

Chapter 10

Project Cost Estimates

10. Project Cost Estimates

10.1 General Conditions

(1) Method of Cost Estimation

The estimation of project cost for the construction of Bago River Bridge is based on the results of the preliminary design of this Preparatory Survey and rough quantity estimation of work items.

Financing for the 100% of eligible portion of the Project is assumed to be funded through the JICA loan scheme. As for the non-eligible portion, it is assumed that the state budget of the Government of Myanmar (GOM) will be allocated.

(2) Conditions of Cost Estimation

The conditions of cost estimation as instructed by JICA are shown in Table 10.1.

Table 10.1 Conditions of Cost Estimation

Item	Condition	Note
Date of Estimate	December 2013	
Currency	Foreign Currency : US dollar (USD), Japanese yen (JPY) Local Currency: Myanmar kyat (MMK)	
Exchange Rate	USD 1 = JPY 99.7 USD 1 = MMK 975.0	3 months average rate
Price Escalation Rate	Foreign Currency Portion: 1.3%, Local Currency Portion: 3.7%	
Physical Contingency	5%	
Interest During Construction	Construction Cost: 0.01% Consultant Fee: 0.01%	
Commitment Charge	0%	

Source: JICA Survey Team

10.2 Procurement

(1) Procurement Conditions

1) Labor

Major bridge projects in Myanmar have been executed by the Public Works itself. Design, construction, and supervision are conducted by the staff of Public Works. On the other hand, private construction companies in Myanmar have conducted the road construction works through the BOT scheme. Some of the companies probably have their own construction machineries and plants by now. They have the potential to be the subcontractors of the Project and they would have some experiences in the construction of large bridges gradually. By these conditions, special skilled labor for bridge works shall be procured in other ASEAN countries.

2) Materials

There are few construction materials produced in Myanmar such as stone, aggregate, and sand. Cement can also be procured, but the quality is said to be not stable then most of the cement used for construction is imported from Thailand. Ready-mixed concrete can be procured around Yangon.

Among the imported materials, petroleum products will be for local procurement because supply is stable in Myanmar.

Table 10.2 Supplies of Major Construction Materials

Materials	Procured from		Note
	Local	Import	
Concrete Works			
Cement	○		
Aggregate	○		
Sand	○		
Ready-mixed concrete	○		
Reinforcement bar (rebar)		○	
PC cable		○	
Formwork		○	
Steel Works			
Steel plate		○	
Mould steel		○	
Steel pipe sheet pile		○	
Paint (heavy duty)		○	
Bolt, Nut		○	
Welding material		○	
Sheet pile		○	
Petroleum Products			
Fuel (gasoline, diesel)	○		
Asphalt	○		
Guss asphalt	○		For steel deck plate

Source: JICA Survey Team

3) Equipment

Most of the construction equipment and machineries for bridge erection shall be procured from other countries, except the general construction machineries (e.g., bulldozer and backhoe) and barge mounted crane.

Table 10.3 Supplies of Major Construction Machineries

Construction Machines	Procured from		Note
	Local	Import	
Backhoe	○		
Bulldozer	○		
Truck Crane		○	
Crawler Crane		○	
Tower Crane		○	
TEG Crane		○	
Barge Mounted Crane	○		
Pile Driving Equipment		○	
Equipment for Steel Pipe Sheet Pile		○	
Equipment for Prestressed Concrete		○	

Source: JICA Survey Team

10.3 Construction Work Quantities

The construction work quantities are summarized and shown from Table 10.4 to Table 10.7.

Table 10.4 Construction Quantities for Substructure Work

Item	Description	Specification	Unit	Qty
1	Substructure (Reverse T-shaped Abutment)			
	Bored pile	D=1500, Lverage=50m	nos	30
	Footing			
	Concrete	Class A (30N/mm ²)	m ³	936.6
	Re-bar	SD345 or equivalent	t	112.4
	Formwork		m ²	262.4
	Wall, parapet			
	Concrete	Class A (30N/mm ²)	m ³	638.9
	Re-bar	SD345 or equivalent	t	95.8
	Formwork		m ²	793.2
2	Substructure (Pier on land)			
	Bored pile	D=1500, Lverage=50m	nos	65
	Footing			
	Concrete	Class A (30N/mm ²)	m ³	1,890.0
	Re-bar	SD345 or equivalent	t	226.8
	Formwork		m ²	570.0
	Pier column			
	Concrete	Class A (30N/mm ²)	m ³	1,327.3
	Re-bar	SD345 or equivalent	t	199.1
	Formwork		m ²	1,363.3
3	Substructure (Pier on river)			
	Steel sheet pipe pile foundation			
	Steel sheet pipe pile	D=1000, Lverage=50m, with joints for interlocking	nos	396
	Pile driving	L=50m	nos	396
	Connection treatment		nos	396
	Excavation inside of the well		m ³	25,966
	Welding of the dowel		nos	396
	Cut-off the pipe		nos	396
	Footing			
	Concrete	Class A (30N/mm ²)	m ³	4,694
	Re-bar	SD345 or equivalent	t	563.3
	Pier column			
	Concrete	Class A (30N/mm ²)	m ³	30,094
	Re-bar	SD345 or equivalent	t	4,514.1
	Formwork		m ²	16,058

Source: JICA Survey Team

Table 10.5 Construction Quantities for Superstructure (Steel)

Item	Description	Specification	Unit	Qty
4	Steel cable stayed bridge (superstructure)	including fabrication and erection		
	Steel Plate			
	Tower	SM490, SM400	t	578
	Main girder (single box)	SM490, SM400	t	5,775
	Stay cable	Parallel wire strand	t	357
	Bearing			
	300t	Rubber bearing	nos	4
	500t	Rubber bearing	nos	4
	5,000t	Steel pivot bearing	nos	2
	Anchor frame	for steel pivot bearing, W=60t	t	120
	Expansion joint	Steel finger type, W=24m, Unit weight W=15t/nos	nos	4
	Fairing	L=448m, Unit weight W=0.05t/m	nos	45
	Handrail	Steel pipe, H=500mm (on the top of the concrete barrier)	m	896
	Drain Pit	FC	nos	178
	Concrete barrier			
	Concrete	Class A (30N/mm ²)	m ³	188
	Re-bar	SD345 or equivalent	t	18.8
	Formwork		m ²	1,478
	Pavement (carriageway)	Guess asphalt, t=80mm	m ²	1,344
	Pavement (pedestrian)	Gravel/asphalt, t=40mm	m ²	7,168
5	Steel box girder bridge (superstructure)	including fabrication and erection		
	Steel Plate (box girder)	SM490, SM400	t	7,123
	Bearing			
	50t	Rubber bearing	nos	8
	120t	Rubber bearing	nos	12
	150t	Rubber bearing	nos	12
	Expansion joint		nos	-
	Handrail	Steel pipe, H=500mm (on the top of the concrete barrier)	m	1,104
	Drain Pit	FC	nos	220
	Concrete barrier			
	Concrete	Class A (30N/mm ²)	m ³	232
	Re-bar	SD345 or equivalent	t	23
	Formwork		m ²	1,822
	Pavement (carriageway)	Guess asphalt	m ²	1,656
	Pavement (pedestrian)	Gravel/asphalt	m ²	8,832

Source: JICA Survey Team

Table 10.6 Construction Quantities for Superstructure (PC Precast Girder)

Item	Description	Specification	Unit	Qty
6	PC Precast Box Girder (Superstructure)	including fabrication and erection		
	Concrete class P (40N/mm ²)	for precast block (span by span erection method)	m ³	12,496
	Re-bar	SD345 or equivalent	t	1,499.5
	Formwork		m ²	44,692
	PC cable			
	19T15.2	for main girder (outer cable)	t	249.9
	12T15.2	for main girder (inner cable)	t	224.9
	1T28.6	for floor slab	t	150.0
	Bearing			
	500t	Rubber bearing	nos	16
	1,000t	Rubber bearing	nos	52
	Expansion joint	Steel finger type, W=10m, Unit weight W=5t/nos	nos	8
	Handrail	Steel pipe, H=500mm (on the top of the concrete barrier)	m	1,408
	Drain Pit	FC	nos	134
	Concrete barrier			
	Concrete	Class A (30N/mm ²)	m ³	296
	Re-bar	SD345 or equivalent	t	30
	Formwork		m ²	2,323
	Pavement (carriageway)	Asphalt	m ²	2,112
	Pavement (pedestrian)	Gravel/asphalt	m ²	11,264

Source: JICA Survey Team

Table 10.7 Construction Quantities for Roads

Item	Description	Specification	Unit	Qty
7	Approach road			
	Pavement			
	Subgrade course	t=300mm	m ²	27,488
	Subbase course	Aggregate, t=100mm	m ²	27,488
	Base course	Aggregate, t=100mm	m ²	27,488
	Binder course	Coarse asphalt concrete, t=100mm	m ²	27,488
	Surface course	Fine asphalt concrete, t=50mm	m ²	27,488
	Retaining wall			
	Concrete	Class B (24N/mm ²)	m ³	12,249
	Re-bar	SD345 or equivalent	t	980
	Formwork		m ²	6,858
	Bored pile	D=1000, Lverage=50m	nos	444
	Embankment			
	Filling	Bulldozer	m ³	46,998
	Cutting	Bulldozer	m ³	41,231

Source: JICA Survey Team

10.4 Construction Cost

(Confidential until the procurement of the contractor)

10.5 Land Acquisition and Resettlement Cost

10.5.1 Demolition Cost and Land Acquisition Cost

Almost all the areas in the project site are public land. And there is no demolition and land acquisition needed in the project site, no cost will be spent.

10.5.2 Resettlement Cost

There are one stall and four houses in the project site. All the buildings are on public land and lent from the owner of the land. The cost of compensation and resettlement assistance is calculated at USD 6,708.

And there are about 160 trees in the project site. Myanmar's law prohibits cutting of trees and requires replanting. The cost for the compensation of trees shall be calculated at USD 32,000.

10.5.3 Total Cost of Land Acquisition and Resettlement

The total cost of land acquisition and resettlement is calculated at about USD 40,000.

10.6 Estimated Project Cost

(Confidential until the procurement of the contractor)

Chapter 11

Demand Forecast and Economic Evaluation of the Project

11. Demand Forecast and Economic Evaluation of the Project

11.1 Introduction

As described in previous chapters, it is anticipated that the traffic between Yangon area and Thanlyin area will increase in the near future because Thanlyin area is developing and many development projects are planned such as the commercial area in Thilawa SEZ. The current traffic capacity of the two existing bridges cannot accommodate the future traffic demand generated in the area, and will soon become a serious bottleneck. Therefore, the new Bago River Bridge is highly expected to respond to the increased traffic demand and prevent traffic congestion in the area.

Implementation of the Bago River Bridge Construction Project should be evaluated considering of the national economy (income) due to the large amount of capital cost required. Comparative advantage and absolute value (contribution) of the Project to the national economy should be measured in a numerical manner as much as possible to see the feasibility of the Project prior to the decision for actual implementation.

This chapter presents the results of demand forecast analysis and evaluation of the Project from a viewpoint of the national economy based on future demand forecast. For this Project, financial analysis is not conducted since the bridge is not assumed to be a toll bridge.

11.2 Socio-Economic Framework and Future Transport Demand

This section provides results of the travel demand forecast for the YUTRA study area (the Greater Yangon including Yangon City and part of the six adjacent townships i.e., Thalyin, Hmawbi, Helgu, Htantabin, Twantay, and Kyauktan) for the master plan development³ horizon years of 2025 and 2035. The inputs to the travel demand forecast are the future years of the socio-economic framework and the data for the forecast years, 2018, 2025, and 2035. Subsection 11.2.1 shows the socio-economic framework, Subsection 11.2.2 presents the future transport demand without the Project (do-nothing case), and Subsection 11.2.3 provides the demand forecast of the base case with the Project.

11.2.1 Socio-Economic Framework

The future socio-economic framework was prepared by YUTRA based on past trends, future land use planned by SUDP, national framework estimated by MYT-Plan, and a series of GIS analyses. It covers the following indicators by traffic zone:

- Population (night-time and day-time);
 - Employment by sector (night-time and day-time);
 - Number of students (night-time and day-time);
 - Household income; and
 - Ratio of car-owning households.
- Table 11.1 summarizes the socio-economic framework for Greater Yangon estimated by YUTRA.

³ As for the details in the master plan projects proposed by YUTRA, please refer to the Final report of YUTRA. Subsection 11.2.3 of this chapter also mentions the master plan projects.

Table 11.1 Summary Socio-economic Framework for Greater Yangon

			2013	2018	2025	2035	Annual Growth Rate			
							2013-2018	2018-2025	2025-2035	Average 2013-2035
Night-time Population ('000)	Workers	Primary	58	58	58	58	0.0%	0.0%	0.0%	0.0%
		Secondary	219	263	350	562	3.7%	4.2%	4.8%	4.4%
		Tertiary	2,263	2,601	3,214	4,470	2.8%	3.1%	3.4%	3.1%
		Total Workers	2,540	2,921	3,622	5,089	2.8%	3.1%	3.5%	3.2%
	Student at Residence		1,164	1,303	1,532	1,938	2.3%	2.3%	2.4%	2.3%
	Others		2,013	2,212	2,462	2,685	1.9%	1.5%	0.9%	1.3%
	Total Night-time Population		5,716	6,437	7,615	9,712	2.4%	2.4%	2.5%	2.4%
Day-time Population ('000)	Employment	Primary	58	58	58	58	0.0%	0.0%	0.0%	0.0%
		Secondary	244	289	378	595	3.4%	3.9%	4.6%	4.1%
		Tertiary	2,263	2,610	3,242	4,547	2.9%	3.1%	3.4%	3.2%
		Total Employment	2,565	2,956	3,678	5,200	2.9%	3.2%	3.5%	3.3%
	Student at School Places		1,164	1,303	1,532	1,938	2.3%	2.3%	2.4%	2.3%
	Others		2,013	2,212	2,462	2,685	1.9%	1.5%	0.9%	1.3%
	Total Day-time Population		5,741	6,472	7,672	9,823	2.4%	2.5%	2.5%	2.5%
Household Income ('000 MMK/month)			240.6	340.5	522.2	954.7	7.2%	6.3%	6.2%	6.5%
Household Car Ownership Ratio (%)			11.6	16.8	23.2	32.3	7.8%	4.7%	3.4%	4.8%

Source: JICA Survey Team

11.2.2 Transport Demand Forecast (Do-Nothing Case)

This subsection analyzes the future traffic condition of the present road network within YUTRA study area, for which no projects will be implemented (do-nothing case) by the master plan development horizon years of 2018 (short term), 2025 (medium term), and 2035 (long term).

Travel demand estimates were made for a single urban development scenario as stipulated by the JICA SUDP study. The travel demand estimates for three years are summarized in Table 11.2. It compares the demand growth for each of the forecasted years.

The table reflects the rapid growth in travel demand with almost constant population growth rate of just over 2.4% per annum. The demand forecast growth in trip rate is reflective of the rapid growth in mechanized trips. The high growth in mechanized trips is caused by the increase in vehicle-owning households from some 12% of the population to over 34% of all households by 2035. The pace of growth is rather rapid in earlier years than in the later years due to higher growth of car ownership in earlier years.

The mechanized person trips are forecasted to almost double from 4.9 million trips in 2013 to 9.5 million trips by 2035. The share of walk trips and by bicycle would also grow steadily, albeit at slower pace as vehicle-ownership grows. There is a tendency for all members of the household to use the vehicle for all trips, once the vehicle is available. This is a common phenomenon in developing countries, wherein the purchase of a vehicle is a major step towards a 'status' in a society, and then its maximum use is inevitable as there is limitations or restraints (parking availability/charges, no road user charges).

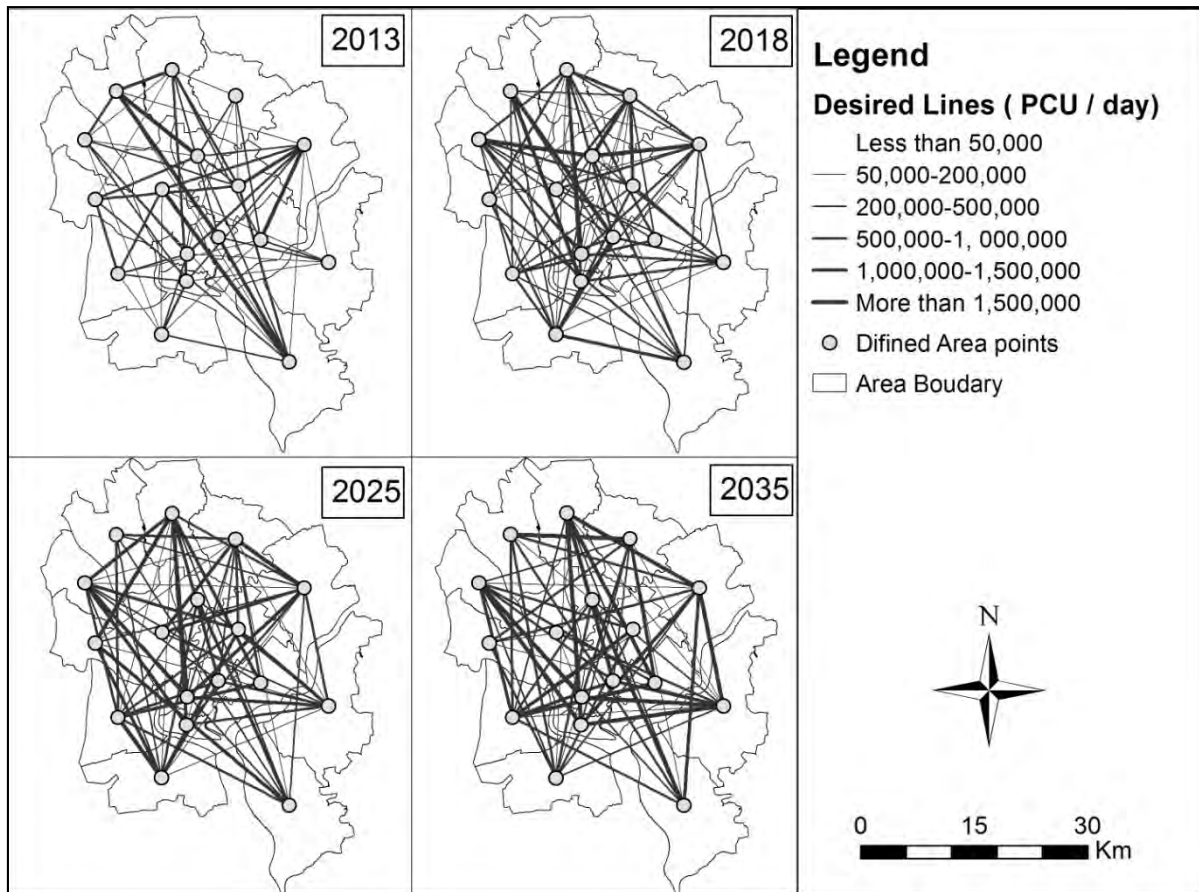
Table 11.2 Growth in Total Travel by All Modes, Person Trips ('000)

Description	2013	2018	2025	2035
Walk	4,778	5,238	6,072	7,403
Bicycle	1,472	1,661	1,981	2,704
Mechanised	4,935	5,862	7,185	9,477
%mechanised	44.1	45.9	47.2	48.4
Total Trips	11,185	12,761	15,238	19,584
Population	5,716	6,437	7,616	9,712
Trip Rate	1.96	1.98	2.00	2.02
Growth Indicator	Growth Rate %p.a.			
	2013-18	2018-25	2025-35	
Walk	1.86	2.13	2.00	
Bicycle	2.45	2.55	3.16	
Mechanised	3.50	2.95	2.81	
Total Trips	2.67	2.57	2.54	
Population	2.40	2.43	2.46	
Trip Rate	0.26	0.13	0.08	

Source: JICA Survey Team

The next stage in the demand forecast process is the distribution of estimated trip ends between origins and destinations. Results of the trip distribution patterns are illustrated by the desire-line diagrams for base and forecast years in Figure 11.1. It is evident that the demand for travel from the new town centers that spread around the central core of Yangon City would considerably grow.

Travel demand to and from areas outside the YUTRA area (external trips) was exogenously estimated, and added to the above described estimated demand. The external travel demand forecast was then compared with the MYT-Plan, and controlled by the MYT-Plan travel demand to/from Yangon and those that pass through the YUTRA area by private and public modes as well as for the goods vehicles. Table 11.3 summarizes the total travel demand in the study area by mode of travel and commercial vehicles.



Source: JICA Survey Team

Figure 11.1 Current and Forecasted Trip Distribution Patterns in YUTRA Areas

Table 11.3 Total Travel Demand in the YUTRA Study Area

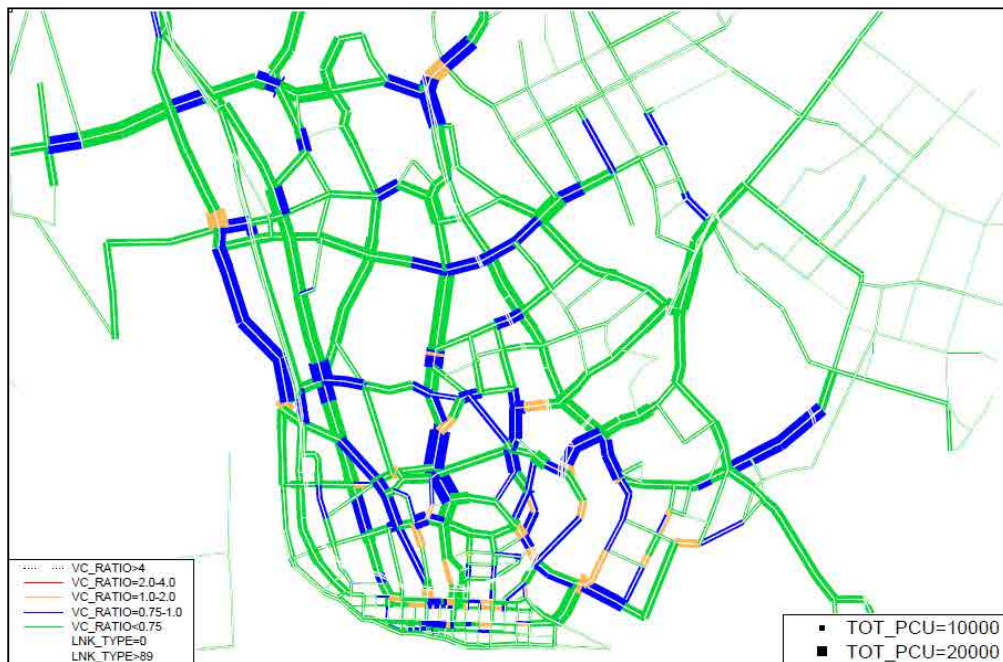
Summary of Trip Totals by Mode (Inter-zonal)					% Growth			% Growth p.a.		
Total Trips	2013	2018	2025	2035	2013-2018	2018-2025	2025-2035	2013-2018	2018-2025	2025-2035
Bicycle	598,500	422,900	504,200	688,900	-29.3	19.2	36.6	-6.7	2.5	3.2
Motorcycle	304,500	208,200	246,100	320,300	-31.6	18.2	30.2	-7.3	2.4	2.7
Car & Van	628,400	1,201,300	1,771,300	2,728,000	91.2	47.4	54.0	13.8	5.7	4.4
Taxi	595,000	756,200	909,200	1,173,100	27.1	20.2	29.0	4.9	2.7	2.6
Bus / Train / Ferry	3,065,900	3,915,400	4,560,400	5,672,600	27.7	16.5	24.4	5.0	2.2	2.2
Total Person Trips	5,192,300	6,504,000	7,991,200	10,582,900	25.3	22.9	32.4	4.6	3.0	2.8
% by Public (Taxi, Bus, Ferry & Train)	70.5	71.8	68.4	64.7						
Goods Vehicle PCU	110,900	151,200	205,200	301,600	36.3	35.7	47.0	6.4	4.5	3.9

Source: JICA Survey Team

The impact of traffic assignment is measured in terms of volume (assigned traffic) capacity (road capacity of each section of road in the network) ratio commonly called as “V/C Ratio”. This section outlines the impact of future traffic demand on the current network. Figure 11.2 shows the current traffic volumes on the current road network in 2013 with the V/C ratios that are illustrated by color.

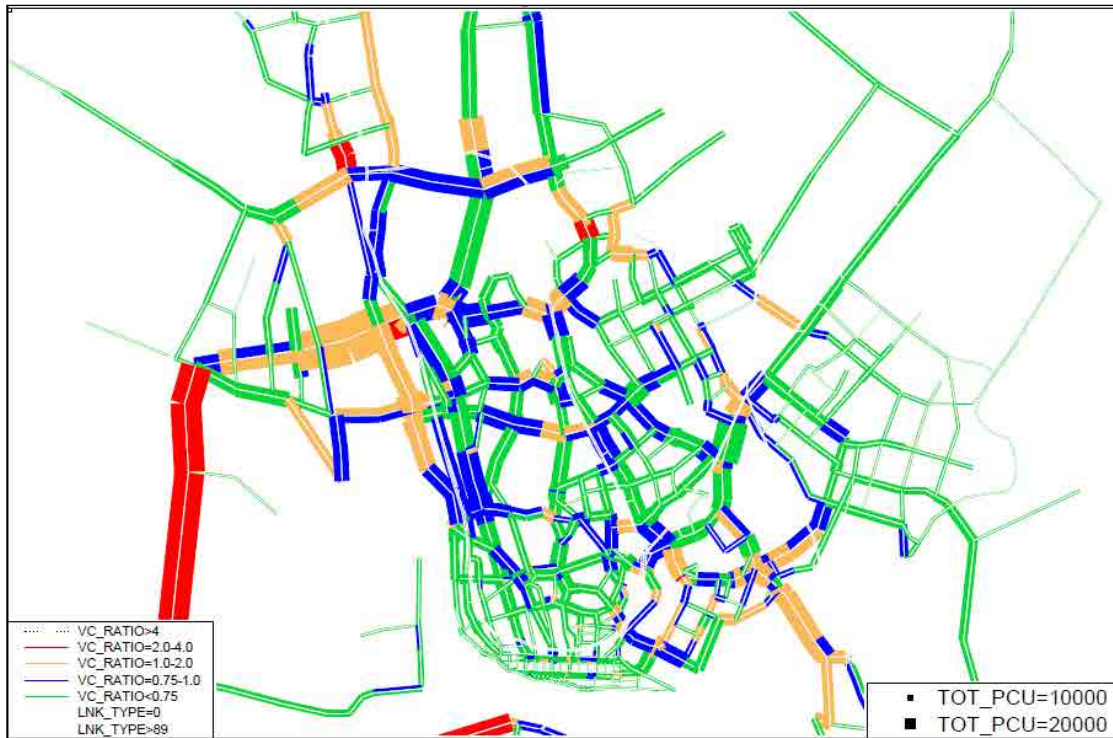
Figure 11.2 also shows that most of the network is congestion free (i.e., green links with V/C Ratio <0.75) and there are only limited number of road sections which are above capacity. This network also reflects the impact of the current rampant on-street parking, which is the main reason of traffic congestion in the CBD area. There are some key links outside the CBD area that are at near capacity (blue links with V/C Ratio between 0.75~1.0). Some bottlenecks are also illustrated by the brown color links.

Figure 11.3 shows the assigned traffic volumes on the current road network in 2018 with the V/C ratios illustrated by color. The figure clearly illustrates that if the current transport infrastructure is not improved, congestion would worsen. The most severe impact would be the rapidly growing urban areas in the west and south of the Yangon River, where the V/C Ratio exceeds 2.0 at the only arterial road in the area. Congestion on bridges from the west and from the Bago area would be operating almost at its capacity most of the day. This illustrates the immediate need for additional Yangon and Bago River crossings.



Source: JICA Survey Team

Figure 11.2 2013 Assigned Traffic Volume on the Current Transport Network

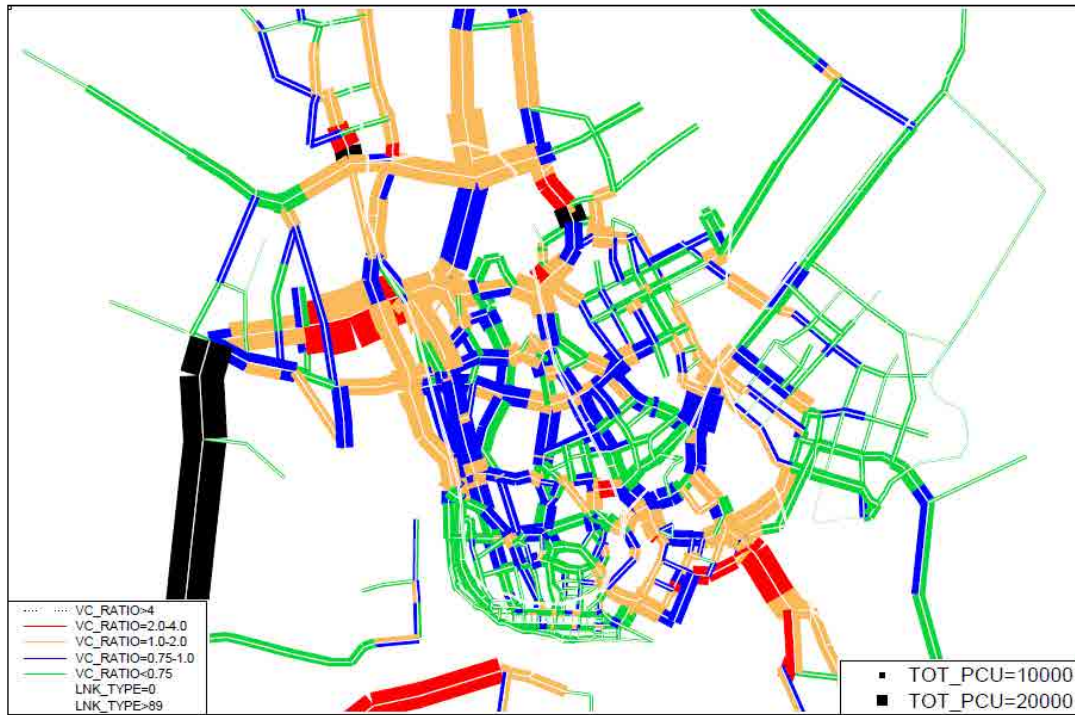


Source: JICA Survey Team

Figure 11.3 2018 Assigned Traffic Volume on the Current Transport Network

Figure 11.4 shows the assigned traffic volume on the current road network in 2025 with the V/C ratios are illustrated by color.

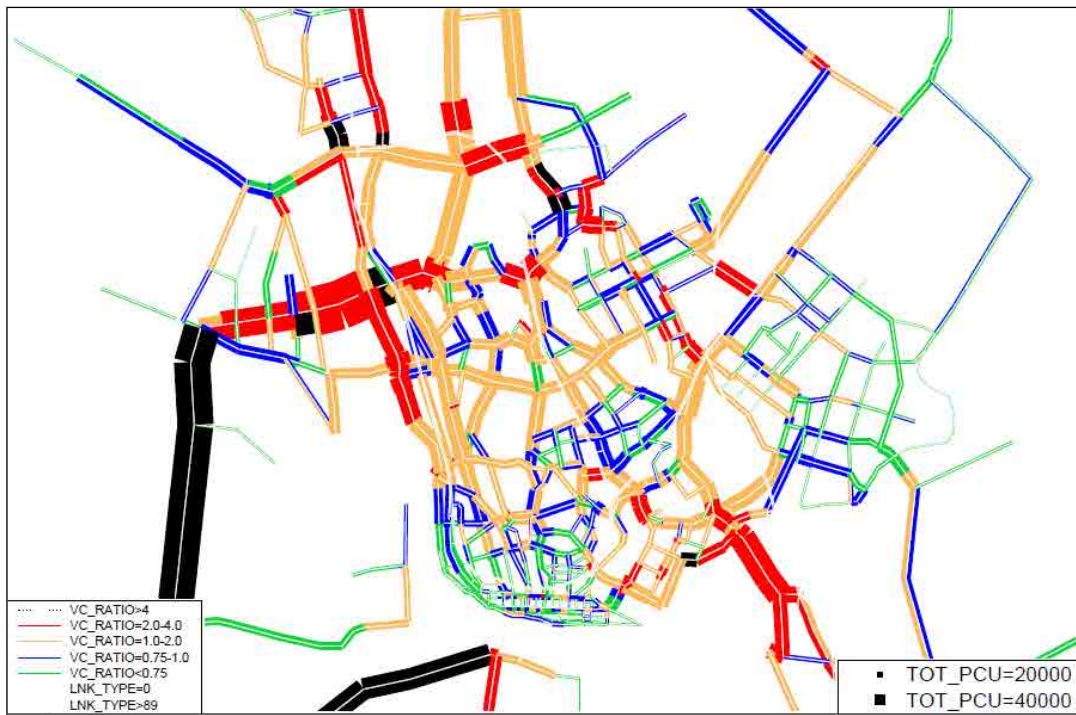
The figure demonstrates that considerable road network capacity would be required to accommodate almost 80% increase in road traffic volume (see Table 11.3 above). The need for a comprehensive arterial and secondary road network would be required in the townships at the west of the Yangon River, as indicated by the black color wherein the only current north-south road reached the V/C Ratio of over 4. Additional river crossings would be required as shown in the 2018 V/C Ratio figures. By 2025, the whole of the Yangon area road network would be required to almost double its road network capacity, or carry out some traffic restraint and use of the charges system would need to be in place. The demand for public transport would also require more efficient systems other than the regular bus services to alleviate congestion. The stress on the outer area highway network is also evident in the V/C Ratio between 1~2 (brown) and over 2.0 indicated by the red color. By 2025, the internal external traffic would also require arterial or expressway network to be in place to meet the demand efficiently.



Source: JICA Survey Team

Figure 11.4 2025 Assigned Traffic Volume on the Current Transport Network

The impact on the road network by 2035 under the stress of increase in the total passenger car unit (PCU) to 2.3 million would be unthinkable if the city will grow and the transport infrastructure remains at the current 2013 level. The need for additional capacity is illustrated below in Figure 11.5, which shows the projected 2035 traffic volume and illustrates the likely V/C ratios on the network. It can be seen that on most of the networks the V/C ratios exceeds 1.0, and the brown, red, and black colors show the intensity of the poor level of service. In fact the red and black colors imply the need to further double the current road capacity and the need for an efficient mass transit system by 2035. A corridor based supply demand analysis is presented in the next section.



Source: JICA Survey Team

Figure 11.5 2035 Assigned Traffic Volume on the Current Transport Network

In summary, these figures above show that V/C of the existing Thanlyin Bridge is expected to rapidly increase between 2013 and 2018. In addition, V/C will reach over 2.0 in 2025, which means that under the current road network there will be severe congestion on the existing Thanlyin Bridge after 2025.

11.2.3 Base Case Demand Forecast (Do Master Plan)

In this subsection, future travel demand of the targeted area (existing Thanlyin Bridge and the new Bago Bridge) of this Survey in Base Case is presented. YUTRA proposed some prioritized projects⁴ for the master plan of the urban transport in Greater Yangon and the Base Case in this chapter is defined as “Do Master Plan Scenario.” The Do Master Plan Scenario assumes the following transport facilities to be developed on the condition that the major road network, the urban railways including two lines of the Urban Mass Rapid Transit (UMRT), and four routes of the Bus Rapid Transport (BRT) will be conducted as scheduled.

Road Network: Road Projects are composed of three types of projects: i) arterial roads, ii) expressways, and iii) traffic control and the Intelligent Transport Systems (ITS). A total of 27 projects were proposed by YUTRA. The Bago Bridge construction project is also included in the project list.

Public Transport: Urban Railway Projects and BRT Projects are also included. The Urban Railway Projects are composed of three types of projects: i) Urban sections of the existing Myanmar Railways, ii) UMRT, and iii) Transit Oriented Development (TOD). A total of 29 projects were proposed. A BRT line is planned to be developed on Thanlyin Bridge. After the new Bago Bridge is constructed, roads of the existing bridge will be occupied by BRT.

Traffic Management: The purposes of the Traffic Management Projects are to manage traffic congestion and keep traffic safety. Six short-term projects were proposed.

⁴ The projects are divided into three categories by implementation schedule: short-term (2014-2018), medium-term (2019-2025), and long-term (2026-2035).

Freight Transport: Two truck terminal projects (medium term) were proposed.

On the assumption that the prioritized projects will be conducted as scheduled, the future travel demand in PCU on the existing Thanlyin Bridge and the new Bago Bridge was calculated through a benchmark year. Table 11.4 presents the travel demand in PCU by mode of transport in two cases: with and without project (new Bago Bridge construction).

Table 11.4 Total Travel Demand in PCU on Thanlyin Bridge and new Bago Bridge

Case	Mode	2013	2018	2025	2035
With	Motorcycle	232	1,150	1,089	1,352
	Car	5,022	16,895	19,103	27,593
	Taxi	4,805	12,539	9,319	12,874
	Bus	4,406	5,199	3,069	3,645
	Truck	4,485	6,181	4,610	6,578
Without	Motorcycle	232	1,150	1,039	1,305
	Car	5,022	16,895	12,916	17,115
	Taxi	4,805	12,539	8,084	9,767
	Bus	4,406	5,199	3,346	4,043
	Truck	4,485	6,181	1,364	1,934
With - Without	Motorcycle	-	-	50	47
	Car	-	-	6,187	10,478
	Taxi	-	-	1,235	3,107
	Bus	-	-	-277	-398
	Truck	-	-	3,246	4,644

Source: JICA Survey Team

The result of the demand forecast also shows that travel speed at each bridge will increase and the V/C Ratio will be improved by the construction of the new bridge. The travel speed and V/C Ratio by each benchmark year are summarized in Table 11.4. Table 11.5 reveals that travel speed on the existing Thanlyin Bridge will increase by 27.41 km/h in 2025 and 36.59 km/h in 2035, respectively.

Table 11.5 Travel Speed on Thanlyin Bridge and new Bago Bridge (km/hour)

Case	Bridge	2013	2018	2025	2035
With	Existing Thanlyin Bridge	27.00	4.97	45.00	45.00
	New Bago Bridge	NA	NA	56.43	36.09
Without	Existing Thanlyin Bridge	27.00	4.97	17.59	8.41
With - Without	Existing Thanlyin Bridge	NA	NA	27.41	36.59

Note: As for without case, buses of BRT are assumed to run on the existing bridge except that the lane is not exclusive.

Source: JICA Survey Team

11.3 Economic Evaluation

11.3.1 Methodology and Assumptions

The economic analysis is to determine whether a proposed public infrastructure project deserves investment of public fund. The concept is to analyze whether the return on a project is worth the investment from the viewpoint of the national economy as a standpoint of the government. The rationality of the investment in the project is evaluated by comparing the economic costs and benefits over the life of the project.

In general, the economic benefit of the transportation development project is defined as the savings in vehicle operation costs (VOC) and travel time costs (TTC) of users attributable to the project. The benefit is comparatively easy to quantify and is estimated through a “with-and without” comparison of traffic demand analysis, that is, comparison of traffic assignment results on a network with the Project and without the Project.

Economic analysis of this Project was conducted based on the following assumptions and standardizations:

1) Construction Period

Construction period for this Project is about six years from 2015 to 2020. The construction period is composed of two years for detailed design/tender period and three years for construction period.

2) Period of Analysis

Period of analysis is 30 years which includes the construction period from 2014 to 2020 and the operation period from 2021 to 2043.

3) Project Life

Fifty years after starting operation. Evaluation period does not cover project life and therefore, residual value was considered.

4) Traffic Assignment:

Traffic assignment was conducted for year 2025 and year 2035, and the economic benefits were estimated for the two years and an interpolation was done for the intermediate years. The economic benefits have been calculated from the results of traffic assignment. After 2035, the economic benefit was assumed to be increased by the same trend.

5) Indicators of Economic Viability

The following three indicators were calculated for economic evaluation of this Project:

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

6) Social Discount Rate:

A 10% per annum was assumed as the social discount rate.

7) Annual Maintenance Cost

A 3% of construction cost of the Project was assumed.

8) Standard Conversion Factor (SCF)

In this analysis, all the costs are classified into the following items: 1) traded goods, 2) non-traded goods, and 3) transfer item. It is assumed that traded goods are equivalent to the foreign currency portion, and aggregation of non-traded goods stands for the local

currency portion. Transfer item means the portion of taxes, which should be excluded from the economic price.

Items such as import duties cause price differential between the domestic market and international market. The standard conversion factor is an index which converts domestic prices to border prices by adjustment of the distortion of domestic prices. The economic prices of the whole portion of non-trade goods are assumed to be obtained by applying the standard conversion factor (SCF).

The standard conversion factor is estimated based on the value of import, export, and taxes. According to the statistical data regarding foreign trade and governmental revenues in Myanmar and to compensate unclear figures on trading such as custom rates, conversion factors in neighboring countries are also referred, such as 0.85 of SCF in Indonesia and in the Philippines. The SCF for this Project is assumed to be 0.85 as the conservative figure which is the same as SCF of YUTRA.

9) Exchange Rate

USD 1.00 = MKK 1,000 in December 2013 was applied.

11.3.2 Economic Cost of the Project

Project cost stated in Chapter “10.6 Estimated Project Cost”, is presented in the financial price. The portion of contingency and taxes is excluded from the economic project costs. Using a standard conversion factor (SCF) set at 0.85 above, the economic prices of the Project is estimated. The economic and financial costs, which are the basis of the economic prices are shown in Table 11.6.

Table 11.6. Financial and Economic Costs for the Project
(Confidential until the procurement of the contractor)

11.3.3 Economic Benefits of the Project

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

(1) Vehicle Operation Cost (VOC)

The savings in VOC is one of the major sources of economic benefits in transport projects. Most important is that the VOC should be a function of vehicle speed so that the improvement of road conditions would be duly reflected as an economic benefit. The unit cost by mode of transport is shown in Table 11.7.

Table 11.7 VOC by Vehicle Type (Economic Price)

Unit: USD-km in '000

Speed (km/h)	Motor cycle	Car	HOV/Van	Mini Bus	Standard Bus	Small Truck	Big Truck
5	58	447	633	662	743	840	1,152
10	34	258	374	437	483	611	795
20	22	158	233	304	333	451	568
30	17	122	177	246	270	367	458
40	15	103	144	212	235	313	391
50	14	92	129	193	215	279	354
60	14	87	124	184	204	261	335
70	14	85	124	182	202	257	332
80	14	86	129	189	209	268	349
90	15	90	136	203	224	293	382

Source: JICA Survey Team

(2) Value of Time (VOT)

The savings in passenger time cost is another major source of economic benefit of transport projects. Table 11.8 below presents the unit of VOT by mode of transport calculated from the personal income data which was collected by the Household Interview Survey conducted by YUTRA. This value is assumed to be increased at the same growth rate as per-capita gross regional domestic product (GRDP) used in this study.

