevelopment area will play roles as not only commercial and business center but also transit hub because the station accept entering many transit mode and pedestrians. In order to fulfill the function as transport hub, the following public functions and the integration should be considered.</p> <p>< Public Transport Transfer > MR lines (Yangon Circular Railway), Feeder bus terminal, Taxi stand < Private Vehicle Connection > Road connection including access rotary road to station entrance, bus terminal, and taxi stand, etc., Small car parking < Others ></p>	<p>The number of railway users including business/commercial area will be increased due to high ability to attract users and having high transport hub function.</p>

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
				<p>Pedestrian path</p> <p>It is recommended to conduct the project by PPP scheme in order to maximize use of private investor's fund. It is a one of options that public side (MR) provides their land and private side (developer) develop the area including public facilities by their own fund, and developer pay decided royalty to MR.</p>	
RL-10	Railway	Insein Workshop Area Redevelopment Project	MORT/MR	<p>The redevelopment plan should be prepared by selected developer from the commercial viewpoint, although layout of business offices, commercial facilities, residential apartments, etc. are expected. However, the redevelopment area will play roles as not only commercial and business center but also transit hub because the station accept entering many transit mode including Yangon Circular Railway, UMRT Line2, BRT, feeder buses, taxis, private vehicles, and pedestrians. In SUDP, Insein workshop is selected as the target for TOD case study. In the study, it is proposed to apply phasing development for the area.</p>	<p>The number of railway users including business/commercial area will be increased due to high ability to attract users and having high transport hub function.</p>
RL-11	Railway	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase3	MORT/MR	<p>There is a huge land which is owned by MR at the northern side of Ywa Tar Gyi station along Yangon-Mandalay line. Therefore, it is proposed to use the yard for the project.</p> <p>The whole integrated new depot and workshop will be established by phasing development due to the difference of timing to redevelop each yards, and this project will be the third phase for relocation of the existing function (depot and workshop) in Kyeemyindaing yard and Insein yard. 26ha of Kyeemyindaing yard and Insein workshop yard to be redeveloped, the required substitute land area is assumed as 26ha.</p> <p>The relocation cost to be born from the development benefit of each yards.</p>	<p>Yard redevelopment projects can be implemented.</p> <p>Depot and workshop equipments and buildings are renewed.</p>

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
RL-12	Railway	Electrified and Elevated Project for Yangon Circular Railway Western Half	MORT/MR	The western half of Yangon Circular Railway, which runs Yangon Central Station – Insein Station – Danyingone Station with 21km length, is to be electrified and elevated as long-term project. Actual project implementation schedule should be reviewed by the possibility of stable power supply, budget allocation, etc.	<ul style="list-style-type: none"> To assure the modal shift from road to railway transport, especially the north - south direction transport. To reduce traffic congestions due to grade separation. To improve the transport capacity and travel speed of the line.
RL-13	Railway	Yangon-Mandalay Line Improvement: Phase 1 (Partial operation)	MORT/MR	<p>The project scope is composed of earthwork improvement, bridge improvement, track improvement, other civil works, signaling & telecom system modernization including automatic level crossing installation, procurement of rolling stocks (DMU and DEMU) with maintenance facilities, and rehabilitation of two freight terminals (Satsan and Botataung). The project is conducted as a national transport condition improvement project.</p> <p>On the other hand, it is not clear whether the number of DEMU procured by the national transport project is enough for commuter operation or not. Therefore, it is planned to procure additional rolling stock (DEMU). The cost shown in the sheet means the cost for the additional DEMU procurement.</p>	<ul style="list-style-type: none"> To facilitate the modal shift from road to railway transport, especially CBD - Dagon Myothit direction transport. To reduce road traffic volume and traffic congestions. To improve the transport condition between Dagon Myothit and CBD area drastically, especially commuting condition.
RL-14	Railway	Malwagone Depot/Workshop Area Redevelopment Project (including Track Improvement between Yangon Central Station and Malwagone Station)	MORT/MR	The redevelopment plan should be prepared by selected developer from the commercial viewpoint, although layout of business offices, commercial facilities, residential apartments, etc. are expected. However, the redevelopment area will play roles as not only commercial and business center but also transit hub because the station accept entering many transit mode and pedestrians. In order to fulfill the function as transport hub, the following public functions and the integration should be considered. < Public Transport Transfer >	The number of railway users including business/commercial area will be increased due to high ability to attract users and having high transport hub function.

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
				MR lines (Yangon Circular Railway, Yangon Suburban Lines, Middle and Long Distance Trains), BRT station, Feeder bus terminal, Taxi stand < Private Vehicle Connection > Road connection including access rotary road to station entrance, bus terminal, and taxi stand, etc., Car parking for Park & Ride or commercial / business building users < Others > Pedestrian path, Green space	
RL-15	Railway	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) ;Phase2	MORT/MR	There is a huge land which is owned by MR at the northern side of Ywa Tar Gyi station along Yangon-Mandalay line. Therefore, it is proposed to use the yard for the project. The whole integrated new depot and workshop will be established by phasing development due to the difference of timing to redevelop each yards, and this project will be the 2nd phase for relocation of the existing in Malwagone depot and workshop yard. 61ha of Malwagone yard to be redeveloped, the required substitute land area is assumed as 61ha. The relocation cost to be born from the development benefit of Malwagone yard.	Yard redevelopment projects can be implemented. Depot and workshop equipments and buildings are renewed.
RL-16	Railway	Toe Kyaung Galay Station Development Project	MORT/MR	Toe Kyaung Galay station is approximately 10km to 15km far from CBD, is transfer station to Thilawa and UMRT line2, is located at the southern side of Dagon Myothit sub-center, and has plenty vacant land at the northern side. The redevelopment plan should be prepared by selected developer from the commercial viewpoint, although layout of business offices, commercial facilities, residential apartments, etc. are expected. However, the redevelopment area will play roles as not only commercial and business center but also transit hub	The number of railway users including business/commercial area will be increased due to high ability to attract users and having high transport hub function.

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
RL-17	Railway	Yangon-Mandalay Suburban Line Electrification	MORT/MR	<p>The project section, which is 28.3km from Yangon Central Station to the border of the study area (between Ledaungan Station and Dabein Station), is to be electrified as long-term project. Actual project implementation schedule should be reviewed by the possibility of stable power supply, budget allocation, etc.</p>	<ul style="list-style-type: none"> To assure the modal shift from road to railway transport, especially CBD - Dagon Myothit direction transport. To reduce traffic congestions due to grade separation. To improve the transport capacity and travel speed of the line.
RL-18	Railway	Yangon Circular Railway Improvement (Non-electrified) - Phase2: Eastern Half Loop	MORT/MR	<p>The project scope is the same as "[RL-5] Yangon Circular Railway Improvement (Non-electrified) Phase1: Western Half Loop" as follows.</p> <ul style="list-style-type: none"> Civil Structure Improvement (Drainage Improvement, Embankment/Cut Improvement, Bridge Improvement, Culvert Improvement) Track Improvement (Replace Rail from existing 37kg/m rail to 50kg/m rail, Install New PC sleeper for 50kg/m rail, Spread new ballast) Signaling & Telecom System Modernization Station and Station Facility Improvement (High height platform, ticket selling system improvement, introduction of AFC system with IC card) DEMU Procurement Establishing new depot and maintenance shed for New DEMU. Installation of automatic level crossing <p>Note that no elevated and no electrified are applied.</p>	<ul style="list-style-type: none"> To facilitate the modal shift from road to railway transport, especially the north - south direction transport. To reduce road traffic volume and traffic congestions. To improve the transport condition between the north Yangon and CBD area drastically, especially commuting condition.
RL-	Railway	Railway Land Redevelopment	MORT/MR	<p>The redevelopment plan should be prepared by selected developer from the commercial viewpoint, although layout</p>	<p>The number of railway users including business/commercial area will be increased due</p>

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
19		Project along Yangon Circular Railway Eastern-half		<p>of business offices, commercial facilities, residential apartments, etc. are expected. However, the redevelopment area will play roles as not only commercial and business center but also transit hub because the station accept entering many transit mode and pedestrians. In order to fulfill the function as transport hub, the following public functions and the integration should be considered.</p> <p>< Public Transport Transfer >: MR lines, UMRT Line1 and Line2, BRT stations, Feeder bus terminal, Taxi stand</p> <p>< Private Vehicle Connection >: Road connection including access rotary road to station entrance, bus terminal, and taxi stand, etc., Car parking for Park & Ride or commercial / business building users</p> <p>< Others >: Pedestrian path, Green space</p> <p>It is recommended to conduct the project by PPP scheme in order to maximize use of private investor's fund.</p>	to high ability to attract users and having high transport hub function.
RL-20	Railway	Electrification of Yangon Circular Railway Eastern Half	MORT/MR	<p>The project section, which is the eastern half of Yangon Circular Railway (Yangon Central Station – Malwagone Station – Mingalardon Station – Danyingone Station with 26.5km length), is to be electrified as long-term project. Actual project implementation schedule should be reviewed by the possibility of stable power supply, budget allocation, etc.</p>	<ul style="list-style-type: none"> To assure the modal shift from road to railway transport, especially the north - south direction transport. To reduce traffic congestions due to grade separation. To improve the transport capacity and travel speed of the line.
RL-21	Railway	Yangon-Pyay Suburban Line Improvement and Double-tracking (between Danyingone R.S and Hmawbi R.S)	MORT/MR	<p>Although the line has 20.1km from Danyingone station to the border of the Study area near Hmawbi station, the half of them (9.6km from Hlawga Station to the border of the study area near Hmawbi station) is single track. The section should be double-tracked in order to increase train operation capacity in addition to improvement of the existing track.</p> <p>The other scope is as follows.</p> <ul style="list-style-type: none"> Civil Structure Improvement (Drainage Improvement, 	<ul style="list-style-type: none"> To enhance the modal shift from road to railway transport, especially the north - south direction transport. To reduce road traffic volume and traffic congestions. To improve the transport condition between the northern outskirts of Yangon and CBD area drastically, especially commuting condition.

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
				<p>Embankment/Cut Improvement, Bridge Improvement, Culvert Improvement)</p> <ul style="list-style-type: none"> • Track Improvement (Replace Rail from existing 37kg/m rail to 50kg/m rail, Install New PC sleeper for 50kg/m rail, Spread new ballast) • Signaling & Telecom System Modernization • Station and Station Facility Improvement (High height platform, ticket selling system improvement, introduction of AFC system with IC card) • DEMU Procurement • New depot and workshop for new DEMU • Installation of automatic level crossing <p>Note that no elevated and no electrified are applied.</p>	
RL-22	Railway	Hlawga Station Development	MORT/MR	<p>Hlawga station is located near new town core and new industrial zone planned in SUDP and has plenty vacant land, although the distance from/to CBD is approximately 30km.. The redevelopment plan should be prepared by selected developer from the commercial viewpoint, although layout of business offices, commercial facilities, residential apartments, etc. are expected. However, the redevelopment area will play roles as not only commercial and business center but also transit hub because the station accept entering many transit mode and pedestrians. In order to fulfill the function as transport hub, the following public functions and the integration should be considered. It is recommended to conduct the project by PPP scheme in order to maximize use of private investor's fund.</p>	<p>The number of railway users including business/commercial area will be increased due to high ability to attract users and having high transport hub function.</p>
RL-23	Railway	Yangon-Pyay Suburban Line Electrification	MORT/MR	<p>The project section, which is 20.1km from Danyingone Station to the border of the study area (between Hlawga Station and Hmawbi Station), is to be electrified as long-term project. Actual project implementation schedule should be reviewed by the possibility of stable power</p>	<ul style="list-style-type: none"> • To assure the modal shift from road to railway transport, especially the north - south direction transport. • To reduce road traffic volume and traffic congestions more.

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
				supply, budget allocation, etc.	<ul style="list-style-type: none"> To improve the transport capacity and travel speed between the northern ourshirt of Yangon and CBD area more, especially commuting condition.
RL-24	Railway	Thilawa Access Line Improvement and Double-tracking (for Commuter and Freight)	MORT/MR	To improve and double-track the existing line which has 26.2km from Toe Kyaung Galay station to Thilawa station. Regarding the double-tracking, it will be a one of main issues that how to across Bago river due to the long length with approximately 2km. There is a problem in the existing Thanlyin bridge across Bago river that any container train cannot pass due to the small construction gauge and car gauge. Therefore, all freight container train should pass the new railway bridge, and the existing bridge will be for commuter/passenger train.	<ul style="list-style-type: none"> To facilitate the modal shift from road to railway transport, both passenger transport between Yangon and Thilawa and freight transport between Thilawa and Mandalay, etc. To reduce road traffic volume and traffic congestions. To improve the transport condition between Yangon and Thilawa drastically, especially commuting condition.
RL-25	Railway	Thilawa New Container Railway Station Development Project	MORT/MR	To construct railway container terminal	<ul style="list-style-type: none"> To facilitate the modal shift of container transport from road to railway transport between Thilawa and remote inland cities such as Mandalay, etc. To reduce road traffic volume and traffic congestions.
RL-26	Railway	Thilawa Access Line Electrification	MORT/MR	The project section, is 26.2km from Toe Kyaung Galay station to Thilawa Station, is to be electrified as long-term project. Actual project implementation schedule should be reviewed by the possibility of stable power supply, budget allocation, etc.	<ul style="list-style-type: none"> To assure the modal shift from road to railway transport, especially commuter from/to Thilawa. To reduce road traffic volume and traffic congestions more. To improve the transport capacity and travel speed between Yangon and Thilawa, especially commuting condition.
RL-27	Railway	UMRT Line1 Construction Project - North-South Line	MORT/MR	UMRT Line 1 is planned to install one of North-South axis which have many traffic volume for commuter. The line connecting CBD with Yangon International Airport with 21.8km length via Yangon Central Station and Mindama	<ul style="list-style-type: none"> - Improve passenger transport capacity and travel speed of north-south axis of the city. - Another alternative route for north-south direction is provided.

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
				sub-center area, along Sule Pagoda Rd., Kaba Aye Rd., Yangon Airport Rd., and NH No.3. In order to save construction cost, underground section is minimized. However, 10.5km length becomes underground section due to no room for elevated viaduct construction. Two sections that i) 7.5km from the starting point which is the intersection of Strand Rd. and Sule Pagoda Rd. to the east side of Inya lake, and ii) 3.0km along the southeast side of Yangon International Airport are planned as underground section. The other sections are planned as elevated. The depot and workshop will locate at the north end of the line judging from the current plenty vacant lot.	- Land development along the line, especially Mindama sub-center, is accelerated
RL-28	Railway	UMRT Line1 Extension Project - North-South Line Extension	MORT/MR	The project is to extend UMRT Line1 from the south end to Dala with 6km length. In order to save construction cost, underground section is minimized. However, 3.7km length becomes underground section due to across Hlaing river and no room for elevated viaduct construction around the river side of Dala.	- Large public transport corridor can be provided from/to Dala - Land development along the line, especially Dala is accelerated
RL-29	Railway	UMRT Line2 Construction Project - East-West Line	MORT/MR	UMRT Line2 is installed as East-West axis with 26.0km length. The route is planned to connect sub-centers planned by SUDP, named Hlaing Tharya, Mindama, and Dagon Myothit. In order to save construction cost, underground section is minimized. However, 13.0km length becomes underground section due to no room for elevated viaduct construction. Two sections that i) 6.2km from the starting point which is located beside Hlaing Tharya. Sub-center to the west bank side of Aung Zay Ya bridge, and ii) 6.8km from near the west end of Yarzaa Dirit Rd. to the end point beside Toe Kyaung Galay station are planned as elevated section. The other sections are planned as	- All sub-centers are connected by railway - Improve passenger transport capacity and travel speed of East-West axis of the city. - Land development along the line is accelerated

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
				underground. The depot and workshop is planned to locate at the beside Hlaing Tharya sub-center judging from the current plenty vacant lot.	
TMS -1	Traffic Management and Safety	Yangon CBD Traffic Congestion Mitigation Project	YCDC	<ul style="list-style-type: none"> - Modernization of the signal system - Remove on-street parking from the congested road sections, provide sufficient number of lots to less-congested sections - Parking Fee charging system (including parking meter) - Remove street vendors from foot path and develop a Hawker Centre, and improve pedestrian environment - Provision of bus-bays and taxi-bays - Implementation of Mobility Management Measures (TDM measures) 	the project will contribute to mitigate traffic congestions in CBD so as to enhance economic activities and to improve urban environment.
TMS -2	Traffic Management and Safety	Yangon Main Roads Traffic Congestion Mitigation Project	Yangon Region/YCDC	<ul style="list-style-type: none"> - installation and upgrading traffic signal control system - improvement of intersection geometrics, installation of Road signs and pavement marking - installation of Traffic monitoring system - provision of pedestrian bridges - development of bus interchanges and improvement of bus stops, etc. 	the project will contribute to mitigate traffic congestions and provide to smooth and safe traffic flows, reducing economic losses and environment deterioration in the congested urban areas.
TMS -3	Traffic Management and Safety	Capacity Development on Traffic Planning and Management in Yangon	YCDC	<ul style="list-style-type: none"> - training on traffic engineering and management - implementation of pilot projects - development of rules and regulation related to the traffic demand management - training in Japan and third countries - seminar and workshop 	through the human resource development project, YCDC will improve capability to implement appropriate traffic management measures for the environmentally friendly urban transport system.
TMS -4	Traffic Management and Safety	Yangon Parking Development Project (Master Plan)	Yangon Region/YCDC	<ul style="list-style-type: none"> - Survey on parking situation and estimation of parking demand - establishment of laws and regulations as well as technical guidelines - Public parking development plans - examination of public parking operation, enforcement 	Comprehensive parking development plan will contribute to implement necessary parking project effectively, subsequently improve traffic flows and environment in the CBD and other commercial/business areas.

No.	Sector	Project Title	Implementation Agency	Project Outline	Expected Project Effect
TMS-5	Traffic Management and Safety	Yangon Parking Development Project (Construction)	YCDC	<ul style="list-style-type: none"> for illegal parking financial and economic evaluation, and funding to carry out Feasibility Study for the proposed public parking including environmental assessment to prepare detail design and tender document to supervise the construction 	<p>On-street parking can be removed and traffic congestions will be mitigated. Moreover the spaces can be used for urban environmental improvement or pedestrian space.</p>
TMS-6	Traffic Management and Safety	Yangon Traffic Safety Five-Year Program	Yangon Region/YCDC	<ul style="list-style-type: none"> preparation of traffic safety projects for five years including 3Es (Engineering, Enforcement and Education) Establishment Traffic Safety Committee Development of Traffic Accident Database implementation of the traffic safety projects Capacity Development for Traffic Police Force and other stakeholder involved in traffic safety activities 	<p>reduce traffic accident and fatalities so as to develop safe traffic society</p>
FT-1	Rail / Truck (Freight)	Inland Container Depot and Highway Truck Terminal Development	Myanmar Railways, Ministry of Rail Transportation, Yangon Region	<ul style="list-style-type: none"> ICD and Highway Truck Terminal development (150ha) Installation of cargo handling facilities (MR workshop and Depot can be included) 	<ul style="list-style-type: none"> To increase opportunity of international cargo transportation related business. To improve MR business performance To remove goods traffic from the highly urbanized area To achieve better transport environment in the urbanized area (residential areas). To contribute the national economy.
FT-2	Rail / Truck (Freight)	Redesignation of Highway Truck Routes	Yangon Region, PW, MOC, YCDC	<ul style="list-style-type: none"> Missing link improvement by PW, MOC / YCDC (refer to RD-18, 19, and 21) - these are not included in FT-02. Redesignation of highway truck route by Yangon Region and MORT Installation of signage, monitoring system (CCTV, etc.) along the designated route. 	<ul style="list-style-type: none"> Easy access for highway trucks to reach new highway truck terminal in East Dagon Township To remove goods traffic from the highly urbanized area To achieve better transport environment in the urbanized area (residential areas). To contribute the national economy.

Source: YUTRA Project Team

6.3 Evaluation of Major Master Plan Projects

6.3.1 Economic Evaluation of Projects

1) Methodology and Assumption

For the economic analysis of the priority projects selected by YUTRA MP, two (2) direct effects by the projects were taken into consideration as economic benefits; one was savings in Vehicle Operating Cost (VOC) and the other was savings in Travel Time Cost (TTC). These effects were measured by “with and without” comparison, that is, comparison of traffic assignment results on a network with the MP projects (*Do MP case*) and without the projects (*Do nothing case*).

Considering the impact on the traffic assignment, the urban railway, BRT, and road development projects were selected for economic evaluation.

The following assumptions and standardizations were adopted for the sake of simplification and convenience of comparison, since there are many projects to be evaluated and a main purpose of evaluation is to put a comparative priority on each project.

(1) Project Evaluation Period:

Project evaluation period was set 30years from 2014.

The construction period and the commencement of operation year are varied by each project. For those projects which are expected to be commenced in mid and/ or long term stage, the residual value was considered.

(2) Project Life Period:

Project life period was differed by the transportation mode. To simplify the evaluation, 30years were set for Public Transportation projects, whereas 50years were set for road development projects.

If the project life period for the target project were not covered by the above mentioned project evaluation period, the residual value was considered.

(3) Traffic Assignment:

Traffic assignment was conducted for the years 2018, 2025, and 2035, respectively. The economic benefits have been calculated from the results of traffic assignment. After 2035, economic benefit was assumed to be increased by the same trend.

(4) Indicators for the Economic Viability

Economic viability of each project is calculated by the following three (3) Indicators from the annual cost and benefit streams:

- B/C (Cost Benefit Ratio)
- NPV (Net Present Value)
- EIRR (Economic Internal Rate of Return)

(5) Social Discount Rate:

Social discount rate for the Project is set at 10 percent.

(6) Annual Maintenance Cost:

Annual maintenance cost of a road development and rail project was assumed to be 3% of construction cost of the project except expressways and 5% of that for expressways. As for BRT project, annual operation and maintenance cost was estimated separately for each project.

(7) Economic Cost:

Economic cost was assumed as 85% of the market price. So, the standard conversion factor (SCF) from the financial cost to the economic cost was 0.85.

(8) Exchange Rate:

Exchange rate set for the project evaluation is USD 1.00 =MMK 1,000.00

2) VOC and TTC

As savings in VOC and TTC were selected as the economic benefit of a project, unit costs of VOC and TTC were required to estimate those benefits. The unit costs were estimated in 2013 price.

(1) VOC

The unit VOC by vehicle type was estimated based on an analysis on actual performance data collected from different transport operators as well as automobile dealers. The followings are described about the estimation of VOC.

(i) Vehicle Cost

The market price of each type of vehicles in Yangon was obtained first through the interviews with car dealers. Then, for converting to the economic value, the import duty and commercial tax levied on the imported vehicle were deducted from the market price.

(ii) Fuel and Lubricant Cost

The economic cost of fuel and lubricant was calculated by converting the financial price of each oil, gasoline and diesel which was obtained through the interview surveys. Then the unit fuel and lubricant cost per travel speed and type of vehicle was estimated by employing the consumption coefficient widely applied.

(iii) Tire Cost

The tire cost in the economic price per travel speed and type of vehicle was estimated by applying the JATMA formula, which is widely utilized for the estimation of tire consumption cost.

(iv) Repair Cost

The vehicle repair cost in economic value for each vehicle type was calculated by the following formula:

$$\text{Repair cost} = (i) \text{ Vehicle cost} - (iii) \text{ Tire cost}$$

(v) Depreciation Cost

The percentage share of depreciation for both distance related and time related were set up based on the data which have been applied in the road transport study so called

MMUTIS.

(vi) Capital Opportunity Cost

The capital opportunity cost for each type of vehicle was estimated by utilizing the interest rate and salvage value

(vii) Crew Cost

The crew cost for each type of vehicle was estimated by the information of hourly wages through the interviews with private bus companies, trucking companies and so on.

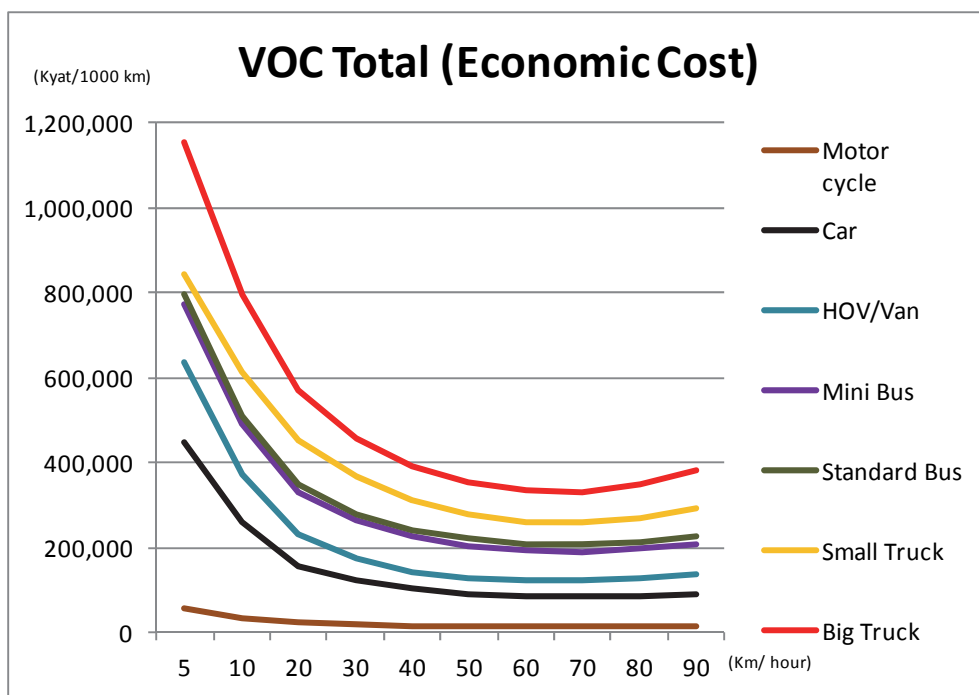
Based upon the above mentioned information on the cost, the unit VOC for each type of vehicle was estimated. The summary of the unit VOC is shown as following Table 6.3.1.1 and Figure 6.3.1.1.

Table 6.3.1.1 VOC by Vehicle Type (Economic Price)

Unit: '000MMK-km

Speed (km/h)	Motor cycle	Car	HOV/Van	Mini Bus	Standard Bus	Small Truck	Big Truck
5	57,900	447,132	633,195	661,973	742,929	840,234	1,151,759
10	34,295	257,712	373,860	437,362	483,119	611,153	795,493
20	21,849	157,594	232,658	304,153	332,735	451,173	568,219
30	17,456	121,618	176,768	246,379	269,885	367,305	458,218
40	15,148	102,844	143,898	212,305	234,639	312,747	390,639
50	14,188	91,836	129,495	193,113	215,174	279,481	354,415
60	13,646	86,853	124,392	183,500	204,314	260,910	334,571
70	13,606	85,227	124,195	182,208	202,200	257,244	332,035
80	14,196	86,333	128,713	188,949	209,178	268,277	349,084
90	15,293	89,972	135,816	202,879	224,490	292,710	381,993

Source: YUTRA Project Team



Source: YUTRA Project Team

Figure 6.3.1.1 VOC by Vehicle Type

(2) TTC

Value of Time (VOT) is an important parameter to determine the modal split of passenger traffic, and to provide the basis for economic evaluation of the proposed project. The value of passengers travelling time cost was estimated by mode of transport as summarized in Table 6.3.1.2.

This value is assumed to be increased at the same growth rate as per-capita GRDP used in this study.

Table 6.3.1.2 TTC by Travel Modes (kyat/ min)

No	Mode	2013 (Current)	2018	2025	2035
1	Motor Cycle	8.9	12.4	19.0	34.5
2	Car	21.9	30.6	46.7	85.0
3	Taxi	17.1	23.9	36.5	66.4
4	Bus	11.0	15.4	23.5	42.7

Source: YUTRA Project Team

3) Evaluation Results

The evaluation results of economic analysis for the each priority project are summarized in the following sections. To compare the economic viability of each Project, i)B/C, ii)NPV, and iii) EIRR were computed based on the assumptions mentioned in the foregoing sections.

The evaluation results reveal that most of the projects are assessed as economically feasible, as the threshold of EIRR is 12%.

BRT Projects

The following table exhibits the evaluation results of each BRT project. Among the four major projects, BRT-2B Gray Line construction and implementation project has recorded the highest EIRR of over 30%.

As a whole, the evaluation results for the BRT projects revealed the high economic efficiencies.

Table 6.3.1.3 Economic Evaluation Results for BRT Projects

Package No.	Code	Project	EIRR (%)	NPV (US\$ Mil.)	B/C
BR-01	1A	BRT Green Line and Blue Line	15.4%	145.3	1.83
BR-02	1B	BRT Orange Line and Red Line	17.8%	257.6	2.29
BR-03	2A	BRT Purple Line and Brown Line	21.9%	185.5	2.33
BR-04	2B	BRT Gray Line	31.2%	277.4	4.04
		Overall BRT Projects (combined)	19.3%	882.4	2.41

Source: YUTRA Project Team

Urban Railway Projects

The economic evaluation results for the urban railway projects were summarized as Table 6.3.1.4.

Table 6.3.1.4 Economic Evaluation Results for Urban Railway Projects

Package No.	Code	Project	EIRR (%)	NPV (US\$ Mil.)	B/C
100	RL-5 & RL-12	Yangon Circular Western Half Loop	13.1%	84.8	1.12
101	RL-13 & RL-17	Yangon – Mandalay Line	15.7%	53.9	1.30
102	RL-18 & RL-20	Yangon Circular Eastern Half Loop	19.5%	444.6	2.01
103	RL-21 & RL-23	Yangon-Pyay Suburban Line	19.9%	346.8	1.95
104	RL-24 & RL-26	Thilawa Access Line	14.6%	298.1	1.45
111	RL-24 & RL-26	UMRT-01	13.1%	246.7	1.18
112	RL-29	UMRT-02	12.4%	150.3	1.11
		Overall BRT Projects (combined)	14.6%	4,393.5	1.60

Source: YUTRA Project Team

Road Development Projects

As shown by the following Table 6.3.1.5, all of the road development projects showed much higher EIRR comparing with the target ratio of 12%. Among the projects, Dala bridge construction project and the package program of Improvement (widening) of the existing

arterial road projects showed quite high EIRR and B/C.

Table 6.3.1.5 Economic Evaluation Results for Road Development Projects

Package No.	Code	Project	EIRR (%)	NPV (US\$ Mil.)	B/C
HP-00	RD-01	New Thaketa Bridge	20%	66	4.6
HP-00	RD-24	Bago River Bridge	16%	233	2.8
HP-00	RD-25	Dala Bridge	30%+	1,710	19.9
HP-01	RD-5 & RD-14 to 17	Urban Expressway	18%	489	1.7
HP-02	RD-6 to RD-13	Outer Ring Road	25%	7,313	4.6
HP-03	RD-18 to RD-20	Arterial Roads (New Construction components)	23%	1,772	5.2
HP-04	RL-21 to RD-23	Arterial Roads (Widening the existing roads)	37%	3,476	24.1
	Overall BRT Projects (combined)		26.8%	15,059	5.4

Source: YUTRA Project Team

Finally, the overall MP projects (*Do MP case*) also recoded the high EIRR of 20.2%. The results of economic evaluation revealed that the respective BRT, Urban railway and road development projects are economically feasible.

6.3.2 Financial Evaluation of Projects

1) Methodology and Assumption

Financial evaluation was also carried out only for the income generating (cash earning) projects, such as BRT, Urban railway and a few toll road projects.