Table 11.8 VOT by Travel Mode (USD/hour)

No	Mode	2013 (Current)	2018	2025	2035
1	Motorcycle	0.5	0.7	1.1	2.1
2	Car	1.3	1.8	2.8	5.1
3	Taxi	1.0	1.4	2.2	4.0
4	Bus/Truck	0.7	0.9	1.4	2.6

Source: JICA Survey Team

(3) Estimation of Economic Benefits: Saving VOC and TTC

By applying the above unit costs to the results of traffic demand and summing VOC and TTC, aggregated transportation cost was estimated. Economic benefit is the difference of the aggregated costs between “with project” and “without project” cases. Table 11.9 shows the estimated economic benefits of benchmark years, 2025 and 2035.

Table 11.9 Estimated Economic Benefits of Benchmark Years

Year	Economic Benefit (USD in millions)		
	TTC Saving	VOC Saving	Total
2025	2.7	8.7	11.4
2035	67	65	132

Source: JICA Survey Team

11.3.4 Evaluation Result

(1) Base Case

Evaluation result of the economic analysis for this Project is summarized in Table 11.10. As explained above, three indicators of the cost-benefit analysis, i) B/C, ii) NPV, and iii) EIRR were computed based on the assumptions mentioned in the foregoing section.

The evaluation result clearly shows that the Project is assessed as economically feasible, as the threshold of EIRR is 12%.

Table 11.10 Summary of Cost-Benefit Analysis

Indicator	Value
EIRR	13.5%
B/C (at discounted rate of 10%)	1.29
NPV (USD in millions at discounted rate of 10%)	54

Source: JICA Survey Team

Table 11.11 Benefit-Cost Stream

(Confidential until the procurement of the contractor)

Table 11.12 Discounted Cash Flow for Cost-Benefit Analysis
(Confidential until the procurement of the contractor)

(2) Sensitivity Analysis

The sensitivity analysis was made by changing the projected cost upward and benefit downward. The elasticity of EIRRs against the project cost is at the range of 1.0 and 1.2 and against benefit in the range of 0.8 and 1.0.

Table 11.13 shows the result of the sensitivity analysis by changing cost and benefit. EIRR is still kept at 12% in case cost does not increase but EIRR is below 12% in cases that the cost increases by 10% and the benefit decreases by 20% or the cost increases by 20% and the benefit decreases by over 10%.

Table 11.13 Sensitivity Analysis by Changing Cost and Benefit

		Project Cost Increase		
		Base (0%)	10% up	20% up
Benefit Decrease	Base (0%)	13.5%	12.9%	12.4%
	10% down	12.9%	12.3%	11.8%
	20% down	12.2%	11.7%	11.2%

Source: JICA Survey Team

11.3.5 Establishment of Operation and Effect Indicators

In order to evaluate how the study contributes to the various expected benefits in its ex-ante and ex-post stages, operation and effect indicators are set. Operation indicators quantitatively measure the operational status of a project, while effect indicators measure qualitatively the effects generated by the study. In case of the road project, operation indicators include increase in traffic volume (vehicles/day), etc. and effect indicators are time cost saving, traffic smoothness, and so on.

In the case of Bago Bridge, the following operation and effect indicators are set, taking into account the collection of baseline and post-project implementation data. The indicators and target figures are summarized in Table 11.14

Construction of the new Bago Bridge is expected to improve the traffic condition on the existing Thanlyn Bridge. Therefore, target figures of the operation and effect indicators of Thanlyn Bridge are also presented in the table.

Table 11.14 Operation and Effect Indicators

Indicator		Direction	Baseline (2013)	Target (2022)	
			Thanlyin Bridge	With	Without
				New Bago River Bridge	(existing Thanlyin Bridge)
Operation Indicators	Increase in traffic volume (PCU/day/1 way)	South Bound	9,254	26,069	24,770
		North Bound	9,696	24,254	21,888
Effect Indicators	Increase in travel speed (km/h)	South Bound	28.0	29.1	4.5
		North Bound	26.0	33.5	4.8
	Alleviation of traffic congestion (V/C)	South Bound	0.67	0.87	1.79
		North Bound	0.70	0.80	1.59

Source: JICA Survey Team

Chapter 12

Environmental and Social Considerations

12. Environmental and Social Considerations

12.1 Policy, Legislative, and Institutional Framework

12.1.1 Legislation related to Environmental and Social Considerations

Major legislations relevant to environmental conservation are shown in Table 12.1.

Table 12.1 Laws and Regulations Relevant to Environmental Conservation

	Name of Laws, Rules, etc.	Year
1. Constitutional and Environmental Policy		
	Constitution of the Republic of the Union of Myanmar	2008
	Myanmar National Environmental Policy	1994
	National Sustainable Development Strategy 2009	2009
2. Environmental Conservation		
	Myanmar Environmental Conservation Law 2012	2012
	Environmental Impact Assessment Procedures (Draft) 2013	2013
3. Biodiversity and Natural Conservation		
	Wildlife Protection Act 1936	1936
	Myanmar Marine Fisheries Law 1990	1990
	Fresh Water Fisheries Law 1991	1991
	Forest Law 1992	1992
	Animal Health and Development Law 1993	1993
	Protection of Wildlife and Conservation of Natural Area Law 1994	1994
	Conservation of Water Resources and River Law 2006	2006
	National Biodiversity Strategy Action Plan in Myanmar 2012	2012
4. Urban Development and Management		
	The City of Rangoon Municipal Act 1922	1922
	Law Amending the City of Yangon Development Law 1996	1996
	City of Yangon Development Law 1990	1990
	The City of Yangon Municipal Amendment Act 1961	1961
5. Land Acquisition and Resettlement		
	The Upper Burma Land and Revenue Regulation	1889
	The Land Acquisition Act 1894	1894
	Transfer of Immovable Property Restriction Act	1947
	Land Nationalization Act	1953
	Disposal of Land Tenancies Law	1963
	Transfer of Immovable Property Restriction Law	1987
	Farmland Law 2012	2012
	Farmland Rules 2012	2012
	Vacant, Fallow, and Virgin Lands Management Law 2012	2012
	Vacant, Fallow, and Virgin Lands Management Rules 2012	2012
6. Pollution Control and Occupational Health		
	Factory Act	1951
	Standing Order 2_95 Occupational Health Plan 1995	1995
	Standing Order 3_95 Water and Air Pollution Control Plan 1995	1995
	Occupational Safety and Health Law (Draft)	2012
	The Science and Technology Development Law 1994	1994
	Myanmar Mines Law 1994	1994

Source: JICA Survey Team

12.1.2 Environmental Conservation Law, 2012

To establish sound environment policies in the utilization of water, land, forests, mineral, marine resources, and other natural resources in order to conserve the environment and prevent its degradation, the National Environment Policy of Myanmar was proclaimed on December 5, 1994. Then the drafting of ‘Myanmar Agenda 21’ followed the Policy in 1997.

However, progress in the development of environmental policy has passed through a rather slow pace since then. In addition, the legal framework for environmental protection has been indebted to sectoral laws and these laws do not possess holistic visions on environmental protection.

In order to solve the above situation, the Environmental Conservation Law was established and enacted by the Union Hluttaw on March 30, 2012, and promulgated on April 1, 2012.

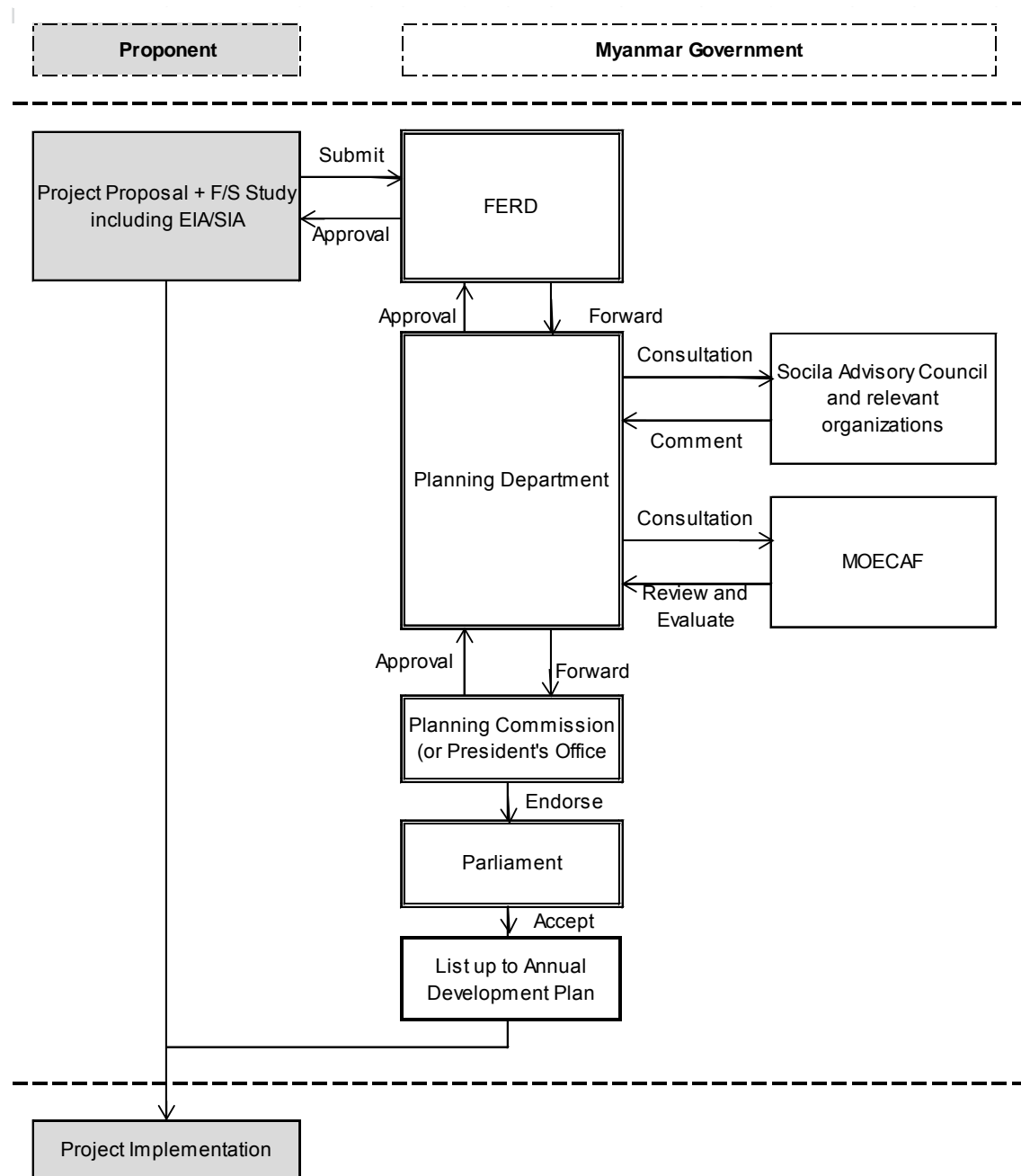
The law consists of the following objectives: formation of the environmental conservation committee, environmental conservation functions, and powers of the Ministry of Environment Conservation and Forestry (MOECAF) and environmental emergency.

12.1.3 Regulations for Environmental Impact Assessment (EIA)

(1) Existing Situation of the EIA Regulations in Myanmar

At present, in the case of the official development scheme by foreign public sector including foreign donors, the approval for project implementation is attained after several processes as follows (Figure 12.1):

- (i) The project proponent shall submit the project proposal documents together with a feasibility study report including the results of the environmental impact assessment (EIA)/social impact assessment (SIA) to the Foreign Economic Relations Department (FERD) of the Ministry of National Planning and Economic Development (MNPED).
- (ii) After all the required documents have been examined by FERD, the documents are then forwarded to the Planning Department of MNPED.
- (iii) The Planning Department consults with the Social Advisory Council and other relevant organizations, as well as, MOECAF for a detailed examination of the documents. In this process, MOECAF reviews and evaluates the results of EIA/SIA in terms of the environmental and social considerations.
- (iv) After all the above organizations have approved the submitted documents, the Planning Department forwards the documents together with the results of the above examination and evaluation to the Planning Commission (or the President's Office).
- (v) After the approval of the documents, the Planning Commission will endorse them to the Parliament together with its recommendation.
- (vi) In the Parliament, after acceptance of the project approval, the project will be registered into the national annual project list without which no project will be conducted in the target year.



Source: JICA Survey Team

Figure 12.1 Existing Procedures of Project and Environment Approval

However, Article 7 of the Environmental Conservation Law stipulates that MOECAF is responsible for laying down and carrying out the EIA and SIA systems as to whether or not a project or activity that will be undertaken by any government department, organization, or person may cause a significant impact on the environment.

The above law, however, does not stipulate the detailed procedures to be taken for the conduct of the EIA. With regard to this, MOECAF has been working on the draft of the “Environmental Conservation Rules” in which the “Environmental Impact Assessment Procedures” (hereafter, “the EIA procedures”) shall be stipulated. As of January 2013, the EIA procedures have been drafted and waiting for further brush up and official enactment.

The draft of the EIA procedures stipulates that MOECAF shall be the Executing Agency in compliance with the rules stipulated in the document.

Regarding environmental approval for the development projects, the Project Appraisal and Progress Reporting Department (PAPRD) of MNPED has been taking the responsibility from 1972 to 1988 and since 2011.

However, Article 7 of the Environmental Conservation Law stipulates that the Ministry of Environment, Conservation and Forestry (MOECAF) has responsibility for laying down and carrying out of a system of Environmental Impact Assessment (EIA) and Social Impact Assessment (SIA) as to whether or not a project or activity to be undertaken by any government department, organization or person may cause a significant impact on the environment.

The above law, however, does not stipulate the detail procedures to be taken for conducting environmental impact assessment. With regard to this, MOECAF has been working for the drafting of the “Environmental Conservation Rules” in which “Environmental Impact Assessment Procedures” shall be stipulated. As of January 2013, the “Environmental Impact Assessment Procedures” has been drafted and waiting for further brush up and official enactment. The draft of the “Environmental Impact Assessment Procedures” (hereafter, “the EIA procedures”) stipulates that MOECAF shall be the Executing Agency for the purpose of the rules stipulated in the document.

As of November 2013, the EIA procedures have been drafted awaiting official enactment through discussions with the Inter-Ministry Committee.

Referring the EIA procedures (draft), outlines of the EIA regulations are described below.

(2) Outline of the EIA Procedures

According to the EIA procedures, the present outlines of EIA regulations are described below.

(3) Projects Requiring IEE/EIA

The lists of projects requiring IEE/EIA are provided in Schedules I and II of the EIA procedures.

1) Schedule I projects

All projects that are likely to have some adverse environmental impacts, but of lesser degree and/or significance than those of Schedule II projects, require an initial environmental examination (IEE) to determine whether or not significant environmental impacts warranting an EIA (full EIA) are likely. If an EIA is not needed, the report of the IEE is regarded as the final environmental assessment report.

2) Schedule II projects

All projects that are likely to have potential for significant adverse environmental impacts require an EIA (full) to address such significant impacts.

The lists of projects in infrastructure development requiring IEE/EIA are shown in Table 12.2.

Table 12.2 List of Projects in Infrastructure Development Requiring IEE/EIA

Specific Types of Projects	Project Features (size, etc.)
(I) Projects Requiring IEE (Schedule I)	
1. Water supply schemes	For a population of more than 20,000 and less than 50,000
2. Housing development scheme	More than 250 ac (100 ha) and less than 500 ac (200 ha)
3. River training works	All projects
4. Municipal solid waste and municipal sewerage management system	For a population of 10,000 or more
5. Construction of bridges	More than 50 ft and less than 200 ft
6. Port development	All projects
(II) Projects Requiring EIA (full EIA) (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 ft
5. Construction of shipyards	Dead weight tonnages greater than 5,000 t
6. Construction of airports	Airstrips of 8,200 ft (2,500 m) or longer
7. Construction of railways including construction of new routes	All projects if recommended by IEE
8. Solid waste and sewerage management system	
a) Garbage disposal using incineration	2,000 ac (800 ha) and above
b) Garbage disposal using controlled landfill or sanitary landfill system	2,000 ac (800 ha) and above
c) Garbage disposal using open dumping systems	32 t/ac or 80 t/ha and above
d) Municipal sewerage management	
(i) Construction of wastewater treatment facilities in urban areas	125 ac (50 ha) and above
(ii) Construction of sewerage systems	Service area 6,250 ac (200 ha) and above
9. Public housing and settlement construction	More than 500 ac (200 ha)
10. Construction of multi-stories and apartment building	Height more than 65 yd (60 m)
11. Construction of multi-purpose reservoirs	
a) Construction of medium dams	Height between 50 ft (15 m) to 100 ft (30 m) covering an irrigable area of 100,000 ac or more
b) Construction of high dams	Height of 100 ft (30 m) or more together with hydropower generation of town water supply of any size
12. Groundwater development for industrial, agricultural and water supply	More than 160,000 cu ft (4,500 cu m)
13. Water supply schemes	For population of 50,000 or more

Note: Project activities other than new construction such as rehabilitation, extension, and/or improvement are not clearly stipulated.

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

3) Schedule III

In addition, Schedule III identifies environmentally, ecologically, and socio-culturally sensitive areas which should not be included in any development project and a reasonable distance should be ensured from such areas so as not to cause any permanent damage or result in any adverse environmental, ecological, or social impacts (see Table 12.3).

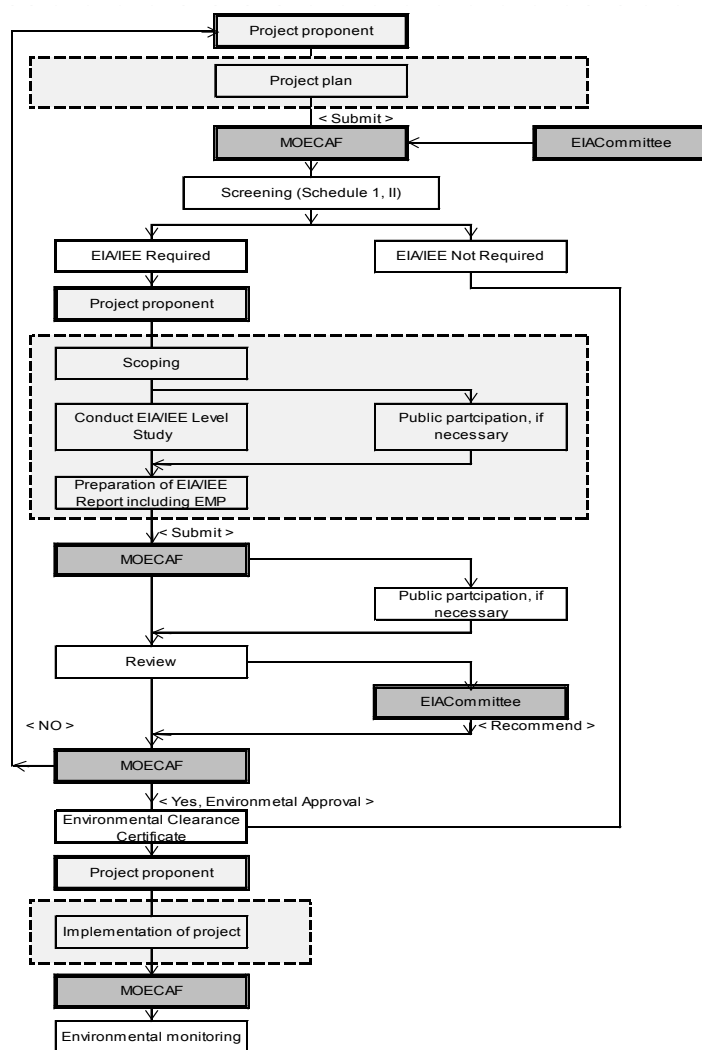
Table 12.3 Environmentally, Ecologically, and Socio-cultural Sensitive Areas (Schedule III)

No.	Sensitive Areas
1	Areas of unique historical, cultural, archaeological, scientific, or geographical significance
2	Wetlands
3	Ecologically fragile area
4	National parks, wildlife sanctuaries, and protected areas
5	Wilderness areas containing rare or endangered species of flora or fauna and their habitat
6	Areas susceptible to natural hazards
7	Major sources of public drinking water
8	Areas surrounding lakes and reservoirs
9	Resort areas and areas closed to oyster fishing and pearl farms areas
10	Floodplains or other hazardous zones

Source: JICA Survey Team

(4) Process of Environmental Approval

The schematic process of environmental approval in the EIA procedures is shown in Figure 12.2.



Note: MOECAF - Ministry of Environmental Conservation and Forests
Source: Environmental Impact Assessment Procedures (Draft, 2013)

Source: JICA Survey Team

Figure 12.2 Schematic Process of Environmental Approval

(5) Gaps of Environmental and Social Considerations between Myanmar Legislations and the JICA Guidelines

At present, the roles and importance of environmental and social considerations in the planning and implementation of projects are not necessarily recognized in Myanmar. In order to cope with this, the Environmental Conservation Law was enacted in 2012 and the EIA procedures were proposed as described above.

Regarding the policies for environmental and social considerations, those of the JICA guidelines are basically the same as that of the World Bank and ADB.

Table 12.4 shows the results of the comparison between the policies of Myanmar legislations including the EIA procedures and those of the JICA guidelines. It is found that there are still considerable gaps between Myanmar legislations and the JICA guidelines.

Table 12.4 Gaps between the JICA Guidelines for Environmental and Social Considerations (JICA Guidelines) and Myanmar Legislations

JICA Guidelines/WB OP4.12	Legislation of Myanmar	Gaps between the JICA Guidelines/WB OP4.12 and the Law of Myanmar
Underlying Principles		
1. Environmental impacts that may be caused by projects must be assessed and examined in the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan.	EIA-P (A 9,13)	Article 9 of the EIA procedures requires IEE or EIA for the proposed projects based on the types of activities according to the defined thresholds.
		Article 13 of the EIA procedures stipulates the analysis of feasible alternatives as well as mitigation measures while there is no line which stipulates the timing of the above implementation.
2. Such examinations must be endeavored to include an analysis of environment and social costs and benefits in the most quantitative terms possible, as well as a qualitative analysis; these must be conducted in close harmony with the economic, financial, institutional, social, and technical analyses of projects.	EIA-P (A 13)	Article 13 of the EIA procedures stipulates the analysis of feasible alternatives, mitigation measures as well as cost and benefit.
3. The findings of the examination of environmental and social considerations must include alternatives and mitigation measures, and must be recorded as separate documents or as a part of other documents. EIA reports must be produced for projects in which there is a reasonable expectation of particularly large adverse environmental impacts.	EIA-P (A 9,13,14)	Article 9 of the EIA procedures requires IEE or EIA for the proposed projects based on the types of project activities according to the defined thresholds. Article 13 of the EIA procedures stipulates the analysis of feasible alternatives as well as mitigation measures.
		Article 14 of the EIA procedures requires the preparation of the EIA report for projects that need EIA and preparation of EMP for projects requiring IEE/EIA. On the other hand, there is no line which stipulates the IEE report should be prepared for projects requiring IEE.
4. For projects that have a particularly high potential for adverse impacts or that are highly contentious, a committee of experts may be formed so that JICA may seek their opinions, in order to increase accountability.	EIA -P (A 4)	Article 4 of the EIA procedures requires the establishment of the EIA Committee composed of at least five persons with necessary expertise.
		The committee's duty is to recommend approval of the submitted IEE/EIA and EMP.

Examination of Measures		
1. Multiple alternatives must be examined in order to avoid or minimize adverse impacts and to choose better project options in terms of environment and social considerations. In the examination of measures, priority is to be given to avoidance of environmental impacts; when this is not possible, minimization and reduction of impacts must be considered next. Compensation measures must be examined only when impacts cannot be avoided by any of the aforementioned measures.	EIA-P (A 13)	Article 13 of the EIA procedures stipulates the investigation of all potential environmental impacts including an analysis of feasible alternatives and mitigation measures. However, the conduct of compensation measure is not stipulated in the EIA procedures.
2. Appropriate follow-up plan and system, such as monitoring plans and environmental management plans, must be prepared; the costs of implementing such plans and systems, and the financial methods to find such costs, must be determined. Plans for projects with particularly large potential adverse impact must be accompanied by detailed environmental management plans.	EIA-P (A 13,14)	Article 13 of the EIA procedures stipulates the analysis of feasible alternatives, mitigation measures as well as cost and benefit.
		Article 14 of the EIA procedures requires the preparation of EMP for projects that needs IEE/EIA.
Scope of Impacts to Be Assessed		
1. The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accident, water usage, climate change, ecosystem, fauna and flora, including transboundary 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	EIA-P (A 13)	The items of likely impacts are not clearly stated in the EIA procedures. Article
2. In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are also to be examined and assessed to a reasonable extent. It is also desirable that the impacts that can occur at any time throughout the project cycle should be considered throughout the life cycle of the project.	None	No laws were identified, which mentioned assessment and examination of derivative, secondary, and cumulative impacts as well as the impacts of projects which are indivisible from the project in a reasonable extent.
Compliance with Laws, Standards, and Plans		
1. Projects must comply with the laws, ordinances, and standards related to environmental and social considerations established by the governments that have jurisdiction over project sites (including both national and local governments). They must also conform to the environmental and social consideration policies and plans of the governments that have such jurisdiction.	Environmental Conservation Law 2012 (A 28, 29)	No law directly prescribes that projects must comply with laws, ordinances, and standards related to environmental and social considerations.
		Article 28 of The Environmental Conservation Law prescribes that “No one shall, without prior permission, operate business, work-site or factory, and workshop which is required to obtain prior permission under this Law”

		Article 29 of the law stipulates that “No one shall violate any prohibition contained in the rules, notifications, orders, directives, and procedures issued under this Law.”
2. Projects must, in principle, be undertaken outside of protected areas that are specifically designated by laws or ordinances for the conservation of nature or cultural heritage (excluding projects whose primary objectives are to promote the protection or restoration of such areas). Projects are also not to impose significant adverse impacts on designated conservation areas.	EIA-P (A 8)	Schedule 3 stipulated by Article 8 of the EIA procedures prescribes that projects must, in principle, be undertaken outside of the environmentally, ecologically, and socio-culturally sensitive areas.
	Protection and Preservation of Cultural Heritage Regions Law (Article 18)	This law stipulates that no person shall construct, extend, renovate a building, or extend the boundary of any ancient monumental zone or ancient site zone without prior permission granted under this law.
Social Acceptability		
1. Projects must be adequately coordinated so that they are accepted in a manner that is socially appropriate to the country and locality in which they are planned. For projects with a potentially large environmental impact, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans may be examined. The outcome of such consultations must be incorporated into the contents of project plans.	EIA-P (A 6,15)	Article 6 of the EIA procedures stipulates that MOECAAF shall arrange for public participation of civil society and relevant agencies in the conduct of IEE/EIA and EMP.
		Article 15 of the EIA procedures stipulates that MOECAAF shall invite civil society organizations and affected persons to provide comments and suggestions on the IEE/ EIA report.
2. Appropriate consideration must be given to vulnerable social groups, such as women, children, the elderly, and the poor and ethnic minorities, all members of which are susceptible to environmental and social impacts and may have little access to decision-making processes within society.	EIA-P (A 4)	Article 4 of the EIA procedures prescribes implementation of necessary actions for the project which potentially gives adverse impact on indigenous people and causes involuntary resettlement. However, the details of actions are not provided in the draft procedures.
Ecosystem and Biota		
1. Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests.	Environmental Conservation Law 2012 (A 18)	The Environmental Conservation Law prescribes that relevant government departments/ organizations shall carry out conservation, management, beneficial use, sustainable use and enhancement of regional cooperation of environmental natural resources.
	Forest Law 1992 (A 40)	Article 40 of the Forest Law (1992) prescribed that cause of any damage to reserved forest and its environment is prohibited and will be punished.
	Protection of Wildlife and Conservation of Natural Areas Law 1994 (A 36)	Article 36 of The Protection of Wildlife and Conservation of Natural Areas Law prescribed that cause of any damage to protected areas is prohibited and will be punished.
2. Illegal logging of forests must be avoided. Project proponents etc. are encouraged to obtain certification by forest certification systems as a way to ensure the prevention of illegal logging	Forest Law 1992 (A 17, 40)	The Law stipulates that forest produce may only be extracted after obtaining a permit.
Involuntary Resettlement		

<p>1. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with the people who will be affected.</p>	<p>EIA-P (A 4)</p>	<p>The draft procedures prescribe implementation of necessary actions for the project which potentially gives impact on involuntary resettlement. However, the details of actions are not provided in the draft procedures.</p>
<p>2. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by project proponents etc. in a timely manner. Prior compensation, at full replacement cost, must be provided as much as possible. Host countries must make efforts to enable people affected by projects and to improve their standard of living, income opportunities, and production levels, or at least to restore these to pre-project levels. Measures to achieve this may include: providing land and monetary compensation for losses (to cover land and property losses), supporting means for an alternative sustainable livelihood, and providing the expenses necessary for the relocation and re-establishment of communities at resettlement sites.</p>	<p>Land Acquisition Act 1894 (A 3)</p>	<p>Article 3 of the Land Acquisition Act stipulates that a person who has rights on the land would be entitled to claim compensation if the land was acquired under this Act.</p>
	<p>Farmland Rules 2012 (A 64)</p>	<p>Article 64 of the Farmland Rules 2012 stipulates the compensation in farmland acquisition for the interest of the state or public.</p>
	<p>Land Acquisition Act 1894 (A 23)</p>	<p>Article 23 of the Act stipulates that damages on standing crops and trees, on land, properties, incidental to relocate residence or business and losses of profits due to land acquisition are considered for compensation although it does not clearly state that support to project-affected persons (PAPs) can improve or at least restore their standard of living. However, these laws do not clearly state any more details of compensation and supporting measures.</p>
<p>3. Appropriate participation by affected people and their communities must be promoted in the planning, implementation, and monitoring of resettlement action plans and measures to prevent the loss of their means of livelihood. In addition, appropriate and accessible grievance mechanisms must be established for the affected people and their communities.</p>	<p>EIA-P (A 15)</p>	<p>Article 15 of the EIA procedures describes that relevant agencies, institutions, civil society organizations, and PAPs are invited as appropriate to provide comments and suggestions on the IEE/ EIA/EMP reports. However, it does not describe resettlement action plan.</p>
	<p>Land Acquisition Act 1894 (A 5A, 18)</p>	<p>Article 5A of the Land Acquisition Act stipulates that any person whose land is affected (acquired) can claim the objection for the land acquisition within thirty</p>
<p>4. For projects that will result in large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP4.12, Annex A.</p>	<p>None</p>	<p>No laws were specifically mentioned about the requirement of resettlement action plans for large-scale involuntary resettlement.</p> <p>However, the General Administration Department (GAD) of the Ministry of Home Affairs (MOHA) explained that the Land Acquisition and Resettlement Action Plan (LARAP) will be required for large-scale developments and GAD will approve it. (hearing as of January 2013)</p>
<p>Indigenous People</p>		
<p>1. Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures must be taken to minimize impacts and to compensate indigenous peoples for their losses.</p>	<p>EIA-P (A 4)</p>	<p>The EIA procedures prescribe without details the implementation of necessary actions for the project which potentially gives impacts on indigenous peoples.</p>

<p>2. When projects may have adverse impacts on indigenous peoples, all of their rights in relation to land and resources must be respected in accordance with the spirit of relevant international declarations and treaties, including the United Nations Declaration on the Rights of indigenous Peoples. Efforts must be made to obtain the consent of indigenous peoples in a process of free, prior, and informed consultation.</p>		
<p>3. Measures for the affected indigenous peoples must be prepared as an indigenous peoples plan (which may constitute a part of other documents for environmental and social consideration) and must be made public in compliance with the relevant laws and ordinances of the host country. In preparing the indigenous peoples plan, consultations must be made with the affected indigenous peoples based on sufficient information made available to them in advance. When consultations are held, it is desirable that explanations be given in a form, manner, and language that are understandable to the people concerned. It is desirable that the indigenous peoples plan include the elements laid out in the World Bank Safeguard Policy, OP4.10, Annex B.</p>		
<p>Monitoring</p>		
<p>1. After projects begin, project proponents etc. monitor whether any unforeseeable situations occur and whether the performance and effectiveness of mitigation measures are consistent with the assessment's prediction. They then take appropriate measures based on the results of such monitoring.</p>	<p>EIA-P (A -18)</p>	<p>The EIA procedures prescribe that a project proponent shall prepare and submit an EMP with the IEE/EIA reports. The MOECAAF shall carry out monitoring of the implementation of the approved EMP by the project proponent although there was little information regarding the method or terms for the conduct of monitoring.</p>
<p>2. In cases where sufficient monitoring is deemed essential for appropriate environmental and social considerations, such as projects for which mitigation measures should be implemented while monitoring their effectiveness, project proponents etc. must ensure that project plans include feasible monitoring plans.</p>	<p>None</p>	
<p>3. Project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders.</p>	<p>None</p>	<p>No laws were identified, which stated that project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders.</p>
<p>Others</p>		
<p>1. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits. (WB OP4.12 Para.6)</p>	<p>Land Acquisition Act of 1894 (A 4)</p>	<p>Article 4 of the Act stipulates that a notification of land requirement for public purposes is published to start surveys and land marking although it does not state the details of the surveys that will establish eligibility through an initial baseline survey (including population census).</p>

2. Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP4.12 Para.15)	Land Acquisition Act of 1894 (A 9)	Article 9 of the Act stipulates that the occupier (if any) of land and all persons known or believed to have rights on lands are notified or invited for explanations, although the eligibility is not clearly prescribed in the Act.
3. Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WBOP4.12 Para.11)	None	No law was identified regarding land-based resettlement strategies for displaced persons.
4. Provide support for the transition period (between displacement and livelihoods are land-based. (WB OP4.12 Para 6)	None	No law was identified on the provision of support for the transition period.
5. Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line , landless, elderly women and children, ethnic minorities etc. (WB OP4.12Para.8)	None	No law was identified on particular attention to vulnerable groups.
6. For projects that entail land acquisition or involuntary resettlement for fewer than 200 people, abbreviated resettlement plan is to be prepared, (WB OP4.12 Para.25)	None	No law was identified on the criteria of abbreviated resettlement plan.

Note: JICA - JICA Guidelines for Environmental and Social Considerations, WB - World Bank Safeguard Policy, EIA-P - Environmental Assessment Procedures (Draft 2013, by MOECAF), A - Article.

Source: JICA Guidelines for Environmental and Social Considerations (2010.4) and World Bank OP 4.12 and relevant Myanmar legislations

12.1.4 Environmental quality standards

In Article 10 of the Environmental Conservation Law, 2012, MOECAF may stipulate the environmental quality standards for items such as surface water quality, underground water quality, air quality, noise and vibration with the approval of the Union Government and the Committee, although the standards were established only in October 2013.

However, some emission and/or discharge standards and environmental standards have been established by other ministries and practically, used standards and/or guidelines as references.

(1) Pollution Control Standards at Generation Source

The Private Industrial Enterprise Law (1990) stipulates that one of the basic principles of the law is to avoid or reduce the usage of technologies which causes environmental pollution. In addition, the law also stipulates that one of the duties of the Ministry of Industry (MOI) is to secure or prevent any pollution to cause any adverse effect on the environment as well as on the health of residents and factory workers.

Standing Order 3/95 of the Water and Air Pollution Control Plan of MOI stipulates that factories shall conduct monitoring of wastewater for items defined in the Order. The emission and effluent standards are shown in Tables 12.5 and 12.6.

Table 12.5 Emission Standards

Gas	mg/m ³	ppm
CO ₂	9,000	500
CO	55	50
H ₂ S	14	10
Ammonia	18	25
Benzene	30	10

Source: MOI Standing Order 2/95 Occupational Health Plan 1995

Table 12.6 Effluent Standards

Item	Threshold	Standard Value
B.O.D. (5 days at 20.B.O.D. and 5 days at 20 °C)	max	20 ppm or more but not exceeding 60 ppm, depending on the geography of waste discharging point
Suspended solids	max	30 ppm
Dissolved solids	max	2000 ppm
pH value	Between 5 and 9	
Permanganate value	max	60 ppm
Supplied (as H ₂ S)	max	1 ppm
Cyanide (as HCN)	max	0.2 ppm
Oil and grease	max	5 ppm
Tar	none	
Formaldehyde	max	1 ppm
Phenols and cresols	max	1 ppm
Free chlorine	max	1 ppm
Zinc	max	5 ppm
Chromium	max	0.5 ppm
Arsenic	max	0.25 ppm
Copper	max	1.0 ppm
Mercury	max	0.005 ppm
Cadmium	max	0.03 ppm
Barium	max	1.0 ppm
Selenium	max	0.02 ppm
Lead	max	0.2 ppm
Nickel	max	0.2 ppm
Insecticides	none	
Radioactive materials	none	
Temperature	max	40 °C
Color and odor	Not objectionable when mixed in receiving water	

Source: MOI Standing Order 3/95: Water and Air Pollution Control Plan

- (2) Regulation of Wastewater Discharge in Yangon City Development Committee (YCDC) Area
- Section 7 (7) of the YCDC Order No. 10/99 prohibits discharging of wastewater into common properties. No one shall be allowed to dispose and/or flow sewage and wastewater from any activity, such as business and factory, into drainages, creeks, and rivers without necessary

treatment in compliance with standards, norms, and criteria designated by the concerned agency. The effluent standards from factories and facilities are shown in Table 12.7.

Table 12.7 Effluent Standards for Wastewater from Factories and Facilities

	Item	Value
1	pH	6-9.6
2	BOD	20-60 ppm
3	COD	< 200 ppm
4	TS	up to 2,000 ppm
5	SS	up to 500 ppm

Source: Proposed National Standard from Occupational Health Division,
Department of Health under the Ministry of Health

(3) Water Quality Standards

With regard to the water quality, however, the guidelines proposed in the workshops in 1990 and 2011 (draft) were compared with the World Health Organization (WHO) guidelines in Table 12.8. Compared with 1990, the values for 2011 tended to be closer to the WHO guidelines. However, for copper and iron, the values are less strict than in the WHO guidelines.

Table 12.8 Water Quality Standard in Myanmar

Parameters		Unit	Myanmar Standard		WHO Guidelines
			1990	2011 (Draft)	
1	pH	-	6.5-9.2	6.5-8.5	Preferably <8.0
2	Turbidity	NTU	20	5	5
3	Colour	Pt-unit	6.5-9.2	15	15
4	Aluminum (Al)	mg/l	0.2	0.2	0.2
5	Arsenic (As)	mg/l	0.05	0.05	0.01
6	Calcium (Ca)	mg/l	75-200	100	-
7	Chloride (Cl)	mg/l	200-600	250	250
8	Copper (Cu)	mg/l	1	2	1
9	Cyanide (CN)	mg/l	0.05	0.07	0.07
10	Hardness	mg/l	500	500	-
11	Iron (Fe)	mg/l	0.5 -1.5	1	0.3
12	Manganese (Mn)	mg/l	0.3	0.3(0.1)	0.1
13	Lead (Pb)	mg/l	0.05	0.01	0.01
14	Magnesium (Mg)	mg/l	30-50	500	-
15	Nitrate (NO ₃)	mg/l	10 (as N)	50	-
16	Sulfate	mg/l	400	250	250
17	Total dissolved solids	mg/l	1000	1000	1000
18	Zinc (Zn)	mg/l	5 - 15	3	3
19	Total Coliform	No/100 ml	0	0	0
20	<i>E.Coli</i>	No/100 ml	0	0	0

Source: The Study on the Improvement of Water Supply and Wastewater Treatment in Yangon (2012, METI, Japan)

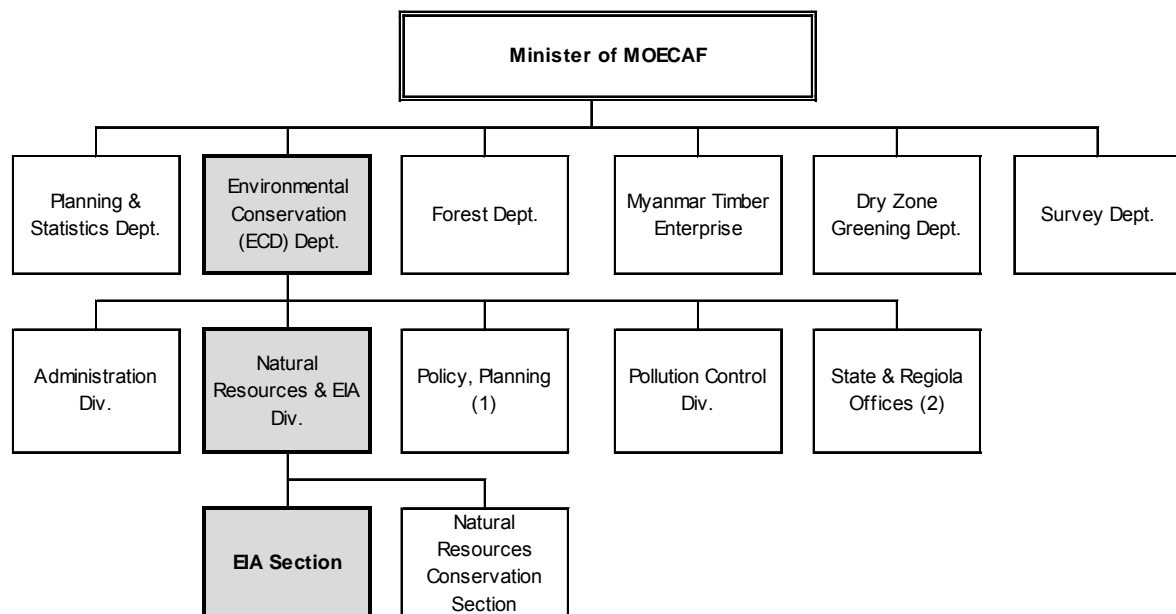
12.1.5 Institutional Framework

(1) Institutional Framework for Environmental Conservation

The Ministry of Forest was renamed as the Ministry of Environmental Conservation and Forestry (MOECAF) on September 6, 2011 in order to undertake both environmental and forest conservation as well as to manage them more effectively. It is after about 90 years from 1923, when the Ministry of the same name was initially formed.

MOECAF consists of six departments as shown in Figure 12.3.

The Environmental Conservation Department (ECD) of MOECAF is responsible for environmental affairs including EIA. ECD has four divisions with state and regional offices as shown in Figure 12.3.



Note: (1) Policy, Planning, and International Relations, Research and Extension Division, (2) State and Regional Offices (Yangon, Mandalay, Sagaing, Bago, Taninthari)

Source: Edited from the documents by MOECAF

Figure 12.3 Organizational Chart of MOECAF

Among the abovementioned departments, divisions, and sections, the EIA Section has the following duties and responsibilities:

- To develop the EIA procedures and regulations in order to avoid, minimize, and/or mitigate adverse environmental impacts,
- To monitor the implementation of environmental conservation, and
- To review the EIA reports for development projects.