Same scenario of “with-without” case setting was applied to the financial analysis of the target projects. In order to make a comparative assessment of the financial viability under the same circumstance, the costs for financing arrangement were excluded from the evaluation.

2) Fare Setting

The fare setting by mode of transport employed for the financial evaluation was as follows.

- Toll Road : 35 Ks./ km for Car
105 Ks. / km for Truck
- Urban Railway: 18.5 Ks. / km
- BRT: 18.5 Ks./ km

3) Evaluation Results

The following table exhibits the financial evaluation results.

Table 6.3.2.1 Financial Evaluation Results for the Selected Projects

Package No.	Code	Project	FIRR (%)
HP-02	RD-6	Yangon Expressway (Inner Ring Road): North Radial Section	13.1%
HP-03	RD-18	Arterial Roads (New Construction components): Short-term	12.5%
HP-04	RL-21	Arterial Roads (Widening the existing roads): Short-term	0.7%
100	RL-5 & RL-12	Yangon Circular Western Half Loop	3%
101	RL-13 & RL-17	Yangon – Mandalay Line	17%
102	RL-18 & RL-20	Yangon Circular Eastern Half Loop	7%
103	RL-21 & RL-23	Yangon-Pyay Suburban Line	4%
104	RL-24 & RL-26	Thilawa Access Line	N/A*
111	RL-24 & RL-26	UMRT-01	N/A*
112	RL-29	UMRT-02	N/A*
BR-01	1A	BRT Green Line and Blue Line	N/A*
BR-02	1B	BRT Orange Line and Red Line	N/A*
BR-03	2A	BRT Purple Line and Brown Line	N/A*
BR-04	2B	BRT Gray Line	N/A*

Note: N/A stands for not available for calculation of IRR as the net cash flow was too low or negative.

Source: YUTRA Project Team

The financial evaluation results revealed that many of the target projects are financially not feasible except project nos. RD-6, RD-18, and RL-13 & 17. In order to compensate the shortage of cash revenues, a large amount of Governmental subsidiaries is required, and/ or much higher fare setting should be considered.

6.3.3 Environmental Evaluation of Projects

1) Methodology and Assumption

Regarding selecting criteria in terms of environment following four criteria are desirable to comply with JICA Guidelines for Environmental and Social Considerations, regardless of extent of contribution to overall evaluation.

- (i) Social Environment
- (ii) Natural Environment
- (iii) Environmental Pollution
- (iv) Global Warming

Table 6.3.3.1 Environmental Criteria

Criteria		Indicator	Expected Major Impacts
i	Impacts on Social Environment	Number of Project Affected Persons (PAPs)	Loss of land, assets, income, livelihood due to land acquisition and resettlement
ii	Impacts on Natural Environment	Number of trees to be cut or replanted	Impacts on vegetation (trees cutting) and valuable species and ecosystem, flooding/inundation etc.
iii	Environmental Pollution	Increase of NOx and PM emissions	Deterioration of air quality, water quality, and noise/vibration etc.
iv	Impacts on global warming	Increase of CO ₂ emissions	Increase in greenhouse gases emissions from transport activities

Source: YUTRA Project Team

Table 6.3.3.2 Rating and Weighting the Criteria

Indicator		Rating					Weight
		A	B	C	D	E	%
		1	3	5	8	10	
i	Number of Project Affected Persons (PAPs)	CBD areas and more than 200 persons (1)	suburban and rural area and more than 200 persons (1)	50 - 200 persons	less than 50 persons	No land acquisition/resettlement	40
ii	Number of trees to be cut or replanted	More than 1,000 trees in park and green area	More than 1,000 trees along existing roads	100 -1000 trees cutting	Less than 100 trees cutting	Several or no trees cutting	20
iii	Increase of NOx and PM emissions	Significant increase (NOx and/or PM)	Some increase (NOx and/or PM)	Almost no change	Some reduction	Significant reduction	20
iv	Increase of CO ₂ emissions	Significant increase	Some increase	Almost no change	Some reduction	Significant reduction	20

Note 1: According to World Bank and ADB Guidelines (and JICA implicitly recognizes), in case of number of project affected persons (PAPs) is more than 200 the project is classified into Category A, which require full EIA study and Resettlement Action Plan for compensation and supporting PAPs.

Source: YUTRA Project Team

2) Results of Environmental Evaluation

The following table summarizes the results of environmental evaluation.

Table 6.3.3.3 Results of Environmental Evaluation

Project Name		Social Environment		Natural Environment		Environmental Pollution		Global Warming		Score	Rank
		Rating	Weight	Rating	Weight	Rating	Weight	Rating	Weight		
(1) Road Project											
RD-1	Construction of New Thaketa Bridge	10	0.4	8	0.2	5	0.2	5	0.2	7.6	A
RD-2	Installation of Advanced Traffic Management System (ATMS), Phase 1	10	0.4	10	0.2	5	0.2	5	0.2	8	A
RD-3	Formulation of ITS Master Plan and ITS Implementation Program	10	0.4	10	0.2	5	0.2	5	0.2	8	A
RD-4	Installation of Advanced Traffic Management System (ATMS), Phase 2	10	0.4	10	0.2	5	0.2	5	0.2	8	A

Project Name		Social Environment		Natural Environment		Environmental Pollution		Global Warming		Score	Rank
		Rating	Weight	Rating	Weight	Rating	Weight	Rating	Weight		
RD-5	Arterial Road of Outer Ring Road (along Road No.7)	3	0.4	5	0.2	1	0.2	1	0.2	2.6	C
RD-6	Construction of Yangon Urban Expressway - North Radial Section	5	0.4	5	0.2	1	0.2	1	0.2	3.4	C
RD-7	Construction of Yangon Urban Expressway - Inner Ring Section (Phase-1)	5	0.4	5	0.2	1	0.2	1	0.2	3.4	C
RD-8	Construction of Yangon Urban Expressway - Inner Ring Section (Phase-2)	5	0.4	5	0.2	1	0.2	1	0.2	3.4	C
RD-9	Construction of Yangon Urban Expressway - East Radial Section (Phase-2)	5	0.4	5	0.2	1	0.2	1	0.2	3.4	C
RD-10	Construction of Yangon Urban Expressway - West Radial Section	5	0.4	5	0.2	1	0.2	1	0.2	3.4	C
RD-11	Construction of Yangon Urban Expressway - Inner Ring Section (Phase-3)	5	0.4	5	0.2	1	0.2	1	0.2	3.4	C
RD-12	Construction of Yangon Urban Expressway - Inner Ring section (Phase-4)	5	0.4	5	0.2	1	0.2	1	0.2	3.4	C
RD-13	Construction of Yangon Urban Expressway - E-W Link Section	5	0.4	5	0.2	1	0.2	1	0.2	3.4	C
RD-14	Arterial Road of Outer Ring Road (Thanlyin TS)	3	0.4	5	0.2	1	0.2	1	0.2	2.6	C
RD-15	Arterial Road of Outer Ring Road (Twantay Section)	3	0.4	5	0.2	1	0.2	1	0.2	2.6	C
RD-16	Arterial Road of Outer Ring Road (Hmawbi-Hlaingthayar Section)	3	0.4	5	0.2	1	0.2	1	0.2	2.6	C
RD-17	Arterial Road of Outer Ring Road (Dala Section)	3	0.4	5	0.2	1	0.2	1	0.2	2.6	C
RD-18	Construction of Arterial Roads based on the proposed road network by YUTRA (Short-term)	1	0.4	5	0.2	1	0.2	1	0.2	1.8	C
RD-19	Construction of Arterial Roads based on the proposed road network by YUTRA (Middle-term)	1	0.4	5	0.2	1	0.2	1	0.2	1.8	C
RD-20	Construction of Arterial Roads based on the proposed road network by YUTRA (Long-term)	1	0.4	5	0.2	1	0.2	1	0.2	1.8	C
RD-21	Improvement of Existing Arterial Roads based on the proposed road network by YUTRA (Short-term)	8	0.4	10	0.2	3	0.2	3	0.2	6.4	B

Project Name		Social Environment		Natural Environment		Environmental Pollution		Global Warming		Score	Rank
		Rating	Weight	Rating	Weight	Rating	Weight	Rating	Weight		
RD-22	Improvement of Existing Arterial Roads based on the proposed road network by YUTRA (Middle-term)	8	0.4	10	0.2	3	0.2	3	0.2	6.4	B
RD-23	Improvement of Existing Arterial Roads based on the proposed road network by YUTRA (Long-term)	8	0.4	10	0.2	3	0.2	3	0.2	6.4	B
RD-24	Construction of Bago River Bridge	10	0.4	8	0.2	5	0.2	5	0.2	7.6	A
RD-25	Construction of Dala Bridge	8	0.4	8	0.2	3	0.2	3	0.2	6	B
(2) BRT Project											
BRT-1	Phase 1A BRT Green Line and Blue Line - Construction and Implementation	10	0.4	8	0.2	3	0.2	3	0.2	6.8	B
BRT-2	Phase 1B BRT Orange Line and Red Line - Construction and Implementation	10	0.4	8	0.2	3	0.2	3	0.2	6.8	B
BRT-3	Phase 2A BRT Purple Line and Brown Line - Construction and Implementation	10	0.4	8	0.2	3	0.2	3	0.2	6.8	B
BRT-4	Phase 2B BRT Grey Line - Construction and Implementation	10	0.4	8	0.2	3	0.2	3	0.2	6.8	B
(3) Bus Transport Project											
BT-1	Improvement of Existing Public Bus Transport Services in Yangon Region	10	0.4	8	0.2	3	0.2	3	0.2	6.8	B
(4) Railway Projects											
RL-1	TA for the Integration of Rail Transport Improvement and Station Area Urban Development in Yangon (Enhancing Transit Oriented Development)	10	0.4	10	0.2	5	0.2	5	0.2	8	A
RL-2	TA for Commuter Service Level Enhancement in Greater Yangon	10	0.4	10	0.2	5	0.2	5	0.2	8	A
RL-3	Railway Central Control Center System Installation (Ongoing by JICA)	10	0.4	10	0.2	5	0.2	5	0.2	8	A
RL-4	TA for Railway Safety and Service Improvement - (Ongoing by JICA)	10	0.4	10	0.2	5	0.2	5	0.2	8	A
RL-5	Yangon Circular Railway Improvement (Non-electrified) - Phase1: Western Half Loop	10	0.4	8	0.2	10	0.2	10	0.2	9.6	A
RL-6	TOD Enhancement Project along Yangon Circular Railway Western Half	5	0.4	5	0.2	5	0.2	5	0.2	5	B
RL-7	Yangon Central Station Redevelopment Project	8	0.4	5	0.2	5	0.2	5	0.2	6.2	B

Project Name		Social Environment		Natural Environment		Environmental Pollution		Global Warming		Score	Rank
		Rating	Weight	Rating	Weight	Rating	Weight	Rating	Weight		
RL-8	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase1	3	0.4	5	0.2	5	0.2	5	0.2	4.2	B
RL-9	Kyee Myin Daing Station Yard Redevelopment Project	8	0.4	5	0.2	5	0.2	5	0.2	6.2	B
RL-10	Insein Workshop Area Redevelopment Project	8	0.4	5	0.2	5	0.2	5	0.2	6.2	B
RL-11	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase3	5	0.4	5	0.2	5	0.2	5	0.2	5	B
RL-12	Electrified and Elevated Project for Yangon Circular Railway Western Half	8	0.4	8	0.2	10	0.2	10	0.2	8.8	B
RL-13	Yangon-Mandalay Line Improvement: Phase1 (Partial operation)	8	0.4	8	0.2	3	0.2	3	0.2	6	B
RL-14	Malwagone Depot/Workshop Area Redevelopment Project (including Track Improvement between Yangon Central Station and Malwagone Station)	5	0.4	8	0.2	5	0.2	5	0.2	5.6	B
RL-15	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase2	5	0.4	8	0.2	5	0.2	5	0.2	5.6	B
RL-16	Toe Kyaung Galay Station Development Project	5	0.4	8	0.2	5	0.2	5	0.2	5.6	B
RL-17	Yangon-Mandalay Suburban Line Electrification	10	0.4	10	0.2	10	0.2	10	0.2	10	A
RL-18	Yangon Circular Railway Improvement (Non-electrified) - Phase2: Eastern Half Loop	10	0.4	10	0.2	10	0.2	10	0.2	10	A
RL-19	Railway Land Redevelopment Project along Yangon Circular Railway Eastern-half	5	0.4	5	0.2	5	0.2	5	0.2	5	B
RL-20	Electrification of Yangon Circular Railway Eastern Half	10	0.4	10	0.2	10	0.2	10	0.2	10	A

Project Name		Social Environment		Natural Environment		Environmental Pollution		Global Warming		Score	Rank
		Rating	Weight	Rating	Weight	Rating	Weight	Rating	Weight		
RL-21	Yangon-Pyay Suburban Line Improvement and Double-tracking (between Danyingone R.S and Hmawbi R.S)	5	0.4	5	0.2	10	0.2	10	0.2	7	B
RL-22	Hlawga Station Development	3	0.4	5	0.2	5	0.2	5	0.2	4.2	B
RL-23	Yangon-Pyay Suburban Line Electrification	10	0.4	10	0.2	10	0.2	10	0.2	10	A
RL-24	Thilawa Access Line Improvement and Double-tracking (for Commuter and Freight)	8	0.4	8	0.2	10	0.2	10	0.2	8.8	A
RL-25	Thilawa New Container Railway Station Development Project	3	0.4	8	0.2	10	0.2	10	0.2	6.8	A
RL-26	Thilawa Access Line Electrification	8	0.4	8	0.2	10	0.2	10	0.2	8.8	A
RL-27	UMRT Line1 Construction Project - North-South Line	5	0.4	5	0.2	10	0.2	10	0.2	7	B
RL-28	UMRT Line1 Extension Project - North-South Line Extension	5	0.4	5	0.2	10	0.2	10	0.2	7	B
RL-29	UMRT Line2 Construction Project - East-West Line	5	0.4	5	0.2	10	0.2	10	0.2	7	B
(5) Traffic Management Project											
TMS-1	Yangon CBD Traffic Congestion Mitigation Project	10	0.4	8	0.2	5	0.2	5	0.2	7.6	A
TMS-2	Yangon Main Roads Traffic Congestion Mitigation Project	10	0.4	8	0.2	5	0.2	5	0.2	7.6	A
TMS-3	Capacity Development on Traffic Planning and Management in Yangon	10	0.4	10	0.2	5	0.2	5	0.2	8	A
TMS-4	Yangon Parking Development Project (Master Plan)	10	0.4	10	0.2	5	0.2	5	0.2	8	A
TMS-5	Yangon Parking Development Project (Construction)	10	0.4	8	0.2	5	0.2	5	0.2	7.6	A
TMS-6	Yangon Traffic Safety Five-Year Program	10	0.4	10	0.2	5	0.2	5	0.2	8	A
FT-01	Inland Container Depot and Highway Truck Terminal Development	3	0.4	5	0.2	1	0.2	1	0.2	2.6	C
FT-02	Redesignation of Highway Truck Routes	3	0.4	3	0.2	1	0.2	1	0.2	2.2	C

Note: Ranking is based on value of following score: A – Score > 7, B – 7 ≥ Score > 3, C – 3 ≥ Score.

Through the above environmental evaluation 67 candidate projects are classified into three ranks, A, B and C. Out of them, Rank A projects having the first priority are 23 (34.3 %), Rank B projects having the second priority are 26 (38.8 %) and Rank C projects having the third priority are 18 (26.9%).

Among five project types, railway and traffic management projects have higher scores, while road projects are lower scores. This is mostly due to contribution lower scores by criteria of air pollution and global warming, which are lower values of rating.

These rank data is compiled with other evaluation factor and subject to comprehensive evaluation by using multi-criteria-analysis (6.3.6).

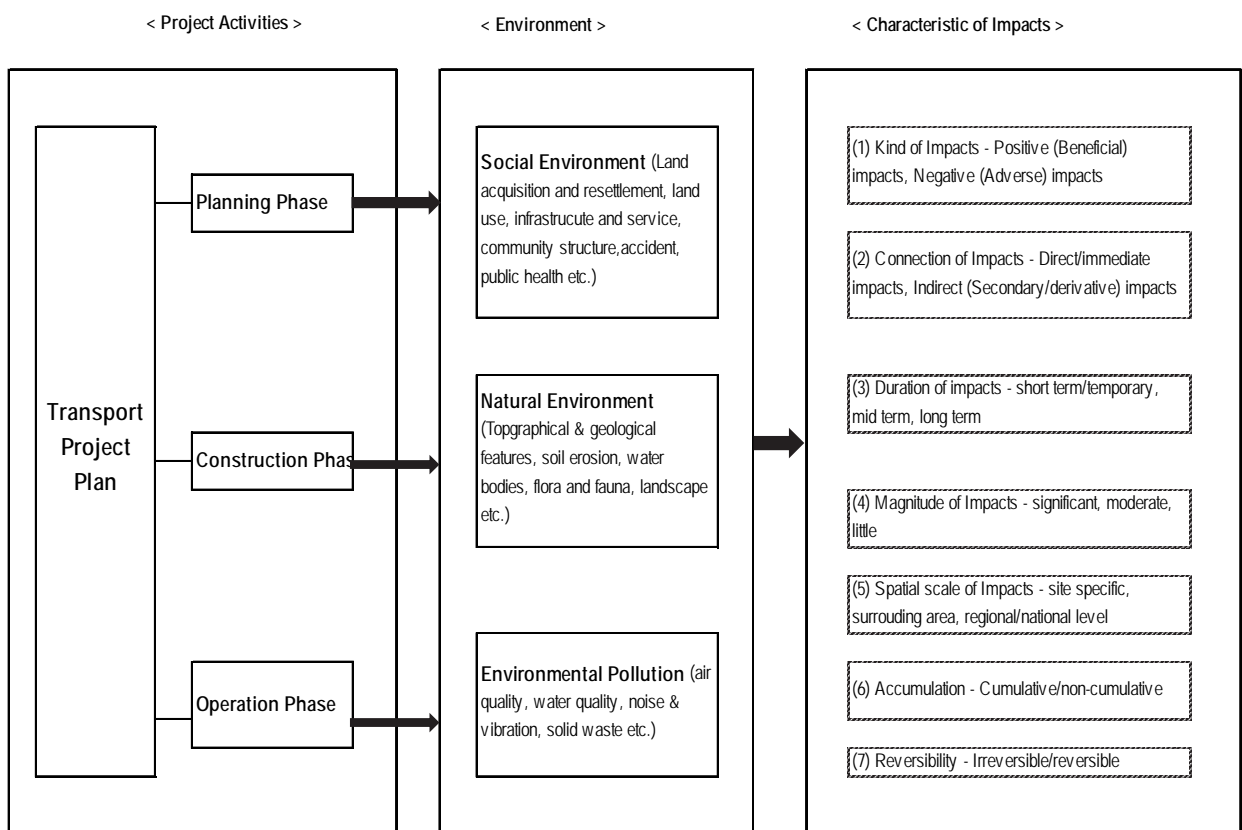
6.3.4 Necessary Environmental and Social Considerations in Planning and Implementation of Prioritized Projects

1) Introduction

In general transport activities are carried out to improve the mobility of goods and persons, which should result in improved economic development. Consequently, it will improve the social environment. However, almost every activity has also negative impacts on the environment, being slight or severe.

In this Sub-section at first identify roughly anticipated negative impacts due to candidate transport projects as a whole and possible mitigation measures against the impacts are examined. Then suggestions and recommendations for project plans in general and to major environmental items are described in terms of environmental and social aspects.

Figure 6.3.4.1 indicates schematic features of impact process due to transport projects activities in view of characteristics of the impacts.



Source: YUTRA Project Team

Figure 6.3.4.1 Schematic Features of Transport Projects and Expected Environmental Impacts

2) Identifying Anticipated Impacts due to Candidate Projects and Examining Possible Mitigation Measures

(1) Setting of Environmental Items

According to JICA Guidelines, anticipated impacts to be assessed are as follows:

-Impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety.

-In addition to the direct and immediate impacts of projects, the derivative, secondary, and cumulative impacts as well as impacts associated with indivisible projects will also be assessed with regard to environmental and social considerations, so far as it is rational.

In this examination thirty four (34) environmental items (social environment, natural environment and environmental pollution) are selected with taking into considerations the above and legislation of Myanmar as well as features of project area.in Greater Yangon.

(2) Identifying Project activity

Activities which might affect environmental impacts due to the projects are identified for three stages of implementation, i.e. planning, construction and operation stages.

Table 6.3.4.1 Activities due to Candidate Projects

Stage	Expected activities due to the projects	Types of Projects				
		Roads	BRT	Bus Transport	Railways	Traffic Management
Planning Stage (I)	Securing land for the project	XX			X	
	Change in land use and local resources	XX			X	
Construction Stage (II)	Extraction and transportation of construction materials	XX	X	X	X	
	Construction work (earth moving and engineering works)	XX	X	X	X	
	Operation of plants, machines, vehicles, ships, etc. for construction work	XX	X	X	X	
	Installation of warehouse, plants and worker's camp	XX	X	X	X	
	Construction of roads and related facilities	XX	X	X	X	
	Construction of railway lines and related facilities				X	
Operation Stage (III)	Operation of road transport (car, bus, truck, etc.)	XX	X	X		
	Operation of road transport related facilities (parking, signals etc.)	XX	X	X		
	Operation of railway transport (passenger, freight)				XX	
	Operation of railway transport related facilities (depot, railway station etc.)				XX	
	Operation of transport management and related system	X			X	XX
	Spatial occupancy of transport networks and related facilities	XX			XX	

Note: XX – major concerned, X – some concerned, No mark – no relevant activity

Source: YUTRA Project Team

(3) Preliminary Scoping of Anticipated Environmental Impacts

Environmental impacts are identified and described for each environmental item with provisional scoping assuming activities due to five types projects (Roads, BRT, Bus Transport, Railway and Traffic Management) in Table 6.3.4.1 and cases with more serious negative impacts. Results of preliminary scoping are shown in Table 6.3.4.2. Therefore, the rating in Table 6.3.4.2 may change depending on the contents and scale of project plans.

Table 6.3.4.2 Results of Preliminary Scoping

Environmental item (1)	Rating			Anticipated Impacts and Reasons
	I	II	III	
(A) Social Environment				
1) Land acquisition and resettlement (Involuntary resettlement)	A-	D	D	(I) To secure the lands for transport and related facilities, there is a possibility of involuntary resettlement including land acquisition and generation of Project Affected Peoples (PAPs), although it depends on the project plan (site location/route, scale, components etc.).
2) Local economy such as employment and livelihood etc.	D	B+	A+	(II, III) Beneficial impacts are expected on local economy; (i) creation of employment opportunity for construction work during construction stage, (ii) improvement of transport network may raise living condition and make easier access to social services. However, some adverse impacts are also expected by change in local economic structure and means of livelihood.
3) Land use and utilization of local resources	B-	B-	D	(I) Some alteration of existing land use and utilization of local resources is expected depending on the project plan.
4) Social institutions such as social infrastructure and local decision-making institutions, a split of communities	A-	B-	B-	(III) Accessibility to social services and communication among peoples will be promoted. However, there will be some possibility to cause a split of communities and conflict depending on the project plan.
5) Existing social infrastructures and services	D	B-	A+	(III) Beneficial impacts such as expansion of commuting range and easier access to social infrastructure and services in remote area are expected due to the project.
6) Transport and Traffic conditions	D	B-	A+	(II) Construction works may give rise to temporary traffic congestion and inconvenience for accessibility to social services. (III) Smooth access to offices and working places, and increase of convenience to social services such as hospitals, schools, churches, etc. are expected due to the improvement of the traffic condition.
7) The poor, indigenous of ethnic people	C-	C-	C-	(II, III) Transport project is expected to contribute to creation of employment opportunity for public works during construction stage and to improve living condition and access to social services. However, it is unknown whether the poor and vulnerable are able to enjoy the benefit equally or not at present.
8) Misdistribution of benefit and damage	A-	B-	D	(III) Beneficial impacts such as expansion of commuting range and easier access to social infrastructure and services in remote area are expected due to the project. However, there may be some possibility of misdistribution of benefit and damage depending on selection of route and location in the project plan.
9) Local conflict of interests	A-	B-	D	(I, II, III) Beneficial impacts such as expansion of commuting range and easier access to social infrastructure and services in remote area are expected due to the project. However, there may be some possibility of occurring conflict of interests depending on selection of route and location in the project plan.
10) Cultural property and religious facilities	D	B-	C-	(II, III) In Yangon City many religious facilities such as temples, monasteries, mosques and churches as well as pagodas are distributed. Thus, there is a possibility that the project may give rise to inconvenience to access by tourists and citizens and disturb religious activities depending on the route and location in the project plan.
11) Fishing Rights, Water Rights and Rights of Common	C-	C-	D	(III) There is a possibility of disturbing fishing rights, water rights and rights of common depending on the project plan.

Environmental item (1)	Rating			Anticipated Impacts and Reasons
	I	II	III	
12) Public health and Sanitation	D	B-	C-	(II) There is a possibility of deterioration respiratory functions due to emission of air pollutants such as dust, NOx, etc. during construction. (III) Air pollution due to increase of traffic volume may cause adverse impacts on respiratory organs during operation stage.
13) Infectious diseases such as HIV/AIDS	D	B-	D	(II) In many developing countries infection of HIV/AIDS were often reported due to worker's contact with HIV/AIDS affected people at their camp in case of transport infrastructure development . There is a possibility of occurrence of similar case during construction stage.
14) Working condition including occupational safety	D	B-	D	(II) Many workers would be engaged in construction work, although extent of number of workers depends upon the project plan. Thus, safety and health condition of the workers may be jeopardized due to construction work.
15) Hazard/risk (disaster, drainage patterns)	D	B-	D	(II, III) No additional risk of disaster and security are anticipated due to the project. However, there is a possibility of increase in disaster risk, if construction of tunnels and/or bridges are included in the project plan.
16) Accidents	D	B-	C-	(II, III) Increase in occurrence of accident is expected somewhat due to construction plants, vehicles, and machines during construction stage, and increase in number and frequency of transport services in operation stage.
(B) Natural Environment				
17) Topography and Geology	C-	B-	D	(II) There is little possibility that a large-scale alteration of topographic and geologic features depending on the project plan. However, if construction of tunnels and/or bridges is included in the project, larger impact is expected.
18) Soil erosion/sand movement	D	B-	D	(II) Occurrence of land slide and soil erosion are expected due to excavation and dredging work at river bank and earth moving work, and cutting and filling in sites of a soft ground, although surface is mostly flat in Greater Yangon.
19) Groundwater	C-	B-	C-	(II) If construction of tunnels and a large scale excavation are included in the project plan, there is a possibility of significant change of groundwater flow and quality.
20) Movement of water/Hydrological situation	C-	B-	C-	(II, III) 1) There is a possibility that hydrological conditions such as water flow and water level are adversely affected due to dredging work, and installation of piers and other structures in case of construction of bridges . 2) There is also a possibility that water flow and water level are adversely affected due to excavation and dredging works of waterways during construction stage.
21) Coastal zone	D	B-	D	(II, III) Some adverse impacts are expected on tidal conditions, and deterioration of coastal vegetation such as mangroves, coastal erosion, and sedimentation due to bridge construction.
22) Flora, Fauna and Biodiversity	D	B-	C-	(I, II, III) 1) In Greater Yangon three threatened animal species and two threatened plant species were reported. These are likely to distribute in protected area (Hlawga Park) and forest area. Thus, it is necessary to consider avoiding the route close to these areas in the project plan. 2) Trees along roads and railway lines and in parks and green spaces are important components to keep "green and clean" environment and contribute to aesthetic amenity in the city. Thus, cutting and/or removal of trees should be minimized and is required of prior permission with compensation fee from YCDC. 3) In tidal flats of river banks Mangroves, which function breeding and hatchery of fishes, are distributed on tidal flats of river banks in Greater

Environmental item (1)	Rating			Anticipated Impacts and Reasons
	I	II	III	
				Yangon. Thus, it is required to avoid or minimize removal of mangroves especially in bridge construction projects.
23) Protected areas (National Parks, Bird Sanctuaries etc.)	C-	B-	C-	(I, II, III) In Greater Yangon Hlawga Park is only one designated protected area where is managed strictly as Watershed Protection Forest. The Park has the objectives of providing environmental education facilities and protecting the forest and plant cover in the catchment area of the Hlawga Lake. Thus it is expected that exhaust emission, wastewater discharge and noise generation due to construction work and road traffic may cause to disturb living and breeding conditions of plants and animals.
24) Landscape	D	C-	B-	(III) In Greater Yangon two types of landscape are dominant and produce unique aesthetic atmosphere, i.e., natural landscape by forest and parks and waterbodies such as rivers and lakes, and cultural and historical landscape by cultural property and religious facilities and historical monuments sites. Thus, there is a possibility of deterioration aesthetic value of landscape by spatial occupancy of transport network and related facilities, although extent of the impact depends on the project plan.
25) Micro Climate	C-	C-	C-	(II, III) In case that elevated transport structures such as flyovers and elevated expressway are constructed in densely populated and/or CBD area, some change in micro-climate is expected.
26) Global Warming	D	B-	B-	(II, III) Generation of greenhouse gases (GHG) such as CO ₂ which may affect global warming are expected from plants, vehicles and machines at construction work and operation of transport services and related facilities. Regarding factors of CO ₂ emissions from railway and inland waterway transport are less than that from road transport. Therefore, modal shift to railway and inland waterway transport is preferable in terms of prevention of global warming.
(C) Environmental pollution				
27) Air pollution	D	B-	B-	(II) Air pollution is expected due to dust rising from earth moving and engineering works, and air pollutants such as dust (PM) and NO _x from construction plants, vehicles, ships and machines. (III) In general, higher emissions of air pollutants, which will be resulted from increased number of traveling vehicles. In addition, poor emission control of vehicles due to insufficient maintenance and inspection may accelerate to spew out bad smell and black smoke. On the contrary, air pollutant emissions from railway and inland waterway transport are much less.
28) Water pollution	D	B-	D-	(II) Water pollution is expected due to increase in turbidity of river water by excavation and dredging works of riverbed and bottom mud, and discharge of wastewater from worker's camp during construction stage.
29) Soil contamination	D	B-	C-	(II) There is a possibility of soil contamination due to spill over of toxic materials such as lubricant oils, asphalt emulsifiers, heavy metals, etc., which are utilized at construction work.
30) Bottom sediment pollution	D	B-	D	(II) There is a possibility of bottom sediment contamination in Yangon and Bago River and other water bodies due to excavation and dredging work of riverbed, if construction of bridges and tunnels is included in the project plan.
31) Waste	D	B-	C-	(II) Generation of construction waste and garbage from worker's camp during construction stage. (III) Generation of various kind

Environmental item (1)	Rating			Anticipated Impacts and Reasons
	I	II	III	
				of wastes from road transport and relating facilities during operation stage.
32) Noise and Vibration	D	A-	B-	(II, III) It is expected that generation of significant noise and vibration are expected from both construction vehicles, ships and machines and increases in number and speed of traveling vehicles during operation stage.
33) Ground Subsidence	D	C-	D	(II, III) There is a possibility of ground subsidence if extraction of a large scale extraction of groundwater is included in the project plan. Otherwise, it is hardly expected.
34) Offensive odor	D	C-	D	(II) There is a possibility of offensive odor due to materials such as asphalt emulsifier at construction work. However, it is expected to be temporary and a small scale.

Note 1: Environmental items are prepared based on the JICA Guidelines for Environmental and Social Considerations (2010.4) with referring to relevant Myanmar legislation, and features of the project area.