12.2 Existing Environmental Conditions around the Proposed Route

The project area belongs to both Thaketa Township in Yangon City and Thanlyin Township in Greater Yangon Region.

12.2.1 Location and Route

(1) Right Bank of the Bago River in Yangon Area

The route starts at the intersection between Shukhinthar-Mayopat Road and Thanlyin Chin Kat Road. From starting point to the Bago River, the road traverses the compound of Myanmar Railways, touching the existing narrow road beside the compound of the Public Works.







(2) Left Bank of the Bago River in Thanlyin Area

After crossing over the Bago River with the proposed Bago River Bridge, the approach road runs on Myanmar Railways' compound parallel to the eastern border of the housing area developed by the Htut Khaung Construction Family Co., Ltd., having the Excel River View Hotel inside, and link to Kyaik Khauk Pagoda Road.



Source: JICA Survey Team

Figure 12.4 Proposed Bago River Bridge and Existing Thanlyin Bridge

	
<p>1) Intersection of Thanlyin Chin Kat Road with Shukyinthar Myo Pat Road</p>	<p>2) Thanlyin Chin Kat Road with Shukyinthar Myo Pat Road</p>
	
<p>3) View of the existing Thanlyin Bridge from the National Racing Village</p>	<p>4) Mangrove community next to the National Racing Village</p>
	
<p>5) View of the right bank in downstream</p>	<p>6) Storage site of railway materials within Myanmar Railways' compound (right bank, downstream of the existing Thanlyin Bridge)</p>

Source: JICA Survey Team

Figure 12.5 Right Bank of the Bago River near the Existing Thanlyin Bridge (Thaketa Township)



Source: JICA Survey Team

Figure 12.6 Left Bank of the Bago River near the Existing Thanlyin Bridge (Thanlyin Township)

12.2.2 Social Environment

Profiles of the social environment for Thaketa and Thanlyin townships are shown in Figures 12.7 and 12.8, and Table 12.9.

(1) Administrative Location

Thaketa Township is located on the small peninsula between the Yangon River and Bago River. It is surrounded by Dagon Myothit South Township in the east, Dawbon Township in the west and south, and Thingangyun Township in the north.

While Thanlyin Township is situated in the southern part of Yangon Region and its eastern and northern parts are facing the Bago River and the Yangon River. Then, the western and southern parts are adjoining the Tonkwa/Kayan townships and Kyauktan Township, respectively.

(2) Population and Population Density

The population of Thaketa and Thanlyin townships in 2011 are 253,284 and 204,486, respectively. The population density of Thaketa Township is rather high at 18,850 persons/km², while that of Thanlyin Township is low at 548 persons/km².

(3) Employment

More than 83% of employment in Thaketa Township is in the tertiary sector while around 0.02% is in the primary sector. In Thanlyin Township more than 60% of its employment is in the tertiary sector whereas around 36% is in the primary sector, especially in the agricultural sector.

(4) Land Use

In Thaketa Township land is mostly used for residential areas (55%), industrial areas (8%) in the northwestern part, and public facilities area (3%), which spread along the Bago River area including the project approach road of Bago River Bridge. In Thanlyin Township land is used mostly for agricultural areas (74%) and the residential areas occupy only about 10% of the land.

(5) Public Transport

The public transportation modes in Thaketa Township are road and railways transportation. While those in Thanlyin Township are bus, railway, and inland water transportation.

(6) Cultural, Historical, and Religious Facilities

Reflecting Buddhism is the major religion in Myanmar. There are many pagodas and Buddhist temples in both townships as indicated in Table 12.9 However, there are no pagodas or Buddhist temples found nearby the alignment.

(7) Protected Areas and Parks

In the Greater Yangon Region the only designated protected area is the Hlawga Wildlife Park with an area of 624 ha. It is situated in Mingaladon Township of Yangon Division, in the northern part of Yangon City. Thus, there is no protected area in both townships.

There is, however, the National Race Village, a park for citizen's recreation and amusement, which is located just eastside of the existing Thanlyin Bridge in Thaketa Township side.

(8) Water Supply

Sources of water for drinking and other use of residents in Thaketa Township are pipe water and tube well, while river/stream and reservoir in Thanlyin Township.

(9) Sanitation

In Greater Yangon the existing sewerage system covers only a small part of the central business district (CBD) area. People living outside the sewerage service area employ on-site disposal systems such as septic tank and pit latrine.

(10) Natural Disasters/Hazards

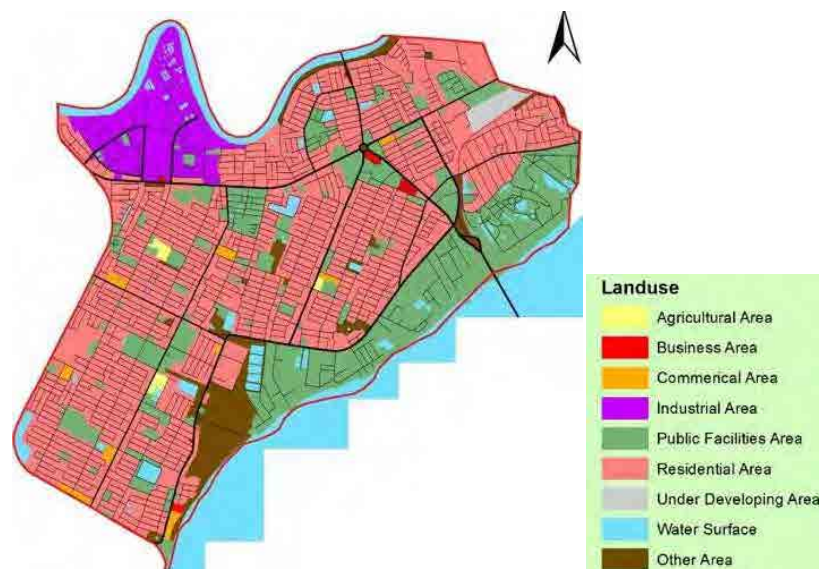
Flooding is one of the major hazards in Myanmar, accounting for 11% of all disaster losses. The low-lying area of Greater Yangon often suffered from flood inundation during the rainy season every year.

Severe cyclones tend to occur either during the pre-monsoon season from April to May or post-monsoon season from October to November. In May 2008, Cyclone Nargis also hit Greater Yangon causing big damage to the project area such as flooding in Thanlyin Township area and destruction of the jetty near Thanlyin Bridge.

(11) Fishing Rights and Activities

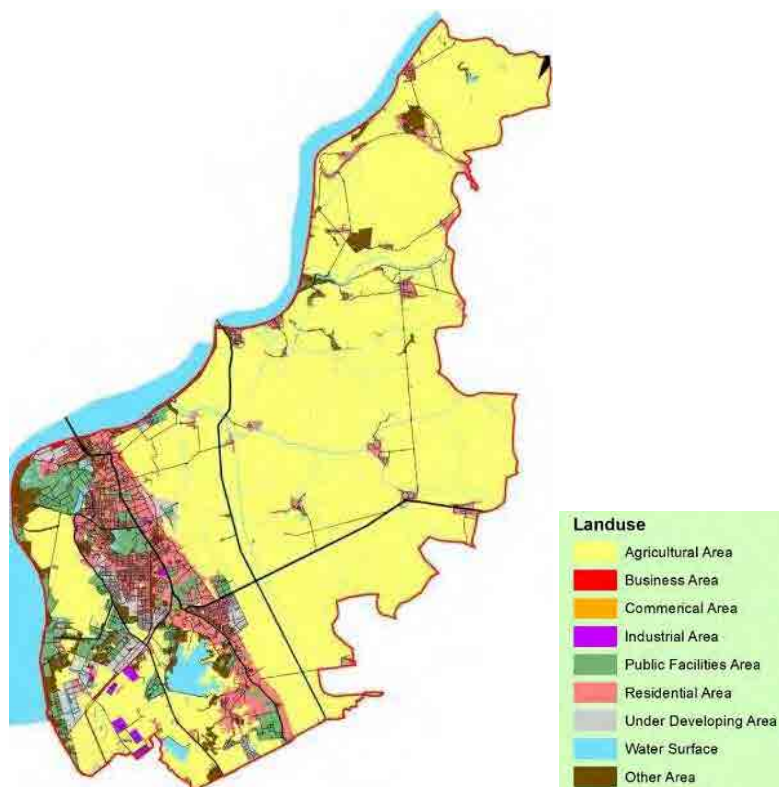
In Myanmar there are two types of fishing rights; one is the "fishing grant", which is given with a specified river area and another is the "fishing license", which is a permit in fishing. In the project area no fishing grant is established. Thus, permission from fishermen is not required.

Fishing activities, aquatic ecology, and some fish species were observed around the proposed Bago River Bridge site. According to the field survey, more than 20 fish species were identified during the actual environmental survey. The fishing activities observed in the Bago River were in small scale and mostly applying traditional fishing methods.



Source: SUDP Project Team, JICA (2013)

Figure 12.7 Land Use of Thaketa Township



Source: SUDP Project Team, JICA (2013)

Figure 12.8 Land Use of Thanlyin Township

Table 12.9 Environmental Profile of Related Townships

Item	Township	
	Thaketa	Thanlyin
1. Location/Administration		
Location	Right bank of the Bago River	Left bank of the Bago and Yangon rivers
Highest Point (above sea level)	3.1 m	25.1 m
Size of Township Area	13.31 km ²	372.88 km ²
Administration in Greater Yangon	Yangon City (YCDC)	Thanlyin Township (YRDC)
Number of Ward/Village	19 Wards	17 Wards, 28 Village Groups (composed of 57 villages)
2. Population and Demography		
Population (2011)	253,284	204,486
Share in Yangon Total Population (%) (2003)	4.3	3.5
Ave. Population Growth Rate 2000-2011 (%/year)	-0.76	Not available
Population Density (persons/km ²)	81,704	548
Numbers of Household	43,076	44,119
Average Household Size (persons)	6	5
Average Monthly Household Income	20,879	111,596
Ratio (%) of Working Population (Primary, Secondary Tertiary)	0%, 16.8%, 83.2%	36.6 %, 0%, 63.3%
3. Land Use		
Share in Yangon Total Area (%)	0.88	16.6
Residential Area (%)	55	10
Commercial and Business (%)	5	0
Industrial Area (%)	8	3
Agricultural Area (%)	0	74

Others (%)	32	11
4. Others		
Source of Water	Pipe water and tube well	River and stream 5, reservoir 10
Numbers of Pagoda/Buddhist Temple	3/204	126/177

Source: SUDP Project Team, JICA (2013)

12.2.3 Natural Environment

The natural environment conditions except flora, fauna, and ecosystem are described in detail in Chapters 7 and 8.

(1) Topography

Thaketa Township is located on a flat plain consisting of alluvial soils with a height of 15 m above sea level. While Thanlyin Township is situated at the southern part of Yangon Region and its eastern and northern parts are facing the Bago River and the Yangon River. Some small hills that are over 30 m can be seen along the Thanlyin-Kyauktan Road, but most of the township area are flatland. Thus, the topographical feature of the project area is nearly flat terrain with no major differences in altitude.

(2) Geology and Soil Type

According to the geological map of Greater Yangon, the study area lies within the Quaternary alluvium deposit. The unconsolidated Quaternary deposits occupy the whole study area. According to the soil map of Yangon area, the study area is mainly located within the meadow and meadow alluvial soil group.

The detailed geological condition is described in Section 7.2 using the geological survey results.

(3) Climate

Greater Yangon including the project area has a tropical monsoon type of climate. Rainfall is highly seasonal being concentrated in the hot humid months of the southwest monsoon (May to October). By contrast, the northwest monsoon (December to March) is relatively cool and dry. Occasionally, severe cyclones cross the Myanmar coast during the April-May period.

The climate condition is described in more detail in Section 8.1.

(4) Hydrological Conditions

The Bago River has its source near Thikkyi in the Bago Yoma. It flows down to the east-facing

slope of Bago Yoma from north to south which is approximately parallel to the Sittang River. When it reaches Bago it turns to the southwest and flows into the sea as the Yangon River.

The total length from its source to its mouth at the confluence of the Yangon River is about 260 km (162 miles) long. The Bago River at Bago Gauging Station is clearly influenced by tidal level during the period of low flows.

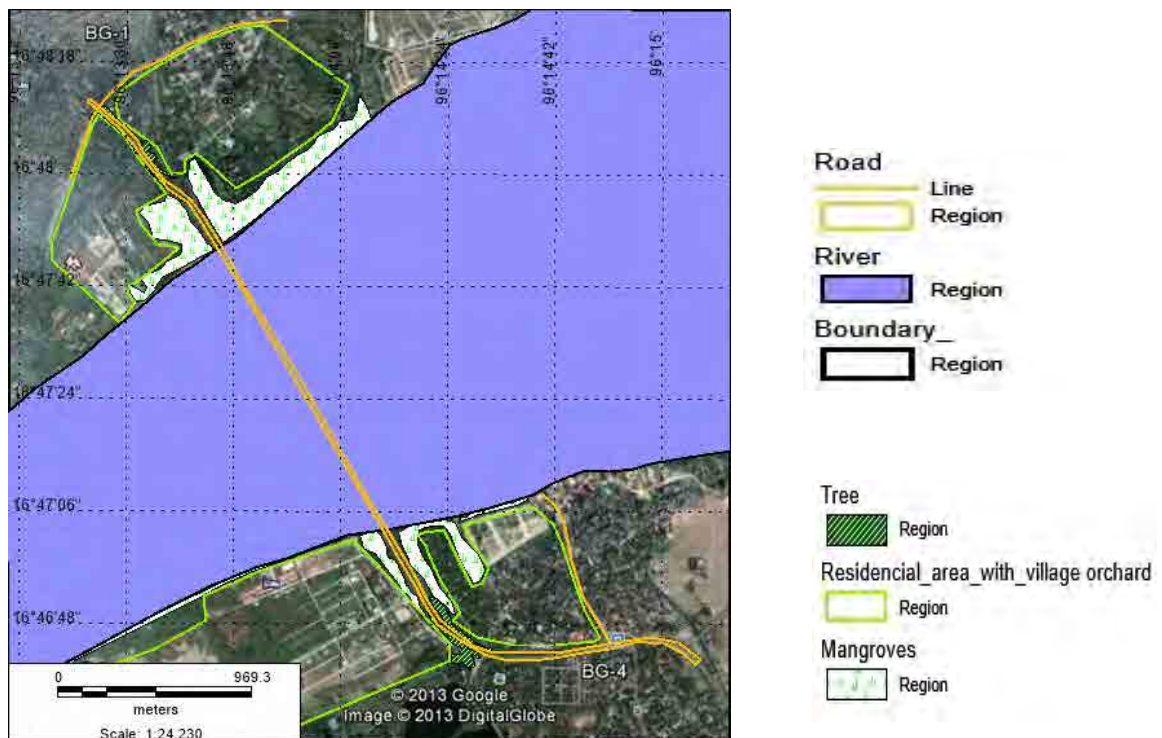
(5) Flora, Fauna, and Ecosystem

The existing flora, fauna, and ecosystem are mostly described using results from the actual environmental survey. The survey area and habitat map are shown in Figures 12.9 and 12.10.



Source: JICA Survey Team

Figure 12.9 Ecosystem in the Survey Area



Source: JICA Survey Team

Figure 12.10 Habitat Map of Bago River Bridge Site

1) Flora 1 - Terrestrial plants in the project area

There were 141 plant species identified in the survey area. The identified species were classified into seven groups; tree, small tree, shrub, herb, creeper, climber, and grass. The list of identified plant species in the survey area was presented in Appendix 10.1.

2) Flora 2 Aquatic plants in the project area

A total of 15 mangrove species were observed in the Bago River bank near the existing Thanlyin Bridge (See Appendix10.1). These species are commonly observed in the tidal flat areas of Myanmar and most mangroves are isolated, although small-scale mangrove communities were observed along the river bank of the National Races Village.

These species are commonly observed in the tidal flat areas of Myanmar and most mangroves are isolated patches, although small-scale mangrove communities were observed along the river bank of the National Races Village. The small and patches of common mangrove species were found in the ROW of approach roads.

Among 15 species, there are six species that are widely distributed and others are rarely found in the project area. The *Acanthus ilicifolius* L., *Avicennia officinalis* L., *Hibiscus tiliaceus* L., *Nypa fruticans* Wurm, *Sonneratia caseolaris* (L.) Engl., and *Vitex trifolia* are widely distributed in the project area.

3) Fauna

There were 16 butterflies, 24 birds, six reptiles, four amphibians, and 26 fishes identified in the survey area. The list of identified animal species in the survey area are shown in Appendix 10.1. All the species were identified through interview with residents, survey literatures, and field observations.

4) Endangered species

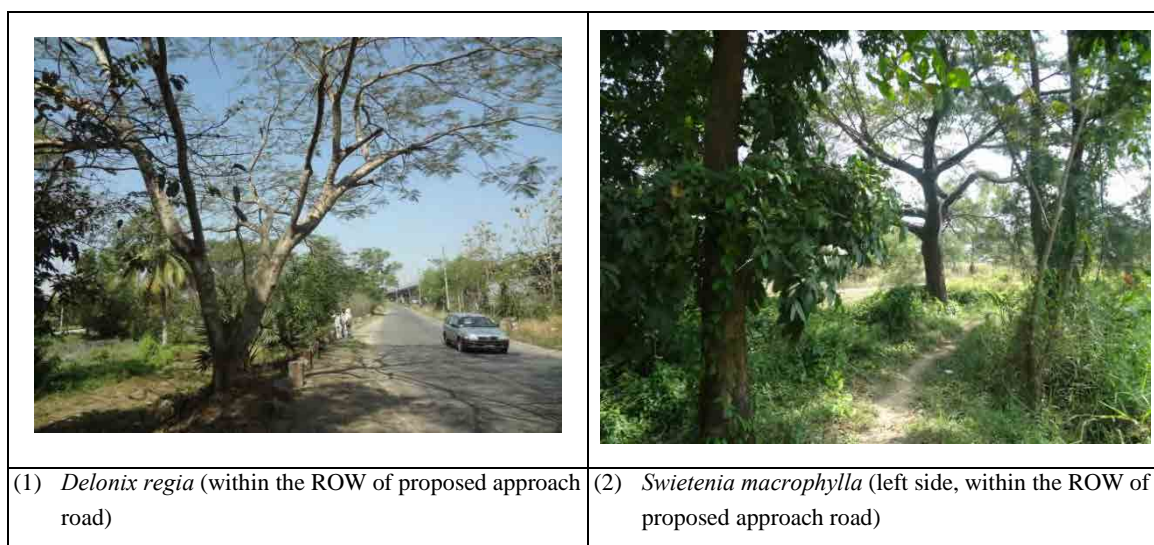
The plant species that were listed and recorded in the study area were checked with the IUCN Red List of Threatened Species. There were two globally threatened plant species in the survey area as shown in Table 12.10 and Figure 12.11.

Table 12.10 List of Globally Threatened Species in the Survey Area

Scientific Name	Family Name	Myanmar Name	Habit	Global Threat Status*
<i>Delonix regia</i> (Bojer ex Hook.) Raf.	Caesalpiniaceae	Seinban	Tree	Vulnerable B1+2c
<i>Swietenia macrophylla</i> King	Meliaceae	Mahogani	Tree	Vulnerable A1cd+2cd

Note: *IUCN Red List

Source: JICA Survey Team



Source: JICA Survey Team

Figure 12.11 Globally Threatened Tree Species Found in the Project Site

However, both species are subcategorized as vulnerable ones, which means in the condition of less threatened than critically endangered or endangered species in the Red List. In fact, two tree species are planted and commonly found at parks, greenery area, and along the roads in Yangon City.

12.2.4 Environmental Pollution

(1) Air Quality

1) Purpose of the survey

With respect to ambient air quality, Myanmar has no air quality standard of its own yet. Accordingly, ambient air quality monitoring was not conducted and a few measurements were carried out in commercial areas, residential areas, and nearby industrial zone of Yangon City in 2007-2008 as well as in the suburban area, east of the city (in Dagon Myo Thit – South), in 2010-2011.

However, as for areas along the road where vehicular exhaust emissions are dominant, ambient air quality data was hardly found. In this regard, ambient air quality measurement of roadsides and background areas were conducted for the purpose of obtaining baseline data for Bago River Bridge construction as well as future air quality monitoring.

2) Survey stations

Ambient air quality measurements were carried out for five stations (BAN-1 to BAN-5) in and around the Bago River Bridge area as shown in Table 12.11 and Figure 12.12.

Table 12.11 Locations of Ambient Air Quality Measurements

No.	ID	Coordinate	Location
1.	BAN-1	N 16° 48' 02.0", E96° 13' 40.1"	In front of the National Races Village, Tharkata Township
2.	BAN-2	N 16° 48' 08.0", E96° 13' 31.6"	Monastery, Tharkata Township
3	BAN-3	N 16° 47' 57.2", E96° 13' 32.3"	Construction Area, Tharkata Township
4	BAN-4	N 16° 46' 46.3", E96° 14' 18.3"	Shwe Thanlyin Housing, Thanhlyin Township
5	BAN-5	N 16° 46' 40.4 ,E"96° 14' 28.0"	Monastery, Thanhlyin Township

Source: JICA Survey Team



Source: JICA Survey Team

Figure 12.12 Location Map of Air Sampling Points

3) Measured pollutants

Measured pollutants were selected considering impacts due to vehicle exhaust emissions, i.e., nitrogen dioxide (NO₂), sulfur dioxide (SO₂), carbon monoxide (CO), suspended particulate matter (PM10), and fine particulate matter (PM2.5).

4) Environmental standards as references

As mentioned above, at present, there is no air quality standard in Myanmar. In addition, conditions of measurements are different from those of daily average due to the limited arrangement of equipment. Thus, measured air quality levels were roughly compared with those of the environmental quality standard for air in Thailand, Japan, and WHO as shown in Table 12.12 as references.

Table 12.12 Ambient Air Quality Standards in Thailand, Japan, and WHO

No.	Parameter	Unit	Environmental Standard (24 hr)		
			Thailand*	Japan**	WHO
1	Sulfur dioxide (SO ₂)	ppm	< 0.12	< 0.04	0.02
2	Carbon monoxide (CO)	ppm	-	< 10	-
3	Nitrogen dioxides (NO ₂)	ppm	-	< 0.04~0.06	-
4	Suspended particulate matter 10 (PM10)	mg/m ³	< 0.12	< 0.10	0.05
5	Fine particulate matter 2.5 (PM2.5)	mg/m ³	0.05	0.035	0.025

Note 1: *Notification of the National Environmental Board No. 10, B.E. 2538 (1995); No. 24, B.E. 2547 (2004); and No. 28, B.E. 2550 (2007) in Thailand.

Note 2: ** Environmental Quality Standard for Air in Japan (1973, 1978).

Note 3: *** WHO Media Centre (2014) - Standards for ambient (outdoor) air quality and health

Source: JICA Survey Team

5) Results of air quality measurements

(i) Sulfur dioxide (SO₂)

The SO₂ levels were found to be lower than the environmental standards (1-day) in Japan. Whereas, SO₂ level in BAN-1 and BAN-3 in Thailand are higher than the WHO standards (see Table 12.13). It is indicated that the area had few emission sources and it is certain to say that the measured data were the baseline level in the area.

Table 12.13 Sulfur Dioxide (SO₂) Level

Date	BAN-1	BAN-2	BAN-3	BAN-4	BAN-5
	Unit: ppm				
December 3-10, 2013 (24-	0.04	0.01	0.04	0.003	0.01
December 10-13, 2013 (24-	0.01	0.01	0.02	0.003	0.006
Environmental Standards -	<0.04				
Environmental Standards - Thailand (24 hrs)	<0.12				
WHO Standards	<0.02				

Source: JICA Survey Team

(ii) Carbon monoxide (CO)

The CO levels were found to be lower than the environmental standards (1-day) in Japan (see Table 12.14). It is indicated that the area had few emission sources and it is certain to say that the measured data were the baseline level in the area.

Table 12.14 Carbon Monoxide (CO) Level

Date	BAN-1	BAN-2	BAN-3	BAN-4	BAN-5
	Unit: ppm				
December 3-10, 2013 (24-hour average)	0.67	0.44	0.72	0.62	0.44
November 10-13, 2013 (24-hour average)	0.37	0.47	0.8	0.8	0.7
Environmental Standards - Japan (24 hrs)	<10				
Environmental Standards - Thailand (24 hrs)	-				
WHO Standards	-				

Source: JICA Survey Team

(iii) Nitrogen dioxide (NO₂)

The NO₂ levels were found to be lower than the environmental standards (1-day) in Japan (see Table 12.15). It indicated the area had few emission sources and it is certain to say that the measured data were the baseline level in the area.

Table 12.15 Nitrogen Dioxide (NO₂) Level (First Time)

Date	BAN-1	BAN-2	BAN-3	BAN-4	BAN-5
	(Unit: ppm)				
November 3-10, 2013 (24-hour average)	0.02	0.04	0.01	0.03	0.02
November 10-13, 2013 (24-hour average)	0.03	0.03	0.02	0.02	0.03
Environmental Standards - Japan (24 hr)	0.06				
Environmental Standards - Thailand (24 hr)	-				
WHO Standards	-				

Source: JICA Survey Team

(iv) Suspended particulate matter 10 (PM10)

Almost all PM10 level were found lower than the environmental standards (1-day) in Thailand and Japan (see Table 12.16). But PM10 level in BAN-3 during first time monitoring is higher than all standards.

Table 12.16 Suspended Particulate Matter 10 (PM10) Level

Date	BAN-1	BAN-2	BAN-3	BAN-4	BAN-5
	(Unit: mg/m ³)				
December 3-10, 2013 (24-hour average)	0.06	0.09	0.15	0.06	0.05
December 10-13, 2013 (24-hour average)	0.1	0.09	0.07	0.06	0.05
Environmental Standards - Japan (24 hrs)	0.1				
Environmental Standards - Thailand (24 hrs)	0.12				
WHO Standards	0.05				

Source: JICA Survey Team

(v) Fine particulate matter 2.5 (PM2.5)

Almost all PM 2.5 level were found to be lower than the environmental standards (1-day) in Thailand, Japan, and WHO as shown in Table 12.17.

Table 12.17 Fine Particulate Matter 2.5 (PM2.5) Level

Date	BAN-1	BAN-2	BAN-3	BAN-4	BAN-5
	(Unit: mg/m ³)				
December 3-10, 2013 (24-hour average)	0.006	0.005	0.008	0.001	0.004
December 10-13, 2013 (24 hour average)	0.005	0.008	0.006	0.008	0.003
Environmental Standards - Japan (24 hrs)	0.15				
Environmental Standards - Thailand (24 hrs)	0.05				
WHO Standards	0.025				

Source: JICA Survey Team

(2) Water Quality of the Bago River

1) Purpose of the survey

Until now, with regard to environmental quality data such as air quality, water quality, and ambient noise which indicate the level of environmental pollution as well as features, the actual quantitative measurements have been hardly found even in Greater Yangon.

Survey on river water and bottom sediment quality was conducted for the purpose of obtaining the baseline data for the Bago River Bridge construction as well as future water and bottom sediment quality monitoring.

2) Survey stations

Water sampling of the Bago River was conducted at two layers of the surface and bottom (1.5 m above the bottom), in six locations as shown in Table 12.18 and Figure 12.13.

Among the six locations three locations are near the side of the existing Thanlyin Bridge and sampling points are 400 m away from the river bank on both sides. The other three locations are 1,200 m downstream of the existing Thanlyin Bridge and sampling points are 300 m away from the river bank on both sides.

Table 12.18 Locations of Water and Sediment Quality and River Velocity Survey Points

Name of Survey Data		Coordinates	Downstream Distance from the existing Thanlyin Bridge
Water and Sediment Sample	River Velocity		
BSW-1	BRV-1	N 16°47'35.70", E 96°13'50.28"	Near side
BSW-2	BRV-2	N 16°47'25.39", E 96°13'57.67"	Near side
BSW-3	BRV-3	N 16°47'14.87", E 96°14'1.94"	Near side
BSW-4	BRV-4	N 16°47'15.15", E 96°13'13.77"	1,200 m downstream
BSW-5	BRV-5	N 16°47'8.00", E 96°13'18.90"	1,200 m downstream
BSW-6	BRV-6	N 16°47'0.20", E 96°13'26.16"	1,200 m downstream

Source: JICA Survey Team



Source: JICA Survey Team

Figure 12.13 Location of Water Sampling and River Velocity Measurement

3) Parameters for water quality

The following water quality parameters were measured: transparency, temperature, salinity, pH, conductivity, suspended solids (SS), turbidity, dissolved oxygen (DO), biological oxygen demand (BOD), chemical oxygen demand (COD), E. coliform, total coliform, oil content, total nitrogen (TN), and total phosphorus (TP).

4) Results of water quality measurements

Results of water quality measurements are shown in Tables 12.19, 12.20, and 12.21 referring to the water quality standards of Japan and Vietnam.

Table 12.19 Results of Water Quality Measurements -1

No.	Parameter	BSW-1T	BSW-1B	BSW-2T	BSW-2B	BSW-3T	BSW-3B	Environmental Standards	
								Japan	Vietnam
1	Temperature	28.77	28.7	28.67	28.66	28.54	28.44	-	-
2	Turbidity/ Transparency	829	876	937	959	1000	1000	-	-

3	Water Depth (channel)	5.7	5.7	3.9	3.9	10.7	10.7	-	-
4	Depth (of sample taken)	0.5	4.5	0.5	3	0.5	9.5	-	-
5	pH	7.88	7.82	7.36	7.24	7.59	7.22	6.5~8.5	5.5~9
6	BOD5	2	2	2.5	2	2.5	2.5	3	15
7	Suspended Solids (SS)	65	64	61	61	66	63	25	50
8	Dissolved Oxygen (DO)	6.29	6.64	6.63	6.35	6.22	6.03	>=5	>=4
9	Oil and Grease	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	-	0.1
10	E. Coli	0	0	0	0	0	3x10 ²	-	-
11	Fecal Coliform	8x10 ²	1.4x10 ³	2.8x10 ³	1x10 ³	4x10 ²	5x10 ³	-	-
12	Total Coliform	8x10 ²	1.4x10 ³	2.8x10 ³	1x10 ³	4x10 ²	5.3x10 ³	5x10 ³	7.5 x10 ³
13	COD	1.47	0.36	3.31	3.32	2.94	2.2	5	30
14	Total Nitrogen	2.016	2.016	2.016	0.672	U.D.L	0.672	-	-
15	Total Phosphorous	0.33	0.33	0.33	0.0396	0.0363	0.0363	-	-
16	Salinity	ND	ND	ND	ND	ND	ND	-	-

Source: JICA Survey Team

Table 12.20 Results of Water Quality Measurements - 2

No.	Parameter	BSW-4T	BSW-4B	BSW-5T	BSW-5B	BSW-6T	BSW-6B	Environmental Standards	
								Japan	Vietnam
1	Temperature	28.95	28.88	28.88	28.87	28.88	28.86	-	-
2	Turbidity/Transparency	931	957	1000	1000	0.2	0.14	-	-
3	Water Depth (channel)	9.3	9.3	4.4	4.4	906	995	-	-
4	Depth (of sample taken)	0.5	8	0.5	3	2.3	2.3	-	-
5	pH	7.95	7.87	7.76	7.74	0.3	2	6.5~8.5	5.5~9
6	BOD5	2.5	2	2	2	7.94	7.91	3	15
7	Suspended Solids (SS)	61	60	60	60	2	2	25	50
8	Dissolved Oxygen (DO)	6.49	6.44	6.71	6.47	62	61	>=5	>=4
9	Oil and Grease	<1.0	<1.0	<1.0	<1.0	6.44	6.25	-	0.1
10	E. Coli	0	0	2x10 ²	0	<1.0	<1.0	-	-
11	Fecal Coliform	2.2x10 ³	4x10 ²	5x10 ²	6x10 ²	0	1x10 ²	-	-
12	Total Coliform	2.2x10 ³	4x10 ²	7x10 ²	6x10 ²	6x10 ²	2x10 ²	5x10 ³	7.5 x10 ³
13	COD	1.84	2.94	4.41	3.31	6x10 ²	3x10 ²	5	30
14	Total Nitrogen	0.672	0.672	U.D.L	2.013	3.68	6.99	-	-
15	Total Phosphorous	0.0396	0.033	0.03	0.0396	0.672	2.016	-	-
16	Salinity	ND	ND	ND	ND	ND	ND	-	-

Source: JICA Survey Team

Table 12.21 Summarized Data of River Water Quality at Surface and Bottom Layer

No.	Parameter	Min-Max (Average)	
		BSW-T	BSW-B
1	Temperature (°C)	28.5 - 29.0 (28.7)	28.4 - 28.9 (28.6)
2	Turbidity/Transparency (FNU)	829 - 1,000 (924)	876 - 1,000 (948)
3	Water Depth (m)	2.3 - 10.7 (5.4)	2.3 - 10.7 (5.4)
4	Depth (of sample taken) (m)	0.3 - 0.5 (0.46)	2 - 9.5 (5.0)
5	pH	7.4- 8.0 (7.6)	7.2- 7.9 (7.4)

6	BOD (mg/l)	2 - 2.5 (2.3)	2 - 2.5 (2.1)
7	SS (mg/l)	60 - 65 (62.5)	60 - 64 (61.5)
8	DO (mg/l)	6.2- 6.7(6.5)	6.0 - 6.6 (6.4)
9	Oil and Grease (mg/l)	<1.0 - 3 (1.3)	(<1.0)
10	E. Coli (MPN/100ml)	0 - 2x10 ² (0.3x10 ²)	0 - 3x10 ² (0.6x10 ²)
11	Fecal Coliform (MPN/100ml)	4x10 ² - 2.8x10 ³ (1.2x10 ³)	2x10 ² - 5x10 ³ (1.4x10 ³)
12	Total Coliform (MPN/100ml)	4x10 ² - 2.8x10 ³ (1.2x10 ³)	3x10 ² - 5.3x10 ³ (1.5x10 ³)
13	COD (mg/l)	1.5 - 4.4 (2.9)	0.4 - 7.0 (3.2)
14	Total Nitrogen (mg/l)	0.67 - 2.1(1.3)	0.67 - 2.0 (1.3)
15	Total Phosphorous (mg/l)	0.036 - 0.33 (0.13)	0.033 - 0.33 (0.085)
16	Salinity (%)	(ND)	(ND)

Source: JICA Survey Team

Considering the values of pH (7.4-8.0), BOD (2-2.5 mg/l), and DO (6.2 -6.7 mg/l), they suggest that the organic pollution of the Bago River is not advancing. However, higher values of turbidity, transparency, and SS (60-65 mg/l) indicate that the river water is considerably turbid due to soil surface runoff from riverbanks.

(3) Bottom Sediment Quality

1) Survey stations

As mentioned in (2), bottom sediment sampling was carried out in six stations, which is about the same location as the water sampling stations shown in Figure 12.13.

2) Results of bottom sediment measurements

Results of the measurements are shown in Table 12.22.

Table 12.22 Results of Bottom Sediment Measurements

Sr. No.	Parameter							Unit
		BSD-1	BSD-2	BSD-3	BSD-4	BSD-5	BSD-6	
1	Colour	Yellowish	Yellowish	Yellowish	Gray	Gray	Gray	-
2	Odor	Earthy	Earthy	Earthy	Muddy	Muddy	Muddy	-
3	Mercury (Hg)	0.005	0.007	0.005	0.005	0.004	0.006	ppm
4	Arsenic (As)	0.005	0.003	0.003	ND	ND	0.004	ppm
5	Lead (Pb)	140	135	130	135	125	130	ppm
6	Chromium (Cr)	10	11	12	9	8	10	ppm
7	Cadmium (Cd)	0.007	0.007	0.008	0.008	0.005	0.007	ppm
8	Copper (Cu)	105	110	95	90	115	110	ppm
9	Zinc (Zn)	95	90	110	105	115	105	ppm
10	Natural Moisture	35.91	29.68	29.83	43.44	39.18	31.08	%
11	Specific Gravity	2.66	2.72	2.65	2.63	2.66	2.68	-
12	TOC	25.40	22.42	20.82	27.52	27.85	22.48	mg/kg
13	Oil and Grease	<100	<100	<100	<100	<100	<100	mg/kg

Source: JICA Survey Team

Although there is no environmental standards for bottom sediment pollution, values of the bottom sediment parameters as well as the result of benthos species suggest that organic pollution advanced slightly, if any, and sedimented surface runoff soil contributes dominantly to the characteristics of the sediment.

(4) Ambient Noise

1) General features

There are no ambient noise level standards, which are the same as those of ambient air quality. Until now, the data of ambient noise level of two locations only in the industrial area of Thaketa Township was reported in March 2012.

However, for areas along the road where vehicular noise are dominant, ambient noise data was hardly found. In this regard, the ambient noise measurement of roadsides and background areas were conducted in order to obtain baseline data for Bago River Bridge construction as well as future ambient noise monitoring.

2) Survey stations

The location of survey stations was almost the same points as those of ambient air quality measurements in and around Bago River Bridge area as shown in Figure 12.12.

3) Results of ambient noise measurements

As shown in Table 12.23, ambient noise levels around the proposed Bago River Bridge site are 47-59 decibel (dB) during daytime (6:00-22:00) and 47-53 dB during night time (22:00-6:00).

Comparing with the ambient noise standards of Japan, observed ambient noise levels during daytime and night time are mostly those corresponding to residential areas.

Table 12.23 Summary of Ambient Noise Measurements

Station	BAN-1		BAN-2		BAN-3		BAN-4		BAN-5		Ambient Noise Standards (Japan)**		
	National Races Village		50 m		150 m		150 m		100 m		Sensitive Area (AA)	Residential Area (A and B)	Commercial and Industrial Area (C)
Measurement*	I	II	I	II	I	II	I	II	I	II			
Daytime/ Nighttime	Sound Level (dB)												
Daytime (6 am - 10 pm)	56.5	52.6	49.1	52.2	53.5	56.2	54.8	47.2	47.8	58.6	50 dB	55 dB	60 dB
Nighttime (10 pm - 6 am)	53.2	47.4	46.5	45.4	46	51.7	51.1	48.5	48.6	46.5	40 dB	45 dB	50 dB

Note 1: (I) First time, (II) Second time.

Note 2: Ministry of Environment, Japan (1998): Environmental Quality Standards for Noise

Source: JICA Survey Team

12.3 Results of the Initial Environmental Examination (IEE) of the Project

12.3.1 Outline of the Project and its Components

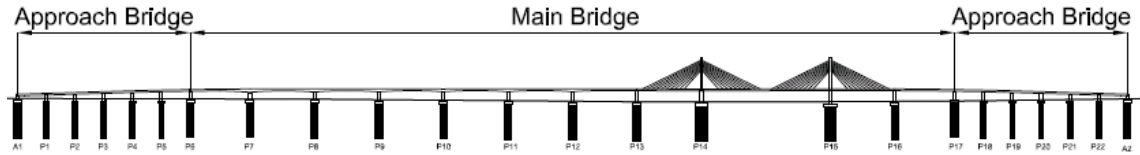
The whole features of the proposed bridge and approach roads are described in Chapter 6, "Preliminary Design of the Bago River Bridge".

(1) Project Site

The Bago River Bridge was proposed to run parallel to the existing Thanlyin Bridge at the downstream side of the Bago River due to land availability and desirable connection arrangement at the existing roads as shown above (see Figure 12.4).

(2) Bridge Structures

The proposed bridge is mainly composed of a main bridge and approach bridges on both sides as shown in Figure 12.14. The main bridge maintains the navigational requirement while the approach bridge connects the main bridge and the highways.



Source: JICA Survey Team

Figure 12.14 Composition of the Proposed Bridge

(3) Approach Roads

At the right bank of the Bago River in Thaketa Township, the proposed road starts from the intersection between Shukhinthar-Mayopat Road and Thanlyin Chin Kat Road. From the starting point to the Bago River, the road traverses Myanmar Railways compound, touching the existing narrow road beside the compound of the Public Works (refer to Figure 12.15).

At the left bank of the Bago River in Thanlyin Township, the proposed approach road runs on Myanmar Railways compound parallel to the eastern border of the housing area developed by private companies that link to Kyaik Khauk Pagoda Road (refer to Figure 12.16).



Source: JICA Survey Team

Figure 12.15 Approach Road at the Right Bank (Thaketa Township)



Source: JICA Survey Team

Figure 12.16 Approach Road at the Left Bank (Thanlyin Township)

(4) Expected Traffic Volume

According to the cordon line survey in YUTRA, traffic volume at the existing Thanlyin Bridge is about 2,000 vehicles/day.

The JICA Survey Team assumed that the construction Bago River Bridge construction will commence in the latter part of 2017, while the operation of Bago River Bridge is expected to start in the latter part of 2019.

According to YUTRA, the forecasted traffic volume at Thanlyin Bridge in 2018 is 27,600 pcu/day, and that of Bago River Bridge is 36,651 pcu/day and 49,503 pcu/day in 2025 and 2035, respectively.

12.3.2 Comparison of Alternatives

(1) Comparison of Bago River Crossing Routes

1) Three Alternative Routes and Candidate Locations for Bago River Bridge

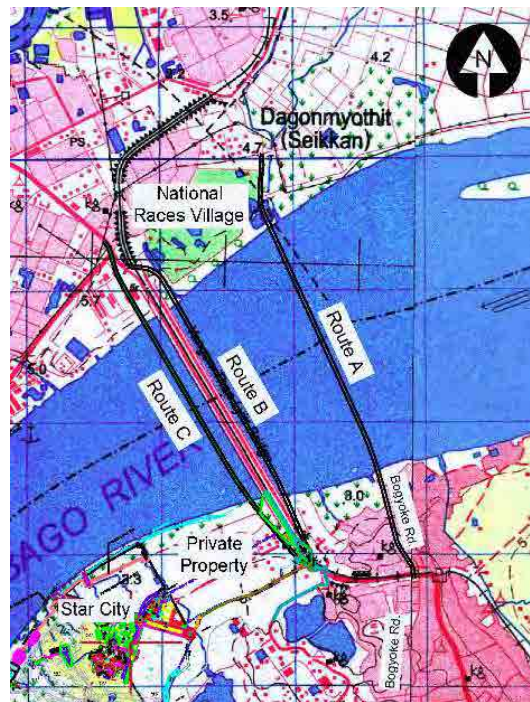
As described in Section 5.2, there are three alternative routes, i.e., Monkey Point Route, Bago Point Route, and the proximity of the existing Thanlyin Bridge Route.

A comparison of the three routes was carried out in terms of environmental and social considerations, applying the following three items below as well as other evaluation factors like the technical feasibility:

- a) Social environment: involuntary resettlement (land acquisition, resettlement, etc.), cultural heritage and/or religious sites, and fishery activities;
- b) Natural environment: endangered/valuable plants and animals, protected areas, and row of trees along the road; and
- c) Environmental pollution: air pollution and noise.