Note 2: * Regarding the impacts on "Gender" and "Children's Right" might be related to all items of Social Environment.

Note 3: (I) - Planning stage, (II) - Construction stage, (III) - Operation stage.

Note 4: (i) Rating (Magnitude of impacts); In general, both positive (beneficial) impact (+) and negative (adverse) impact (-) are expected due to the project activities. A (+/-) - Serious impact is expected, B (+/-) - Some impact is expected, C (+/-) - Extent of impact is unknown or not clear (Further examination is needed. It should be taken into consideration that impacts may become clear as study progresses.), D - Negligible or No impact is expected.

Source: JICA YUTRA Study Team (2013)

(4) Possible Mitigation Measures

The above mentioned impacts should be fully taken into considerations to conduct further baseline survey in case of lack of required information and to examine the possible mitigation measures and monitoring as much as possible.

- Baseline survey will be done to make further understanding of existing environment and the effects expected to be caused by the project activities.
- Mitigation measures will minimize the negative impact to an acceptable level through the planning, construction and operation phases.
- Monitoring is required to ensure that the specified mitigation measures are properly carried out through construction and operation stages.

Possible mitigation measures are shown in Table 6.3.4.3.

Table 6.3.4.3 Possible Mitigation Measures

Environmental item	Possible Mitigation Measures
(A) Social Environment	
1) Land acquisition and resettlement (Involuntary resettlement)	(I) 1) Consider alternative plans to avoid and/or minimize the occurrence of involuntary resettlement. 2) Detailed inventory survey on plots, facilities, structures and peoples living and business activities along the planned routes. 3) Survey on encroachment on ROW (Right Of Way) of the planned site/alignment. 4) Examine procedure and condition of involuntary resettlement and compensation to PAPs taking legislation of Myanmar and the JICA Guidelines into considerations. 5) From early stage of the project, pay attention to information disclosure and consultation with stakeholders including PAPs for thorough understanding of the issues or to make agreement as much as possible. 6) Elaborate Resettlement Action Plan (RAP), if involuntary resettlement is unavoidable.
2) Local economy such as employment and livelihood etc.	(I) 1) Promote cooperation with relevant development plans. 2) Give inhabitants in the project area preference to having a chance to construction work and training to get working skills.
3) Land use and utilization of local resources	(I) Promote cooperation with regional development plans and regulations of land and resources utilization.
4) Social institutions such as social infrastructure and local decision-making institutions, a split of communities	(I, II, III) 1) Survey on community structures, procedure of decision-making and opinion leaders in the project area. 2) Information disclosure and public participation should be fully considered for stakeholders including decision-makers of the communities from early stage of planning for obtaining thorough understanding and consensus of the people and communities.
5) Existing social infrastructures and services	(I) Promote integrated development master plan including other social infrastructure and services.
6) Transport and Traffic conditions	(II) 1) Alternative traffic routes shall be provided during construction, and adequate warning signs installed at the approach to road crossings from both directions. 2) Traffic management shall be undertaken in coordination with the local traffic police department.
7) The poor, indigenous of ethnic people	(II) 1) Give the vulnerable groups in the project area higher priority to having a chance to construction work and training to get working skills. 2) The vulnerable people should be taken fully considerations to compensate properly or support to restore the present living condition in case of involuntary resettlement, even if they are illegal occupants.
8) Misdistribution of benefit and damage	(I, II, III) 1) Information disclosure and public participation should be fully considered from early stage to obtain thorough understanding the project and consensus among the communities and PAPs in order to share with benefit and damage equally.
9) Local conflict of interests	(I, II, III) Information disclosure and public participation should be fully considered from early stage to obtain understanding the project and consensus among the communities and PAPs in order to avoid or minimize local conflict of interests.
10) Cultural property and heritage	(I) 1) Avoid the route penetrating or close to the sites of cultural properties, heritages and archaeological importance in the project plan. 2) If any buried cultural properties are found at construction work, report and consult with concerned organizations such as Ministry of Cultures without delay.
11) Fishing Rights, Water Rights and Rights of Common	(I) Promote participation of those who have the rights in order to get their opinion and ensuring understanding and making consent in the course of the stakeholder meeting from the planning stage
12) Public health and Sanitation	(I, II, III) 1) Monitor outbreak and prevalence of diseases. 2) Enlighten peoples about awareness of public health and sanitation.

Environmental item	Possible Mitigation Measures
13) Infectious diseases such as HIV/AIDS	(I, II) 1) Monitor cases of HIV/AIDS before and after the project. 2) Enlightenment and campaign on prevention and cure of HIV/AIDS.
14) Working condition including occupational safety	(II) 1) Prepare tangible safety considerations in place for individuals involved in the project, such as the installation of safety equipment which prevents accidents, and management of hazardous materials. 2) Plan and implement intangible measures for individuals involved in the project, such as the establishment of a safety and health program, and safety training for workers etc.
15) Hazard/risk (disaster, drainage patterns)	(I) 1) Avoid routes and sites with higher risk of disaster and security in the project plan. 2) Survey properly on topography, geology, soils and ground foundations in the project area.
16) Accidents	(I, II, III) 1) Consider proper preventive measures against accidents in the project plan. 2) Enlighten passengers, drivers, skippers and/or peoples in the project area about rules and manners of traffic safety.
(B) Natural Environment	
17) Topography and Geology	(I) 1) Avoid the routes and site of unstable ground condition. 2) Consider proper preventive measures against landslide at construction site, quarries and borrow pits in the project plan.
18) Soil erosion/sand movement	(II, III) 1) Avoid the site of unstable soil condition in the project plan. 2) Consider preventive measures such as retaining walls, and barriers of trees and vegetation against soil erosion and sand movement along roads, railway tracks and inland waterways in the project plan.
19) Groundwater	(I, II, III) Monitor groundwater level and quality in the project area.
20) Movement of water/Hydrological situation	(I, II, III) 1) Consider proper preventive measures against dredging work, riverbed siltation and scouring in case of bridge construction. 2) Avoid blocking of natural drainage patterns by construction work. 3) Monitor hydrological conditions and water quality of water bodies.
21) Coastal zone	(II, III) 1) Consider proper preventive measures against coastal erosion, and sedimentation of sand and soil in the project plan. 2) Monitor tidal conditions, and coastal erosion and sedimentation.
22) Flora, Fauna and Biodiversity	(I) 1) Avoid routes and sites protected area and ecologically important sites in the project plan. 2) Formulate environment management plan in the project area to comply with relevant National and/or Governorate Environment Action Plan.
23) Protected areas	(I, II, III) 1) Avoid routes and sites protected area and ecologically important sites in the project plan. avoiding the route close to these areas in the project plan. 2) Enlighten importance and awareness to preserve protected area and parks to construction workers, passengers and drivers.
24) Landscape	(I) 1) Avoid routes and location of cultural properties, and religious and historic sites in the project plan. 2) Consider arrangement with green belt and tree planting to harmonize with existing landscape along the transport network and related facilities in the project plan, if necessary.
25) Micro Climate	(II, III) Monitor microclimate change in the project area, if necessary.
26) Global Warming	(I) 1) Estimate generation of greenhouse gases from construction work and operation of transport services and related facilities, and evaluate contribution due to the project comparing with other sectors, activities and sources. 2) Promote modal shift to railway and inland waterway transport as much as possible.
(C) Environmental pollution	
27) Air pollution	(I, II, III) 1) Consider preventive measures against air pollution due to construction vehicles, boats and machines during construction stage and transport services and related facilities during operation stage in the project plan. 2) Arrangement of preventive measures such as green belt and planting trees along roads to alleviate air pollution. 3) Monitor air quality before and after operation.
28) Water pollution	(I, II, III) 1) Consider preventive measures against water pollution due to construction work and operation of transport services especially inland waterway

Environmental item	Possible Mitigation Measures
	transport in the project plan. 2) Monitor wastewater and water quality before and after operation.
29) Soil contamination	(I) Survey on cases of soil contamination in the project area. (II, III) Monitor soil contamination before and after operation.
30) Bottom sediment	(I) Survey on cases of bottom sediment contamination in the project area. (II, III) Monitor bottom sediment contamination before and after operation.
31) Waste	(I, II, III) 1) Survey on major source of generation of wastes and waste management system in the project area. 2) Consider preventive measures for reduction, proper treatment and disposal of solid waste during construction and operation stage in the project plan. 3) Reflect concept of 3R (Reduce, reuse and recycle) to the project plan. 4) Enlighten awareness of waste management.
32) Noise and Vibration	(I) 1) Inventory survey on major source of noise and vibration. 2) Collect data of complaint about noise and vibration. 3) Consider preventive measures against noise and vibration such as (i) using low noise and vibration machines, (ii) suspending construction work in night time, (iii) installation of soundproof walls and buffer zones in the project plan. (I, II, III) Monitor environmental and road/railway noise and vibration before and after the operation.
33) Ground Subsidence	(I) Survey on cases of subsidence in the project area. (II, III) Monitor occurrence of subsidence, if necessary.
34) Offensive odor	(I, II) 1) Monitor occurrence of offensive odor, if necessary.

Note 1: Mitigation measures include (i) further necessary baseline study, (ii) Measures to prevent, minimize and alleviate adverse impacts, (iii) monitoring etc.

Source: JICA YUTRA Study Team (2013)

3) Overall Suggestions and Recommendations – In General

Major items of environmental and social considerations in planning and implementation of prioritized projects are described below.

(1) Comply with both Legislation of Myanmar Government and JICA Guidelines for Environmental and Social Considerations

In general, it is necessary to comply with both Legislation of Myanmar Government and the JICA Guidelines. At the same time it is also necessary to take into considerations differences of policies and legislation between them such as EIA/IEE requirement, processes of Environment Approval, land acquisition and resettlement policy.

According to the JICA Guidelines, EIA (full EIA)/IEE requirement for projects including transport development are as follows:

- (i) Full EIA is required for category A projects, which are likely to have significant adverse impacts on the environment and society.
- (ii) An IEE is required for category B projects, whose potential adverse impacts on the environment and society are less adverse than those of Category A projects.
- (iii) Neither full EIA nor IEE is required for Category C projects, which are likely to have minimal or little adverse impact on the environment and society.

On the other hand, based on the Environmental Impact Assessment Procedures (draft, 2013), which was prepared by MOECAP and have been waiting for official enactment through discussion in the Inter-Ministry Committee. Most of transport development projects are required of full EIA as shown in Table 6.3.4.4.

Table 6.3.4.4 List of IEE/EIA required project related to transport development

Purpose and type of project	Project feature (size, etc.)
(I) IEE required project (Schedule I)	
1) River Training Works	All projects
2) Construction of Bridges	more than 50 feet and less than 200 feet
3) Port Development	All projects
(II) EIA (full EIA) required project (Schedule II)	
1) Construction of Highways and fly-over	all projects if recommended by IEE
2) Ports Development	all projects if recommended by IEE
3) Construction of subways	all projects if recommended by IEE
4) Construction of Bridges	more than 200 feet
5) Construction of Shipyards	dead weight tonnages greater than 5,000 tons
6) Construction of Airports	airstrips of 8,200 feet (2,500 meters) or longer
7) Construction of Railways including Construction of new routes	all projects if recommended by IEE

Source: Compiled from Environmental Impact Assessment Procedures (draft, 2013)

(2) Public participation and information disclosure

Public participation is another pillar of SEA as well as information disclosure. Thus, information disclosure and public participation should be fully considered for all the stakeholders from early stage of planning for obtaining thorough understanding and consensus of the people and communities. In addition, delay or standstill of the project implementation and a split of communities may occur, if fully considerations are not taken to minimize misdistribution of benefits and damage, and to avoid local conflict of interest

(3) Comparison of Alternative Project Plans

Proposed projects should be evaluated with alternatives including “no action” case in SEA and/or EIA process.

(4) Formulation of Environmental Management Plan including Monitoring

Environmental Management Plan (EMP) should be prepared by incorporating mitigation measures and environmental monitoring plan as well as the roles of implementing, supervising and responsible organizations

Environmental monitoring plan describes basic contents regarding monitoring the occurrence of possible negative impacts with related items, the extent, situation, etc.

(5) Overall Suggestions and Recommendations – Social Environment

(i) Land acquisition and Resettlement Issues

One of the most critical issues in development projects is land acquisition and resettlement. In the transport development if land of Right of Way (ROW) is required for transport alignment and related structures, land acquisition and resettlement issues occur.

In order to make clear the occurrence of land acquisition and resettlement, following survey are needed in general:

- Survey on ownership, usage and usufruct right in the project site.
- Inventory survey on facilities and structures along corridor/road and encroachment on the ROW. Identify the occurrence and features of land acquisition and resettlement and

anticipated PAPs through the detailed survey of ROW based on cadastral map.

- Survey on legal and institutional framework for resettlement and compensation.

From the results of comparison between the JICA Guidelines and Myanmar legislation on land acquisition and involuntary resettlement, there are found several gaps between them. For example, neither the avoidance and minimization of involuntary resettlement and loss of livelihood nor the requirement of preparation of Resettlement Action Plan is stated in any law. For the compensation only market value of the land is considered. No law is identified on the participation of project Affected Persons (PAPs) in public consultation in the land acquisition and resettlement procedures (See Vol.2 Chapter3).

If the occurrence of land acquisition and resettlement are anticipated, project proponent should provide adequate information to PAPs and consult with stakeholders including PAPs to reach an agreement or thorough understanding of the issues from an early stage of the project plan as much as possible.

Project proponent should also formulate Resettlement Action Plan (full or abbreviated) and monitor result of compensation and restoring living conditions and livelihood after implementation.

(ii) Special Concerns with Cultural and Religious Facilities

In Greater Yangon many religious facilities such as temples, monasteries, mosques and churches as well as pagodas are distributed and are important income resource for the city by attracting foreign tourists by attractive place to foreign guests. At the same time, these facilities are highly linked to ordinary life of religious citizens. Thus, it is necessary to avoid or to keep sufficient distance from these facilities in route selection of alignment in the project plan.

(iii) Avoid a Split of Community

Structures of road and railway line may cause a split of community, i.e. interruption the crossing movement of people and cattle to both side of road and railway line and may disturb communication in the communities.

To avoid split of community and interference of crossing movement, devices such as underpass and walking bridge are required for road and railway structure design.

(iv) The Poor, Indigenous or Ethnic people

In general, the vulnerable groups such as poor, indigenous or ethnic people are easily damaged and are difficult to share with benefit from the projects. Therefore, give the vulnerable groups in the project area higher priority to having a chance to construction work and training to get working skills. In addition, the vulnerable people should be taken fully considerations to compensate properly or support to restore the present living condition in case of involuntary resettlement, even if they are illegal occupants.

(v) Working Conditions

A large scale of construction work including underground station requires a large number of construction workers would engage the work. Thus, safety and health condition of the workers may be jeopardized due to construction work.

- Prepare tangible safety considerations in place for individuals involved in the project,

such as the installation of safety equipment which prevents accidents, and management of hazardous materials.

- Plan and implement intangible measures for individuals involved in the project, such as the establishment of a safety and health program, and safety training for workers etc.

(vi) Infectious Diseases such as HIV/AIDS

In general, road construction workers, and construction vehicle drivers are considered as having high potential for the spread of sexually transmitted diseases (STDs) and HIV/AIDS virus due to their mobility. Infection with HIV/AIDS and venereal disease was often reported at worker's camps during road construction in other countries.

(vii) Measures against disaster/hazards

Flooding is one of the major hazards in Myanmar accounting for some 10% of all losses by disasters. Among them localized flood inundations in urban areas may aggravate traffic congestion. Considerations should be proper mounting of road surface and making gutter to keep good drainage condition in the project plan.

(6) Overall Suggestions and Recommendations – Natural Environment and Environmental Pollution

(i) Topographical and Geological Conditions

In transport projects considerable scale topographical and geological alteration are expected for road and railway constructions such as a bridge, underground stretch and stations of UMRT. In these cases precise topographical and detailed geotechnical survey are necessary.