2) Comparison of the Bago River Bridge Construction Site between the Upstream and Downstream of the Existing Thanlyin Bridge

As described in Section 9.1, the proposed bridge site locations were compared with the three alternatives (Routes A, B, and C), located in the upstream and downstream of the existing Thanlyin Bridge, as shown in Figure 12.17. The three alternatives were evaluated on their technical feasibility as well as environmental and social considerations. As a result, Route C was chosen as the best option, which is in proximity to the existing Thanlyin Bridge Route based on the above comparison.



Source: JICA Survey Team

Figure 12.17 Three Alternative Routes

- (2) Comparison with No Action Plan
 - (i) Without the Project (No Action Case)

The situation of terrible traffic congestion is left unsolved. Also, poor commuter transportation as well as freight transportation between Yangon City and Thanlyin area including Thilawa SEZ area is left unchanged.

- (ii) With the Project

The Greater Yangon Region is expanding outwards including Thanlyin area. Accordingly, the traffic between Yangon City and Thanlyin area is expected to increase. Results of SUDP and YUTRA also pointed out the insufficient transport infrastructure between these two areas in the near future.

The current traffic capacity of these two existing bridges, namely, Thanlyin and Dagon bridges, cannot accommodate the future traffic demand of the area, and will soon result in serious bottlenecks. The construction of Bago River Bridge will surely guarantee the expected economic growth in Thanlyin area, accelerate Thilawa SEZ development, and greatly contribute to the economic development of Myanmar.

12.3.3 Procedures of IEE Level Study of the Project Plan

- (1) Procedures of IEE Level Study

The procedures for the IEE level study for the proposed Bago River Bridge construction plan are shown in Figure 12.18.

groups such as the 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 the Project, 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 to do so.

By taking into consideration the JICA guidelines, relevant laws, and regulations of the Myanmar government, together with environmental condition of Greater Yangon Region, there are three environmental components with 40 items in total (social environment has 22 items, natural environment has ten, and environmental pollution has eight) that will be examined as indicators expressing environmental and social conditions. In the table, the impacts on "gender" and "children's rights" might be related to all items of social environment.

(3) Activities of the Project

The activities of the Project by stages are shown in Table 12.24.

Table 12.24 Activities of the Project

Project Stage	Anticipated Activities of the Project
Planning Stage (I)	Securing land/space for bridge, roads, and related facilities
	Securing temporary land/space for construction work
	Change of utilization of land and local resources
Construction Stage (II)	Procurement of construction materials, equipment, plants, etc.
	Engineering works such as earthmoving
	Operation of construction machines, vehicles, plants, etc.
	Installation of construction work offices, worker's camps, storage sites, etc.
	Construction of bridge and related facilities
	Construction of approach roads and related facilities
Operation Stage (III)	Operation of bridge related facilities
	Operation of approach roads and related facilities
	Spatial occupancy of bridge, roads, and related facilities
	Movement of people (inflow, outflow, migration, etc.)
	Movement of goods (inflow, outflow, etc.)

Source: JICA Survey Team

(4) Rating of Anticipated Environmental Impacts

In the evaluation, the following rating criteria were adopted depending on the extent of impacts:

A (+/-) – Significant positive/negative impact is expected.

B (+/-) – Positive/negative impact is expected but not significant.

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 or Blank - Negligible or no impact is expected.

12.3.4 Identification and Evaluation of Possible Impacts

(1) Results of the Identification and Evaluation of Possible Impacts

Possible impacts are identified and the extent of the impacts is also evaluated one by one and rated against the 40 environmental items on social environment, natural environment, and environmental pollution. Results are shown together with the results of scoping in Table 12.25.

Table 12.25 Identification and Evaluation of Anticipated Impacts

Environment Item */**	Rating				Identification and Evaluation of Anticipated Impacts and their Reasons
	Scoping		After Survey		
	I/II	III	I/II	III	
(1) Social Environment					
1) Involuntary resettlement (land acquisition/resettlement)	B-		B-		1) The right-of-way (ROW) for the planned bridge and approach roads is on public lands and owned by the government such as Myanmar Railways, Ministry of Construction, YCDC, and YRDC. Thus, displacement of houses and people is not expected. 2) However, encroachment of a few stalls and three small religious facilities were found on the ROW. Therefore, the aforementioned structures are required to be removed, relocated, or given income and/or assistance in the restoration of existing living condition. 3) About 20 trees within the ROW should be cut, relocated, and/or planted. 4) About ten electric poles within the ROW should be relocated. 5) Diesel fuel and CNG pipelines laid down within the ROW should be relocated or properly protected in order to avoid damage caused by construction works and bridge operation. 6) Secure land for construction-related facilities (construction office, worker's camp, storage of construction materials, and wastes).
		D		D	No additional involuntary resettlement is expected during the operation stage.
2) Local economy such as employment and livelihood.	B+		B+		Beneficial impacts such as creation of employment opportunity for construction works are expected.
				A+	Through the construction of Bago River Bridge, existing traffic congestion will be greatly solved in Greater Yangon. Thus improved road network may raise the living condition and make social services easily accessible, leading to the enhancement of the local economy.
3) Fishing activity	B-		B-		There are small scale fishing activities in the Bago River. Thus, construction works including dredging and excavation may disturb their environment.
				D	No negative impact is expected.
4) Utilization of land and local resources	B-		B-		1) Quarries and/or borrow pits will be utilized for procurement of construction materials. 2) Water for construction works including worker's camp may compete with the existing water resources.
				D	No negative impact is expected.
5) Existing social infrastructures and services: 1) Road and railway traffic	B-		B-		1) Basically, traffic condition will not be changed by using the existing Thanlyin Bridge during the construction stage. However, the delivery of construction machines and materials as well as traffic created by construction vehicles may cause temporary closure of roads, one-way traffic, and restriction of vehicle speed. Therefore, using diversion route will be required in these situations. Even so, these may result in traffic congestion and inconvenience in accessing public facilities.
				A+	Road traffic condition will be improved significantly by the operation of the new bridge and approach roads.
6) Existing social infrastructures and services: 2) Water transport	B-		B-		Bridge construction works such as riverbed dredging may disturb water transport due to change in navigation channel.
				B-	Bridge foundations and piers may change the flow conditions of the Bago River, resulting in disturbance of navigation.
7) Existing social infrastructures and services: 3) Others	B-		B-		1) There are utility lines such as high voltage electrical lines, water pipes, and telephone lines, underneath the bridge and road. 2) Water use for construction work may compete with the community water supply.
				A+	Improvement of traffic condition among Yangon City, Thanlyin Township, and Thilawa SEZ will greatly enhance the economic and industrial development of Greater Yangon as well as improve the accessibility to social services.
8) Social institutions such as social infrastructure and local decision-making institutions	B-		B-		If information disclosure of the project plan, and procedure and public participation are not properly conducted, people's anxieties and complaints may occur and spread over the communities resulting in difficulties to obtain a thorough understanding of the Project and consensus among the people.
				B-	
9) Vulnerable groups such as the poor, women, children, elderly, and disabled.	B+		B+		The Project may create employment opportunities for the vulnerable groups such as the poor and women in the construction works.
				B+	Vulnerable groups such as children and women are also encouraged to go to the hospitals and schools in Yangon City due to the improvement of accessibility and resolution of traffic congestion.

10) Indigenous people or ethnic minority	D		D		Myanmar is an ethnically diverse nation with 135 distinct ethnic groups. However, neither indigenous people nor ethnic minority group are found in the project area.
11) Misdistribution of benefit and damage	B-		B-		There is some possibility of misdistribution of benefit and damage, if the project plan including procedures of the implementation and involuntary resettlement matters are not properly disseminated and consulted with residents, communities, and other stakeholders.
12) Local conflicts of interest	B-		B-		There is some possibility of local conflicts of interest, if the project plan including implementation procedures and involuntary resettlement matters are not properly disseminated and consulted with the residents, community, and other stakeholders.
13) Cultural, historical, archaeological, and religious heritage sites	B-		B-		1) In Greater Yangon Region, there are many religious facilities such as Buddhist temples (pagodas) and monasteries, Hindu temples, and mosques. However, no cultural and religious sites are distributed in and around the project site.2) Recently, two small religious praying facilities (Buddhism and traditional religion) were installed within the ROW in the Thanlyin Township side. However, according to Myanmar Railway Authority, which owns the ROW, it has already been agreed with the real estate company, who rented the land from the authority, to remove and/or relocate these structures before the commencement of construction works.
				D	No negative impact is expected.
14) Water rights, fishing rights, and rights of common	B-		B-		1) Although the Bago River in the project area is under the control of MPA and Inland Water Waterway Authority, water rights belong to the Department of Water Resources Improvement. 2) In Myanmar, there are two types of fishing rights: one is "fishing grant", which is given for specified river area, and the other is "license", which is a permit for fishing. In the project area, no fishing grant is established. Thus, permission from fishermen is not required. 3) As the fishing activity in the project area is only small in scale, bridge construction work may only cause little adverse impact on such activity. 4) Rights of commons are not established in the project area.
15) Landscape	D		D		Temporary change in the existing landscape is expected but only a little.
				B-	1) Existing bridge landscape in and around the Bago River produced by Thanlyin Bridge will somehow change due to the appearance of Bago River Bridge, which is planned to be constructed nearby at about 140 m downstream of the existing Thanlyin Bridge. Thus, it is required to design the bridge so as to establish the new attractive landmark and to harmonize it with Thanlyin Bridge.
16) Public health and sanitation	B-		B-		Air pollutants such as dust, SPM, NOx, and SOx emitted from construction vehicles and machines as well as construction works may cause some adverse effects to respiratory health.
				B-	Air pollution due to increase in traffic volume may cause some adverse effects to the respiratory organs.
17) Infectious diseases such as HIV/AIDS	B-		B-		1) Road construction workers and truck drivers are considered as having high potential for the spread of sexually transmitted diseases (STDs) and HIV/AIDS due to their mobility. Reports on infection with HIV/AIDS and venereal diseases at worker's camp during road construction stage were observed in other developing countries.
				D	No negative impact is expected.
18) Working condition (including occupational health)	B-		B-		Many workers will be engaged in construction works and stay at worker's camps under poor living conditions. Thus, the health and occupational safety of the workers may be jeopardized in case of severe working conditions.
				D	No negative impact is expected.
19) Hazards/security risks	B-		B-		Although the project activities will not pose any hazard or risk, migration of workers from other areas may worsen the condition of public security and increase in community awareness.
				D	No negative impact is expected.
20) Accidents	B-		B-		Occurrence of accidents may increase due to construction works, machine and plant deployment, and construction materials handling, as well as the occurrence of traffic accidents caused by construction vehicles.
				B-	Improvement of traffic congestion may give rise to an increase in number of traffic accidents due to the increase in vehicle speed and number of vehicles travelling.
21) Sunlight shading	D		D		The site of Bago River Bridge and approach roads are surrounded by scattered area and the Bago River. Thus, adverse impact on sunlight shading is not expected.
				D	
22) Radio-frequency interference	D		D		The site of Bago River Bridge and approach roads are surrounded by scattered area and the Bago River. Thus, adverse impact on radio-frequency interference is not expected.
				D	
(2) Natural Environment					
23) Protected area	B-		B-		1) There is neither protected nor environmentally sensitive area in and around the project area. 2) Close to the existing Thanlyin Bridge (upstream side) is the National Racing Park, which is a place of recreation and relaxation for citizens with a 1,000 visitors/day at maximum. Thus, construction vehicles may somewhat disturb visitor's access to the park.
				B+	Reduction of traffic congestion due to the construction of Bago River Bridge may result in improved road access to National Racing Park.

24) Terrestrial fauna, flora, and biodiversity	B-		B-	1) According to the field survey, two plant species of globally threatened species registered in IUCN Red List were found in the project area. 2) Trees planted along the road contribute to the greenery and visual amenity providing an area of relaxation and recreation for local residents. Thus, cutting or removal of trees along the roads may spoil the greenery environment and its amenities. 3) Air pollutants emission from construction vehicles and machines, and earthmoving and construction works may affect trees and plants around the construction site.
				B- Increase in air pollutants due to the increase in the number of vehicles may cause adverse impacts on trees and greens planted along the road.
25) Aquatic fauna, flora, and biodiversity	B-		B-	1) No rare, endangered, or endemic aquatic plant or animal species are reported in the project area. 2) The Bago River is a tidal river, and mangroves, which are places for breeding and hatchery of fishes, are distributed with isolated or with a small community along the riverbank. Mangroves function in the reproduction of fish resources and sheltering from high tidal waves and tsunami as well as making riparian natural landscape. 3) Riverbed dredging and excavation caused by the bridge construction work may increase turbidity and deteriorate mangrove communities.
				B- There is some awareness about river scouring at the bridge site. Scouring action will be strong especially during rainy season.
26) Hydrological situation/drainage pattern	B-		B-	1) Excavation and dredging works at the bottom and sides of the river for the construction of the bridge may result in changes of hydrogeological situation of the river.
				B- There is some awareness about river scouring at the bridge site. Scouring action will be strong especially during rainy season.
27) Topography and geology	D		D	No large-scale land alteration is expected. The scale of dredging and excavating river bed is expected to be too small to change the topographical and geological features
28) Soil erosion	B-		B-	1) No large-scale land cutting and filling are expected. However, improper soil embankment works will likely cause soil erosion during rainy season.
29) Groundwater	D		D	There is some possibility of pumping up of groundwater if water supply is not available.
30) Coastal zone	B-		B-	New bridge foundation and piers may somehow change the tidal flow of the Bago River. Thus, there is a possibility of coastal erosion, sand sedimentation, and some changes in the aquatic ecosystem including mangrove community, although they are small in scale.
31) Micro-climate	D		D	The site of Bago River Bridge and approach roads are surrounded by scattered flat area and the Bago River. In addition, neither construction of tall buildings nor large-scale reclamation is planned. Thus, change in microclimate is not expected.
32) Global warming/climate change	D		D	Small scale and temporary generation of greenhouse gases like CO ₂ are expected due to construction vehicles and machines. Thus, impact on transboundary and climate change is negligible.
				D Increase in greenhouse gases like CO ₂ is expected in a small scale due to increase of traffic volume. Thus, impact on transboundary and climate change is negligible.
(3) Environmental Pollution				
33) Air pollution	B-		B-	1) At present, air quality standards are not established in Myanmar. 2) Emission of air pollutant such as PM and NO _x from construction vehicles and machines, and earthmoving and construction works may temporarily deteriorate air quality.
				B- 1) Improvement of traffic congestion will result in a smoother traffic condition through the construction of Bago River Bridge. Thus, reduction in the emission of air pollutants such as NO and PM is expected due to decrease in idling time. 2) On the other hand, improvement of traffic congestion may increase the number of vehicles travelling (about 30,000 pcu/day in 2020). This may also result in an increase in emission load of air pollutants such as PM and NO _x .
34) Water pollution	B-		B-	1) At present, water quality standards are not established in Myanmar. 2) Water pollution is expected due to the following pollutant generation from construction works, although they are only temporarily: (i) Runoff of dirty water including soils from cutting, filling, and excavation from earthmoving work. (ii) Wastewater from worker' camps and construction office. (iii) Increase in turbidity of river water due to stirred river bottom mud. (iv) Spilling over of toxic materials such as asphalt emulsifiers.
				D No negative impact is expected.
35) Soil contamination	B-		B-	Leakage of toxic materials such as lubricating oil from construction vehicles and machines, and asphalt emulsifiers utilized for road construction may give rise to soil contamination.
				D No negative impact is expected.
36) Bottom sediment	B-		B-	Sedimentation and accumulation of water pollutants including toxic materials in the river may result in the pollution of bottom sediments.
				D No negative impact is expected.
37) Waste	B-		B-	Generation of soil, sand, and construction wastes is expected at quarries, borrow pits, site of bridge and road construction works, and worker's camp.
				D No negative impact is expected.
38) Noise and vibration	B-		B-	1) At present, noise and vibration standards are not established in Myanmar. 2) Generation of noise and vibration from construction machines and vehicles is expected.

				B-	1) Improvement of traffic congestion may give rise to an increase in the number of vehicles travelling (about 30,000 pcu/day in 2020). This may also result in an increase in vehicle noise and vibration.
39) Ground subsidence	D		D		Neither major reclamation nor pumping up of groundwater is expected.
				D	
40) Offensive odor	B-		B-		1) Noxious odor from polluted river bottom sediment may generate due to the dredging work for bridge construction.
				D	No negative impact is expected.

Note 1: * Environmental items are chosen based on the JICA Guidelines for Environmental and Social Considerations (2010.4) and relevant legislations of the Myanmar government as well as the project plan and environmental condition of the project area, as indicators expressing environmental and social conditions.

Note 2: ** Regarding the impacts on "gender" and "children's right" might be related to all items under social environment.

Note 3: *** Rating - In general, both positive impact (+) and negative impact (-) are expected due to the anticipated project activities. Thus, the following rating criteria are adopted with respect to the extent of impacts: A (+/-) – Significant positive/negative impact is expected, B (+/-) – Positive/negative impact is expected to some extent, C (+/-) - Extent of positive/negative impact is unknown or not clear (Further examination is needed. It should be taken into consideration that impacts may become clear as study progresses), Blank - Negligible or no impact is expected.

Note 4: **** I - Planning Stage, II - Construction Stage, III - Operation Stage

Source: JICA Survey Team

(2) Categorization of the Proposed Project Major Negative Impacts

According to the JICA guidelines, a project maybe classified into four categories, i.e., Categories A, B, C, and FI by the extent of environmental and social impacts, taking into account the outline of the project, scale, site condition, etc.

The proposed Project is classified under Category B due to the following reasons:

- (i) The Project does not belong to (1) sensitive sectors like large-scale development of roads and bridges; (2) sensitive characteristics like large-scale involuntary resettlement of more than 200 PAPs; and (3) sensitive areas such as nationally-designated protected areas, primeval forests areas, or areas with unique archaeological, historical, or cultural values as listed in Appendix 3 of the JICA guidelines.
- (ii) Results of the identification and evaluation of expected environmental and social impacts indicated that there is no item with a rating of (A-), which means negative (adverse) impact; while other items are have a rating of (B-), which means impacts are not significant but to some extent, or with a rating of (D), which means no or negligible negative impact, as shown in Table 12.25.

Thus, the proposed Project is classified under Category B, which is the same as the result of scoping.

(3) Major Negative Impacts

1) Planning Stage 1 - Social Environment

(i) Involuntary Resettlement

- The right-of-way (ROW) for the planned bridge and approach roads are on public land and land owned by the government such as Myanmar Railways, Ministry of Construction, YCDC, and YRDC. Thus, displacement of houses and people is not expected.
- However, a few stalls and small religious praying facilities encroach the ROW. Therefore, these structures should be removed and/or relocated by using appropriate

means and all the losses should be subject to proper compensation and resettlement assistance.

- About 150 trees within the ROW of approach roads will be affected.
- Some land for construction related facilities (e.g., construction office, worker's camp, and storage of construction materials and waste) will be affected.
- Detailed features are described in Section 12.4, Abbreviated Resettlement Plan (ARP).

2) Planning Stage 2 - Natural Environment

- No item.

3) Planning Stage 3 – Environmental Pollution

- No item.

4) Construction Stage 1– Social Environment

(i) Fishing activity

- There are small-scale fishing activities in the Bago River. Thus, construction works including dredging and excavation may disturb their environment.

(ii) Utilization of land and local resources

- Some negative impacts are expected in case that quarries and/or borrow pits will be utilized for the procurement of construction materials.
- Water for construction works including worker's camp may compete with the existing water resources.

(iii) Existing social infrastructures and services: 1) Road and railway traffic

- Basically, traffic condition will not change by using the existing Thanlyin Bridge during the construction stage. However, the delivery of construction machines and materials, as well as traffic created by construction vehicles, may cause temporary closure of road, one-way traffic, and restriction of vehicle speed; therefore, using diversion route will be required in these situations. Even so, these may result in traffic congestion and inconvenience in accessing public facilities.

(iv) Existing social infrastructures and services: 2) Navigation

- Bridge construction works such as riverbed dredging may disturb water transport due to change in navigation channel.

(v) Existing social infrastructures and services: 3) Others

- There are utility lines such as high voltage electrical lines and fuel pipelines (diesel fuel and CNG) within the ROW of proposed approach roads.
- Water use for construction work may compete with community water supply.

(vi) Cultural, historical, archaeological, and religious heritage sites

- In Greater Yangon Region, there are many religious facilities such as Buddhist temples (pagodas) and monasteries, Hindu temples, and mosques. However, no cultural and religious sites are distributed in and around the project site.
- Recently, three small religious praying facilities (Buddhism and traditional religion) were installed within the ROW of approach roads.
- (vii) Public health and sanitation
 - Air pollutants such as dust, SPM, NO_x, and SO_x emitted from construction vehicles and machines and construction works may cause some adverse effects to respiratory organs.
- (viii) Infectious diseases such as HIV/AIDS
 - Road construction workers and truck drivers are considered as having high potential for the spread of sexually transmitted diseases (STDs) and HIV/AIDS due to their mobility. Reports on infection with HIV/AIDS and venereal diseases at worker's camp during road construction stage in other developing countries were observed.
- (ix) Working condition (including occupational health)
 - Many workers will engage in construction works and will stay at worker's camps under poor living conditions. Thus, the health and occupational safety of workers may be jeopardized in case of severe working conditions.
- (x) Hazards/security risks
 - Although the project activities will not pose any hazard or risk, migration of workers from other areas may worsen the condition of public security and increase in community awareness.
- (xi) Accidents
 - Occurrence of accidents may increase due to construction works, machine and plant deployment, and construction materials handling, as well as occurrence of traffic accidents caused by construction vehicles.

5) Construction Stage 2 – Natural Environment

(i) Protected area

- There is neither protected nor environmentally-sensitive area in and around the project area. However, close to the existing Thanlyin Bridge at the upstream side is the National Race Village, which is a place of recreation and relaxation for citizens and accepts a maximum of 1,000 visitors per day. Thus, construction vehicles may somewhat disturb visitor's access to the park.

(ii) Terrestrial fauna, flora and biodiversity

- According to the field survey two plant species of globally threatened species registered in IUCN Red List were found in the project area.
- Trees planted along the road contribute to the greenery and visual amenity providing an area of relaxation and recreation for local residents. Thus, cutting or removal of trees along the roads may spoil the greenery environment and its amenities.

- Air pollutants emission from construction vehicles and machines, and earthmoving and construction works may affect the trees and plants around the construction site.

(iii) Aquatic fauna, flora and biodiversity

- No rare, endangered, or endemic aquatic plant or animal species are reported in the project area.
- The Bago River is a tidal river, and mangroves, which are places for breeding and hatchery of fishes, are distributed with isolated or with a small community along the riverbank. Mangroves function in the reproduction of fish resources and sheltering from high tidal waves and tsunami as well as making riparian natural landscape.
- Riverbed dredging and excavation caused by the bridge construction work may increase the turbidity and deteriorate mangrove communities.

(iv) Hydrological situation/drainage pattern

- Excavation and dredging works at the bottom and sides of the river for the construction of the bridge may result in changes in the hydrogeological situation of the river.
- Based on the geological survey, a maximum of 2 m scouring can be seen at the pier location by just only a year (2012) for Thanlyin Bridge. Therefore, it is necessary to pay close attention to scouring.

(v) Soil erosion

- No large-scale land cutting and filling are expected. However, improper soil embankment works will likely to cause soil erosion during rainy season. 2) Land in the project area is mostly flat except for the riverbank. Thus, there is a quite low possibility of landslides.

(vi) Coastal zone

- New bridge foundation and piers may somehow change the flow of the tidal flow of the Bago River. Thus, there is a possibility of coastal erosion, sand sedimentation, and some changes in the aquatic ecosystem including mangrove community, although they are small in scale.

6) Construction Stage 3 – Environmental Pollution

(i) Air pollution

- Air pollutants emission such as PM and NO_x from construction vehicles and machines, and earthmoving and construction works may temporarily deteriorate air quality, although at present, the ambient air quality standards are not established in Myanmar.

(ii) Water pollution

- At present, the environmental water quality standards are not established in Myanmar. Water pollution is expected due to the following pollutant generation from construction works: (a) runoff of dirty water including soils from cutting, filling, and excavation under earthmoving works; (b) wastewater from worker' camps and

construction office; (c) increase in turbidity of river water due to stirred river bottom mud; and (d) spilling over of toxic materials such as asphalt emulsifiers.

(iii) Soil contamination

- Leakage of toxic materials such as lubricating oil from construction vehicles and machines, and asphalt emulsifiers utilized for road construction may give rise to soil contamination.

(iv) Bottom sediment pollution

- Sedimentation and accumulation of water pollutants including toxic materials in the river may result in the pollution of bottom sediments.

(v) Solid waste

- Generation of soil, sand, and construction wastes is expected at quarries, borrow pits, site of bridge and road construction works, and worker's camp.
- Mud generated by riverbed dredging will be kept from dispersion by dredging of footing area.

(vi) Noise and vibration

- Generation of noise and vibration from construction machines and vehicles is expected, although at present, ambient noise and vibration standards are not established in Myanmar.

(vii) Offensive odor

- Noxious odor from malfunctioned construction vehicles and machines.
- Bad smell from polluted river bottom sediment may be generated due to the dredging work for bridge construction.

7) Operation Stage 1 – Social Environment

(i) Existing social infrastructures and services -2 Water transport

- Bridge foundations and piers may change the flow conditions of the Bago River resulting in disturbance of navigation.

(ii) Landscape

- Existing bridge landscape in and around the Bago River produced by Thanlyin Bridge will somehow change due to the appearance of the Bago River Bridge, which is planned to be constructed nearby at about 140 m downstream of the existing Thanlyin Bridge. Thus, it is required to design the bridge design so as to establish the new attractive landmark and to harmonize it with Thanlyin Bridge.

(iii) Public health and sanitation

- Air pollution due to increase of traffic volume may cause some adverse effects to the respiratory organs.

(iv) Accidents

- Improvement of traffic congestion may give rise to an increase in the number of traffic accidents due to the increase in number of travelling vehicles.

8) Operation Stage 2 – Natural Environment

(i) Terrestrial fauna, flora and biodiversity

- Increase in air pollutants due to increase in the number of vehicles may cause adverse impacts on trees and greens planted along the road

(ii) Hydrological situation/drainage pattern

- There is some awareness about river scouring at the bridge site. Scouring action will be strong during rainy season.

(iii) Coastal zone

- New bridge piers may somehow change the tidal flow of the Bago River resulting in coastal erosion, sand sedimentation, and some changes in the aquatic ecosystem including mangrove community.

9) Operation Stage 3 – Environmental Pollution

(i) Air pollution

- Improvement of traffic congestion may increase the number of vehicles travelling. This may also result in an increase in emission load of air pollutants such as PM and NO_x.
- Poor emission control of many vehicles due to lack of maintenance and inspection may accelerate the spewing out of air pollutants (such as PM and NO_x) along the road.

(ii) Noise and vibration

- Increase in generation of noise and vibration is expected due to the increase in traffic volume.

10) Overall Stage 1 – Social Environment

(i) Social institutions such as social infrastructure and local decision-making institutions

- If information disclosure of the project plan, and procedure and public participation are not properly conducted, people's anxieties and complaints may occur and spread over the communities, resulting in difficulties to obtain a thorough understanding of the Project and consensus among the people.

(ii) Misdistribution of benefit and damage

- There is some possibility of misdistribution of benefit and damage, if the project plan including procedures of the implementation and involuntary resettlement matters are not properly disseminated and consulted with the residents, communities, and other stakeholders.

(iii) Local conflicts of interest

- There is some possibility of local conflicts of interest, if the project plan including implementation procedures and involuntary resettlement matters are not properly disseminated and consulted with the residents, communities, and other stakeholders.

11) Overall Stage 2 – Natural Environment

- No item.

12) Overall Stage 2 – Environmental Pollution

- No item.

12.3.5 Mitigation Measures against Negative Impacts and Environmental Management Plan

Mitigation measures, which may avoid, minimize, eliminate, and/or reduce the abovementioned negative impacts were examined for the respective items in the planning, construction, and operation stages, as well as whole stages. This was conducted so that the Project can achieve the intended objectives while minimizing the accompanied environmental impacts.

In addition, the environmental management plan (EMP) was prepared by incorporating the mitigation measures and monitoring, as well as, the roles of implementing, responsible, and supervising organizations as shown in Table 12.26.

Table 12.26 Mitigation Measures against Negative Impacts and Environmental Management Plan (EMP)

Affected Environment Item */**	Mitigation Measures	Implementing Organization ***	Responsible and/or Supervising Organization ***
(I) Planning Stage			
(A) Social Environment			
1) Involuntary resettlement	1) From the early stage of planning, provide adequate information to PAPs and consult with stakeholders including PAPs to make agreement or thorough understanding of the issues as much as possible.	PW	YCDC, YRDC, GAD, and MOECAAF
	Through the inventory survey on possible affected land, assets and structures within the ROW to clarify features of involuntary resettlement and identify PAPs. 3) Declare the cutoff date and determine the eligibility of PAPs, if necessary. Then, based on eligibility data, prepare the abbreviated resettlement plan (ARP) for compensation and resettlement assistance to PAPs.	PW	YCDC, YRDC, GAD, and MOECAAF
	Consult with YCDC-PPGD and YRCD for the removal or replantation with payment of necessary cost (about MMK 8 million)	PW	YCDC, MR, YRDC, GAD, and MOECAAF
	Convert the compounds of PW and Myanmar Railways with prior permission in order to secure construction site. Obtain prior permission from MPA to utilize riverbank as a jetty for ships and delivery of construction materials.	PW	YCDC, MR, YRDC, GAD, and MOECAAF
(II) Construction Stage			
(A) Social Environment			
3) Fishing activity	The following measures will be conducted: 1) Prior to construction works, inform the contents of the construction works and schedule. 2) Implement time shift of construction works. 3) Educate the construction workers on navigation safety and manner. 4) Raise the warning signal on waterway. 5) Arrange watchmen, if necessary.	CT	PW, YCDC, YRDC, and DOF
4) Utilization of land and local resources	1) To consider preventive measures for the procurement of construction plants, materials, machines, vehicles, etc. 2) To consult with YCDC and YRCD about water use for the construction works.	CT	PW, YCDC, and YRDC

5) Existing social infrastructures and services: 1) Road and railway traffic	In order to avoid or minimize traffic disturbance and nuisance to local people and communities, the following measures will be conducted: 1) Prior to construction works, inform the contents of the construction works and schedule, 2) Implement time shift of construction works. 3) Educate the construction workers and drivers on traffic safety and manners. 4) Raise the traffic signal and arrange the watchmen stationed on the approach road. 5) Equip sheet cover from the bed of the truck in order to prevent scattering of dusts. 6) Assign staff who will be in charge of complaints.	CT	PW, YCDC, and YRDC
5) Existing social infrastructures and services: 2) Navigation	The following measures will be conducted: 1) Prior to construction works, inform the contents of the construction works and schedule. 2) Implement time shift of construction works. 3) Educate the construction workers on navigation safety and manners. 4) Raise the warning signal on the waterway. 5) Arrange watchmen, if necessary.	CT	PW, YCDC, and YRDC
7) Existing social infrastructures and services: 3) Others	1) To obtain necessary permission from concerned authorities for the removal and/or relocation of installed utilities (electric poles, diesel fuel, CNG pipeline, etc.) along the alignment. 2) To consult with YCDC and YRCD about water use for the construction works.	CT	PW, MR, YCDC, and YRDC
	Consult with Myanmar Electric Power Enterprise (MEPE) for relocation.	CT	PW, MR, MEPE, YCDC, and YRDC
	Consult with Myanmar Gas and Oil Enterprise (MGOE) and Myanmar Petroleum Products Enterprise (MPPE) for relocation and other measures.	CT	PW, MR, MPPE, MGOE, YCDC, and YRDC
13) Cultural, historical, archaeological, and religious heritage sites	1) According to Myanmar Railways (MR), which owns the ROW, there is already an agreement with a real estate company, who rented the land from MR, to remove and/or relocate these structures before commencement of the construction works.	CT	PW, YCDC, and YRDC
16) Public health and sanitation	To install proper sanitation facilities such as lavatory during construction works. In order to avoid or minimize traffic disturbance and nuisance to local people and communities, the following measures are necessary: (i) Prior to construction works, inform the contents of the construction works and schedule, (ii) Implement time shift of construction works, (iii) Educate the construction workers and drivers on traffic safety and manners. (iv) Raise the traffic signal on the approach road.	CT	PW, YCDC, and YRDC
17) Infectious diseases such as HIV/AIDS	1) Education and campaign on the prevention and cure of HIV/AIDS to residents and construction workers. 2) Monitoring of HIV/AIDS cases before, during, and after the construction stage, if necessary.	CT	PW, YCDC, and YRDC
18) Working condition (including occupational health)	1) In the construction works, the contractor should comply with the requirement of Labor Law and Labor Safety Law (draft). 2) Safety management plan should be prepared and construction workers should be educated on occupational safety. 3) Tangible safety considerations should be prepared for individuals involved in the Project, such as: (i) installation of safety equipment and management of hazardous materials. (ii) strict implementation on the wearing of personal protective equipment (such as safety shoes, hats, and earplugs) for workers and personnel entering the construction sites for construction works. 4) Health condition and occupational safety of workers should be monitored.	CT	PW, YCDC, and YRDC
19) Hazards/security risks	1) Inspect the daily behavior of construction workers and instruct them to work with good manners 2) Prioritize the employment of local residents, who are familiar to the project area, as construction workers.	CT	PW, YCDC, and YRDC
20) Accidents	1) Suitable planning and management of construction works in order to prevent and minimize the number and consequences of accidents. 2) Collect and analysis of cases and causes of accidents. 3) Raising the awareness of workers and local residents on accident prevention by providing training and adequate notice.	CT	PW, YCDC, and YRDC

(2) Natural Environment			
23) Protected area	To avoid disturbance of access to the National Racing Park, the following means should be planned: (i) proper route induction of construction vehicles, (ii) time shift of work, and (iii) arrangement of watchmen for traffic control.	CT	PW, YCDC, YRDC, and MOECAAF
24) Terrestrial fauna, flora and biodiversity	1) Places where valuable two plant species are distributed should be avoided. If unavoidable, prior consultation with YCDC-PPGD and MOECAAF and permission to replanting should be conducted. 2) Planted trees along the road contribute to the greenery and visual amenity providing relaxation and recreation area to local residents. Thus, cutting or removal of trees along the roads may spoil the greenery environment and amenity. 3) To make a greenbelt with trees and/or vegetation covers.	CT	PW, YCDC, YRDC, and MOECAAF
25) Aquatic fauna, flora and biodiversity	1) If removal of mangrove trees are unavoidable, obtain permission of relocation or replanting from YCDC-PPGD. 2) Monitor change in riverine environment including mangrove communities near the project site.	CT	PW, YCDC, YRDC, and MOECAAF
26) Hydrological situation/drainage pattern	1) Consideration of preventive measures against scouring such as steel pipe sheet pile foundation. It is considered the optimal solution for the mainstream of the foundation type in terms of its applicability to deepwater construction and anti-scouring properties. 2) Monitoring of scouring.	CT	PW, YCDC, YRDC, and MOECAAF
28) Soil erosion	1) To avoid run-off of soil from construction works. 2) To maintain roadside gutter and stormwater drainage in good condition.	CT	PW, YCDC, YRDC, and MOECAAF
30) Coastal zone	1) Measures for prevention of scouring at bridge foundation and during pier construction works. 2) Monitoring of erosion and/or sedimentation of riverbank. 3) Monitoring tidal flat and mangrove vegetation.	CT	PW, YCDC, YRDC, and MOECAAF
(3) Environmental Pollution			
33) Air pollution	1) Use of construction machines and vehicles equipped with good exhaust emission system and filled with good quality fuel and oil. 2) Safety driving and control of vehicle speed. 3) Enlightenment and education of construction workers for the prevention or minimization of air pollutants generation. 4) Monitoring of air quality.	CT	PW, YCDC, YRDC, and MOECAAF
34) Water pollution	1) Proper treatment of water pollutants generated from construction works to comply with wastewater regulation by YCDC. 2) Surface runoff from the construction site shall be directed to silt traps or sedimentation basin with the help of channels before reuse or discharge. 3) To shelter scattered river mud from the dredging works by using submerged fence in order to avoid increase in turbidity.	CT	PW, YCDC, YRDC, and MOECAAF
35) Soil contamination	1) To keep clean storage sites for the construction equipment, 2) To install storage tank to prevent spill and leakage of lubricating oil and asphalt emulsifier, etc. 3) Training of workers on proper handling of toxic materials.	CT	PW, YCDC, YRDC, and MOECAAF
36) Bottom sediment pollution	1) To shelter scattered river mud from dredging work by using submerged fence. 2) Monitoring of bottom sediment pollution.	CT	PW, YCDC, YRDC, MOECAAF
37) Waste	1) Consider ways to minimize waste generation in the construction work plan. 2) Enlightenment and education of construction workers for waste management based on 3R principle (reduce, reuse, and recycle). 3) Construction waste and wastes from the worker's camp will be carried out by proper segregation, collection, treatment, reuse, and recycle. Then, the remaining waste will be transferred to designated dumping sites for final disposal.	CT	PW, YCDC, YRDC, MOECAAF
38) Noise and vibration	1) Avoidance of working during sensitive hours and placing construction machines close to sensitive receptors shall be avoided. 2) Use of equipment with low-noise and vibration. 3) Installation of soundproof walls/acoustic enclosures and provision of buffer zones. 4) Setting of staff in charge of complaints.	CT	PW, YCDC, YRDC, and MOECAAF

40) Offensive odor	1) To use construction vehicles and machines with good maintenance. 2) To shelter scattered river mud from dredging works by using submerged fence made of plastics.	CT	PW, YCDC, YRDC, and MOECAF
(III) Operation Stage			
(A) Social Environment			
6) Existing social infrastructures and services -2 Water transport	In the bridge design, consider location plan of bridge foundations and piers to prevent change of existing navigation route.	PW	YCDC, YRDC, and MOECAF
15) Landscape	1) In the bridge structure design of Bago River Bridge, it will be considered to generate new aesthetic value and harmonize it with existing Thanlyin Bridge. 2) In the approach road design, it will be considered to contribute in the roadside aesthetic scenery by arranging a greenbelt with trees and vegetation covers.	PW	YCDC, YRDC, and MOECAF
16) Public health and sanitation	Similar preventive measures of air pollution (Item 33).	PW	YCDC, YRDC, and MOECAF
20) Accidents	1) Enlighten and educate the drivers and residents on traffic safety. 2) Collect cases and causes of traffic accidents.	PW	YCDC, YRDC, MOECAF
(2) Natural Environment			
24) Terrestrial fauna, flora and biodiversity	1) Proper management for the control of vehicle exhaust emission and establish inspection system of exhaust gas emission. 2) To develop a greenbelt with trees and/or vegetation covers in order to shelter vehicle exhaust emissions. 3) To monitor air quality along the roads	PW	YCDC, YRDC, and MOECAF
26) Hydrological situation/drainage pattern	1) To consider preventive measures against scouring such as steel pipe sheet pile foundation. This is considered the optimal solution for the mainstream of the foundation type in terms of its applicability to deepwater construction and anti-scouring properties. 2) Monitoring of scouring.	PW	YCDC, YRDC, and MOECAF
30) Coastal zone	1) In the design of bridge foundation and pier, and construction works of dredging and excavation of river bed, consider to minimize the change in topographical and hydrologic condition. 2) Monitoring change in erosion/sedimentation condition, tidal flat zone, and mangrove vegetation.	PW	YCDC, YRDC, and MOECAF
(3) Environmental Pollution			
33) Air pollution	1) Proper management on the control of vehicle exhaust emission and establishment of an inspection system for exhaust gas emission. 2) Development of a greenbelt with trees and/or vegetation covers in order to shelter vehicle exhaust emissions. 3) Monitoring of air quality along the roads.	PW	YCDC, YRDC, and MOECAF
38) Noise and vibration	1) Preventive measures for noise pollution such as avoiding abuse of horns, good maintenance of vehicles, and regulation on overloading. 2) Development of a greenbelt with trees and/or vegetation covers in order to shelter vehicle noise. 3) Monitoring of noise along the roads.	PW	YCDC, YRDC, and MOECAF
(IV) Overall Stages			
(1) Social Environment			
8) Social institutions such as social infrastructure and local decision-making institutions	1) Information disclosure and public participation should be fully considered for all the stakeholders including local residents and road users from the planning stage to operation stage in order to obtain thorough understanding and consensus of the people and communities. 2) Set up a section in charge of complaints from people.	PW, CT	YCDC, YRDC, and MOECAF
11) Misdistribution of benefit and damage	1) Plan consultations with stakeholders including local residents, community organizations, etc., should be planned from an early stage to obtain an understanding and consent among the stakeholders in order to share equal benefits and damages. 2) Consider preference of employment to local residents and the poor for construction works. 3) Set up a section in charge of complaints from people.	PW, CT	YCDC, YRDC, and MOECAF

12) Local conflict of interests	1) Plan consultations with stakeholders including local residents, community organizations etc., at an early stage in order to obtain understanding and consent among the stakeholders in order to avoid local conflict of interests. 2) Consider preference of employment to local residents and the poor for construction works. 3) Set up a section in charge of people's complaints.	PW, CT	YCDC, YRDC, and MOECAF
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Note 1: * "x)" indicates number of environmental item

Note 2: ** Rating of the negative impacts are (B-) for all items.

Note 3 : Implementing organizations/ responsible and supervising organizations - PW: Public Works, CS: Consultant, CT: Contractor, YCDC-PPGD - YCDC Playgrounds, Parks and Gardening Department, YCDC-PCD - YCDC-Pollution and Cleansing Department, YRDC, MOECAF - Ministry of Environmental Conservation and Forestry, MPA - Myanmar Port Authority, DOF - Department of Fishery, MOH - Ministry of Health, FERD - Foreign Economic Relations Department, PD - Planning Department, MEPE - Myanmar Electric Power Enterprise, MPPE - Myanmar Petroleum Products Enterprise, and MGOE - Myanmar Gas and Oil Enterprise.

Source: JICA Survey Team

12.3.6 Environmental Monitoring Plan (EMP)

Considering the mitigation measures against negative impacts in the EMP, which may support the measures, was prepared as shown in Table 12.27.