(ii) Protected Areas

In Greater Yangon Hlawga Park is only one designated protected area where is managed strictly as Watershed Protection Forest. The Park has the objectives of providing environmental education facilities and protecting the forest and plant cover in the catchment area of the Hlawga Lake. Thus, it is necessary to consider avoiding the route close to these areas in the project plan.

(iii) Flora, Fauna and Ecosystem

In Greater Yangon three threatened animal species and two threatened plant species were reported. These are likely to distribute in protected area (Hlawga Park) and forest area. Thus, it is necessary to consider avoiding the route close to these areas in the project plan.

Trees along roads and railway lines and in parks and green spaces are important components to keep “green and clean” environment and contribute to aesthetic amenity in the city. Thus, cutting and/or removal of trees should be minimized and is required of prior permission with compensation fee from YCDC.

In tidal flats of river banks Mangroves, which function breeding and hatchery of fishes, are distributed on tidal flats of river banks in Greater Yangon. Thus, it is required to avoid or minimize removal of mangroves especially in bridge construction projects.

(iv) Global Warming/climate change

Generation of greenhouse gases (GHG) such as CO₂ which may affect global warming

and climate change are expected from plants, vehicles, boats and machines at construction work, and operation of transport services and related facilities. Regarding factors of CO2 emissions from railway and inland waterway transport are less than that from road transport. Therefore, modal shift to railway and inland waterway transport is preferable in terms of prevention of global warming.

(v) Air pollution

In general, higher emissions of air pollutants, which will be resulted from increased number of traveling vehicles. In addition, poor emission control of vehicles due to insufficient maintenance and inspection may accelerate to spew out bad smell and black smoke. Therefore, modal shift to railway and inland waterway transport is also preferable in terms of prevention of air pollution.

Consider preventive measures against air pollution due to construction plants, vehicles and machines during construction stage and transport services and related facilities during operation stage in the project plan.

6.3.5 Overall MCA of Major Master Plan Projects

Although economic feasibility is the most important factor for the prioritization of the candidate MP projects, the economic and financial evaluation was conducted only for the specific projects whose economic benefits and financial revenues were quantifiable. Therefore, in addition to the results of environmental evaluation, a Multi-criteria analysis (MCA) was conducted. The MCA for YUTRA MP employed the following six (6) evaluation criteria.

Economic feasibility

Considering the constraint governmental expenditures for transport development projects, economic feasibility and efficiency of a project is the most important criterion for the prioritization of the candidate MP projects.

The results of the project evaluation mentioned in the foregoing section 6.3.1 were utilized for the Economic feasibility criteria for each candidate project.

Number of Beneficiaries

Number of the beneficiaries of a project is also the important element for setting the priority. For instance, the economic feasibility of a project requiring the large amount of capital investment and longer period of preparation and construction like UMRT projects is generally calculated lower than that of the small sized projects. Therefore, the projects covering wider area and serving more people shall be considered additional grade to the small sized projects.

Consistency with National Policies and Development Plans

To invest a project from the limited amount of Governmental expenditures, the implementation of the project shall be consistent to the national, regional and sectoral development plans and policies. A project which is already listed in the governmental plan or policies, or may strongly contribute to the achievement of such the policies shall be considered more important.

Urgency; the needs for traffic congestion alleviation

The alleviation of traffic congestion is the most important objective of the YUTRA MP and urgent requirements by the Government of Myanmar. Therefore the urgent requirements for the implementation of such the project shall be evaluated highly.

Readiness; the maturity of a project

Without the strong initiative and implementation capacity of the executing authorities of the Government, the implementation of a project is quite difficult. Therefore, if the concerned Governmental agency is ready for the implementation of the project by, for instance, setting up the project management unit, the smooth implementation of the project is expected.

Environmental and Social aspects

Without a doubt, social and environmental impact by implementation of a project shall be carefully considered for the prioritization of the project.

Each project was evaluated by the threshold defined by each evaluation criteria as shown in the following Table 6.3.5.1. Three (3) scores, namely; ten (10), five (5), and one (1) point, were set based upon the high, mid and low performance by each project.

Table 6.3.5.1 Ranking Threshold by Evaluation Criteria

Criteria	Weight	Indicator	High (10pt.)	Mid (5pt.)	Low (1pt.)
1) Economic Return	0.3	Economic IRR	$X \geq 20\%$	$20\% > X \geq 12\%$	$12\% > X$ / None*
2) Number of Beneficiaries	0.1	Number/ Coverage area	Very large	Large	Medium
3) Consistency with the Policies	0.1	--	Already planned	Consistent	Not consistent
4) Urgency	0.2	--	Direct/quick effects	A certain effects	Not much urgent
5) Readiness	0.1	--	Ready to implement	Will be ready soon	Still planning
6) Environmental/ Social Evaluation	0.2	(SEA result)	No impact (no mark)	Some impact (+)	Serious impact (++)

Note: * The project which was not objective to the economic evaluation.

Source: YUTRA Project Team

Finally, the scores are aggregated per project and used for the prioritization. The project whose score was above 7 points was ranked "A", higher than 4 points was ranked "B", and less than 4 points was ranked "C".

The overall evaluation results were summarized in Table 6.3.5.2. The projects which was evaluated "A" were 23 (35% of total MP projects). The number of "B" ranked projects was 33 (51%), whereas "C" rank was 9 (14%).

Table 6.3.5.2 Summary of Multi-criteria Analysis Results

Project No.	Project Description	Economic Indicator (EIRR)	Number of Beneficiaries	Consistency with Policies		Urgency	Readiness	Environmental/Social Aspect	Total Score	Rank
				0.3	0.1					
(1) Road Development Projects										
HP_00	RD-1	Construction of New Thaketa Bridge	10	5	10	10	10	10	9.5	A
	RD-24	Construction of Bago River Bridge	5	5	5	5	5	5	5	B
	RD-25	Construction of Dala Bridge	10	5	1	5	1	5	5.7	B
	RD-2	Installation of Advanced Traffic Management System (ATMS), Phase 1	1	10	10	10	10	10	7.3	A
	RD-3	Formulation of ITS Master Plan and ITS Implementation Program	1	10	10	10	10	10	7.3	A
	RD-4	Installation of Advanced Traffic Management System (ATMS), Phase 2	1	10	10	10	10	10	7.3	A
	RD-5	Arterial Road of Outer Ring Road (along Road No.7)	5	1	5	5	5	1	3.8	C
	RD-14	Arterial Road of Outer Ring Road (Thanlyin TS)	5	1	5	1	5	1	3	C
HP_01	RD-15	Arterial Road of Outer Ring Road (Twantay Section)	5	1	5	5	5	1	3.8	C
	RD-16	Arterial Road of Outer Ring Road (Hmawbi-Hlaingthayar Section)	5	1	5	1	5	1	3	C
	RD-17	Arterial Road of Outer Ring Road (Dala Section)	5	1	5	1	5	1	3	C
	RD-6	Construction of Yangon Urban Expressway - North Radial Section	10	5	5	5	5	1	5.7	B
	RD-7	Construction of Yangon Urban Expressway - Inner Ring Section (Phase-1)	10	5	10	5	10	5	7.5	A
HP_02	RD-8	Construction of Yangon Urban Expressway - Inner Ring Section (Phase-2)	10	5	5	5	5	1	5.7	B
	RD-9	Construction of Yangon Urban Expressway - East Radial Section (Phase-2)	10	5	5	5	5	1	5.7	B
	RD-10	Construction of Yangon Urban Expressway - West Radial Section	10	5	5	1	5	1	4.9	B
(2) BRT Projects										
	BRT-1	Phase 1A BRT Green Line and Blue Line -	5	5	10	10	10	10	8	A

Project No.	Project Description	Economic Indicator (EIRR)	Number of Beneficiaries	Consistency with Policies	Urgency	Readiness	Environmental/Social Aspect	Total Score	Rank
Package Code		0.3	0.1	0.1	0.2	0.1	0.2		
	Construction and Implementation								
BRT-2	Phase 1B BRT Orange Line and Red Line - Construction and Implementation	5	5	10	10	10	10	8	A
BRT-3	Phase 2A BRT Purple Line and Brown Line - Construction and Implementation	10	5	10	10	10	10	9.5	A
BRT-4	Phase 2B BRT Grey Line - Construction and Implementation	10	5	10	10	10	10	9.5	A
(3) Bus Transport Project									
BT-1	Improvement of Existing Public Bus Transport Services in Yangon Region	1	5	10	10	10	10	6.8	B
(4) Urban Railway Projects									
	TA for the Integration of Rail Transport Improvement and Station Area Urban Development in Yangon (Enhancing Transit Oriented Development)	1	5	10	10	10	10	6.8	B
RL-2	TA for Commuter Service Level Enhancement in Greater Yangon	1	5	10	10	10	10	6.8	B
RL-3	Railway Central Control Center System Installation (Ongoing by JICA)	1	5	10	10	10	10	6.8	B
RL-4	TA for Railway Safety and Service Improvement - (Ongoing by JICA)	1	5	10	10	10	10	6.8	B
RL-5	Yangon Circular Railway Improvement (Non-electrified) - Phase 1: Western Half Loop	5	10	10	10	10	10	8.5	A
RL-12	Electrified and Elevated Project for Yangon Circular Railway Western Half	5	10	5	1	10	10	6.2	B
RL-6	TOD Enhancement Project along Yangon Circular Railway Western Half	1	5	10	10	5	5	5.3	B
RL-7	Yangon Central Station Redevelopment Project	1	5	10	10	5	5	5.3	B
RL-8	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase1	1	5	10	10	5	5	5.3	B
RL-9	Kyee Myin Daing Station Yard	1	1	5	5	5	5	3.4	C

Project No.	Project Description	Economic Indicator (EIRR)	Number of Beneficiaries	Consistency with Policies			Urgency	Readiness	Environmental/Social Aspect		Total Score	Rank
				0.1	0.2	0.1			0.2	0.1		
	Redevelopment Project											
	Insein Workshop Area Redevelopment Project	1	1	5	5	5	5	5	5	3.4	C	
	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase3	1	1	5	5	5	5	5	5	3.4	C	
101	Yangon-Mandalay Line Improvement: Phase1 (Partial operation)	5	10	10	10	10	10	10	5	7.5	A	
	Yangon-Mandalay Suburban Line Electrification	5	5	5	1	5	5	10	10	5.2	B	
	Malwagone Depot/Workshop Area Redevelopment Project (Including Track Improvement between Yangon Central Station and Malwagone Station)	1	10	10	10	10	5	5	5	5.8	B	
	New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase2	1	10	10	10	10	10	5	5	5.8	B	
	Toe Kyaung Galay Station Development Project	1	10	10	10	10	10	10	5	6.3	B	
102	Yangon Circular Railway Improvement (Non-electrified) - Phase2: Eastern Half Loop	5	10	10	5	10	10	10	10	7.5	A	
	Electrification of Yangon Circular Railway Eastern Half	5	10	10	10	10	10	10	10	6.7	B	
	Railway Land Redevelopment Project along Yangon Circular Railway Eastern-half	1	10	10	5	10	10	5	5	5.3	B	
103	Yangon-Pyay Suburban Line Improvement and Double-tracking (between Danyingone R.S and Hmawbi R.S)	10	5	10	10	10	10	10	10	9.5	A	
	Yangon-Pyay Suburban Line Electrification	10	5	10	1	10	10	10	10	7.7	A	
	Hlawga Station Development	1	5	10	5	10	10	5	5	4.8	B	
104	Thilawa Access Line Improvement and Double-tracking (for Commuter and Freight)	5	5	10	5	10	10	10	10	7	A	
	Thilawa Access Line Electrification	5	5	10	1	10	10	10	10	6.2	B	
	Thilawa New Container Railway Station Development Project	1	1	5	5	5	5	10	10	4.4	B	

Project No.	Project Description	Economic Indicator (EIRR)	Number of Beneficiaries	Consistency with Policies	Urgency	Readiness	Environmental/Social Aspect	Total Score	Rank
Package	Code	0.3	0.1	0.1	0.2	0.1	0.2		
111	UMRT Line1 Construction Project - North-South Line	5	10	10	5	10	10	7.5	A
	UMRT Line1 Extension Project - North-South Line Extension	5	10	5	1	5	10	5.7	B
112	UMRT Line2 Construction Project - East-West Line	5	10	5	1	5	10	5.7	B
(5) Traffic Management Projects									
	Yangon CBD Traffic Congestion Mitigation Project	1	10	10	10	10	10	7.3	A
	Yangon Main Roads Traffic Congestion Mitigation Project	1	10	10	10	10	10	7.3	A
	Capacity Development on Traffic Planning and Management in Yangon	1	10	5	10	5	10	6.3	B
	Yangon Parking Development Project (Master Plan)	1	10	10	10	10	10	7.3	A
	Yangon Parking Development Project (Construction)	1	10	10	10	10	10	7.3	A
	Yangon Traffic Safety Five-Year Program	1	10	10	10	10	10	7.3	A
(6) Truck (Freight) Projects									
	Inland Container Depot and Highway Truck Terminal Development	△	○	-	-	△	B	△	○
	Redesignation of Highway Truck Routes	△	○	-	-	△	B	△	○

Source: YUTRA Project Team

7 Implementation Program

7.1 Implementation Schedule and Responsible Agency

The proposed major master plan projects are categorized into three (3) implementation stages on the basis of the overall project evaluation as described in Chapter 6.3. The implementation schedule and those responsible agencies are summarized in the following tables. The project summary sheets containing basic information of each project are compiled in the **Appendix**.