Table 12.27 Environmental Monitoring Plan for Bago River Bridge Construction Project

Category	Item	Monitoring Indicator	Method of Monitoring	Place of Monitoring	Frequency (Period)	Implementing Organization*	Responsible and/or Supervising Organization*	Monitoring Cost (USD)
(I) Planning Stage								
1) Approval/ permission etc.	Permission of project implementation and environmental clearance certificate	Project plan and IEE/EIA report	1) Permission procedures of projects for public purpose by foreign donors. 2) Environmental clearance certificate by MOECAF	FERD, PD, and MOECAF	Planning stage (at the latest commencement of construction works)	PW	FERD, PD, and MOECAF	<PW>
	Utility - electric poles	Relocation of electric poles within the ROW	Permission from the Myanmar Electric Power Enterprise (MEPE)	Within the ROW of bridge and approach roads	Before commencement of construction works	PW	YCDC, YRDC, MR, and MEPE	<PW>
	Utility - diesel fuel and CNG pipelines	Relocation or protection of diesel fuel and CNG pipelines	Permission from the Myanmar Railways, Myanmar Petroleum Products Enterprise, and Myanmar Oil and Gas Enterprise	Within the ROW of bridge and approach roads	Before commencement of construction works	PW	YCDC, YRDC, MR, MPPE, MGOE	<PW>
	Construction work in river and river bank	Permission letter	Permission from the Myanmar Port Authority	Bago River and its riverbank	Before commencement of construction works	PW	MPA	<PW>
	Tree cutting, removal and/or replanting	1) Permission letter, 2) Situation of removal and replanting trees	1) Permission from the Forest Department, MOECAF, 2) Implementation by YCDC-PPGD	Approach roads and replanting place	Before commencement of construction works	PW	Forest Department-MOECAF, and YCDC-PPGD	6,400
2) Social Environment	Involuntary resettlement	Necessary compensation and resettlement assistance for Project Affected Persons (PAPs)	Abbreviated Resettlement Plan (ARP)	Residence and/or working place of PAPs	Before commencement of construction works	PW	GAD, YCDC, and HSHDD	<PW> (Cost of compensation and resettlement assistance)
	Results of compensation and resettlement assistance PAPs	Livelihood and living condition of PAPs	Individual consultation with PAPs	Within the ROW of bridge and approach roads	Twice/year (one year from compensation and assistance)	PW	GAD, YCDC, and HSHDD	<PW>
(II) Construction Stage								
1) Social Environment	Complaints and request from residents	Cases and causes of complaints on the construction works	Collection of complaints and requests	Construction site and surroundings	Any time as required	CT	PW, YCDC, and YRDC	<CT>
	Fishing activities	Complaints from fishermen	Collection of complaints and requests	Construction site and surroundings	Any time as required	CT	PW, YCDC, and YRDC	<CT>
	Increase in traffic congestion	Cases and causes of complaints	Visual observation and hearing	Construction site and surroundings	Daily during construction	CT	PW, YCDC, and YRDC	<CT>

	and disturbance of access to public facilities etc.	on traffic condition	with residents and road users		on works			
	Public health and sanitation	Health condition of residents around the construction site	Symptoms of inhabitants within and around the construction site	Construction site and surroundings	Any time as required	CT	PW, YCDC, and YRDC	<CT>
	Infectious Diseases such as HIV/AIDS	Cases and causes of residents and workers related to construction work	Medical examination of construction workers and people who made contact with people with HIV/AIDS, if any	Construction site and surroundings	Before and after construction stage as required	CT	PW, YCDC, and YRDC	<CT>
	Working condition	1) Physical observation, 2) Reports from the workers	Medical check-up and symptoms of workers	Construction site and surroundings	As required	CT	PW, YCDC, and YRDC	<CT>
	Natural disaster/risks	Cases and causes of disasters and hazards	Records of natural disasters and hazards in the project area	Construction site and surroundings	Daily	CT	PW, YCDC, and YRDC	<CT>
	Accident	Cases and causes of accidents	Records of accidents in the project area	Construction site and surroundings	Daily	CT	PW, YCDC, and YRDC	<CT>
2) Natural Environment	Protection of valuable plants	Globally threatened species	Distribution condition	Construction site and surroundings	Once a year	CT	PW, YCDC, YRDC, and MOECA	<CT>
	Conservation of mangrove community	Condition of mangrove community in the project site	Visual observation	Bago River bank around the construction site	Once a year	CT	PW, YCDC, and YRDC	<CT>
3) Environmental Pollution	Air pollution	Qualitative check	1) Visual observation, 2) Complaints from residents	Construction site and surroundings	1) Daily, 2) When a complaint is informed	CT	PW, YCDC, and YRDC	<CT>
		Ambient air quality measurement	Air pollutants (SO ₂ , NO ₂ , CO, PM10, PM2.5) by air quality measurement equipment	Two points near the proposed approach roads	Thrice a year (dry season)	CT, PW, Local consultant	PW, YCDC, and YRDC	7,700
	Water pollution	Qualitative check	1) Visual observation, 2) Complaints from residents	Construction site and surroundings	1) Daily, 2) When a complaint is informed	CT	PW, YCDC-PCD, and YRDC	<CT>
		Water quality measurement	River water quality (pH, SS, DO, BOD ₅ , Turbidity)	Two points downstream of the proposed bridge site (two layers; surface and bottom)	Thrice a year (dry season)	CT, PW, Local consultant	PW, YCDC-PCD, and YRDC	8,900
	Soil Contamination	Leakage of emulsifier and lubricants from construction vehicles and machines	Visual observation	Construction site and surroundings	Daily	CT	PW, YCDC-PCD, and YRDC	<CT>
	Solid waste management	Situation of solid waste management	1) Visual observation, 2) Record of collection, transportation, treatment and disposal	Construction site and surroundings	Daily	CT	PW, YCDC-PCD, and YRDC	<CT>

		Qualitative check	1) Visual observation, 2) Complaints from residents	Construction site and surroundings	Daily	CT	PW, YCDC-PCD, and YRDC	<CT>
	Noise and vibration	Ambient noise quality measurement	Sound level meter	Two points near the proposed approach roads (same as air quality monitoring points)	Thrice a year (dry season)	CT, PW, Local consultant	PW, YCDC-PCD, and YRDC	5,100
(III) Operation Stage								
1) Social Environment	Public health	Complaints and cases of local resident's illness	Medical check-up of residents	Project area	As required	PW	YCDC, YRDC	<PW>
	Accidents	Cases and causes of traffic accidents	Records of accidents	Project area	As required	PW	YCDC, YRDC	<PW>
	Landscape	View from the surrounding area	Actual survey on scenery of bridges	Bago River bridge and existing Thanlyin Bridge	Once after the operation	PW	YCDC, YRDC	<PW>
2) Natural Environment	River bed scouring, bank erosion/sedimentation	Change of river stream, river bank and river bed scouring	1) Visual observation, 2) River crossing survey data by DWIR	River bank and the proposed bridge site	Once a year	PW	YCDC, YRDC	<PW>
3) Environmental pollution	Air pollution	Pollutants from vehicle exhaust emissions	Air pollutants (SO ₂ , NO ₂ , CO, PM10, PM2.5) by air quality measurement equipment	Four points (Thaketa TS 1, Thanlyin TS 1, Background 2)	Twice a year (dry season)	PW, Local consultant	PW, YCDC, YRDC	8,500
	Noise and vibration	Traffic noise	Sound level meter	Four points (basically same as air quality measurement))	Twice a year (dry season)	PW	YCDC, YRDC	5,300
(IV) Whole Stages								
1) Social Environment	Acceptability of the project	Cases and causes of complaints and requests (equality of benefit, damage, and occurrence of conflict)	1) Arrange section and staff in charge of complaints and requests from residents etc.. 2) Hold stakeholder meeting and consultation with residents etc.	Project area	As required	PW	YCDC, YRDC	<PW>

Note 1 : Implementing organizations/responsible and supervising organizations - PW: Public Works, CS: Consultant, CT: Contractor, YCDC-PPGD - YCDC Playgrounds, Parks and Gardening Department, YCDC-PCD - YCDC-Pollution and Cleansing Department, YRDC, MOECAF - Ministry of Environmental Conservation and Forestry, MPA - Myanmar Port Authority, DOF - Department of Fishery, MOH - Ministry of Health, FERD - Foreign Economic Relations Department, PD - Planning Department, MEPE - Myanmar Electric Power Enterprise, MPPE - Myanmar Petroleum Products Enterprise, MGOE - Myanmar Gas and Oil Enterprise.

Note 2: <PW> - Included in the Project general management cost , <CT> - Included in the construction management cost

Source: JICA Survey Team

12.4 Abbreviated Resettlement Plan (ARP)

12.4.1 Necessity of Land Acquisition and Resettlement

(1) Anticipated land acquisition and resettlement

As mentioned in Section 12.3.4, the ROW for the planned bridge and approach roads lies on public land and land owned by the government such as Myanmar Railways, Ministry of Construction, YCDC, and YRDC. Thus, land acquisition is not expected.

However, encroachment of structures, i.e., two stalls and three small religious praying facilities, were found on the ROW. Thus, occurrence of involuntary resettlement is expected for losses of structures, business activities, livelihoods, and living conditions as mentioned in the succeeding section. These structures should be removed and/or relocated by using appropriate means and all the losses should be subject to proper compensation and resettlement assistance.

(2) Initial efforts to avoid or minimize involuntary resettlement

In the project plan, the proposed bridge and approach road alignments were selected in order to avoid or minimize the occurrence of involuntary resettlement as much as possible as mentioned in Sections 9.1 and 12.3. In addition, in order to minimize the affected area, vertical retaining wall structure is proposed for the boundary of approach roads instead of a slope structure.

12.4.2 Legal and Policy Framework for Land Acquisition and Resettlement in Myanmar

(1) Legislation Related to Land and Land Tenure

According to the State Constitution (2008), ‘The Union is the ultimate owner of all lands and all natural resources above and below the ground, above and beneath the water, and in the atmosphere in the Union’. Although the socialist system was abolished in 1988, the existing land law and directions are still in effect today without formal revision.

There are many significant laws which govern land issues, land administration, and land ownership in Myanmar such as the Land Nationalization Act (1953), Disposal of Tenancies Law (1963), Land Acquisition Act(1894), Forest Law(1992), and Farm Land Law (2012).

(2) Types and Classes of Land

From the administrative point of view, land can be classified into the following 11 categories:

- (i) Freehold Land: Freehold land can be interpreted as “ancestral land”. It is transferable in accordance with the Land Acquisition Act.
- (ii) Grant Land: Grant land is a land owned by the government. Government land may be disposed by grant or lease to any person or entity for a stipulated period. The lease period could range from ten years, to 30 years, or even up to 90 years.
- (iii) Agricultural Land: Agricultural land is defined as a “land being utilized or kept in possession for agriculture purposes”. All agricultural lands became under exclusive state ownership with the enactment of the Land Nationalization Act in 1953. Agricultural land is nontransferable in accordance with the act.
- (iv) Garden Land: Garden land is a kind of “agricultural land”, but the type of crop(s) grown in the garden land is different from those usually grown in the agricultural land.

- (v) **Grazing Land:** Grazing land is stipulated in the Nationalization Act (1953) as a land for the grazing of cattle and no revenue is expected from the levy.
 - (vi) **Cultivable Land, Fallow Land, and Waste Land:** These are lands which the right to cultivate/utilize may be granted by the government to state-owned economic organizations, etc. A maximum period of 30 years may be granted to cultivate/utilize the land.
 - (vii) **Forest Land:** Forest land is declared and administered in accordance with the Forest Law. Permission is required from the ministry in extracting timber, cutting firewood, producing charcoal, etc.
 - (viii) **Town Land:** In most cases, it could be classified under either freehold land or grant land. However, the land belongs to a specific categorization because the town is the owner of the land.
 - (ix) **Village Land:** Village land also belongs to a specific categorization like town land because the village is the owner of the land.
 - (x) **Cantonments:** Cantonments is a specific type of land acquired by the government for exclusive use by the military. The land will be acquired under the Land Acquisition Act and exempted from land tax.
 - (xi) **Monastery Land:** The land which the Ministry of Home Affairs may declare as monastery land and it is obtained based on the Land Acquisition Act.
- (3) **Legislations Related to Land Acquisition**

The Land Acquisition Act 1894 promulgated during the British Colonial Era is even now the core law for land acquisition and resettlement in Myanmar. The contents of the act are shown in Table 12.28. According to the State Constitution (2008) as stated above, ‘The Union is the ultimate owner of all lands and all natural resources above and below the ground, above and beneath the water, and in the atmosphere in the Union’. Although the socialist system was abolished in 1988, the existing land law and directions are still in effect today without any formal revision.

Table 12.28 Contents of Land Acquisition Act 1894

Part I	Preliminary
Part II	Acquisition
Part III	Reference to Court and Procedure Thereon
Part IV	Apportionment of Compensation
Part V	Payment
Part VI	Temporary Occupation of Land
Part VII	Acquisition of Land for Companies
Part VIII	Miscellaneous

Source: JICA Survey Team

There are many significant laws that govern land issues, land administration, and land ownership in Myanmar such as the Land Nationalization Act (1953), Disposal of Tenancies Law(1963), Land Acquisition Act (1894), Forest Law (1992), Farm Land Law (2012) (refer to Table 12.1).

(4) **Land Acquisition Process**

According to the Land Acquisition Act 1984, land acquisition process is summarized into five steps enumerated below, and as shown in Figure 12.19.

(i) **Preliminary investigation**

A notification is publicized in the Gazette and the public notice of its substance is given at convenient places. Preliminary investigations are conducted, which include any survey, digging/boring, and delineation of land boundaries.

(ii) Hearing of objections

Objections to land acquisition are collected in writing within 30 days. The collector examines the objections and make consensus against the objections. If the collector decides the necessity, a report containing recommendations on the objections is submitted to the President of the Union for a decision.

(iii) Declaration of intended acquisition

The declaration of land acquisition is publicized in the Gazette, and stated at the district or other territorial division in which the land situates. The declaration includes the purposes, approximate area, location, and plan.

(iv) Enquiry into measurements, value and claims, and award by the collector

(iv-1) The collector marks out and measures the land, and gives a public notice at convenient places near the land. The notice is also provided to persons known or believed to be interested in the land.

(iv-2) Examination of award (area of land and compensation)

The collector proceeds to inquire for objections pertaining to the measurement, the value of the land at the date of the publication of the notification, the respective eligibilities to claim the compensation. Then, the collector examines an award based on the area of the land, as well as compensation including opinions of PAPs and the apportionment of compensation among PAPs.

The award is filed for conclusive evidence between the collector and the persons interested in the land. The collector immediately provides notice of the awards to persons who are not present or their representatives when the award is made.

The collector makes any effort to fix the enquiry.

(iv-3) Grievance

If the deliberation reaches an agreement, the Award Committee issues the decision concerning the type and amount of compensation. If there is no agreement reached, the deliberation will still continue until there is such an agreement. If the affected people and Award Committee could not conclude with further deliberation meetings, the General Administration Department (GAD) can serve as an intermediary between them.

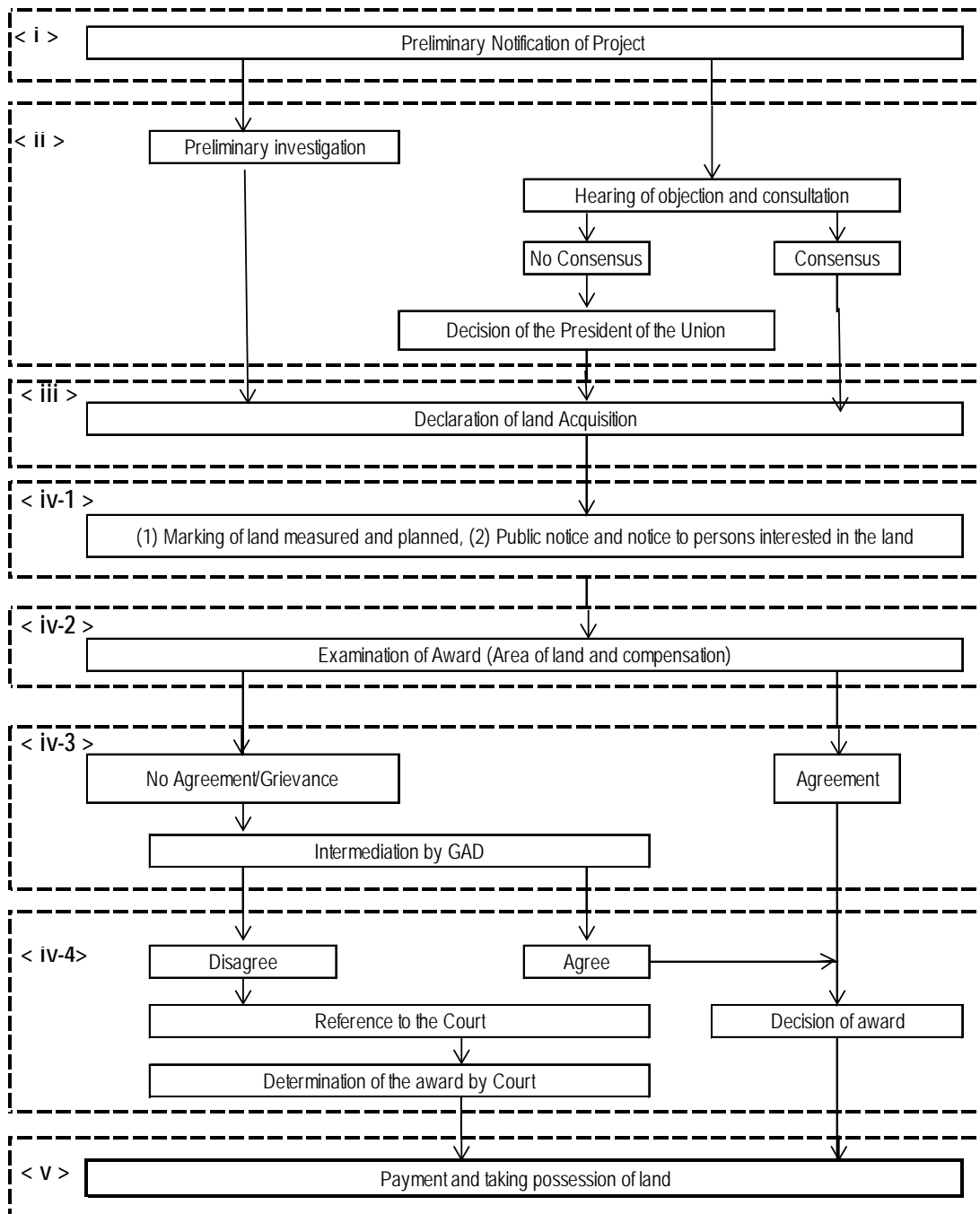
(iv-4) Reference to the Court

Any person interested in the land who does not accept the award may, by written application to the Collector, require that the matter be referred to the court for determination, whether the objection pertains to the measurement of the land, the amount of the compensation, the person to whom it is payable, or the apportionment of the compensation among the persons interested.

If the person agrees with the compensation, the particulars are specified in the award for the conclusive evidence. If any dispute arises, the collector may refer the disputes to the decisions of the court.

(v) Payment and taking possession of land

The collector pays compensation and takes possession of the land. The collector gives the persons sufficient time to remove their property without inconvenience before taking possession.



Source: JICA Survey Team

Figure 12.19 Flow of Land Acquisition under Myanmar Legislation

(5) Comparison between the JICA Guidelines and Myanmar Legislation

Table 12.29 summarizes the gaps between the JICA guidelines/the World Bank’s safeguard policies and Myanmar legislation on land acquisition and involuntary resettlement. Although the Land Acquisition Act was promulgated in 1894, the act may cover the fundamental policies of compensation for land acquisition.

Table 12.29 Comparison of JICA Guidelines with Myanmar Legislation, and Required Project Policy to Fill in the Gaps

JICA Guidelines for Environmental and Social Considerations*	Laws of Myanmar		Required Project Policy to Fill in the Gaps
	Name of the Law	Provision Described	
1. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICAGL)	None	There is no law in Myanmar, as well as corresponding provisions.	Land and structure removal and resettlement are to be avoided when feasible by exploring all viable alternatives.
2. When population displacement is unavoidable effective measures to minimize impact and to compensate for losses should be taken.(JICAGL)	Land Acquisition Act of 1894 (Article 3)	Article 3 of the Land Acquisition Act stipulates that a person who has right in the land would be entitled to claim compensation if the land was acquired under this act. However, it does not state effective measures to minimize the impact.	Effective measures to minimize the impacts and to compensate for losses should be considered.
	Farm Land Law of 2012 (Article 26)	Article 26 of the Farmland Law of 2012 stipulates that suitable compensation and indemnity in farmland acquisition for the interest of the state or public would be taken.	There is no farmland in and around the project site.
	Farmland Rules of 2012 (Article 64)	Article 64 of the Farmland Rules of 2012 stipulates that the compensation in farmland for the interest of the state or public would be taken.	There is no farmland in and around the project site.
3. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities, and production levels to pre-project levels.(JICAGL)	Land Acquisition Act of 1894 (Article 23)	Land Article 23 of the act stipulates that damages on standing crops and trees, land, properties, incidental to relocation of residence or business and losses of profits due to land acquisition are considered for compensation, although it does not clearly state to support PAPs for the improvement or at least restore their standard of living.	The gap is little and "policy on improvement or at least restoration of means of livelihood of PAPs" is described in the Project policy according to the JICA guidelines
4. Compensation must be based on the full replacement cost as much as possible. (JICAGL)	Land Acquisition Act of 1894 (Article 23)	Article 23 of the act stipulates that "the market value of the land at the date of the publication of the notification" is considered, although it does not state "full replacement cost".	The gap is little and "compensation must be based on full replacement cost as much as possible" as described in the project policy according to the JICA guidelines.
5. Compensation and other kinds of assistance must be provided prior to displacement. (JICAGL)	Land Acquisition Act of 1894 (Article 23)	There is no law in Myanmar, as well as corresponding provisions.	The gap is little and "compensation and other kinds of assistance must be provided prior to displacement "as described in the project policy according to the JICA guidelines
6. For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICAGL)	None	No law specifically mentions the requirement of resettlement action plans for large-scale involuntary resettlement. The GAD of MOHA explained that a Land Acquisition and Resettlement Action Plan (LARAP) is required for large-scale development for approval of GAD. (Hearing in Nov. 2012).	It is said in the project policy that "resettlement action plan must be prepared and made available to the public".
7. In preparing a resettlement action	None	Same as above	It is said in the project

JICA Guidelines for Environmental and Social Considerations*	Laws of Myanmar		Required Project Policy to Fill in the Gaps
	Name of the Law	Provision Described	
plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICAGL)			policy that " in preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance".
8. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICAGL)	None	Same as above	Same as above
9. Appropriate participation of affected people must be promoted in the planning, implementation, and monitoring of resettlement action plans. (JICAGL)	None	Same as above	It is said in the project policy that "appropriate participation of affected people must be promoted".
10. Appropriate and accessible grievance mechanism must be established for the affected people and their communities. (JICAGL)	Land Acquisition Act of 1894 (Article 5A, 18)	Article 5A of the Land Acquisition Act stipulates that any person whose land is affected (acquired) can be object to land acquisition within thirty (30) days of the notification. Besides, Article 18 stipulates that any PAP who has not accepted the award can refer to the court for determination.	There is no fundamental difference.
11. Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advance of such benefits (WBOP4.12 Para.6)	Land Acquisition Act of 1894 (Article 4)	Article 4 of the act stipulates that a notification of land requirement for public purposes is published to start surveys and land marking although it does not state the details of the surveys to establish eligibility through an initial baseline survey (including population census).	There is no fundamental difference.
12. Eligibility of benefits includes, the PAPs who have formal legal rights to the land (including customary and traditional land rights recognized under the law), the PAPs who do not have formal legal right to the land they occupying. (WB OP4.12 Para.11)	Land Acquisition Act of 1894 (Article 9)	Article 9 of the act stipulates that an occupier (if any) of the land and all persons known or believed to have rights on the lands are notified or invited for explanations although the eligibility is not clearly prescribed in the act.	It is not clearly prescribed that eligibility of benefits includes PAPs who do not have formal legal rights to land. In the project policy it is said that "those who do not have a legal rights are also regarded as PAPs".
13. Preference should be given to land-based resettlement strategies for displaced persons whose livelihood are land-based. (WB OP 4.12 Para.11)	None	No law was identified on preference to land-based resettlement strategies for displaced person.	No land-based resettlement Is expected in the Project.
14. Provide support for the transition period (between displacement and livelihood restoration). (WB OP 4.12 Para.6)	None	No law was identified on the provision of support for the transition period.	In the project policy it is said that "support to PAPs for the transition period is to be provided".
15. Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those	None	No law was identified on particular attention to vulnerable groups.	In the project policy it is said that "particular attention must be paid to

JICA Guidelines for Environmental and Social Considerations*	Laws of Myanmar		Required Project Policy to Fill in the Gaps
	Name of the Law	Provision Described	
below the poverty line, landless, elderly, women and children, ethnic minorities, etc. (WB OP4.12 Para.8)			the needs of the vulnerable groups among PAPs".
16. For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared. (WB OP 4.12 Para. 25)	None	No law was identified on the criteria of abbreviated resettlement plan.	Abbreviated resettlement plan (ARP) should be prepared by the proponent.

Note: * Including the World Bank Safeguard Policy OP 4.12

Source: Land acquisition resettlement related to the legislation of Myanmar, JICA Guidelines for Environmental and Social Considerations (2010.4) and the World Bank OP 4.12.

(6) Institutional Framework

Agencies responsible for land acquisition differ from those handling the management of land acquisition as shown in Table 12.30.

Table 12.30 Responsible Agencies for Land Acquisition

Land		City Development Committee (CDC)	MOAI	MOECAAF (Forest Department)	GAD (Ministry of Home Affairs)
1	Yangon, Nay Pyi Taw, and Mandalay cities	X			X
2	Farm, vacant, fallow, and virgin lands		X		X
3	Forest lands			X	
4	Other town and village lands				X

Note: X – responsible

Source: JICA Survey Team

The roles and functions of the organizations for implementing land acquisition are shown in Table 12.31.

Table 12.31 Roles and Functions of Organization for Implementing Land Acquisition

Organization	Role and Function
City Planning and Land Administration Department (CPLAD)	1) For non-agricultural land, CPLAD at the township level investigates land use, area size, land ownership and tenancy, and prepare necessary documents and maps for land acquisition. 2) CPLAD routinely handles transfer of land titles or subdivisions of plots, etc., and prepares land lease certificates.
Settlement and Land Record Department (SLRD)	1) For agricultural lands, the SLRD under MOAI at the township level investigates area size and land ownership, and prepares necessary documents and maps for land acquisition. 2) SLRD surveys the market prices of lands, buildings, crops, and trees for compensation.
Award Committee	The Award Committee chaired by the respective Township Administrator is established in order to examine the awards (entitlement and amount of compensation).
District Administrator	The District Administrator issues land lease grant for land not exceeding one acre (The Lower Burma Town and Village Lands Manual, 1899).
General Administration Department (GAD)	The GAD issues land lease grant for land exceeding five acres (The Lower Burma Town and Village Lands Manual, 1899)

Source: JICA Survey Team

12.4.3 Features and Expected Land Acquisition and Resettlement of the Project

(1) Inventory List of Affected Land, Structures, and Assets

As mentioned above, all lands for the proposed Bago River Bridge and approach roads are public land under the Myanmar government (mostly Myanmar Railways, MPA, and MOC), YCDC and Thanlyin Township. Lands for the proposed approach roads should be transferred from these government organizations (mostly Myanmar Railways) to PW through intra-government transaction agreement. Therefore, neither land acquisition nor resettlement of houses and people is expected.

However, results of the inventory survey and household survey (see Appendix 10.3) indicated that there are two stalls and three small religious praying facilities as well as trees within the ROW of the approach roads. In addition, several houses of PW, which are located outside the ROW, are likely to be affected (see Table 12.32 and Figures 12.20, 12.21, and 12.22).

Table 12.32 Inventory of Affected Land, Structures, and Assets

Item	Administrative Division	Present Use	Size, Buildings, Materials, etc.	Affected Person	Ownership and Tenant
(1) Land (Public Land)					
1) Land-1	Thaketa TS	Storage site for railway bridge materials and beautification space of Myanmar Railways	65,000 m ²	-	Government land (Myanmar Railways)
2) Land-2	Thaketa TS	Road section	2,700 m ²	-	Government (Public Works) or Public land (YCDC or YRDC)
3) Land-3	Thanlyin TS	Storage site for railway bridge materials and beautification space of Myanmar Railways	90,000 m ²	-	Government land (Myanmar Railways)
(2) Structures and Business Activities					
1) Stall-1	Thaketa TS	Selling of soft drinks and snacks	2.4 m ² , single story bricks	4	Lent from MR
2) House-1	Thaketa TS	Residence (YCDC officer)	3 m ² , 1 room, single story wooden terrace house	7	Lease from MOC
3) House-2	Thaketa TS	Residence (staff of Myanmar Gas and Oil Enterprise)	3 m ² , 1 room, single story wooden terrace house	5	Lent from MOC
4) House-3	Thaketa TS	Residence (bus driver)	3 m ² , 1 room, single story wooden terrace house	3	Lent from MOC
5) House-4	Thaketa TS	Residence (Goldsmith)	3 m ² , 1 room, single story wooden terrace house	5	
6) Small Praying Facility-1	Thaketa TS	Praying facility of traditional religion for workers	5 m ²	-	JFE Contractor leasing from MR
7) Small Praying Facility-2	Thanlyin TS	Buddhist praying facility for residents	30 m ²	-	Htut Khaung Construction Family Co., Ltd. leasing from MR
8) Small Praying Facility -3	Thanlyin TS	Praying facility of traditional religion for residents	5 m ²	-	Htut Khaung Construction Family Co., Ltd. leasing from MR
(3) Trees					
1) Trees	Thaketa TS	Planted for protecting and beautification of compounds of Myanmar Railways	46 trees	Myanmar Railways	Myanmar Railways
2) Trees	Thanlyin TS	Planted for protecting and beautification of compounds of Myanmar Railways	114 trees	Myanmar Railways	Myanmar Railways

Source: JICA Survey Team



Source: JICA Survey Team

Figure 12.20 Map of the Proposed Approach Road and Surrounding Area (Thaketa Township Side)



Source: JICA Survey Team

Figure 12.21 Map of the Proposed Approach Road and Surrounding Area (Thanyin Township Side)

(2) Features of affected structures and business activities

1) Stalls

In the earlier stage of designing the approach road alignment, two affected stalls were found within the ROW of approach roads. One is in Thaketa Township side and another is in Thanlyin Township side. The former is close to the intersection of Thanlyn Chin Kat Road and Shukyinthar Myo Pat Road where the stall sells soft drinks and snacks.

Another stall located at the toll gate of Khai Khau Pagoda Road in Thanlyin Township, which was assigned to be affected in the initial stage, was found to be outside of the approach road during the detailed inventory survey.




2) Houses within the compound of PW

There are four terrace houses of PW employees built within the compound of PW. Among them is a terrace house and newly constructed small houses resided by four families other than PW employees, which are found to be located about 1 m to 3 m outside the boundary of the proposed approach road in Thaketa Township. In the project plan, vertical retaining wall along the boundary will be installed. In general, a width of allowance of few meters is required for construction works. Thus, it is required to set back or relocate these houses. Assuming that these houses are located at the same place, affected households are expected to be four with 20 persons each.

According to PW, however, these houses will be relocated or set back within the compound of PW in the near future.

3) Religious facilities

Three small religious praying facilities and altars were found within the ROW of the approach roads. In the Thaketa Township side, a traditional religious altar was found. This is a temporary structure, which was installed by the construction contractor of a steel fabrication factory project, PW-JFE Joint Venture, for its workers. In the Thanlyin Township side, one Buddhist praying facility on the pond and another traditional praying altar were found. Both were lent to Htut Khaung Construction Family Co., Ltd. from Myanmar Railways and will be by its own expenses.

		
<p>1) Stall located at the intersection between Shukhinthar-Mayopat Road and Thanlyin Chin Kat Road.</p>	<p>2) Houses of PW lent to people other than PW employee outside the boundary of the proposed approach road (Thaketa TS)</p>	<p>3) Houses of PW lent to people other than PW employee outside the boundary of the proposed approach road (Thaketa TS)</p>



Source: JICA Survey Team

Figure 12.22 Photos of Affected Structures and Trees within the ROW of the Proposed Approach Roads

4) Trees within the ROW

Around 160 trees within the ROW of approach roads will be affected as shown in Appendix 10.3. Results of inventory survey on trees within the ROW indicated that 48 trees in Thaketa Township and 112 trees in Thanlyin Township, as shown in Table 12.33. Out of the total, 14 *Swietenia macrophylla* trees and ten *Delonix regia* trees of IUCN Red List species were found, as shown in Table 12.33.

Table 12.33 Red List Tree Species within the ROW

	Thaketa Township	Thanlyin Township	Total
1) <i>Swietenia macrophylla</i>	10	4	14
2) <i>Delonix regia</i>	0	10	10

Source: JICA Survey Team

In order to preserve these affected trees within the ROW, PW should first consider to provide measures of minimizing the number of affected trees in the project plan. Then, in order to obtain a permit from MOECAF, PW should submit an application letter, which includes the names and numbers of IUCN Red List species together with other tree species, as well as measures for the removal and replanting of trees to the Forest Department, MOECAF. In case of fast approval, the permit from MOECAF will be provided to PW within several days.

In addition, as for the removal and/or replanting of trees within the ROW, PW should also submit an application letter to YCDC's Playgrounds, Parks, and Gardening Department (PPGD). Then, YCDC-PPGD will carry out the removal and replanting of trees in their gardening areas with charges after inventory survey is conducted by themselves. According to YCDC-PPGD, the charges of replanting trees are MMK 40,000, MMK 30,000, and MMK 20,000 per tree, depending on the height of trees and regardless of tree species.

12.4.4 Policy for Land Acquisition and Resettlement

The required policy on losses of structures and assets, and resettlement due to the Project should basically comply with the legal framework of land acquisition and compensation of Myanmar. As shown in Table 12.32, however, there are some gaps between the policy of Myanmar and the JICA guidelines. Accordingly, the policy for loss of structures and assets, and resettlement should be supplemented by the JICA guidelines.

The policy is summarized as follows:

- (i) Losses of structures and assets, and resettlement should be avoided or minimized if feasible, by identifying possible alternative project designs.
- (ii) If losses are unavoidable, all PAPs should be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions.
- (iii) Compensation and resettlement assistance will be provided to any PAPs, that is, any person, household, or business which on account of project implementation would have his, her, or their:
 - Standard of living adversely affected;
 - Right, title, or interest in any property (including commercial properties, tenancy, or any other fixed or moveable assets, acquired or possessed, temporarily or permanently).
 - Income earning opportunities or work adversely affected temporarily or permanently.
- (iv) All PAPs residing, working, or doing business within the project-affected areas as of the date of the latest census and inventory of lost assets, are entitled to compensation for their lost assets at replacement cost, if available, and restoration of incomes and businesses. Also, PAPs will be provided with sufficient rehabilitation measures to assist them in order to improve or at least maintain their living standards, income-earning capacity, and production levels prior to the Project.
- (v) PAPs who will lose only a part of their physical assets will not be left with a portion that will be inadequate for sustaining their current standard of living. The minimum size of remaining structures will be agreed during the compensation process.
- (vi) PW shall prepare the abbreviated resettlement action plan (ARP).
- (vii) ARP will be disclosed for the reference of PAPs as well as other interested groups.
- (viii) Payment for land will be based on the principle of replacement cost, if any.
- (ix) Assistance for losses of structures and resettlement will be provided not only for immediate loss, but also for a transition period needed to restore livelihood and standards of living of PAPs.
- (x) ARP must consider the needs of those most vulnerable to the adverse impacts of resettlement (including the poor, those without legal title to land, ethnic minorities, women, children, elderly, and disabled). Assistance should be provided in order to help the vulnerable in improving their socioeconomic status.
- (xi) PAPs and their communities will be consulted about the Project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to the extent possible be involved in the decisions that are made concerning their loss of land.

- (xii) Adequate budget support will be fully committed and made available to cover the costs of land acquisition within the agreed implementation period. The funds for all replacement activities will come from PW.
- (xiii) Payment of compensation will be completed prior to any construction activity, except when the court of law orders so in expropriation cases.
- (xiv) Institutional arrangements for the effective preparation and implementation of ARP will be identified and put in place prior to the commencement of the process. This will include the provision of adequate human resources for the supervision, consultation, and monitoring of land acquisition and rehabilitation activities.
- (xv) Appropriate reporting (including redress functions and monitoring) will be identified and set in place as part of the ARP system.

12.4.5 Estimation of Compensation and Resettlement Assistance

PW shall conduct necessary compensation for the losses of structures and assets, and resettlement assistance including support to the livelihood of PAPs during the transition period.

Estimated cost for necessary compensation and resettlement assistance are shown in Table 12.34.

Table 12.34 Necessary Compensation and Resettlement Assistance

Item	Size, building material, etc.	Affected Persons	Ownership and tenure	Household income (monthly, MMK)	Compensation and resettlement assistance cost (MMK)*	
1	Stall-1	2.4 m ² , single story bricks	4	Lent from MR	400,000	2,400,000
2	House-1	3 m ² , 1 room, single story wooden terrace house	7	Lent from MOC	193,000	1,158,000
3	House-2	3 m ² , 1 room, single story wooden terrace house	5	Lent from MOC	145,000	870,000
4	House-3	3 m ² , 1 room, single story wooden terrace house	3	Lent from MOC	210,000	1,260,000
5	House-4	3 m ² , 1 room, single story wooden terrace house	5		170,000	1,020,000
6	Small praying facility-1	5 m ²	-	JFE Factory Contractor leasing from MR	-	own expense
7	Small praying facility-2	30 m ²	-	Htut Khaung Construction Family Co.,Ltd. Leasing from MR.	-	own expense
8	Small praying facility-3	5 m ²	-	Htut Khaung Construction Family Co.,Ltd. Leasing from MR.	-	own expense
9	Trees	46 trees	Myanmar Railways	Myanmar Railways	40,000/tree**	1,840,000
10	Trees	114 trees	Myanmar Railways	Myanmar Railways	40,000/tree**	4,560,000
	Cost for Structures (excluding trees)					6,708,000
	Cost including trees					13,108,000

Note 1: * Income of six months + sales of six months, if any.

Note2: ** Charge of tree removal and replanting to be paid to YCDC-PPGD

Source: JICA Survey Team

12.4.6 Specific Procedures for Loss of Structures and Resettlement for the Project

(1) Specific procedures

The Project specifies the following procedure for compensation and resettlement assistance based on the Land Acquisition Act referring to the JICA guidelines:

- 1) Setting up of implementation team for ARP in PW.
- 2) Final identification of PAPs.
- 3) Notification of “land usage by the Project” (including purpose of the Project and details of land to be used; similar function as cutoff date).
- 4) Completion of ARP preparation.
- 5) Forming of Compensation Fixation Committee

Members: PW, YCDC, Officer of GAD (General Administration Department), and PAPs (at necessary time)

Task: a) Valuation of compensation and resettlement assistance amount including support of livelihood of PAPs, b) Negotiation with PAPs and c) Arrangement of payment procedure.

(2) Preparation of ARP

PW should prepare ARP in the planning stage.

ARP should include the following items:

- (i) Necessity of loss of structures and resettlement;
- (ii) Results of the survey on all occupying structures in the project-affected areas;
- (iii) Results of the survey on households and living conditions of the occupants in the project-affected area;
- (iv) Requirement for compensation entitlements for property loss and support for livelihood rehabilitation;
- (v) Compensation procedures for property loss based on the replacement cost, utilizing the survey of replacement cost;
- (vi) Measures of rehabilitation for entitlements to improve or at least recover to the same level as compared to before land acquisition, based on the results of the needs survey for livelihood restoration;
- (vii) Authority of the organization responsible for grievance redress and process of the grievance redress;
- (viii) Specifications of organizations responsible for land acquisition (proponent, local government, consultants, etc.), and duties of such organizations;
- (ix) Implementation schedule of structures removal and land resettlement (after initiation of the process);
- (x) Compensation cost estimates and source of funds;
- (xi) Monitoring framework and monitoring form developed by the proponent;

- (xii) The results of the stakeholders meeting concerning alternatives of the Project and livelihood rehabilitation measures.

PW shall confirm that each item, for example, (a) affected scale, (b) consultative meeting with affected persons, and (c) levels of compensation and resettlement assistance, is in line with the JICA guidelines. PW shall provide compensation and resettlement assistance based on the above confirmation.

12.5 Results of the Stakeholder Meetings

The stakeholder meeting for the results of both IEE and the land acquisition and resettlement issues was held on January 24, 2014.

(1) Schedules and contents

- 1) Date : January 24, 2014
- 2) Time: 10:30 a.m. to 12:15 p.m.
- 3) Venue: Public Work Office, Ministry of Construction, Thaketa Township, Yangon Region
- 4) Host: JICA Survey Team and Public Works
- 5) Participants: 46 members (residents, concerned people including expected PAPs, and government officers including from Public Works) as shown in Appendix 10.2.
- 6) Meeting Schedule:
 1. Opening remarks by U Soe Min, Chief Engineer, Public Works, Ministry of Construction
 2. Presentation of Environmental and Social Consideration for Bago River Bridge Construction by Mr. Okuzawa from JICA Survey Team
 3. Discussion and comments from the participants
 4. Closing remarks by U Soe Min, Chief Engineer, Public Work, Ministry of Construction

(2) Results of the Meeting

1) Opening speech (U Soe Min, Chief Engineer, Public Works)

U Soe Min roughly explained the proposed project plan for the Bago River Bridge Construction by JICA and the purpose of the stakeholder meeting from the standpoint of Public Works, although the plan itself is not yet authorized by the Myanmar government.

He emphasized that the proposed Bago River Bridge is expected to perform an important role as a new transport network in Greater Yangon. He said the bridge will surely contribute to the expected economic growth in Thanlyin area and accelerate the Thilawa (SEZ) development by connecting Yangon City and Thanlyin areas.

2) Results of the Initial Environmental Examination (IEE)

Mr. Okuzawa (JICA Survey Team) showed a slide presentation about the outline of the plan and results of the study in terms of environmental and social considerations. The presentation was also followed and interpreted to Burmese.

3) Records of the Open Session: Questions and Comments from the Participants

In the open session, some questions and comments were proposed. In order to cope with the active participation of the participants, part of it required an individual consultation

after the stakeholder meeting. As a result of the questions and corresponding answers, a compilation was prepared, as shown below.