Table 7.1.1 Implementation Schedule of Public Transport Projects

Project Name	Responsible Agency	Cost (USD Mill.)	Implementation Period		
			Short-term 2014-2018	Med-term 2019-2025	Long-term 2026-2035
RL01 TA for Effective Use of Railway Lands and Properties	MORT/MR	1	====>		
RL02 TA for Commuter Service Level Enhancement in Greater Yangon	MORT/MR	2	====>		
RL03 Railway Central Control Center System Installation (The study is ongoing by JICA)	MORT/MR	-	====>		
RL04 TA for Railway Safety and Service Improvement (Ongoing by JICA)	MORT/MR	-	====>		
RL05 Yangon Circular Railway Improvement (Non-electrified) Phase1: Western Half Loop	MORT/MR	485	====> 485		
RL06 TOD Enhancement Project along Yangon Circular Railway Western Half	MORT/MR	6	====> 6		
RL07 Yangon Central Station Redevelopment Project	MORT/MR	704	====> 704		
RL08 New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase1	MORT/MR	64	====> 64		
RL09 Kye Myin Daing Station Yard Redevelopment Project	MORT/MR	220		====> 220	
RL10 Insein Workshop Area Redevelopment Project	MORT/MR	1,144		====> 1,144	
RL11 New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase3	MORT/MR	104		====> 104	
RL12 Electrified and Elevated Project for Yangon Circular Railway Western Half	MORT/MR	1,260			====> 1,260
RL13 Yangon-Mandalay Line Improvement: Phase1	MORT/MR	144	====> 144		
RL14 Malwagone Depot/Workshop Area Redevelopment Project (including Track Improvement between Yangon Central Station and Malwagone Station)	MORT/MR	2,684	====> 2,684		
RL15 New Integrated Depot and Workshop Construction Project (Integration and Relocation of Current Depots and Workshops to Yangon Suburban Area) :Phase2	MORT/MR	244	====> 244		
RL16 Toe Kyaung Galay Station Redevelopment Project	MORT/MR	220	====> 220		

Project Name	Responsible Agency	Cost (USD Mill.)	Implementation Period		
			Short-term 2014-2018	Med-term 2019-2025	Long-term 2026-2035
RL17 Yangon-Mandalay Suburban Line Electrification	MORT/MR	425			====> 425
RL18 Yangon Circular Railway Improvement (Non-electrified): Phase2: Eastern Half Loop	MORT/MR	568		====> 568	
RL19 Railway Land Redevelopment Project along Yangon Circular Railway Eastern-half	MORT/MR	1,100		====> 1,100	
RL20 Electrification of Yangon Circular Railway Eastern Half	MORT/MR	398			====> 398
RL21 Yangon-Pyay Suburban Line Improvement and Double-tracking	MORT/MR	500		====> 500	
RL22 Hlawga Station Redevelopment	MORT/MR	220		====> 220	
RL23 Yangon-Pyay Suburban Line Electrification	MORT/MR	302			====> 302
RL24 Thilawa Access Line Improvement and Double-tracking (for Commuter and Freight)	MORT/MR	766		====> 766	
RL25 Thilawa New Container Railway Station Development Project	MORT/MR	40		====> 40	
RL26 Thilawa Access Line Electrification	MORT/MR	393			====> 393
RL27 UMRT Line1 Construction Project: (Kabar Aye Pagoda Rd. Line)	YUTA	2,253		====> 2,253	
RL28 UMRT Line2 Construction Project: (Pyay Rd.- Parami Rd.- Dagon Myothit Line)	YUTA	693			====> 693
RL29 UMRT Line3 Construction Project: (Shwe Gon Taing Rd.-Thilawa Line)	YUTA	2,730			====> 2,730
Rail Total (excluding cost for TA)	-	17,667	4,655	6,811	6,201
BR01 Phase 1A BRT Green Line and Blue Line Construction and Implementation	YCDC (BRT Agency)	153	====> 153		
BR02 Phase 1B BRT Orange Line and Red Line Construction and Implementation	YCDC (BRT Agency)	139	====> 139		
BR03 Phase 2A BRT Purple Line and Brown Line Construction and Implementation	YCDC (BRT Agency)	111	====> 111		
BR04 Phase 2A BRT Grey Line Construction and Implementation	YCDC (BRT Agency)	69	====> 69		
BT01 Improvement of Existing Public Bus Transport Services in Yangon Region	YRG, YCDC, MTT Central	108	====> 108		
Bus Total	-	580	580	0	0
Public Transport Total	-	18,247	5,235	6,811	6,201

Source: YUTRA Project Team

Table 7.1.2 Implementation Schedule of Road Development Projects

Project Name	Responsible Agency	Cost (USD Mill.)	Implementation Period		
			Short-term 2014-2018	Med-term 2019-2025	Long-term 2026-2035
RD01 Construction of New Thaketa Bridge	MOC	28	====> 28		
RD02 Installation of Advanced Traffic Management System (ATMS), Phase 1	YCDC, Traffic Police	15	====> 15		
RD03 Formulation of ITS Master Plan and ITS Implementation Program	YCDC, Traffic Police, YRG	55	====> 3	====> 26	====> 26

Project Name	Responsible Agency	Cost (USD Mill.)	Implementation Period		
			Short-term 2014-2018	Med-term 2019-2025	Long-term 2026-2035
RD04 Installation of Advanced Traffic Management System (ATMS), Phase 2	YCDC, Traffic Police	15	====> 15		
RD05 Arterial Road of Outer Ring Road (along Road No.7)	MOC	140		====> 140	
RD06 Construction of Yanon Urban Expressway: North Radial Section	MOC	252		====> 252	
RD07 Construction of Yangon Urban Expressway: Inner Ring Section (Phase-1)	MOC	620		====> 620	
RD08 Construction of Yangon Urban Expressway: Inner Ring Section (Phase-2)	MOC	315		====> 315	
RD09 Construction of Yangon Urban Expressway: East Radial Section (Phase-2)	MOC	403		====> 403	
RD10 Construction of Yangon Urban Expressway: West Radial Section	MOC	368			====> 368
RD11 Construction of Yangon Urban Expressway: Inner Ring Section (Phase-3)	MOC	591			====> 591
RD12 Construction of Yangon Urban Expressway: Inner Ring section (Phase-4)	MOC	434			====> 434
RD13 Construction of Yangon Urban Expressway: E-W Link Section	MOC	307			====> 307
RD14 Arterial Road of Outer Ring Road (Thanlyin TS)	MOC	320		====> 320	
RD15 Arterial Road of Outer Ring Road (Twantay Section)	MOC	103		====> 103	
RD16 Arterial Road of Outer Ring Road (Hmawbi-Hlaingthayar Section)	MOC	309			====> 309
RD17 Arterial Road of Outer Ring Road (Dala Section)	MOC	477			====> 477
RD18 Construction of Arterial Roads based on the proposed road network by YUTRA (Short-term)	MOC	105	====> 105		
RD19 Construction of Arterial Roads based on the proposed road network by YUTRA (Middle-term)	MOC	467		====> 467	
RD20 Construction of Arterial Roads based on the proposed road network by YUTRA (Long-term)	MOC	210			====> 210
RD21 Improvement of Existing Arterial Roads based on the proposed road network by YUTRA (Short-term)	MOC	120	====> 120		
RD22 Improvement of Existing Arterial Roads based on the proposed road network by YUTRA (Middle-term)	MOC	90		====> 90	
RD23 Improvement of Existing Arterial Roads based on the proposed road network by YUTRA (Long-term)	MOC	53			====> 53
RD24 Construction of Bago River Bridge	MOC	220		====> 220	
RD25 Construction of Dala Bridge	MOC	177		====> 177	
Road Total	-	6,194	286	3,133	2,776

Source: YUTRA Project Team

Table 7.1.3 Implementation Schedule of Traffic Management Projects

Project Name	Responsible Agency	Cost (USD Mill.)	Implementation Period		
			Short-term 2014-2018	Med-term 2019-2025	Long-term 2026-2035
TM01 Yangon CBD Traffic Congestion Mitigation Project	YCDC	5	====> 0.5		
TM02 Yangon Main Roads Traffic Congestion Mitigation Project	YRG/YCDC	17	====> 17		
TM03 Capacity Development on Traffic Planning and Management in Yangon	YCDC	3	====> 3		
TM04 Yangon Parking Development Project (Master Plan)	YRG/YCDC	2	====> 15		
TM06 Yangon Parking Development Project (Construction)	YCDC	130	====> 130		
TM06 Yangon Traffic Safety Five Year Program	YRG/YCDC	22	====> 22		
Traffic Management Total	-	179	179	0	0

Source: YUTRA Project Team

Table 7.1.4 Implementation Schedule of Freight Transport

Project Name	Responsible Agency	Cost (USD Mill.)	Implementation Period		
			Short-term 2014-2018	Med-term 2019-2025	Long-term 2026-2035
FT01 New Highway Truck Terminal	YCDC	150		====> 150	
FT02 New Highway Truck Route	YRG	0		====>	
Freight Transport Total	-	150	0	150	0

Source: YUTRA Project Team

7.2 Investment Plan

Based on the previous section, investment requirement for the Major Master Plan Projects are summarized in Table 7.2.1.

Table 7.2.1 Investment Requirement for Major Master Plan Projects

Sector	Category	Estimated Cost (USD Mill.)			Cost to Government (USD Mill.)			
		Short-term 2014-2018	Mid-term 2019-2025	Long-term 2026-2035	% to Capital	Short-term 2014-2018	Mid-term 2019-2025	Long-term 2026-2035
Public Transport	MR Lines Upgrading and Capacity Development	629	1,874	2,778	100	629	1,874	2,778
	UMRT Development	0	2,253	3,423	100	0	2,253	3,423
	TOD/Depot Relocation	4,026	2,684	0	0	0	0	0
	BRT Development	472	0	0	55	212	0	0
	Bus Transport	108	0	0	-	78	0	0
	Sub-Total	5,235	6,811	6,201	-	919	4,127	6,201
Road	Arterial Roads and Bridges	253	1,516	1,049	100	253	1,516	1,049
	Expressways	0	1,591	1,700	30	0	477	510
	Traffic Control/ITS, etc.	33	26	26	-	15	26	26
	Sub-Total	286	3,133	2,776	-	268	2,019	1,585
Traffic Management	Congestion Management	157	0	0	-	17	0	0
	Traffic Safety	22	0	0	-	20	0	0
	Sub-Total	179	0	0	-	37	0	0
Freight Transport	Truck Terminal	0	150	0	-	0	150	0
	Sub-Total	0	150	0	-	0	150	0
TOTAL		5,700	10,094	8,977	-	1,224	6,296	7,786

Source: YUTRA Project Team

Required investment cost for the major master plan projects is compared with the available future fund estimated in Chapter 4.2. As shown in the Table 7.2.1, available fund for transport sector is not enough to cover the required cost, particularly in the short-/med-term. Therefore, it is necessary to consider the potential fund sources such as surplus revenues from on-/off-street parking operation and urban expressways, and profit of TOD together with effective use of unused government lands which is further discussed in the following section.

Table 7.2.2 Investment Requirement vs. Fund Availability

Item	Amount (USD Bill.)			
	Short-term 2014-2018	Mid-term 2019-2025	Long-term 2026-2035	Total for MP Period
(1) Investment Requirement for Master Plan (Cost to Government)	1.2	6.3	7.8	15.3
(2) Budget Envelope (Low-High Case)				
a. Transport Sector Total	2.6-2.7	7.7-8.7	16.3-21.3	26.5-32.7
b. 40% of Transport Sector Total (excluding cost for maintenance, secondary road and other local transport facility development, and vehicles, etc.)	1.05-1.10	3.1-3.5	6.5-8.5	10.6-13.1

Source: YUTRA Project Team

7.3 Potential Funding Source for TOD Project

This section tries to discuss one of the possible measures in financing the urban transport infrastructure development in Yangon. Use of transit oriented development (capture of TOD values) together with effective use of unused lands owned by the Government (by several ministries) in the Yangon area is a focus of this discussion.

7.3.1 Land Values in Yangon

Lands of higher values in Yangon are observed in the area between Inya Lake and Kandawgyi Lake where many high-end and historical buildings are placed, the area near the Youth Training Centre in Thigangyum Township, the area in Insein and Mayangone Township in the north, and the lands along the major roads such as Pyay road and Kabr Aye Pagoda road. The land prices in Dala is almost one tenth or less of the prices in the downtown Yangon area even through the distance between the two places is close. Because of the difficulty in crossing the Yangon River and its poor land condition (the area was heavily damaged by Cyclone Nargis in 2008).

In general major determinates of land values other than the size of land parcel in Yangon include (refer to Figure 7.3.1):

- accessibility to major roads
- distance from CBD
- surrounding environment such as park and green
- accessibility to Yangon River (waterfront)
- availability of clean water and power

It seems that “accessibility to public transport services” is not working as a determinant of land value at present. That is, the lands near the existing transit nodes are undervalued in the current real estate market.

7.3.2 Value Capture

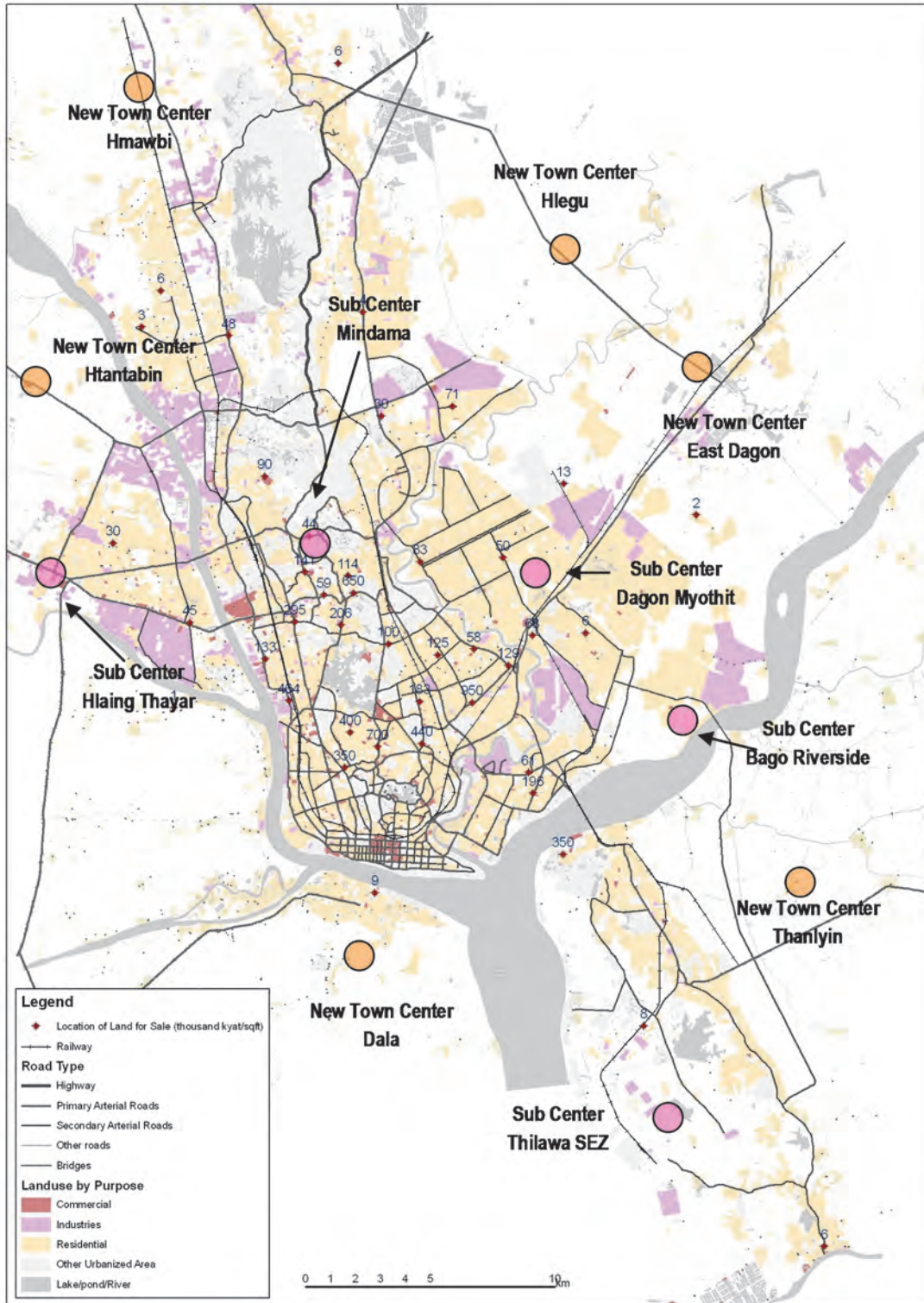
Implementing the proposed transportation plans by YUTRA requires substantial investments in improving the existing road facilities, new infrastructures such as MRT and BRT, and regeneration of transit nodes such as the Yangon station area regeneration

project in line with the proposed TOD policies for Yangon.

Such public sector commitments, in the form of master plan and initial investment partially made by external sources such as Japanese ODA loan, will stimulate private sector investments especially in those TOD centres (proposed sub centres and town centres in SUDP and other transit nodes proposed by YUTRA).

Those economic activities by the private sector will result in increase of land values or land rents, especially in the proposed TOD centers and surrounding areas. Existing land owners of such areas will enjoy such increase of land value without investing to the infrastructure. Those are called “free riders”. In principle, such values should belong to the value creator, that is, the public sector. Such surplus should be captured by the tax authority in the course of real estate transaction, and reinvested to further improvement of the public transport in the city.

As seen in the existing land values spatially, lands near the transit nodes (rail stations) are not properly valued by the current real estate market. This situation will be changed significantly by the proposed MRT development. It is highly recommended that the tax authority should pay special attention to those areas in the course of development, and collect tax on value surplus generated from the infrastructure development.



Source: YUTRA Project Team

Figure 7.3.1 Land Prices in Yangon and Proposed Center Location

7.3.3 Unused Government Lands

There are many large land parcels owned by the public sector including Ministry of Construction (MOC), Ministry of Rail Transportation (MORT), Ministry of Transport (MOT), Ministry of Defence (MOD), YCDC, etc in Yangon (see Figure 7.3.2).

Lands owned by MOC in Yangon have been utilized as industrial areas and low cost housing areas.

There is a huge land parcel owned by MORT in East Dagon Township, which has not been effectively used to date. In general station areas are not well developed, and no quality and effective station square exist in Yangon. The area in the north of Yangon station is one of the prime locations in the downtown area, where very limited commercial activities are observed as of today. While such economic activities in the area in the south of Yangon station is very vital, but no effective connection between the Yangon station and the area exists.

The area owned by MOT (MPA) in Thilawa area will be used as the Thilawa port. MPA owns major part of waterfront area of the Yangon River. Several development (regeneration) plans have been prepared, but no concrete financing scheme has been established yet (refer to Chapter 5).

There are many land parcels owned by Ministry of Defence along the Yangon River, the Bago River and Pazundaung Creek.

In this section some potential use of unused land owned by the Government are considered.

Myanma Railway Land in East Dagon Township

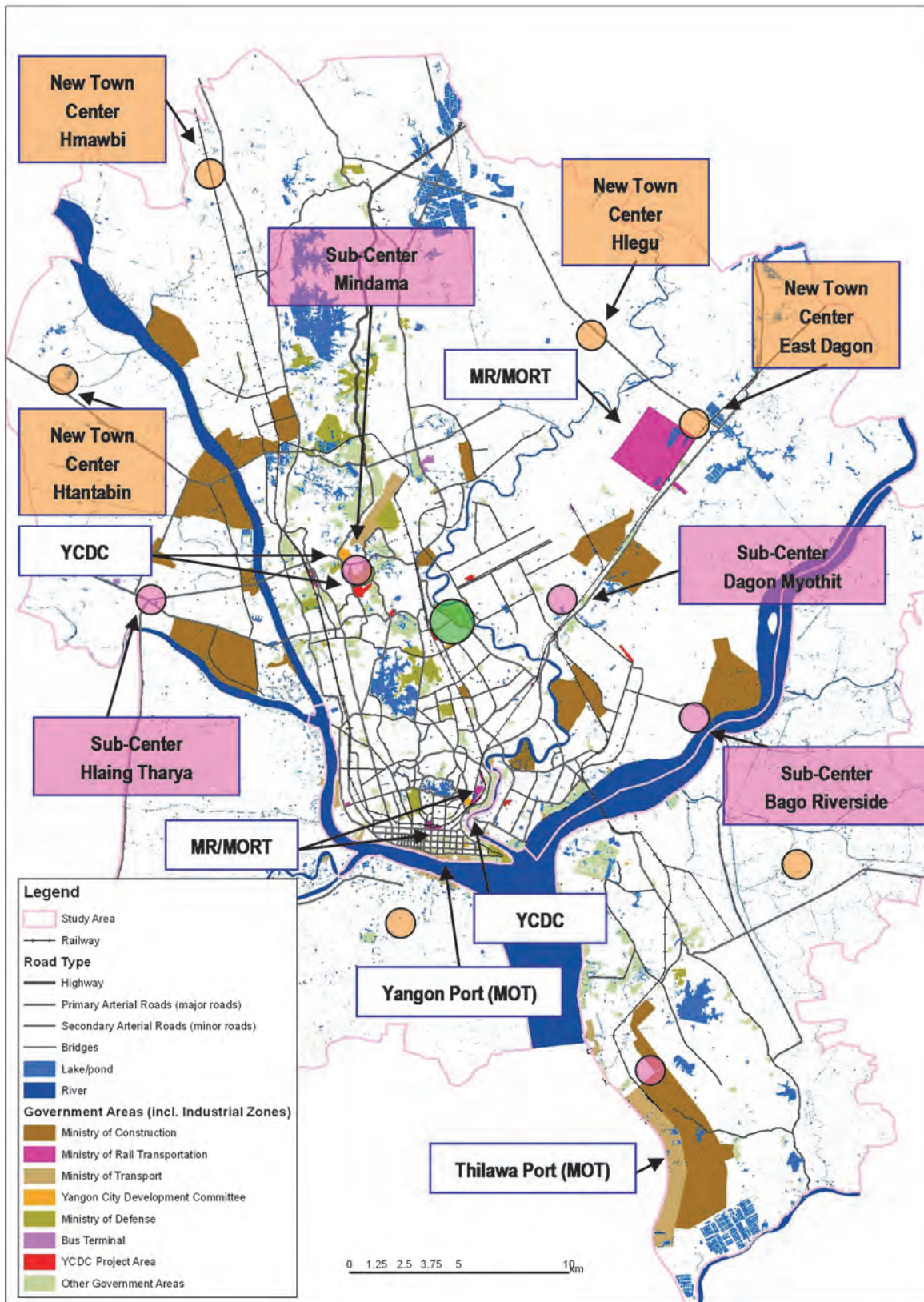
YUTRA recommends development of MR ICD, Depot and Workshop, Truck Terminal and Highway Bus Terminal in this area. The existing YCDC truck terminal at Bayint Naung can be relocated to this area after completion of the proposed extension of the expressway (to Thilawa) and missing link (passing near Ywathargyi). A new highway bus terminal can be developed which serves residents in the proposed new town centre East Dagon and surrounding areas.

Myanma Railway Land – Yangon and Insein Station area

The section between Insein station and Yangon station of the Yangon Circular rail is the busiest section in terms of passenger and train operation. A higher priority is given to the improvement of this section by YUTRA, accordingly there will be a great opportunity in terms of regeneration of the station areas of this section. Especially two terminus stations of this section, namely Insein and Yangon station are the focus in the short-term.

Newly created transit nodes

The proposed two YUTRA MRT lines cross at the area near the MR Yegu rail station. There is a large land parcel owned by Ministry of Defence close to this potential TOD centres, namely Okkala in Mayangone Township. SUDP does not indicate this is a potential TOD centre, but eventually this place will have a great opportunity for investors after completion of the proposed MRT.



Source: YUTRA Project Team

Figure 7.3.2 Government Owned Lands

Traffic Impact Assessment Fee

In the Study Area, urban development will be more active in accordance with the socio-economic growth in the future. Development of large-scale commercial and business facilities will be increased particularly in the CBD and sub-centers including TOD area.

Traffic Impact Assessment (TIA) is to preliminary analyse an impact to traffic caused by land use change and new urban facility development under new development and redevelopment and the results are to be feed-backed to the development plan and transportation plan (road, parking, traffic operation and public transport, etc) in the same manner as environmental impact assessment.

In Japan, traffic impact assessment is incorporated in the process of large scale urban development and district redevelopment plans and environmental impact assessment conducted by local government. There are some cases that developer is pressed to pay one's fair share of the cost of transport facilities based on the development guideline, permit and discussions. "Transportation planning manual for large scale development area" was prepared and applied for the evaluation of transport facility planning related to car, pedestrian and public transport.

On the other hand, the objective of TIA implemented in the United States of America is to secure the necessary transportation facilities and services to work out the project and to minimize the impact to traffic and environment in the surrounding area. In the TIA of the USA, service level of necessary transport facilities such as number of parking lots, width and length of access roads, are determined in accordance with the type and scale of the development. If it is not satisfied, the TIA regulation requires the cost share for the transport facility development or the traffic impact fee¹ to the developer side.

Therefore, it is essential to consider the introduction of the TIA regulation as system in order to minimize the impact of traffic as well as to collect TIA fee for necessary transport facility development.

¹ Traffic Impact Fee varies by local government. Example in Federal Way City in Washington, USA are: single house: \$3,112/unit, hotel: \$2,078/room, retail center: \$2.03/sqf(GFA), general office: \$4.71/sqf(GFA)

7.4 Institutional Reforms

The schedule for establishing the YUTA and BRT Management Agency and supporting technical assistance are planned as shown in Table 7.4.1

Table 7.4.1 Implementation Schedule of Institutional Reform and Strengthening

Activities	Agency	2013	2014	2015	2016	2017	2018
Urban Development Plan for Greater Yangon is formulated	YRG	▲					
Urban Transport Master Plan for Greater Yangon is formulated	YRG		▲				
Yangon Urban Transport Authority (YUTA)							
Institutional Design of YUTA	YRG		■				
Urban Transport and Passenger Service Act	UG/YRG		▲				
Decision by Union/Region Government	UG/YRG		▲				
Establishment of YUTA	YRG			▲			
Start Operation and Management	YUTA			■			
BRT Agency							
Institutional Design of BRTA	YUTA		■				
Feasibility Study	YUTA		■				
Establishment BRTA	YUTA			▲			
Detailed Design, Construction, Procurement	BRTA			■			
Start Operation and Management	BRTA				■		
Capacity Development Program for YUTA and BRT Management Agency (TA under ODA)							
Preparation	DA/YRG		■				
Agreement of TA	DA/YUTA		▲				
Procurement of Consultants	DA		■				
Implementation	DA/YUTA			■			

Source: YUTRA Project Team

UG: Union Government, YRG: Region Government, YUTA: Yangon Urban Transport Authority, BRTA: BRT Agency, DA: Donor Agencies

8 CONCLUSION AND RECOMMENDATIONS

8.1 Conclusion

Challenge to Sustainable Urban Transport Development

The urban transport situation in the Greater Yangon has not yet reached the level that many other large urban areas in Southeast Asia suffer from. People can still move relatively freely but the time will soon come when, if the current trend continues, the current urban transport problem will grow to a level which the society can hardly manage. However, in guaranteeing a sustainable urban transport envisioned by government authorities and the people, the transport sector must not be dealt with independently of other sectors. Rather, urban transport planning must be part of an integrated approach, intertwined with urban planning and economic development. For this reason, it is vital to enhance people's understanding of the importance of the urban transport sector in guiding the future direction of the development of the metropolis. Yangon's competitiveness and livability of in the future depend on actions taken – or not taken – today.

Shared Vision, Common Agenda

With so many governmental bodies, organizations, and individuals involved in the transport planning process, implementation is facilitated when there is unanimity and consistency of actions – especially between union, regional and city governments. This can only occur when all, or most, of them share a common vision about Yangon. A Master Plan articulates that vision in various ways.

A Master Plan involves several trade-offs and choices which are essentially political processes. There will be competition from other sectors for the funds and resources required to implement the plan. Resolving these competing requirements will be a major task, which can only be handled at the political level, guided by technical information. The implementation of schemes and proposals will also require an assessment to be made of the political implications and priorities. The aim of the political processes is to produce a consensus on the plan and its components.

Sector Constraints

The biggest constraint is funding. There is simply no way for Yangon to buy itself out of its existing and emerging problems. Hence, it must turn more and more to the private sector – especially in the provision of transport services, rather than for the government to assume sole responsibilities. Even if the city has unlimited resources, it cannot continuously expand the provision of roads without destroying the fabric of the city nor overcoming ROW obstacles in an expeditious manner. Besides, as apparent from other cities, adding more roads only leads to a vicious cycle of more cars and more congestion.

Getting more commuters on public transport is a must; however, to rapid motorization, this has become a challenging issue. Unlike many developing cities which struggle against the erosion of a high share of public transport, Yangon's public transport is fortunate to have a high modal share presently. This advantage should be maintained or strengthened even further, requiring Government involvement.

A third constraint is weak institutional capability to cope with urban and transport challenges

under an uncertain and changing policy environment. One way to overcome the lack of funds is to improve government's ability to harmonize land use with transport development. This, however, entails expertise and processes that are also scarce in the public sector.

Strategies

YUTRA has proposed the overall goal of urban transport as follows:

“Ensure mobility and accessibility to urban services that are vital for the people and the society, by providing a transport system characterized by safety, amenity, and equity and sustained by an efficient public transport system”

A combination of supply-type and demand-type strategies is required to maintain the present advantage of high modal share of more than 65%.

The overall goal has been developed into eight specific objectives and strategies, as follows:

- A. Promotion of Social Understanding about Urban Transport Problems and Issues
- B. Effective Management of Urban Growth and Development
- C. Promotion and Development of Attractive Public Transport
- D. Efficient Traffic Control and Management
- E. Effective Transport Demand Management (TDM)
- F. Comprehensive Development of Transport Space and Environment
- G. Enhancement of Traffic Safety
- H. Strengthening of Transport Sector Administrative and Management Capacities

Master Plan

The number of projects proposed in YUTRA is summarized in Table 8.1.1.

Table 8.1.1 Proposed Master Plan Projects

Plan Period	Project Type	No. of Projects	Total Cost (US\$ million)
Short-term	Public Transport	17	919
	Road	6	268
	Traffic Management	6	37
	Freight Transport, etc.	-	-
	Sub Total	29	1,224
Mid-term	Public Transport	10	4,127
	Road	11	1,699
	Traffic Management	-	-
	Freight Transport, etc.	2	150
	Sub Total	23	5,677
Long-term	Public Transport	7	6,201
	Road	10	1,905
	Traffic Management	-	-
	Freight Transport, etc.	-	-
	Sub Total	17	9,423
Total		69	16,324

Note: “Total cost” is cost to the Government only. Excludes contribution of the private sector.
 Source: YUTRA Project Team

The public available fund can cover only roughly 60-80% of the total cost (to the Government) shown above, and additional fund source should be developed.

8.2 Recommendations

The recommendation from YUTRA to the Yangon Region Government is naturally to realize the projects proposed in this master plan. Although every project is an integral part of the proposed master plan, the most essential are; A. Parking development and control (short-term), B BRT development (short-term), C. Improvement of existing MR lines (short to long-term), D. UMRT development (middle- to long- term), and E. Inner Ring Road development (middle- to long- term).

Other related recommendations are:

- (1) Authorize and get this master plan approved by the concerned agencies of both Union and Region government, and disseminate its contents to all stakeholders.
- (2) Setup Yangon Urban Transport Authority (YUTA) to make decisions on various transport projects. Allocate implementation responsibilities by project clearly to government agencies. The proposed YUTA will oversee and monitor the implementation of these projects. The establishment of YUTA is crucial for Yangon to have the basis to absorb various types of technical and financial assistance from donor organizations.
- (3) Raise funding capability of the government by seeking various additional revenue sources and optimising current revenue sources under the institutional arrangements of the government. The most feasible fund source seems to exist in the TOD (Transit Oriented Development). Since the Government has a number of vast unused land lots in strategic places in Yangon, this could be a good seed for launching “urban cum transport” development projects where cross-subsidy can be expected from urban development (business/commercial/residential) to public transport development. Some of other initiatives that could be expanded further in Yangon could include the revenue from the proposed parking development and restriction.
- (4) Take necessary actions as soon as possible to launch the short-term projects proposed in the master plan. Particularly for those projects that needs feasibility study or prior coordination among relevant organizations, initiatives from the Myanmar government to donor or other related organizations should be exerted immediately.
- (5) Regarding the proposed BRTs, future patronage will change depending on the development progress of the proposed UMRTs or MR lines. In this case, the affected BRT should adjust its operation. Its disused road space could be reconverted to carriageway for other vehicles, or more preferably, the space could be converted to green promenade for pedestrians and cyclists taking into account the future vision of Yangon.
- (6) In this master plan, the toll rate for expressway was assumed to be the same as the current level of Yangon-Mandalay expressway, and the fare of Myanmar Railway lines, UMRTs and BRTs was set at the current level as well. Although the rate was assumed to increase in the future in proportion to per capita GDP, it is still very low

compared to the international level and the level cannot be raised easily due to the sensitive elasticity of demand against toll/fare rate. This is one of the reasons of the poor financial performance revealed in Section 6.3 of this report. Considering the promotion of private sector participation and the possible magnitude of public subsidy, however, the toll/fare rate should be carefully looked into in the feasibility study.

- (7) This master plan assumes that “normal” situation will continue for a long period of time (20 years or more). If abnormal situation occurs, such as long financial panic and war, this master plan cannot be used and will lose its validity. On the contrary, this master plan could be updated periodically if normal situation continues and a series of traffic surveys are conducted again (except for the person-trip survey, in principle). The conclusion and methodology of the master plan could be handed over to the future with periodical updating (basically every 5 years).