- Question 1 from U Than Htut Naing (Project Manager, Star City Project):
 - (i) At present, the JICA Survey Team decided to construct the Bago River Bridge in proximity to the existing Thanlyin Bridge (Route-3) instead of Monkey Point Route (Route-1) and Bago Point Route (Route-2). However, Route-3 is very close to Thanlyin Bridge, and traffic jam may occur at the junction of the two bridges and at the entrance of Star City. The Star City Project is located at the top of the bridge (Thanlyin Township side) while Thilawa SEZ is also under development, thus, many cars will use that new bridge. After the Star City Project will be finished, about (4,000-5,000) households will have to stay. If the households have one vehicle each, the new bridge will be used by about 5,000 vehicles daily. Moreover, the vehicles and trucks from Thilawa SEZ will also cross that bridge daily. In order to solve the traffic jam condition, MOC has to expand the Thanlyin-Kyauk Khauk Pagoda Road.
 - (ii) For the Thanlyin-Kyauk Khauk Pagoda Road expansion, the Star City Project need to remove the underground power cables (which cost about USD 1 million) for the project as well as other government properties like electric poles and telephone lines. So that, choosing the present route point may cause considerable environment and social impacts. If Route-2 would be chosen, traffic and installation of communication cables are more convenient for both township and faster to develop. Thus, MOC should choose Route-2 rather than Route-3 (proposed Bago River Bridge).
 - (iii) Comments should be recorded and described in the IEE report.
- Answer -1
 - (i) Among these three routes, Routes-1 and -2 are not acceptable because the Myanma Port Authority (MPA) did not give its permission to choose these two points for trespassing of navigation route of inland and abroad vessels. Therefore, MOC chose Route-3 as the route with minimal impact.

Future traffic volume on Bago River Bridge is forecasted to be at 30,000 pcu/day in 2020 according to the results of YUTRA. In addition, traffic from Thilawa SEZ passing through Bago River Bridge is limited to commuters only who use passenger vehicles while freight vehicles like heavy duty trucks passing through Dagon Bridge, same as the present. Therefore, due to the increase in new housing development areas like the Star City, traffic congestion is hardly expected in terms of traffic volume.
 - (ii) Route-2 was examined, and one of the future plans include the installation of an underground tunnel in YUTRA. Regarding the Project widening the existing Thanlyin-Kyauk Khauk Pagoda Road to a dual two-lane of, i.e., the Thilawa SEZ Access Road from the point near to the existing Thanlyin Bridge to the proposed Thilawa SEZ area, the proponent is the Road Department of Public Works. Thus, the JICA Survey Team will inform the department on the requirement for the removal of underground power cables.
 - (iii) Comments and suggestions will be recorded and will be submitted to concerned government organizations. Further questions and comments will be addressed to the Public Works and the JICA Survey Team.
- Question – 2 (U Thurein Win Htut (Director, Htut Khaung Co., Ltd.):

What were the reasons in deciding Route C (downstream of existing Thanlyin Bridge) instead of other upstream options of Route A and Route B?

- Answer -2

After the comparison of three options, namely, two upstream routes (Routes A and B) and a downstream route (Route C) in terms of several evaluation items such as technical feasibility and environmental and social considerations, it was concluded that Route C is the best option (see Sections 9.1 and 12.2).

- Question -3 (U Thurein Win Htut (Director, Htut Khaung Co., Ltd.):

As for Route C, two fuel pipelines are installed within the compound of Myanmar Railways and are close to the ROW of the proposed approach road. In addition, some parts are very close to the crossing of the proposed approach road section. Therefore, there is some fear that accidental explosion from construction works will damage the pipelines.

- Answer 3

The JICA Survey Team will consider appropriate measures in the design of the approach road and implementation plan of construction works. At present, applying safety measures such as wrapping of pipelines to protect from direct contact and construction of elevated road structures to pass over the pipelines during construction works are considered in order to avoid causing any damage to the existing pipelines.

4) Closing Remarks (U Soe Min, Public Works)

U Soe Min give his concluding remarks with appreciating all the attendants. He also mentioned that the JICA Survey Team and Public Works will accept any other question, suggestion, and comment by e-mail, letters, or through verbal communication.



Source: JICA Survey Team

Figure 12.23 Stakeholder Meeting

12.6 Confirmation of Environmental and Social Consideration by the JICA Environmental Checklist

According to the JICA guidelines, results of the above IEE level study are required to be confirmed by comparing with the category, environmental item, and main check items of the JICA environmental checklist for bridge and road sector.

Results of the confirmation of environmental and social considerations by the JICA Environmental Checklist are shown in Appendix 10.4.

Chapter 13

Proposed Implementation Programme

13. Proposed Implementation Programme

13.1 Implementation Structure

As discussed in Chapter 3 of this report, PW and the Ministry of Construction (MOC) are expected to be the execution agency and owner of the Project, respectively.

The execution agency that is PW under MOC, and is responsible for all project works as follows:

- Pre-construction works comprising engineering design, land acquisition, relocation/resettlement, and tender;
- Construction supervision;
- Operation and maintenance of civil works and equipment; and
- Traffic safety management.

13.2 Implementation Schedule

The implementation program (I/P) in this Preparatory Study was established based on the following assumptions:

- Loan agreement will be signed in 2015,
- Construction period will be 28 months as instructed by PW,
- Scheme of Japanese ODA loan will be applied,
- Number of contract package will be one (1),
- Consultancy services of detail design (D/D) will be supported by the Japanese grant, and
- Procurement of D/D consultant will begin after the pledge of the Japanese government

The implementation milestones and I/P are shown in Table 13.1 and Figure 13.1 respectively, assuming that common practice will be adopted.

Table 13.1 Implementation Milestones and Periods

Event/ Milestone	Period
Actions by the Governments	
Pledge by the Japanese Government	: Assumed as beginning in this I/P
Exchange Note and Loan Agreement	: 3 rd month from Pledge
Land Acquisition	: 12 months
Resettlement	: 12 months
Consultancy Services	
Procurement of D/D Consultant (by JICA)	: 4 months from Pledge
Detail Design (by JICA)	: 12 months after Procurement
Procurement of C/S Consultant (by Myanmar)	: 9 months
Pre-construction Services (Tender Period)	: 12 months
Construction Supervision	: 28 months
Post-construction Services (Defect Liability Period)	: 12 months
Construction	
Procurement of Contractor (by Myanmar)	: 12 months
Construction	: 28 months
Defect Liability Period	: 12 months

Source: JICA Survey Team

Financial Year	2015				2016				2017				2018				2019				2020				Total Month
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
Pledge, E/N and L/A	△	△																							
Procurement of D/D Consultant	■	■																							4
Detailed Design		■	■	■	■	■	■	■																	12
Procurement of C/S Consultant			■	■	■	■	■	■																	9
Pre-construction Services (Tender Period)						■	■	■	■	■	■	■													12
Construction Supervision										■	■	■	■	■	■	■	■	■	■	■					28
Post Construction Services (Defect Liability Period)																		■	■	■	■	■	■	■	12
Land Acquisition/Resettlement		■	■	■	■	■	■	■																	12

Source: JICA Survey Team

Figure 13.1 Assumed Implementation Schedule of the Bago River Bridge Construction

Chapter 14

Conclusions and Recommendations

14. Conclusions and Recommendations

14.1 Conclusions

The following items/issues are pointed out as conclusions of this Preparatory Study:

(1) Route Selection

The following three alternatives were studied and compared, which cross the Bago River in its downstream section.

Alternative 1: Monkey Point Route

Alternative 2: Bago Point Route

Alternative 3: Proximity of the existing Thanlyin Bridge Route

Alternative 3 was recommended based on comprehensive comparison in land-use conditions, natural/social environmental impacts, influences on the adjacent road network/traffic environment, possible superstructure types, estimated construction cost, and transport planning, which was agreed by PW at the Bago River Bridge Meeting held on August 6, 2013.

In the further detailed study on the route of the bridge, 140 m downstream of the existing Thanlyin Bridge was selected by considering cost and social impacts.

(2) Natural Condition Survey

Topographic Survey

Plain survey and leveling survey for road centerline, road cross section, river axial direction and river cross section had been carried out at the project site.

Geological Survey

Borehole survey with SPT was carried out at five locations: three in the river and two on land along the bridge alignment. Very soft clay or sand layer is stratified at around 10 m from the surface. Bearing layer with dense sand was found at the depth of EL. -40 m to EL. -50 m.

Hydrological Survey

Meteorological data were collected and rainfall intensities with various return periods were introduced, i.e., approximately 100 mm/hr with a return period of 50 years.

Hydrological data were collected and design water levels and scour depth were estimated, i.e., highest high water level of EL. 7.7.m and the deepest scour depth of 6.3.m at Pier P10 with a return period of 100 years.

(3) Design of Road and Bridge

a) Alignment Design

The following plans at both ends of the new bridge are:

- At the Yangon side, remodeling of the existing intersection was proposed for a desirable connection arrangement from the new bridge.

- At the Thanlyin side, new intersections with the existing approach roads to Thanlyin Bridge are proposed.

b) Cross Section

Considering continuity to Thilawa SEZ Access Road, the cross section was proposed as follows:

Carriageway: 2@3.5 m = 7 m

Inner shoulder 0.5 m

Outer shoulder 0.6 m

Median: 0.6 m

Side walk: 2.0 m

c) Bridge Type Selection

Superstructure

Six alternatives types for the superstructure were studied, and the combination of steel cable-stayed bridge with continuous steel box girder and precast continuous PC box girder is recommended. The recommendation was based on a comprehensive comparison of structural stability, constructability, construction cost, and viewpoints of maintenance, new technology, landscape, navigation and environmental impact, which was agreed by PW at the 3rd Steering Committee Meeting held on August 16, 2013.

Substructure

Three alternatives in foundation type, namely, cast-in-place concrete pile, steel pipe sheet pile, and concrete caisson were studied. Steel pipe sheet pile foundation is recommended for the one in the river based on the comprehensive comparison of workability, work period, stability against ship collision and scoring, safety, cost, and experience in Myanmar, which was agreed by PW on November 1, 2013. On the other hand, cast-in-place concrete pile is recommended for those on land.

d) Outlines of Bridge

The following are the outlines and dimensions of the bridge.

Table 14.1 Outline and Dimensions of Bago River Bridge

Assumed bridge type (tentative)	Steel Continuous Box Girder Bridge with Steel Deck Plate Steel Cable-stayed Bridge PC Precast Box Girder Bridge
Construction period	about 30 months
1) Right bank of the Bago River	
Jurisdiction	Thaketa Township (YCDC)
Road linked to the Project	Shukhinthar-Mayopat Road and Thanlyin Chin Kat Road
Length of approach road	539 m
2) Bridge - Total length 3,114 m	
Bridge part: 1,928 m, approach roads: 539 m and 647 m	
3) Left bank of the Bago River	
Jurisdiction	Thanlyin Township (YRDC)
Road linked to the Project	Kyaik Khauk Pagoda Road
Length of approach road	647 m

Source: JICA Survey Team

(4) Cost Estimate for the Project

(Confidential until the procurement of the contractor)

(5) Project Implementation Program

Based on the premise that the Project will be financed by the Japanese ODA loan, the detailed design services will be implemented through the JICA grant-aid scheme. The project implementation program is as follows:

Financial Year	2015				2016				2017				2018				2019				2020				Total Month
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
Pledge, E/N and L/A	△	△																							
Procurement of D/D Consultant	■	■																							4
Detailed Design		■	■	■	■	■	■	■																	12
Procurement of C/S Consultant			■	■	■	■	■	■																	9
Pre-construction Services (Tender Period)						■	■	■	■	■	■	■													12
Construction Supervision										■	■	■	■	■	■	■	■	■	■	■					28
Post Construction Services (Defect Liability Period)																		■	■	■	■	■	■	■	12
Land Acquisition/Resettlement		■	■	■	■	■	■	■																	12

Source: JICA Survey Team

Figure 14.1 Proposed Implementation Program

The construction works will be covered in one package or divided into two packages, which will be implemented over 24 months and completed after 70 months subsequent to the pledge by the Japanese government.

(6) Project Effects

The Project effects were assessed in terms of economic feasibilities, as usually practiced in the transport sector.

The following three kinds of evaluation indicators were calculated considering savings in vehicle operation cost and time of value as the benefit of the Project:

- Economic internal rate of return (EIRR): 13.5%
- Net present value (NPV): 54
- Benefit-cost ratio (B/C): 1.29

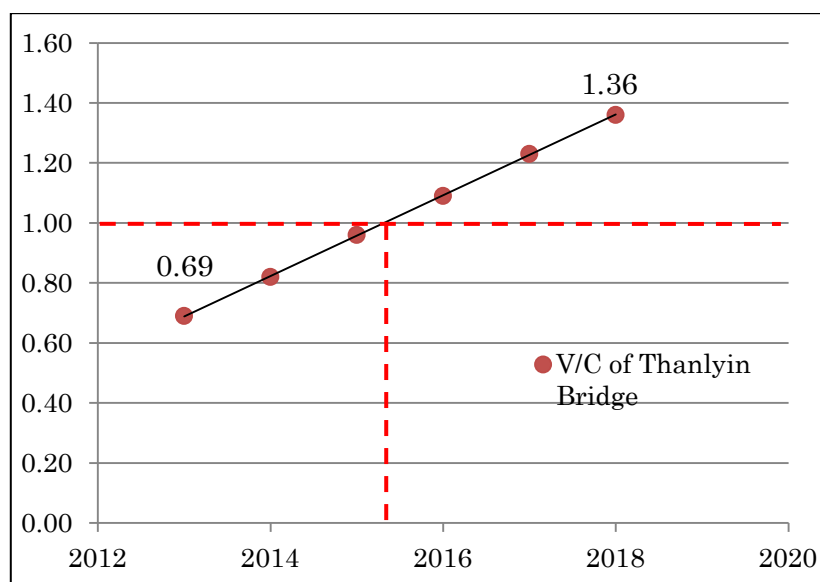
The evaluation result showed that the Project is economically feasible.

14.2 Recommendations

The recommendations of the Preparatory Study are summarized as follows:

(1) Earlier implementation of the project

In YUTRA project transport demand forecast was conducted. Figure 14.2 shows the annual variation of the traffic congestion rate at Thanlyin Bridge. V/C means the ratio by the forecasted traffic volume to the traffic capacity. In the 2015 the V/C will be exceed 1.0, which means the traffic congestion will be seen at several times in a day on Thanlyin Bridge. The congestion will be getting worse if the Bago River Bridge will not be constructed. So the Team recommend the earlier implementation of the detailed design and the construction of the Bago River Bridge.



Source: JICA Survey Team

Figure 14.2 Traffic Congestion Rate (V/C) at Thanlyin Bridge

(2) Selection of the Types of Bridge

Cable-stayed bridge with its center span of 224 m was selected, which resulted in a relatively high construction cost compared to other types with shorter spans. Although the selection was confirmed by PW at the 3rd Steering Committee Meeting held on August 16, 2013, it is necessary to study in detail the rational basis for this selection both in terms of technical and economical aspects for convincing other stakeholders like the Ministry of Finance and Revenue.

(3) Use of Tentative Project Cost

The estimated Project cost in this Survey amounted to USD 288 Million, which is tentative and should only be used as a reference. A more accurate cost estimate will be provided during the detailed design of the Project.

(4) Promotion of New Technology

Knowledge on new construction technologies should be transferred to Myanmar through the Project. The Bago River Bridge construction project can contribute to transfer of knowledge on new technology by involving the following works:

- Steel pipe well method for offshore construction; and
- Span-by-span erection method of precast-box girder.

During this Project, transfer of knowledge on new technologies should be initiated through technical seminars, workshops, construction site visits, and overseas training and study tours.

(5) Environmental and Social Consideration

1) Further works to be carried out for required EIA study and environmental approval

Considering the potential adverse impacts on the environment and society, the proposed Project is classified under Category B. Although the initial environmental examination (IEE) has been performed, it is suggested to implement the following tasks during the detailed design stage:

- a) Carry out surveys to collect environmental and social baseline data on air quality, noise, surface water quality, and ecosystems as well as social conditions in and around the project area.
- b) Work closely with members of the technical design team to examine and work out concrete measures for mitigating impacts to ambient air, acoustic environment, surface water bodies, ecosystems, etc.
- c) Prepare detailed environmental management plan and environmental monitoring plan.
- d) If it is required to obtain environmental approval from MOECAAF, submit the Preparatory Survey Report as the required EIA report to MOECAAF.
- e) Employ an environmental supervision consultant who will conduct trainings on environmental management during the pre-construction phase, and to carry out environmental supervision and monitoring during the construction phase.

2) Land acquisition and resettlement

In order to facilitate measures to mitigate impacts by the project such as losses of structures and business activities and livelihood, to local communities, it is suggested that the following tasks should be carried out during the detailed design stage.

- a) Conduct detailed socioeconomic surveys in the pre-construction phase in order to grasp the socioeconomic features of PAPs for policy-making and for preparing baseline data for ARP monitoring.
- b) Establish policies on compensation, resettlement, and entitlement for PAPs, and the results of the first socioeconomic survey.
- c) Prepare concrete plans to relocate affected houses, public structures, graves, etc., and to construct resettlement sites for PAPs.
- d) Prepare an income/livelihood restoration plan for PAPs.
- e) Identify organizational arrangements for ARP implementation.
- f) Work out a schedule for resettlement-related activities.
- g) Prepare a plan for information dissemination and public consultation (including the preparation of a leaflet introducing the Project)
- h) Prepare an ARP monitoring plan to guide activities related to ARP monitoring and supervision.

- i) Revise the cost estimation for land acquisition, compensation, resettlement, livelihood restoration, monitoring, and supervision.
- j) Prepare an HIV/AIDS prevention plan during the early stages of detailed design.
- k) Entrust a consultant or NGO with the implementation of the HIV/AIDS prevention plan during the pre-construction and construction phases.
- l) Prepare the relocation or protection plan of the existing two fuel pipelines inside the approach road sites.

Appendix 1

*Presentation Slides for
The Presentation of Draft Final Report*

The Preparatory Survey for the Project for Construction of Bago River Bridge

Presentation of the Draft Final Report
JICA Survey Team

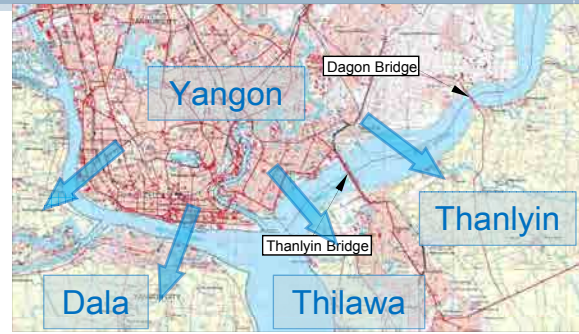
Contents of the survey

- Introduction (Chapter 1)
- Schedule of the Preparatory Survey (Chapter 2)
- Organization of Public Works (Chapter 3)
- Design Criteria Applied to the Project Design (Chapter 4)
- Study of Three alternative Locations for Bago River Bridge (Chapter 5)
- Preliminary Design of Bago River Bridge (Chapter 6)
- Natural Condition Surveys (Chapter 7)
- Hydrological Assessment of the Bago River (Chapter 8)
- Design for Feasibility Study (Chapter 9)
- Project Cost Estimates (Chapter 10)
- Demand Forecast and Economic Evaluation of the Project (Chapter 11)
- Environmental and Social Considerations (Chapter 12)
- Proposed Implementation Program (Chapter 13)
- Conclusions and Recommendations (Chapter 14)

1. Introduction

Project Background

- Yangon Region is expanding outward, including Thanlyin area
- Thilawa International port is developing
- Thilawa special economic zone (SEZ) is planned with Myanmar and Japan cooperation
- New bridge over Bago River is needed in the near future as traffic demand will be increased



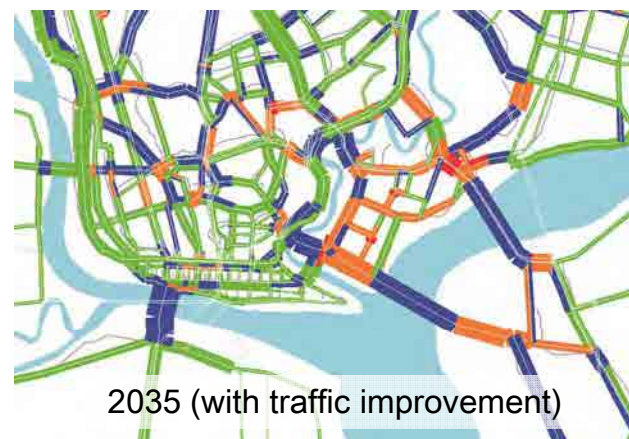
Traffic Volume Forecast



2013 (Current)

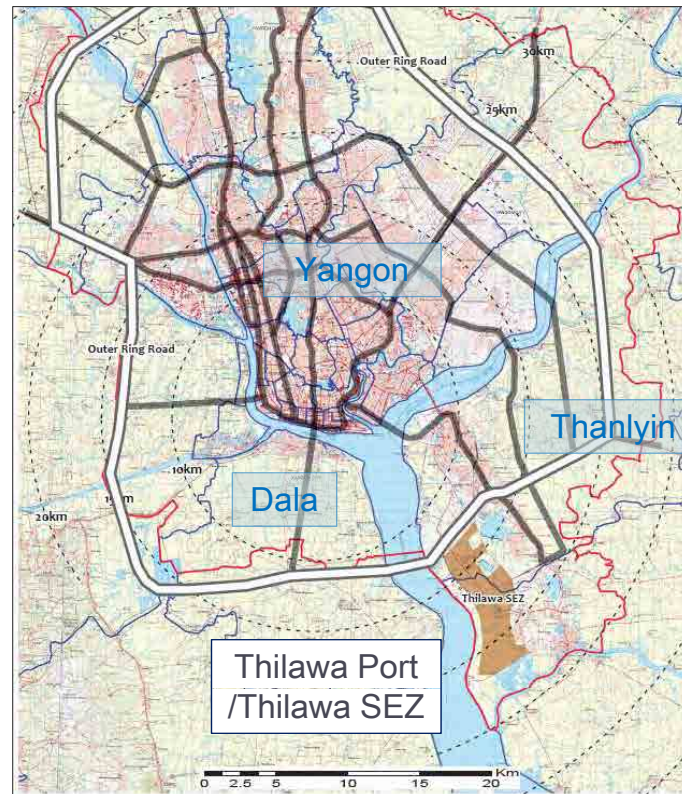


2035 (w/o traffic improvement)



2035 (with traffic improvement)

Proposed Conceptual Plan of Road Network by Strategic Urban Development Plan of the Greater Yangon (SUDP)



Objectives of Survey

- To conduct a feasibility study on the new construction of Bago River Bridge and approach road to the bridge

2. Schedule of preparatory survey

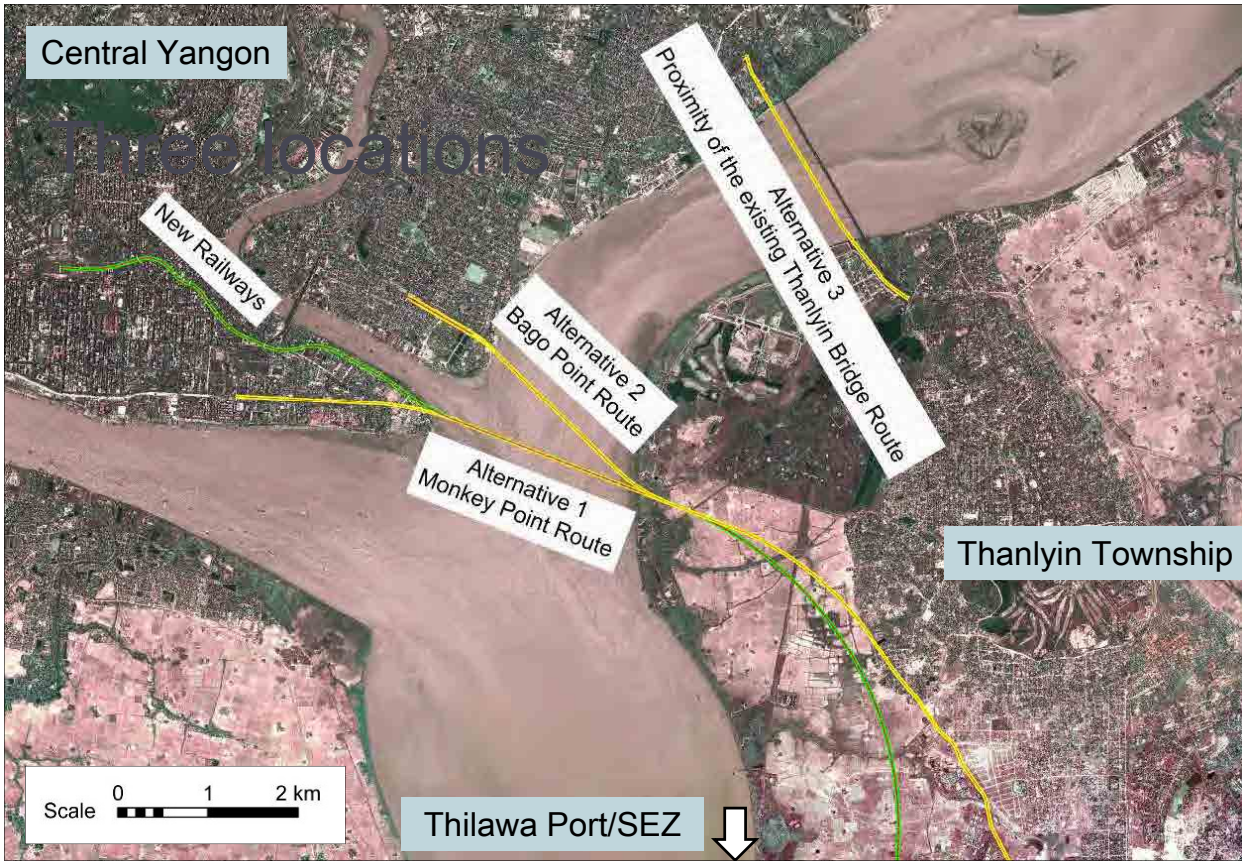
Year	2013						2014									
	Month	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	July	Aug
First Site Survey in Myanmar																
[1-1]	Presentation and Discussion of the Inception report	■														
[1-2]	Collection and Review of Existing Information	■	■													
[1-3]	Study on Highway/Bridges Operation and Maintenance System	■	■	■												
[1-4]	Site Reconnaissance	■	■	■												
[1-5]	Environmental and Social Considerations (IEE)		■	■	■											
[1-6]	Alternative Study of the Project		■	■												
[1-7]	Design Conditions of Approach Road Design		■	■												
[1-8]	Preliminary Design of Approach Road Alternatives		■	■	■											
[1-9]	Preliminary Design of Bridge Alternatives		■	■	■											
[1-10]	Preliminary Project Cost Estimates			■	■											
[1-11]	Presentation of Proposed Project Scheme			■	■	■										
[1-12]	Preparation of Progress Report			■	■											
Second Site Survey in Myanmar																
[2-1]	Implementation of Site Survey		■	■	■	■										
[2-2]	Schematic Design of the Project			■	■	■	■									
[2-3]	Survey of Construction Materials				■	■	■									
[2-4]	Construction Plan and Project Cost Estimates/					■	■	■								
[2-5]	Study on Operation and Maintenance Programme						■	■	■							
[2-6]	Environmental and Social Considerations (EIA)							■	■	■	■					
[2-7]	Traffic Demand Forecast								■	■						
[2-8]	Economic/Financial Analysis										■					
[2-9]	Preparation of Final Report														■	
Report		▲	▲	▲	▲	▲					▲				▲	
Steering Committee		▲	▲					▲								

Please send us comments on DFR by 15th of August

5. Study of Three Alternative Locations for Bago River Bridge

- Three locations are proposed for Bago River Bridge

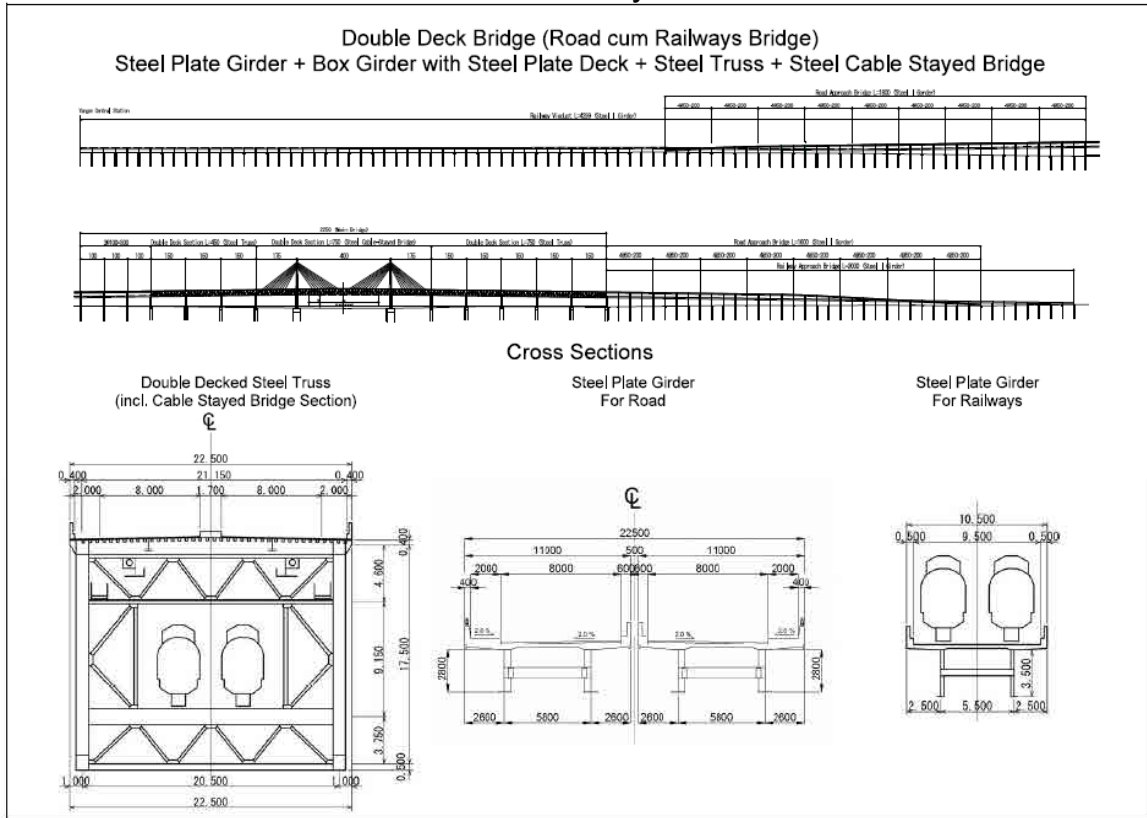




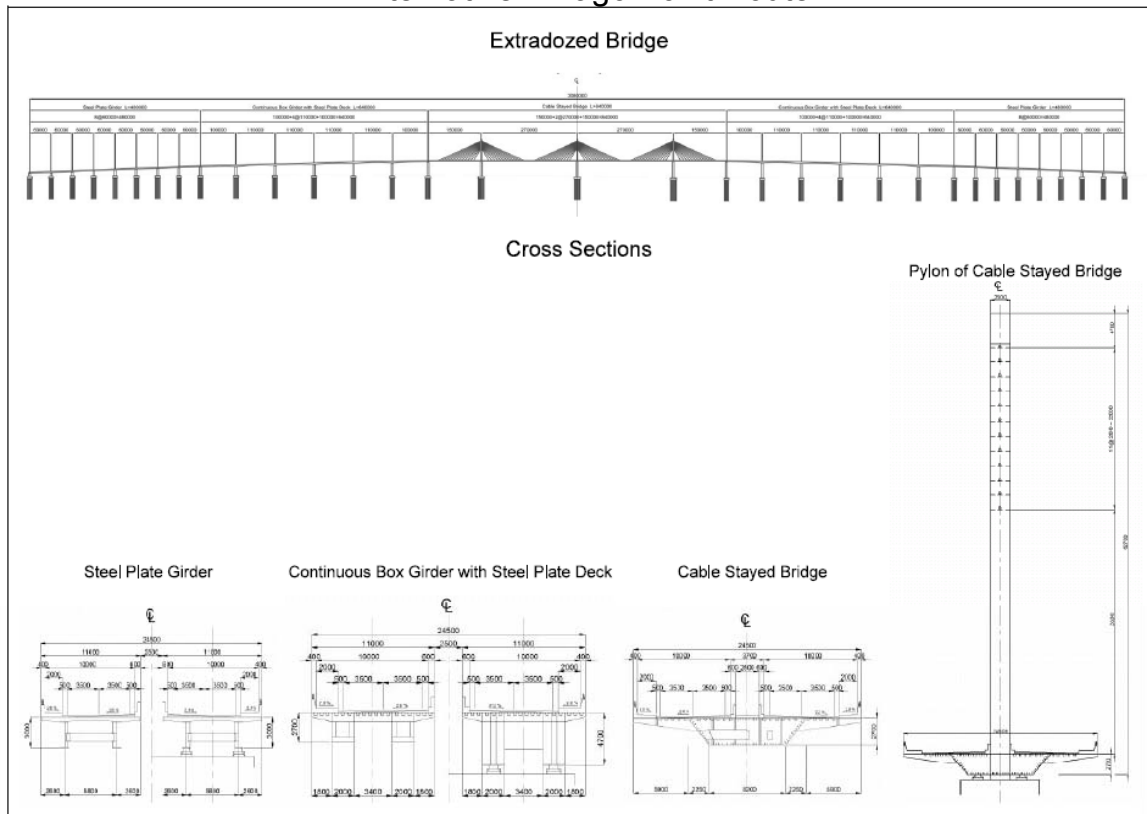
Design conditions of three alternatives

	Alternative 1 Monkey Point	Alternative 2 Bago Point	Alternative 3 Near Thanlyin Brg
Bridge Type	Road cum railway bridge	Road Bridge	
Linking Road	Strand Road/ Local Road (to be improved)	Yamonnar Road/ Local Road (to be improved)	Shukjinthar-Mayopat Road/ Kyaik Khauk Pagoda Road
Vertical Navigation Clearance	35m (for large vessel)		10m (same as Thanlyin Bridge)
Max. Navigation Width	300m	200m	112m (same as Thanlyin Bridge)

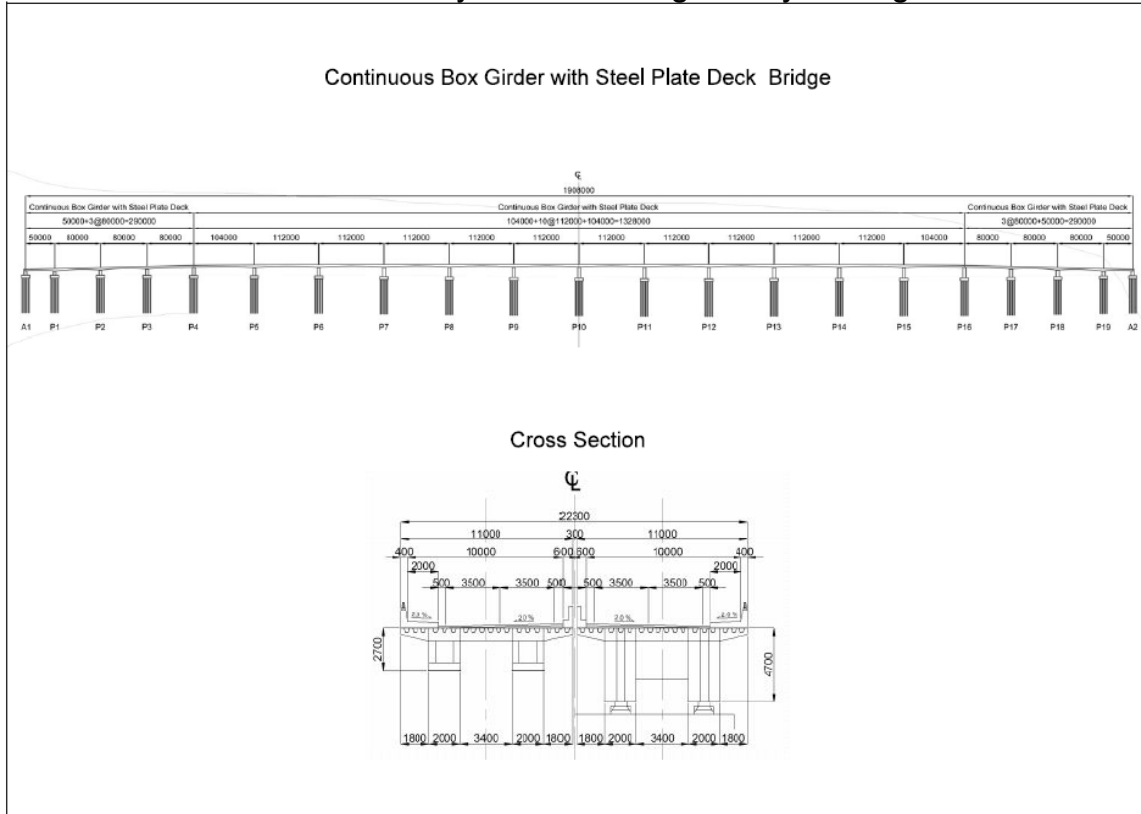
Alternative 1 Monkey Point Route



Alternative 2 Bago Point Route



Alternative 3 Proximity of the Existing Thanlyin Bridge Route



Comments from IWT

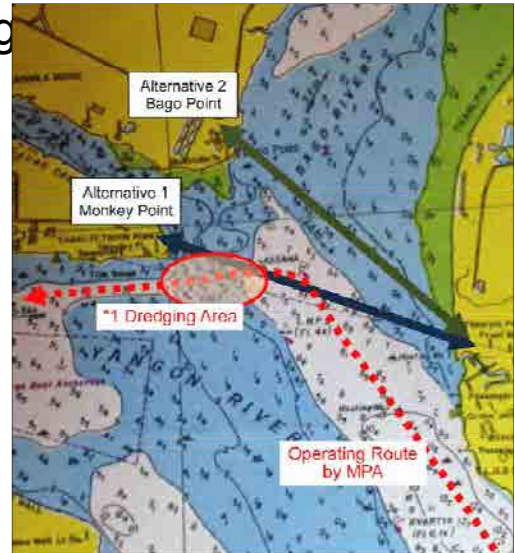
- Inland Water Transport (IWT) informed the 3 facilities along Bago River and vessel operating route

- a) IWT Dockyard
- b) Myanmar Five Star Line (MFSL) Jetty
- c) Navy Jetty



Comments from MPA

- Myanmar Port Authority (MPA) cannot accept Alternative 1, which is exactly on the operating route
- MPA claimed that Alternative 2 is not also acceptable, for it might increase the sedimentation of the operating route
- Alternative 3 is only the acceptable plan for MPA



Comparison of three alternatives (1)

	Alternative 1 Monkey Point	Alternative 2 Bago Point	Alternative 3 Near Thanlyin Brg
Total Project Length	7,120m	5,968m	2,974m
Bridge Length	5,650m	3,081m	1,909m
Land use	Ministry of Energy, Navy YCDC Plant	Private land Ministry of Energy Navy	Myanmar Railway Ministry of Construction
Social Condition	More than 200 PAPs	More than 200 PAPs	Less than 30 PAPs
Environmental	Considerable impact on air, noise (densely urban built- up area)	Some impact on air, noise (urban built-up area)	Small impact on air, noise (suburban area)

Comparison of three alternatives (2)

	Alternative 1 Monkey Point	Alternative 2 Bago Point	Alternative 3 Near Thanlyin Brg
Influence on road network	Increased traffic may cause serious traffic congestion in downtown area	Best route for road network with access road improvement	Appropriate control of traffic and improvement shall be needed in Thaketa Township
Ratio in Construction Cost (Direct Cost)	4.0	1.8	1.0
Comments from stakeholder	Seriously affect to the MPA vessel operating route		No negative comments
Evaluation			Recommend

6. Preliminary Design of Bago River Bridge (1) Alignment Design

Right bank (Thaketa)

- The project road shall be designed along with the remodeling of the existing intersection
- Access to National Races Village is required



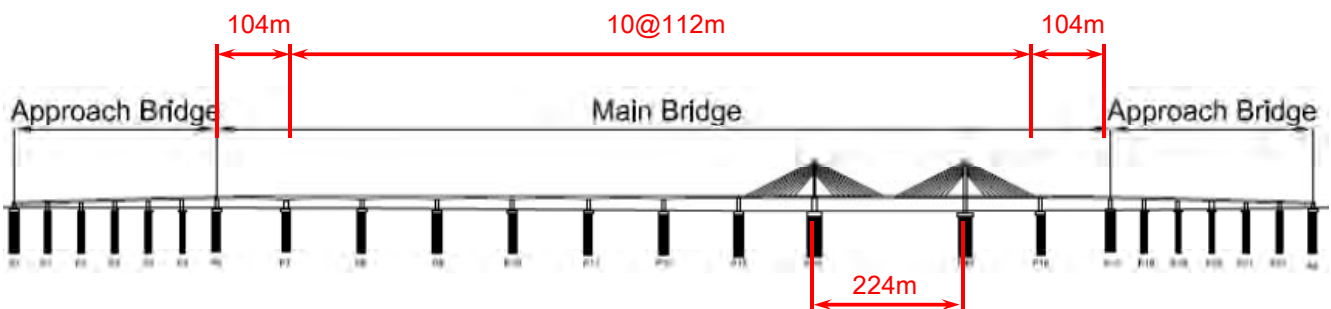
Left Bank (Thanlyin)

- Linking to the existing road
- Intersections with the existing approach roads to Thanlyin Bridge would be required



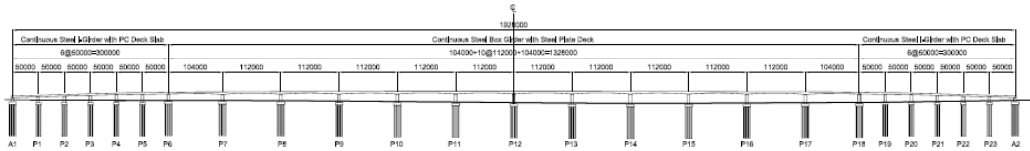
(2) Bridge Type Selection

- Main Bridge: 104m+10@112m+104m
or
104m+7@112m+224m(at navigation channel)+112m+104m
- Approach bridge: 40~60m span

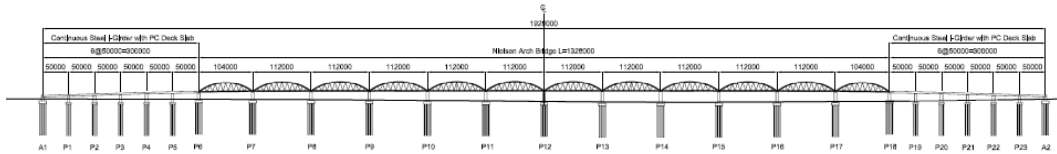


Alternatives of Bridge Type for Main Bridge

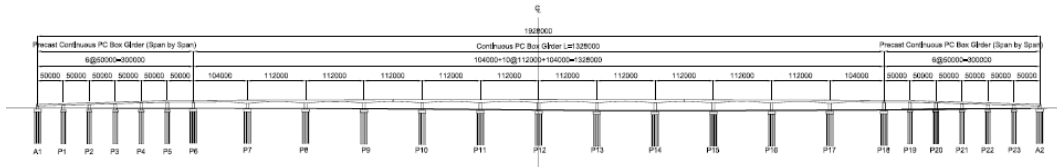
A. Continuous Steel box Girder with Steel Deck



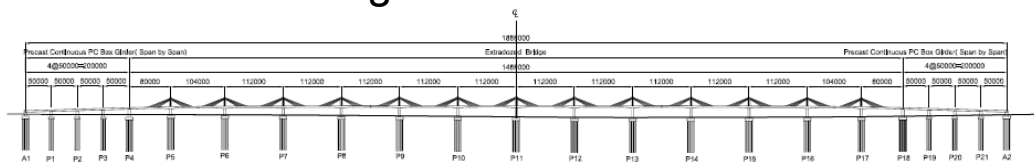
B. Nielsen Lohse Arch



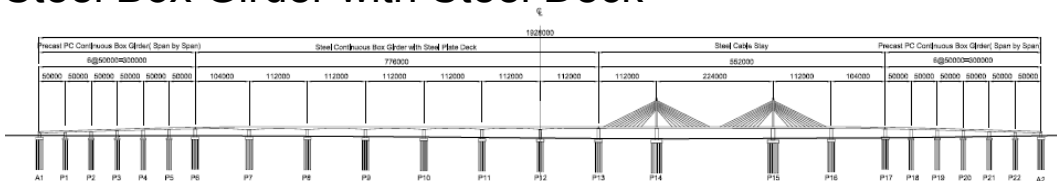
C. Continuous PC Box Girder



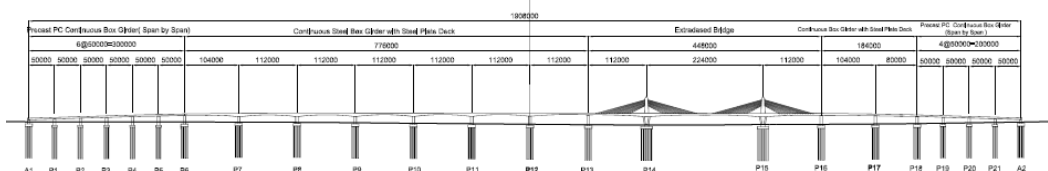
D. PC Extradized Bridge



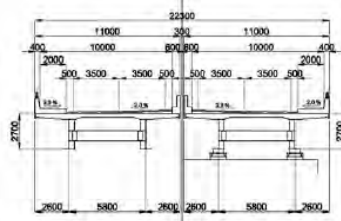
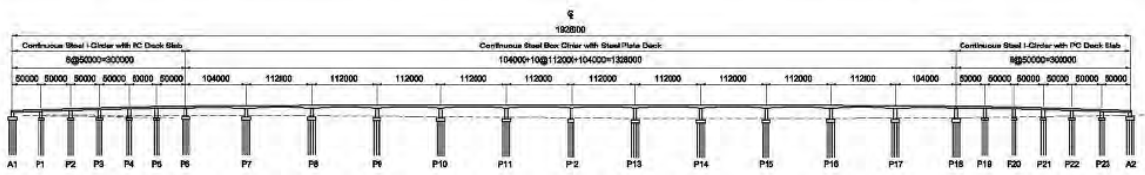
E. Combination with Steel Cable Stayed and Continuous Steel Box Girder with Steel Deck



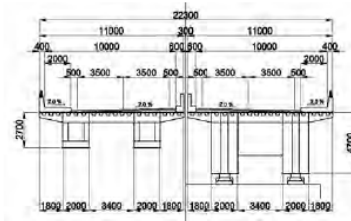
F. Combination with Extradized Bridge and Continuous Steel Box Girder with Steel Deck



Alternative-A. Continuous Steel Box Girder with Steel Plate Deck / Continuous Steel I-Girder with Precast PC Deck Slab



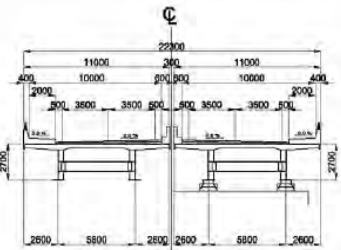
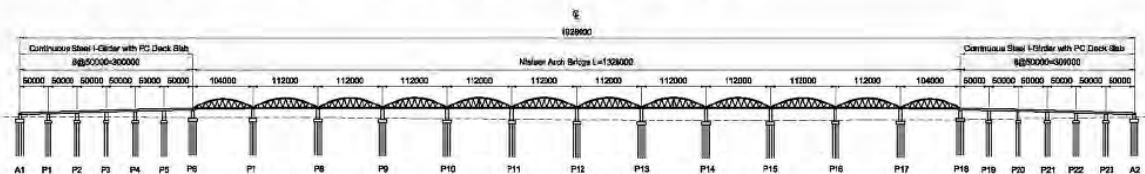
Continuous Steel I-Girder with Precast PC Deck Slab



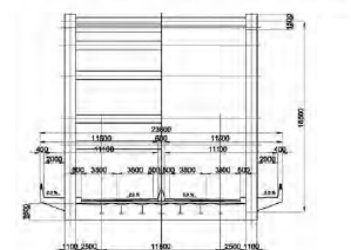
Continuous Steel Box with Steel Deck

Category	Evaluation Criteria	Max. Point	Description	Evaluation	
Technical Viability	Structural Stability	20	Multi-continuous spans is structurally strong for earthquake resistance and smooth driving	Good	20
	Constructability	10	Light and short steel members are advantage for erection. Construction period is 24 months	Good	10
Economic Viability	Construction Cost	20	$\mu=1.00$ Economical bridge type because steel fabrication cost is considerably low in comparison with Japan.	Good	20
	Maintenance	5	Periodical maintenance for painting on steel is required.	Fair	3
Other Viability	New Technology	20	Steel and precast PC deck slabs are new approaches.	Poor	6
	Landscape	10	This type of bridge is relatively visual simplicity associated with the existing Thanlyin bridge.	Poor	3
	Navigation	10	Navigation clearance is secured but careful sailing is required due to the adjacent existing Thanlyin Bridge	Fair	5
	Environment	5	Almost no impact.	Good	5
Evaluation			Recommended in case of cost minimum	72	

Alternative-B. Nielsen Arch Bridge / Continuous Steel I-Girder with Precast PC Deck Slab



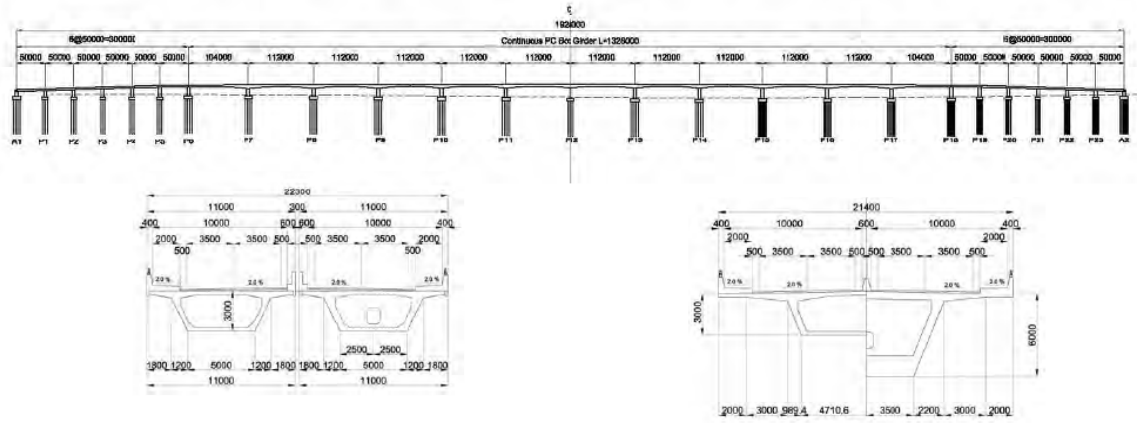
Continuous Steel I-Girder with Precast PC Deck Slab



Nielsen Arch

Category	Evaluation Criteria	Max. Point	Description	Evaluation	
Technical Viability	Structural Stability	20	Multi-simple spans are structurally weak for earthquake resistance and make noise in passing at expansion joints	Fair	10
	Constructability	10	Lift-up barge erection method using tidal movement can be applied. Construction period is 26 Months.	Fair	5
Economic Viability	Construction Cost	20	$\mu=1.21$ Span 12m is not economical span for Nielsen arch in comparison with continuous steel box girder.	Poor	6
	Maintenance	5	Periodical maintenance for painting on steel is required.	Fair	3
Other Viability	New Technology	20	Nielsen arch using cables is new technology but too small scale (Span 112m) for technology transfer.	Fair	10
	Landscape	10	This type is an aesthetical bridge but relatively visual complexity associated with the existing Thanlyin bridge.	Fair	5
	Navigation	10	Navigation clearance is secured but careful sailing is required due to the adjacent existing Thanlyin Bridge.	Fair	5
	Environment	5	Almost no impact.	Good	5
Total Point				49	

Alternative-C. Continuous PC Box Girder / Precast Continuous PC Box Girder (Span by Span)

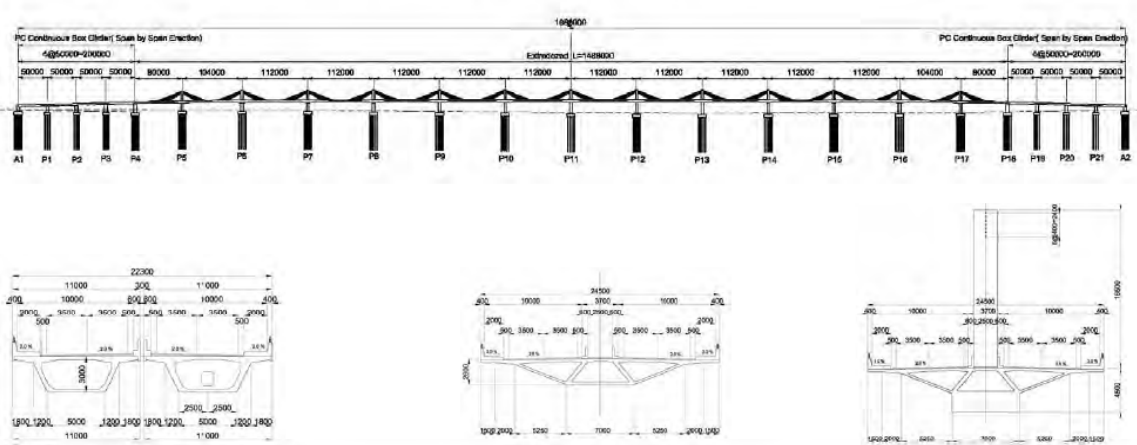


Precast Continuous PC Box (Span by Span)

Continuous PC Box

Category	Evaluation Criteria	Max. Point	Description	Evaluation
Technical Viability	Structural Stability	20	Multi-continuous spans is structurally strong for earthquake resistance but deflection problem at center joints	Fair 10
	Constructability	10	Pre-cast concrete cantilever method is a reliable and safety method in the river. Construction period is 26 months	Fair 5
Economic Viability	Construction Cost	20	$\mu=1.05$ Concrete bridge is relatively high cost because procurement of the materials is difficult and costly.	Good 20
	Maintenance	5	Maintenance is almost free except expansion joints at center hinges.	Fair 3
Other Viability	New Technology	20	Pre-cast PC box girder is new erection method but not enough for technology transfer.	Poor 6
	Landscape	10	This type of bridge is relatively visual simplicity associated with the existing Thanlyin bridge.	Poor 3
	Navigation	10	Navigation clearance is secured but careful sailing is required due to the adjacent existing Thanlyin Bridge.	Fair 5
	Environment	5	Almost no impact.	Good 5
Evaluation			Not recommended	57

Alternative-D. Extradozed Bridge / Precast Continuous PC Box Girder (Span by Span)



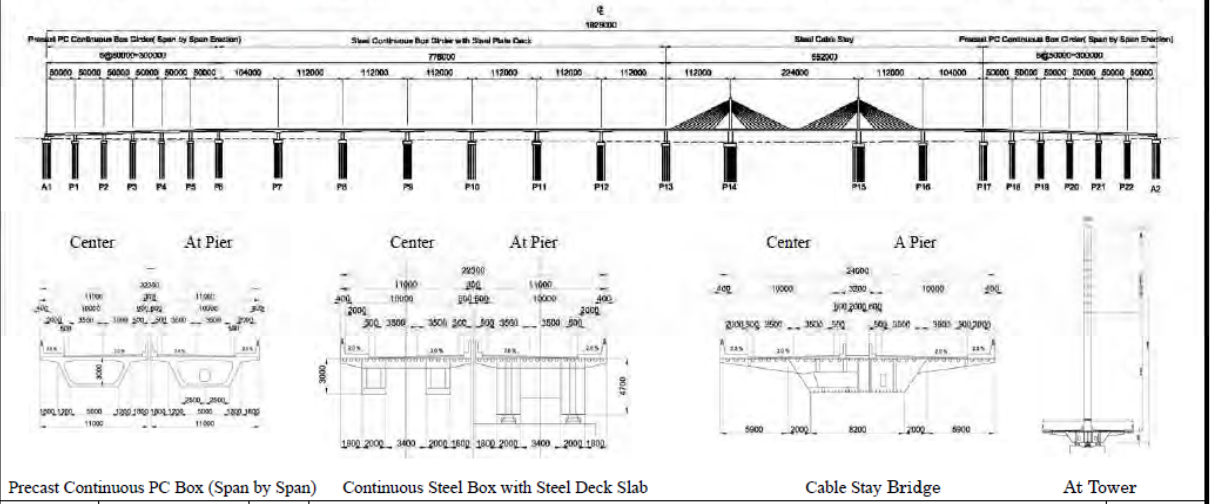
Precast Continuous PC Box (Span by Span)

Extradozed Bridge (At Center)

Extradozed Bridge (At Pier)

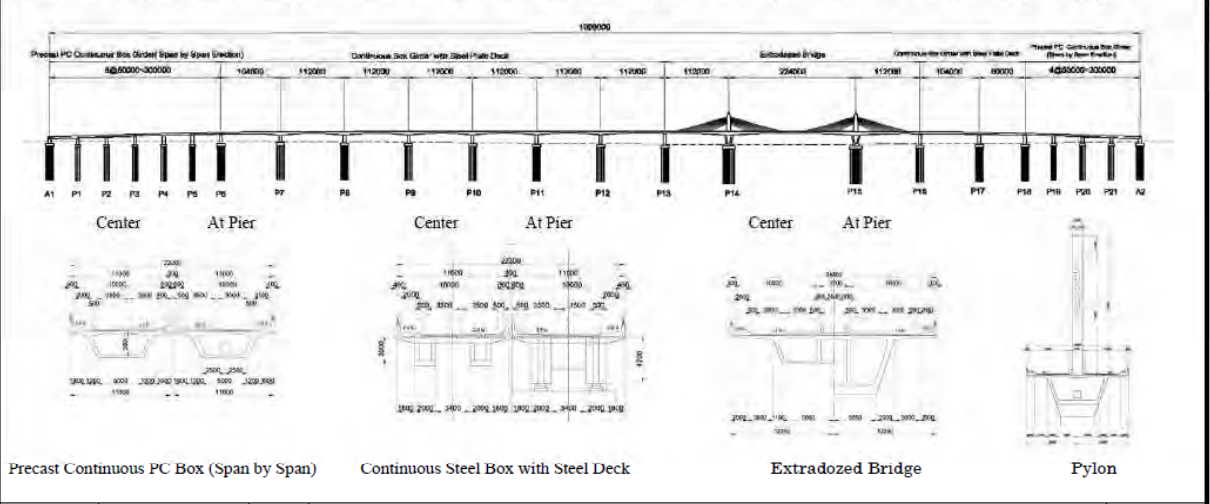
Category	Evaluation Criteria	Max. Point	Description	Evaluation
Technical Viability	Structural Stability	20	Multi-continuous spans is structurally strong for earthquake resistance but deflection problem at center joints	Fair 10
	Constructability	10	Cast-in-place concrete cantilever method using outer cables is applied. Construction period is 30 months	Fair 5
Economic Viability	Construction Cost	20	$\mu=1.15$ Concrete bridge is relatively high cost because procurement of the materials is difficult and costly.	Fair 10
	Maintenance	5	Maintenance is almost free except expansion joints at center hinges.	Fair 3
Other Viability	New Technology	20	Extradozed bridge using cables is new technology but too small scale (Span 112m) for technology transfer.	Fair 10
	Landscape	10	This type is an aesthetical bridge but relatively visual complexity associated with the existing Thanlyin bridge.	Fair 5
	Navigation	10	Navigation clearance is secured but careful sailing is required due to the adjacent existing Thanlyin Bridge.	Fair 5
	Environment	5	Almost no impact.	Good 5
Evaluation			Not recommended	53

Alternative-E. Steel Cable Stayed Bridge /Continuous Steel Box Girder with Steel Deck /Precast Continuous PC Box Girder (Span by Span)



Precast Continuous PC Box (Span by Span)		Continuous Steel Box with Steel Deck Slab		Cable Stay Bridge		At Tower	
Category	Evaluation Criteria	Max. Point	Description			Evaluation	
Technical Viability	Structural Stability	20	Steel cable stay and continuous steel box girders are strong for earthquake and wind resistance.			Good	20
	Constructability	10	Erection of cable stay and steel bridges are performed from barge mounted crane. Construction period is 28 months			Fair	5
Economic Viability	Construction Cost	20	$\mu=1.23$	Cable stayed bridge is rather costly but economical type for long span of 224m.		Poor	6
	Maintenance	5	Periodical maintenance for painting on steel is only required.			Fair	3
Other Viability	New Technology	20	Steel cable stay and box girder with steel deck slab and precast PC box girder (Span by Span) are new technology.			Good	20
	Landscape	10	Excellent view and symbolic structure due to high towers and its cables			Good	10
	Navigation	10	Wide navigation clearance is secure in the sailing from and toward the adjacent existing Thanlyin Bridge.			Good	10
	Environment	5	Almost no impact.			Good	5
Evaluation			Comprehensively Recommended			79	

Alternative-F. Extradozed Bridge / Continuous Steel Box Girder with Steel Deck / Precast Continuous PC Box Girder (Span by Span)

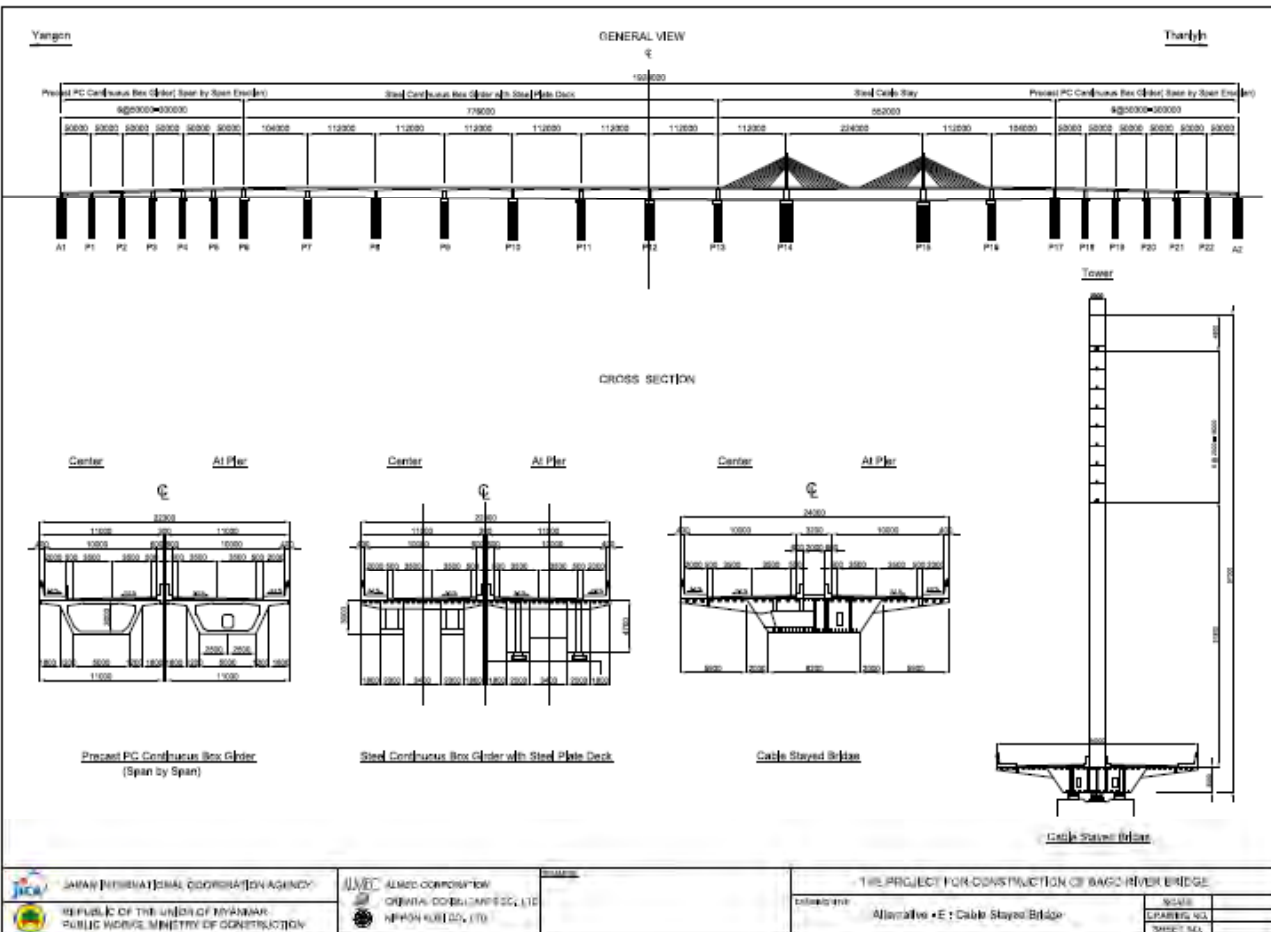


Precast Continuous PC Box (Span by Span)		Continuous Steel Box with Steel Deck		Extradozed Bridge		Pylon	
Category	Evaluation Criteria	Max. Point	Description			Evaluation	
Technical Viability	Structural Stability	20	Extradozed bridge alternated with steel bridges is applied for this span arrangement but not suitable.			Fair	10
	Constructability	10	Extradozed bridge with long span (224m) is technically the most difficult option. Construction period is 32 months			Poor	3
Economic Viability	Construction Cost	20	$\mu=1.28$	Extradozed bridge is costly because center span 224m is out of economical span (120m ~ 200m).		Poor	6
	Maintenance	5	Periodical maintenance for painting on steel is required.			Fair	3
Other Viability	New Technology	20	Extradozed, Precast PC box girder (span by span) and Steel box girder with steel deck slab are new technology			Good	20
	Landscape	10	Extradozed bridge is excellent view but inferior to cable stayed bridge as a symbolic structure due to low pylons.			Good	10
	Navigation	10	Wide navigation clearance is secure in the sailing from and toward the adjacent existing Thanlyin Bridge.			Good	10
	Environment	5	Almost no impact.			Good	5
Evaluation			Not recommended			67	

Results of Selection of Bridge Type

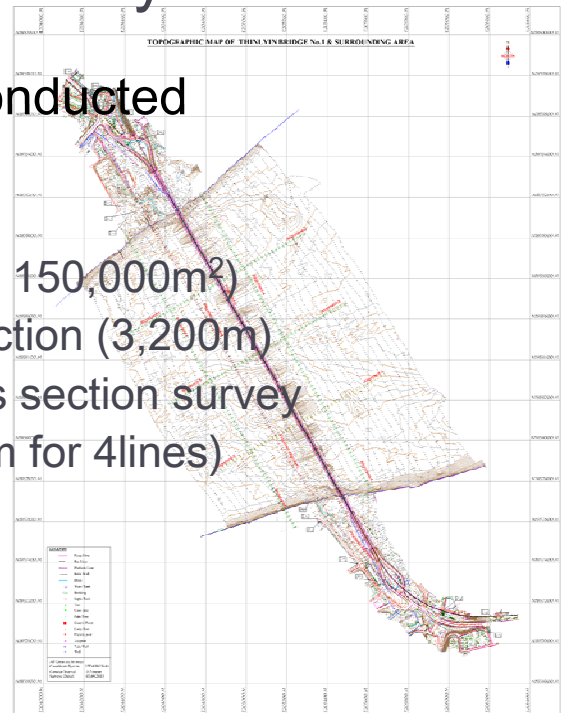
Alternatives	A Continuous Steel Box Girder	B Nielsen Lohse Arch	C Continuous PC Box Girder	D PC Extradosed	E Steel Cable Stayed + Steel Box Girder	F Extradosed + Steel Box Girder
Structural	20	10	10	10	20	10
Constructability	10	5	5	5	5	3
Construction Cost	20	6	20	10	6	6
Maintenance	3	3	3	3	3	3
New Technology	6	10	6	10	20	20
Landscape	3	5	3	5	10	10
Navigation	5	5	5	5	10	10
Environment	5	5	5	5	5	5
Total	72	49	57	53	79	67

E: Combination with Steel Cable Stayed and Continuous Steel Box Girder with Steel Deck is recommendable for Bago River Bridge

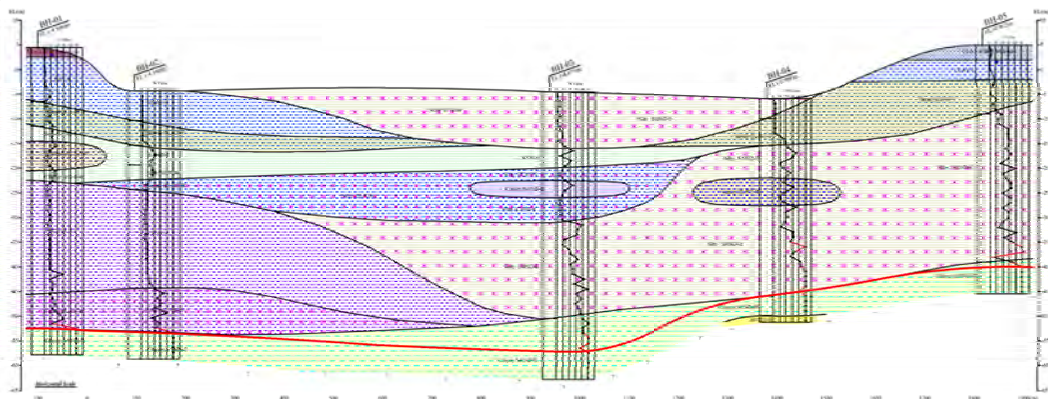


7. Natural Conditions Survey

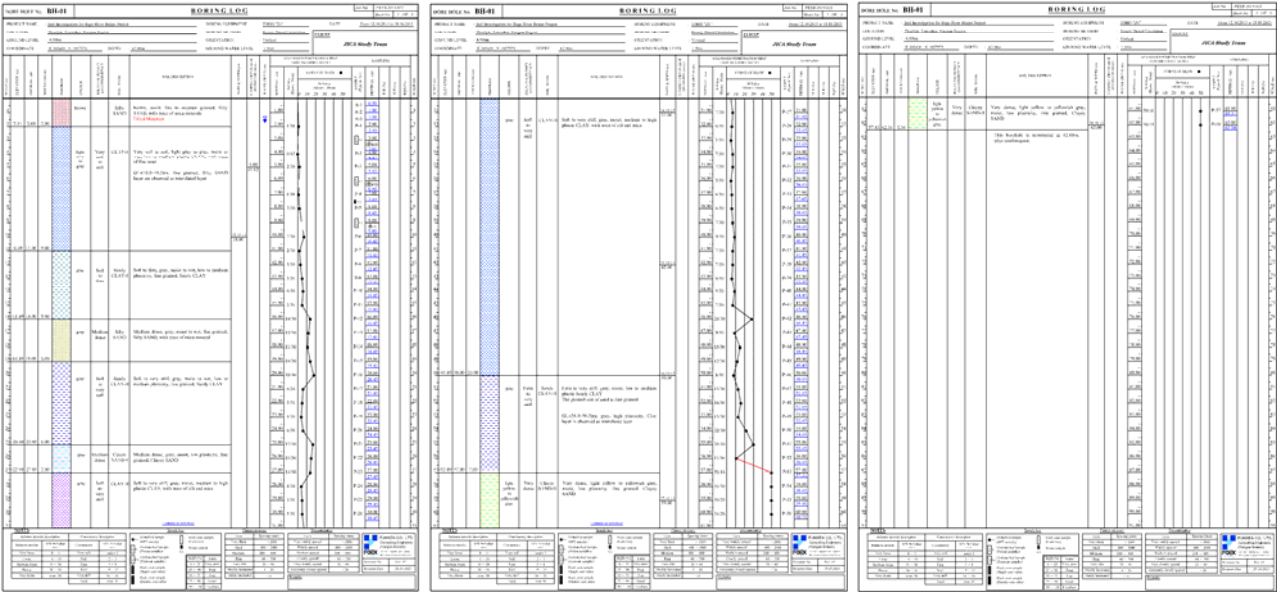
- Topographic survey was conducted
 - Benchmark installation
 - Control point installation
 - Plane survey (200,000m² and 150,000m²)
 - Road centerline and cross section (3,200m)
 - River axial direction and cross section survey (1,000m for 3lines and 1,900m for 4lines)



- Geological survey was conducted
 - Borehole drilling on land and in the river (3 and 2)
 - Standard penetration test (SPT) (5 boreholes)
 - Laboratory test (5 specimens)

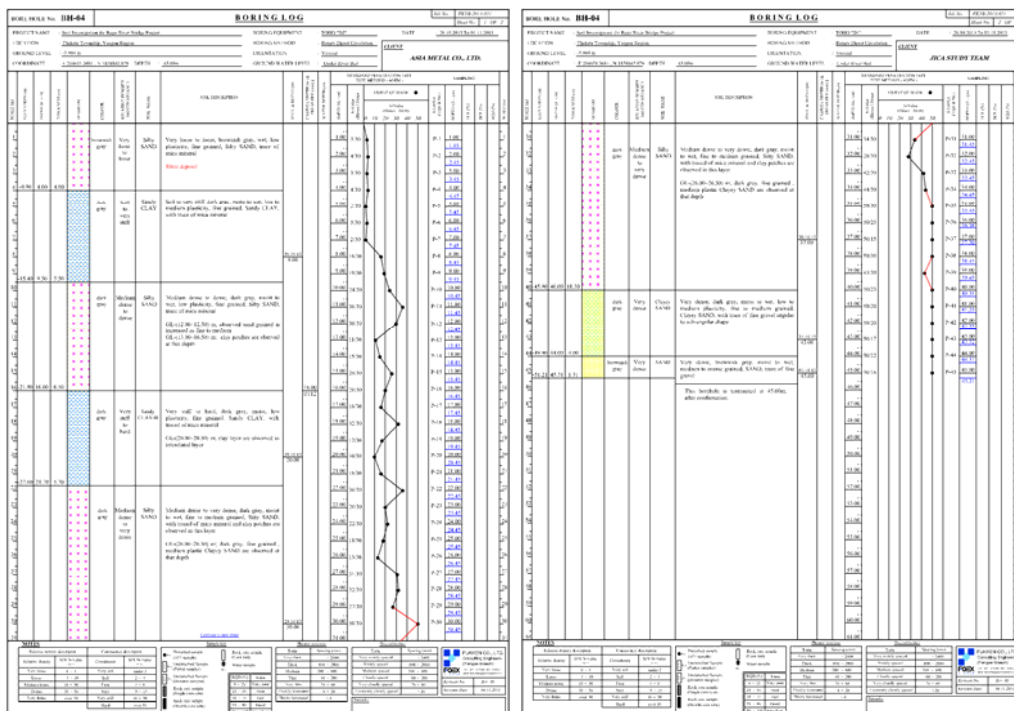


Borehole Log (BH-01) on Land



Very soft clay or sand layer is stratified at around 10 m from the surface.
 Bearing layer with dense sand was found at the depth of EL. -57m.

Borehole Log (BH-04) in the river



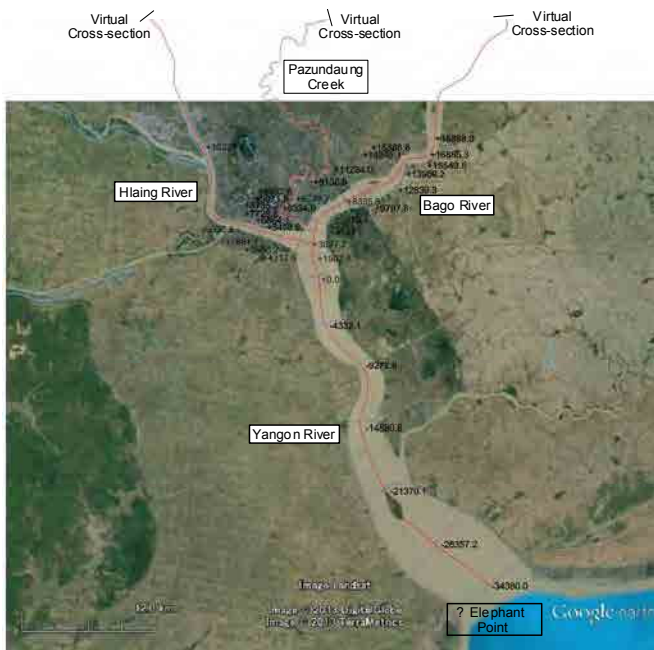
Very soft clay or sand layer is lying at around 10 m from the surface.
 Bearing layer with dense sand was found at the depth of around EL. -30m.

8. Hydrological Assessment

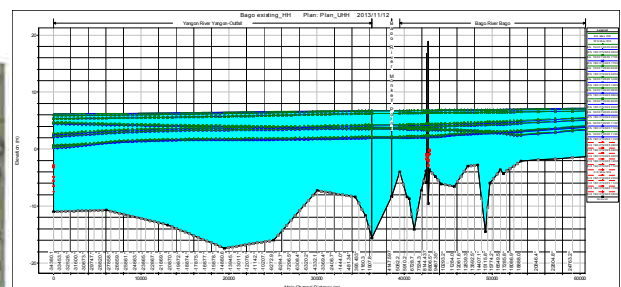
- Collection of meteorological data was conducted
- Correlation data to the current hydrological and hydraulic conditions
- Estimation of probable floods and water levels was conducted
- Hydrological assessment of the proposed bridge sites was conducted

Results of Hydrological Assessment

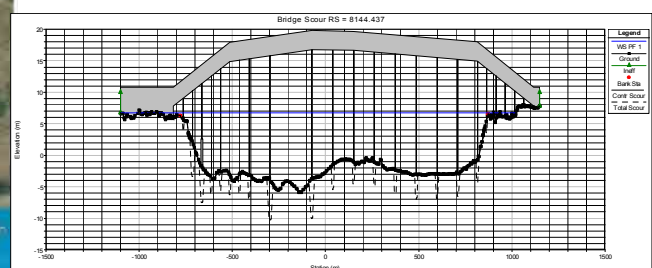
Design Discharge: 14,398m³/s
 High water level: 7.7m(max. depth:-13 m)
 Max. Scouring Depth: 6.27m



Hydraulic Calculation Model



Water Discharge Calculation Result along Bago River

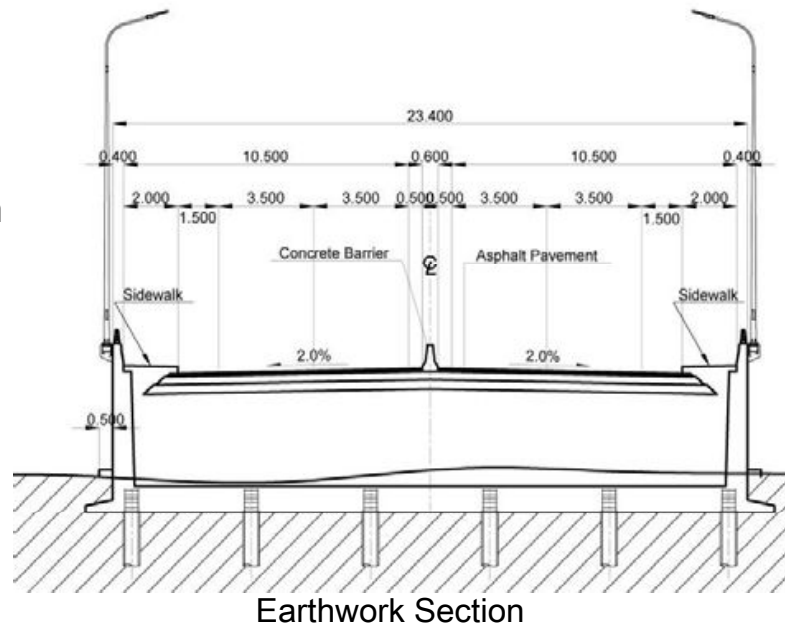


Scouring Computation Result at Bago River Bridge

9. Design for Feasibility Study

(1) Cross Sectional Arrangement

- Carriageway 2@3.50=7.00m
- Inner shoulder 0.50m
- Outer shoulder 1.50m
- Median 0.60m
- Sidewalk 2.00m
- Total width 23.40m

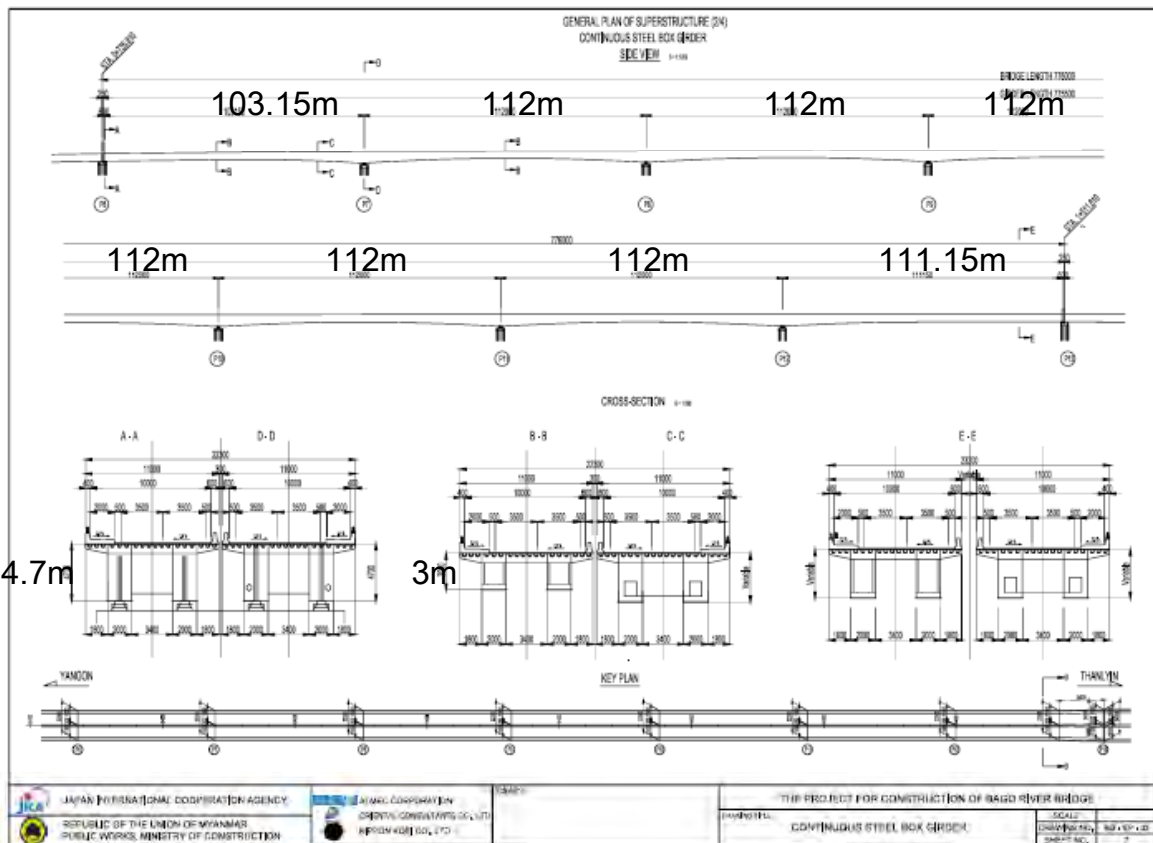
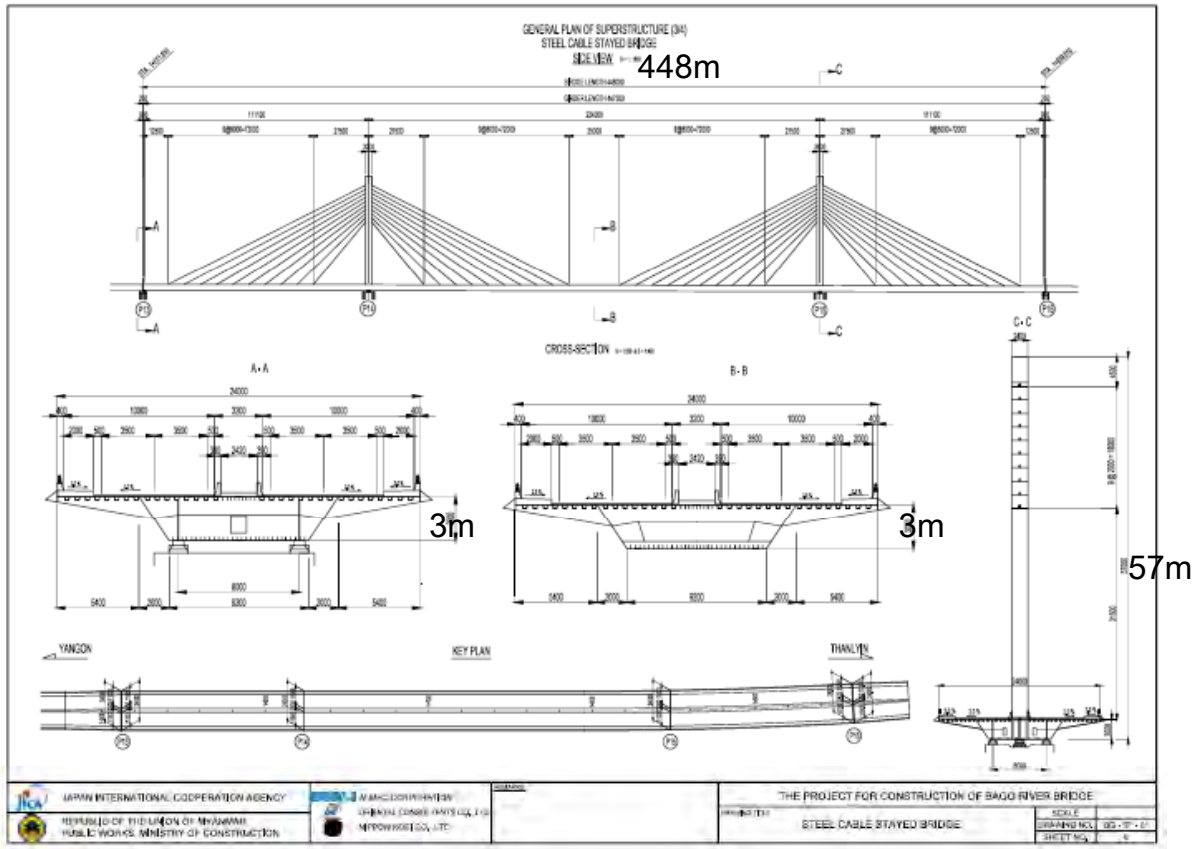


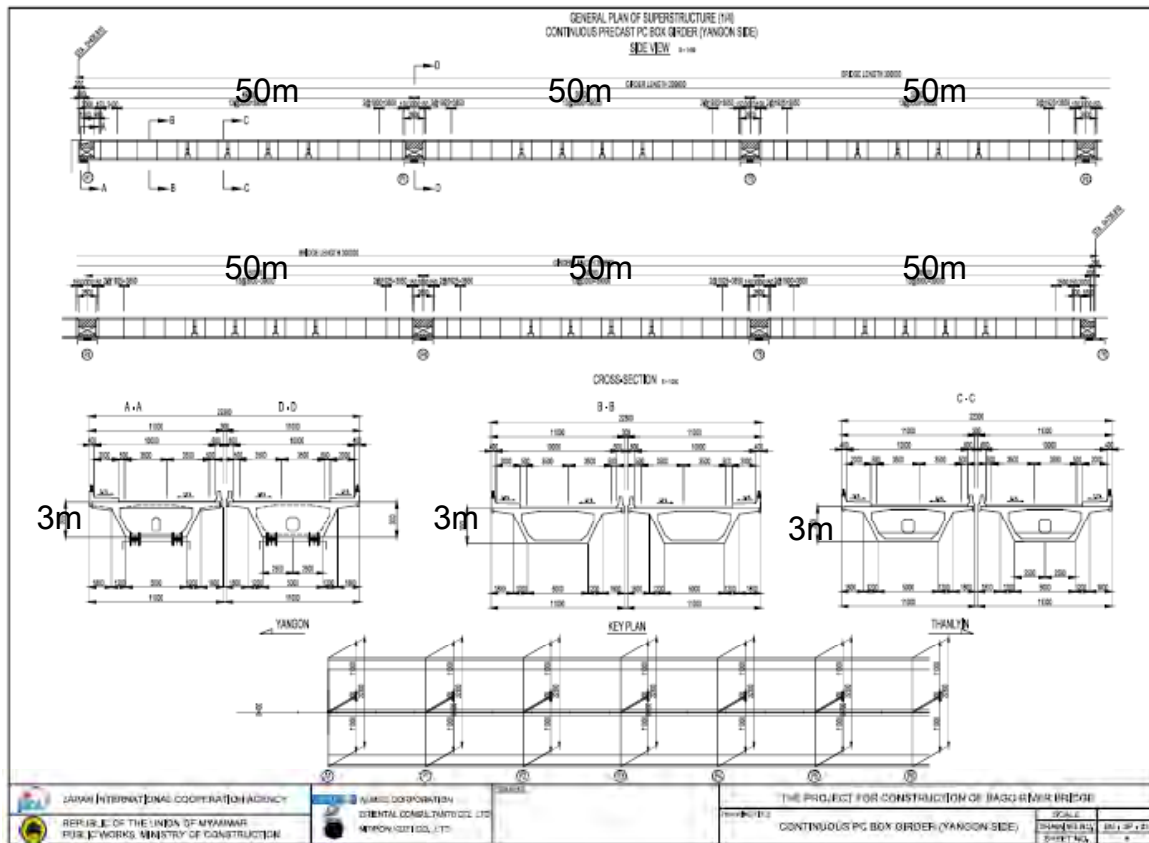
(2) Structural Design

Superstructure Design

Refinement of the preliminary design of;

- Steel cable stayed bridge
- Continuous steel box girder with steel plate deck
- Continuous PC box girder with precast segment and span by span method



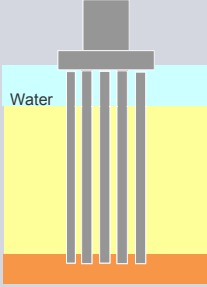
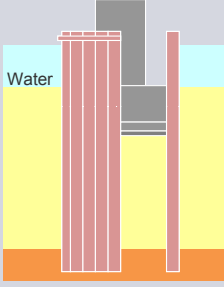
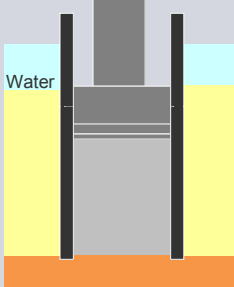


Substructure Design

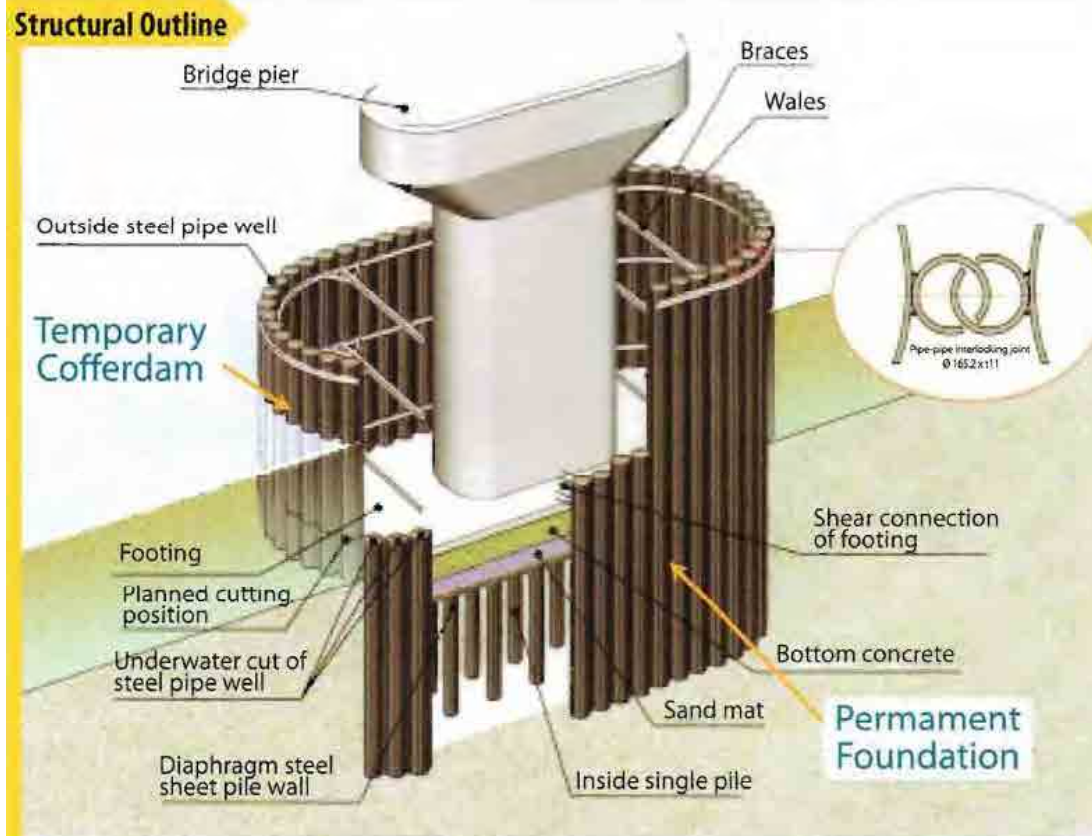
Refinement of the preliminary design of;

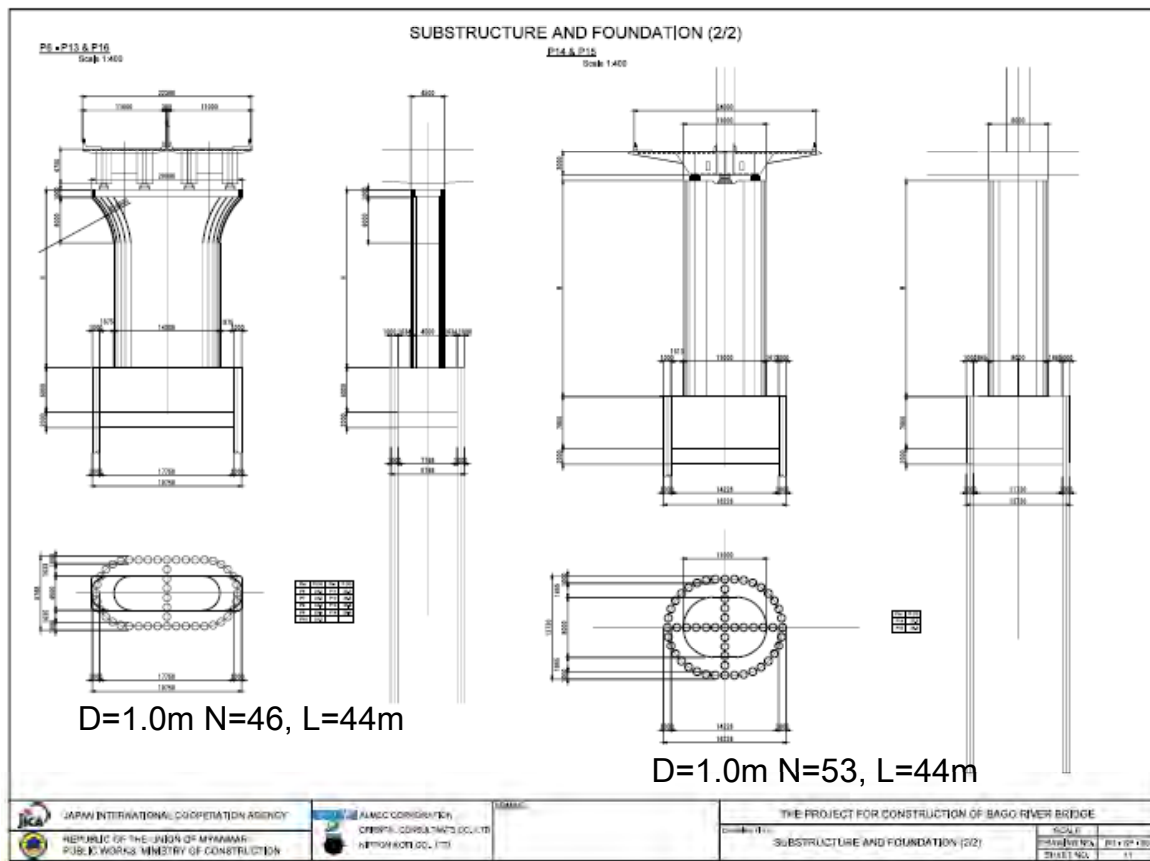
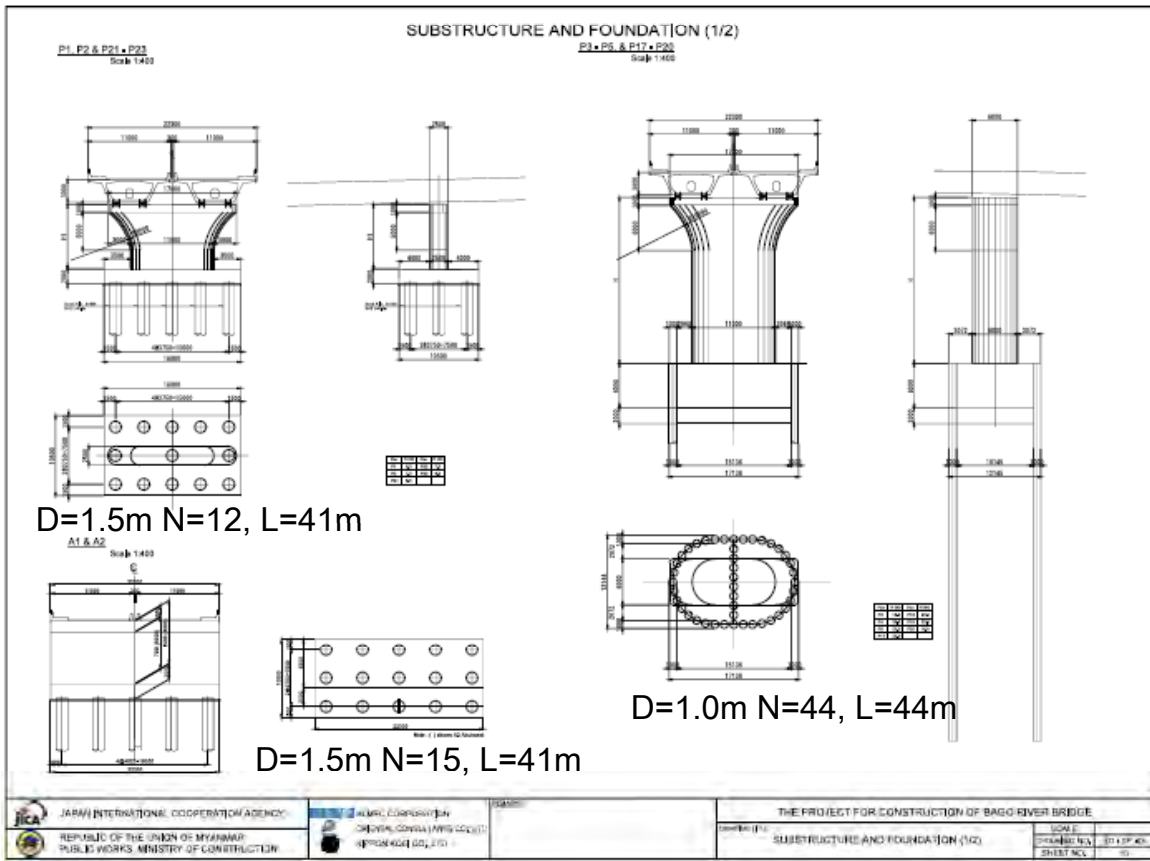
- Steel pipe sheet pile (SPSP) foundation in the river
- Cast-in-place concrete pile on land

Foundation Type Alternatives for Main Bridge

	Cast-in-place Concrete Pile	Steel pipe Sheet Pile Foundation	Concrete Caisson
Image			
Workability in Water	Inferior	Superior	Moderate
Work Period	Moderate	Superior	Moderate
Against Ship Collision	Inferior	Superior	Superior
Against Scouring	Inferior	Superior	Superior
Construction Safety	Moderate	Superior	Superior
Cost	Superior	Moderate	Moderate
New Technology	Not New	New	Not New
Evaluation	Not Recommendable	Recommendable	Not Recommendable

Steel Pipe Sheet Pile Foundation (SPSP Foundation)





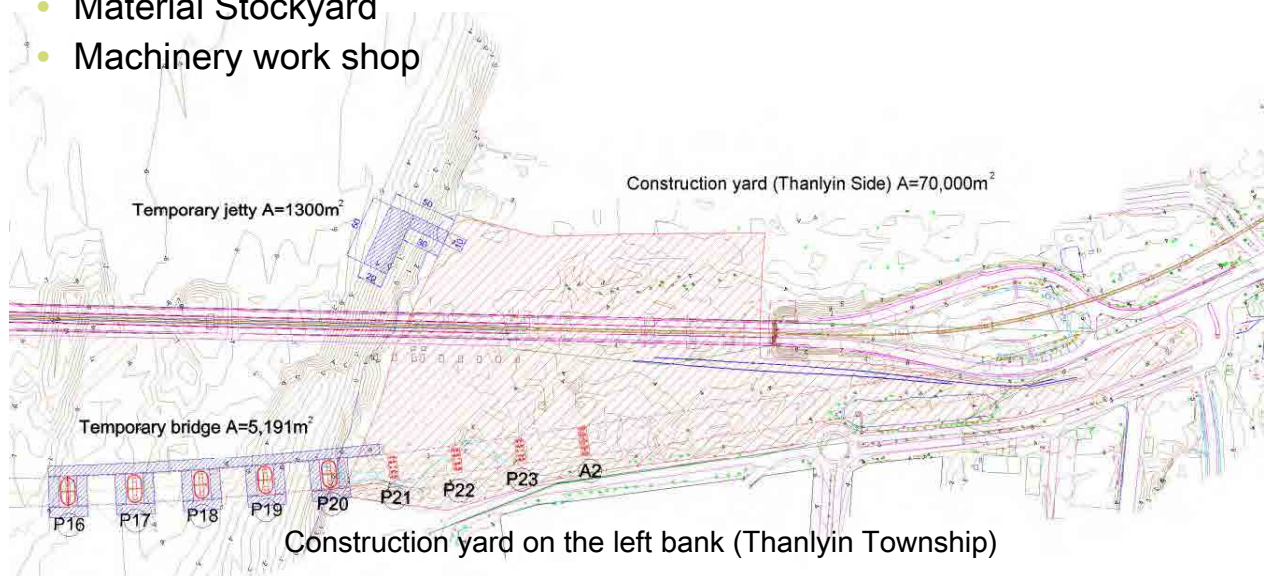
(3) Construction Plan

Basic Conditions

- Most construction materials and machines will be transported by water
- Most of the construction site on the public land is enough for the use of the construction yard

Construction Yard

- Temporary office for contractor with contractor's accommodation
- Concrete batching plant
- Asphalt plant
- PC segment fabrication yard
- Steel girder fabrication yard
- Material Stockyard
- Machinery work shop

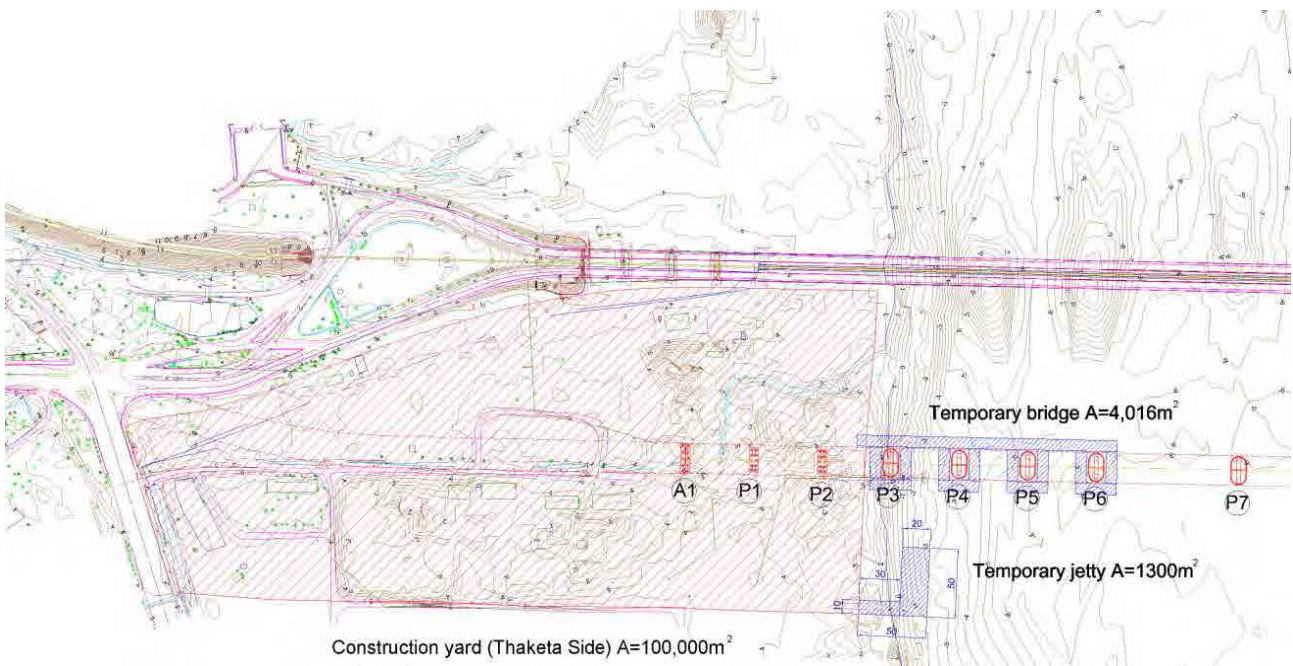
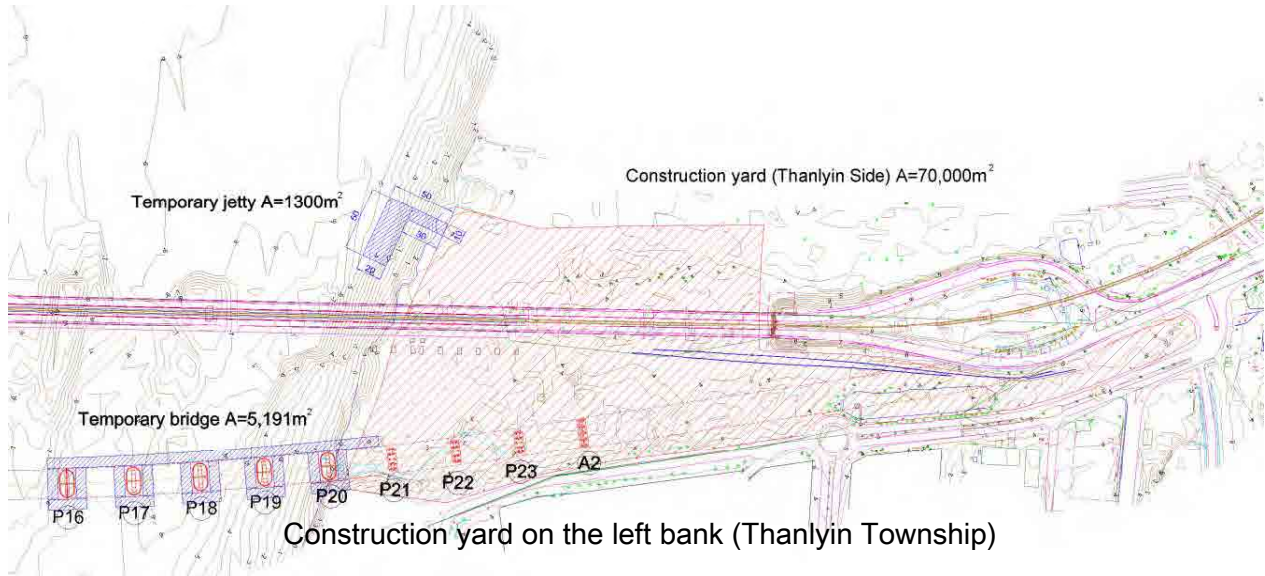


Temporary jetty

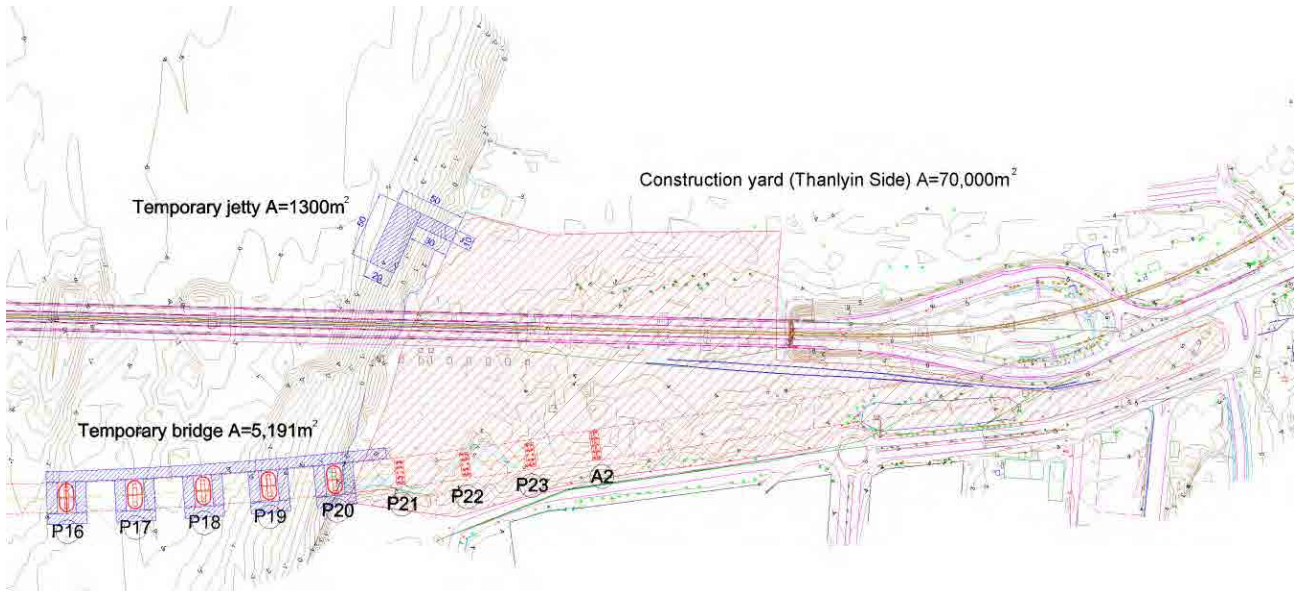
- Loading and unloading jetty

Temporary access

- Entrance access road from public road
- Temporary bridges for substructure construction, superstructure erection

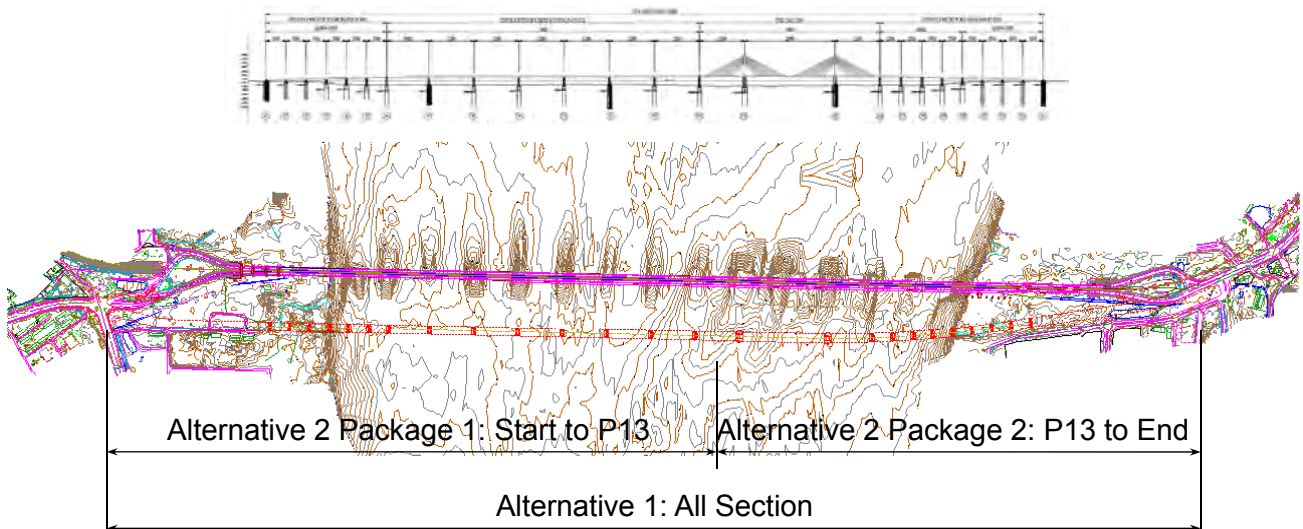


Construction yard on the right bank (Thaketa Township)



Construction yard on the left bank (Thanlyin Township)

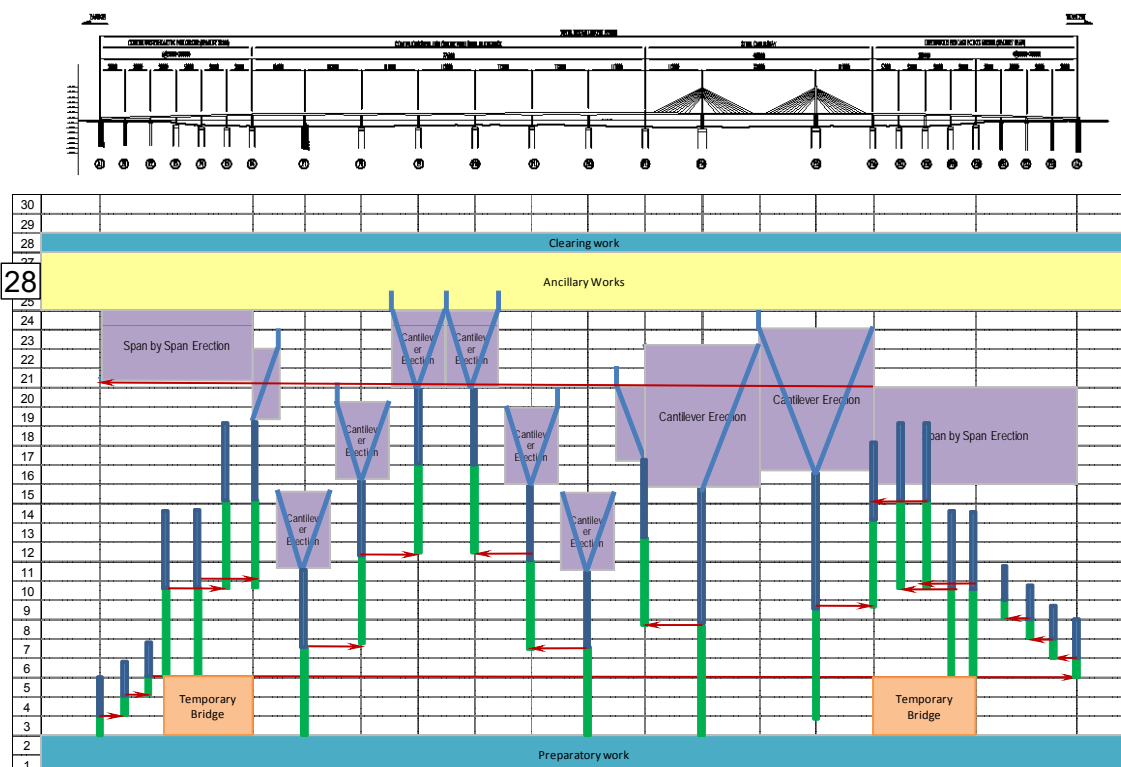
Construction Package Plan



	Single package	Two packages
Management	Construction schedule can be managed comprehensively	It is difficult to control the overall construction schedule as the completion of each package varies.
Influence	Problems concerning interference can be solved as part of the scope of one contractor.	The boundary of the packages is at the west end of the cable-stayed bridge, that may cause small interference
Cost	No major differences	
Bidders Qualification	The contract amount is larger to be required pre-qualification	No major problem in qualification of bidders
Attractiveness	Attractive only for big general contractors	Both packages have reasonable contract amounts
Evaluation	Recommended	

Note: red letter shows the disadvantages for the Project

Construction Program



Procurement Conditions (2)

- **Materials**

- Stone, aggregate, and sand are procured in Myanmar.
- Cement used for construction can also be procured in Myanmar. But the condition of the cost estimation, cement will be imported from Thailand.
- Ready-mixed concrete are procured around Yangon

Procurement Conditions (3)

- **Equipment**

- Most of the construction equipment and machineries for bridge erection shall be procured from other countries
- General construction machineries (e.g., bulldozer and backhoe) and barge mounted crane can be procured in Myanmar

Method of Cost Estimate

- Calculation of construction work quantities
- Formulation of unit cost quoted by Japanese construction association (Japanese Bridge Associations)
- Estimation of construction cost

Result of Estimation of Construction Cost

Work Item		Construction Cost ('000 USD)		
		L/C	F/C	Total
Substructure	Abutment	582	701	1283
	Pier on land	1,197	1,442	2,639
	Pier in the river	7,045	37,931	44,976
Superstructure	Cable stayed	752	38,373	39,125
	Steel box	819	32,423	33,242
	PC box	1,667	19,327	20,994
Bridge construction cost		12,062	130,197	142,259
Approach road		14,917	4,004	18,921
Miscellaneous work		10,264	7,544	17,808
Direct cost		37,243	141,745	178,988
Indirect cost (Direct cost x 20%)		7,449	28,349	35,798
Total Construction Cost		44,692	17,0094	214,786

Result of Estimation of Project Cost

Work Item	Construction Cost ('000 USD)		
	L/C	F/C	Total
Eligible Portion	56,428	197,107	253,535
Construction cost	54,099	187,839	241,938
Base cost	44,692	170,094	214,786
Price escalation	6,831	8,800	15,631
Physical contingency	2,576	8,945	11,521
Consulting service	2,329	9,268	11,597
Base cost	2,018	8,546	10,564
Price escalation	195	268	463
Physical contingency	116	454	570
Non Eligible Portion	34,761	0	34,761
Interest During Construction	0	53	53
Total Project Cost	91,189	197,160	288,349

Non eligible portion includes land acquisition cost, administration cost, commercial tax, import tax etc.

- Construction cost during the route selection (R/S) was calculated by the direct cost, and only the bridge cost (w/o access road, miscellaneous work)
- Unit cost for steel is different (3,500USD/ton (R/S) -> 4,660USD/ton (F/S))
- Superstructure cost of cable stayed bridge is expensive (5,830USD/t)

Unit Direct Cost by Area

	PC Box Girder Right Bank	Steel Box Girder	Cable Stayed Bridge	PC Box Girder Left Bank	Total
Total length (m)	300	776	448	404	1,928
Construction cost (Direct cost, 000USD)	18,139	50,733	49,116	24,271	142,259
Unit cost (USD/m ²)	2,590	2,790	4,690	2,560	3,150

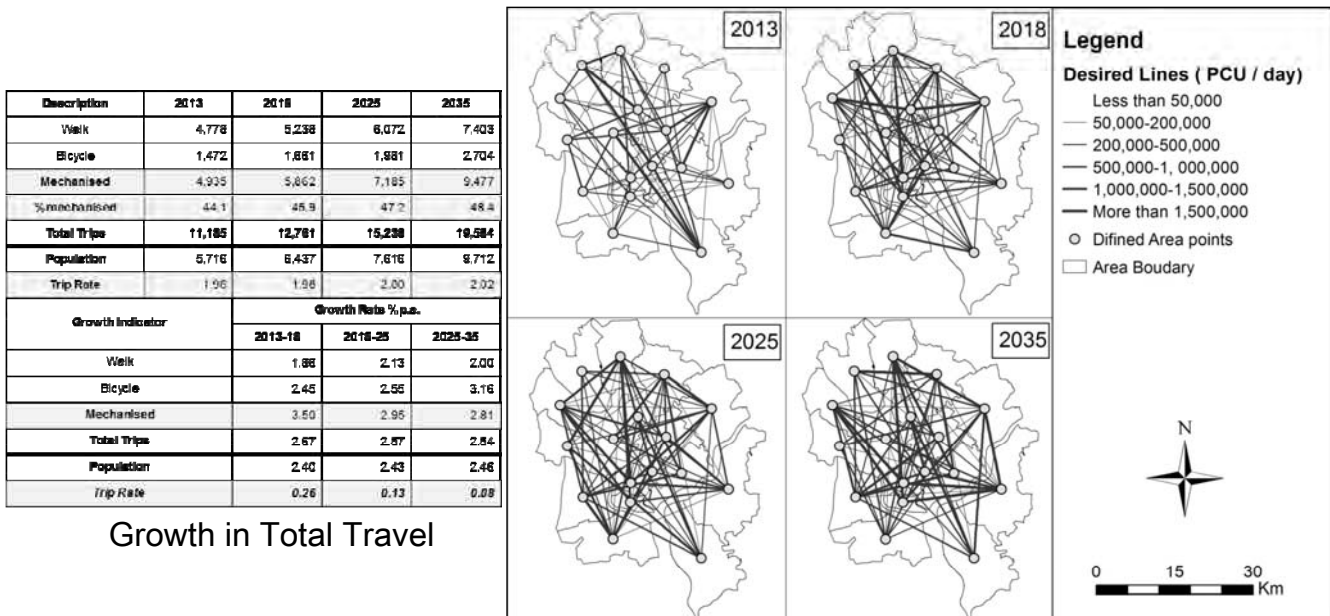
11. Demand Forecast and Economic Evaluation

Summary Socio-Economic Framework for Greater Yangon

			2013	2018	2025	2035	Annual Growth Rate			
							2013-2018	2018-2025	2025-2035	Average 2013-2035
Night-time Population ('000)	Workers	Primary	58	58	58	58	0.0%	0.0%	0.0%	0.0%
		Secondary	219	263	350	562	3.7%	4.2%	4.8%	4.4%
		Tertiary	2,263	2,601	3,214	4,470	2.8%	3.1%	3.4%	3.1%
		Total Workers	2,540	2,921	3,622	5,089	2.8%	3.1%	3.5%	3.2%
	Student at Residence	1,164	1,303	1,532	1,938	2.3%	2.3%	2.4%	2.3%	
	Others	2,013	2,212	2,462	2,685	1.9%	1.5%	0.9%	1.3%	
	Total Night-time Population	5,716	6,437	7,615	9,712	2.4%	2.4%	2.5%	2.4%	
Day-time Population ('000)	Employment	Primary	58	58	58	58	0.0%	0.0%	0.0%	0.0%
		Secondary	244	289	378	595	3.4%	3.9%	4.6%	4.1%
		Tertiary	2,263	2,610	3,242	4,547	2.9%	3.1%	3.4%	3.2%
		Total Employment	2,565	2,956	3,678	5,200	2.9%	3.2%	3.5%	3.3%
	Student at School Places	1,164	1,303	1,532	1,938	2.3%	2.3%	2.4%	2.3%	
	Others	2,013	2,212	2,462	2,685	1.9%	1.5%	0.9%	1.3%	
	Total Day-time Population	5,741	6,472	7,672	9,823	2.4%	2.5%	2.5%	2.5%	
Household Income ('000 MMK/month)			240.6	340.5	522.2	954.7	7.2%	6.3%	6.2%	6.5%
Household Car Ownership Ratio (%)			11.6	16.8	23.2	32.3	7.8%	4.7%	3.4%	4.8%

(1) Transport Demand Forecast

- The future socio-economic framework was prepared by SUDP and YUTRA



Growth in Total Travel

Current and Forecast Trip Distribution Patterns

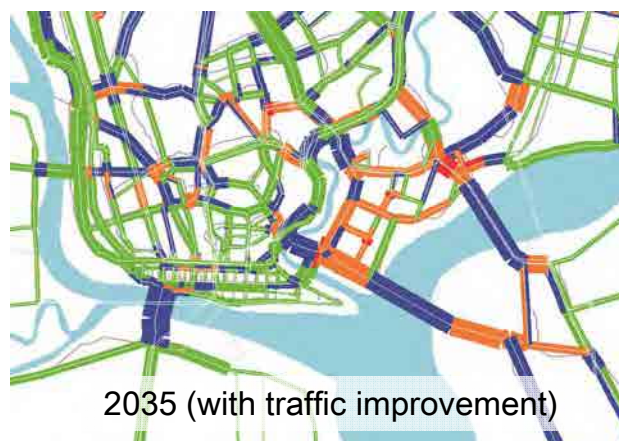
Traffic Volume Forecast



2013 (Current)



2035 (w/o traffic improvement)



2035 (with traffic improvement)

Total Travel Demand on Thanlyin Bridge and New Bago Bridge

Case	Mode	2013	2018	2025	2035
With New Bago Bridge	Motorcycle	N/A	N/A	1,089	1,352
	Car	N/A	N/A	19,103	27,593
	Taxi	N/A	N/A	9,319	12,874
	Bus	N/A	N/A	3,069	3,645
	Truck	N/A	N/A	4,610	6,578
Without (Thanlyin Bridge only)	Motorcycle	232	1,150	1,039	1,305
	Car	5,022	16,895	12,916	17,115
	Taxi	4,805	12,539	8,084	9,767
	Bus	4,406	5,199	3,346	4,043
	Truck	4,485	6,181	1,364	1,934
With - Without	Motorcycle	-	-	50	47
	Car	-	-	6,187	10,478
	Taxi	-	-	1,235	3,107
	Bus	-	-	-277	-398
	Truck	-	-	3,246	4,644

(2) Economic Evaluation

Assumption

- The Project period: from 2015 to 2020
- Analysis period: 30 years (2015 to 2044)
- Traffic Assignment: 2025 and 2035 (YUTRA)
- Indicator: Benefit/Cost Ratio (B/C), Net Present Value (NPV), Economic Internal Rate of Return (EIRR)
- Social Discount Rate: 12%
- Annual Maintenance Cost: 3%
- Standard Conversion Factor (SCF): 0.85

Economic Cost of the Project

Estimated Economic Cost of the Project

Item	Financial Cost	Economic Cost
Construction Cost	214,786	208,082
Engineering Cost	10,564	10,279
Subtotal	225,350	218,361
Land Acquisition Cost	13	11
Administration Cost	12,677	11,671
Taxes	22,069	0
Contingency	12,092	0
Price Escalation	16,095	15,041
Total	288,296	245,084

Economic Benefits of the Project

- Vehicle Operation Cost (VOC) and Value of Time (VOT) was estimated
- Saving VOC and Travel Time Cost (TTC) was estimated

Estimated Economic Benefits of Benchmark Years

Year	Economic Benefits ('000 USD)		
	TTC	VOC	Total
2025	2.7	8.7	11.4
2035	67	65	132

Cost-Benefit Analysis

Results of Cost-Benefit Analysis

Indicator	Value
EIRR	13.5%
B/C (at discount rate of 12%)	1.29
NPV (USD in millions)	54

Sensitivity Analysis

		Project Cost Increase		
		Base	10% up	20% up
Benefit Decrease	Base	13.5%	12.9%	12.4%
	10% down	12.9%	12.3%	11.8%
	20% down	12.2%	11.7%	11.2%

Identification and Evaluation of Anticipated Impacts

Environment Item **	Rating		Identification and Evaluation of Anticipated Impacts and their Reasons
	Scoping	After Survey	
	I II III	I II III	
1) Involuntary resettlement (land acquisition/resettlement)	B-	B-	1) The right-of-way (ROW) for the planned bridge and approach roads is on public lands and owned by the government such as Myanmar Railways, Ministry of Construction, YCDC, and YRDC. Thus, displacement of houses and people is not expected. 2) However, encroachment of a few stalls and three small religious facilities were found on the ROW. Therefore, the aforementioned structures are required to be removed, relocated, or given income and/or assistance in the restoration of existing living condition. 3) About 20 trees within the ROW should be cut, relocated, and/or planted. 4) About ten electric poles within the ROW should be relocated. 5) Diesel fuel and CNG pipelines laid down within the ROW should be relocated or properly protected in order to avoid damage caused by construction works and bridge operation. 6) Secure land for construction-related facilities (construction office, worker's camp, storage of construction materials, and wastes). No additional involuntary resettlement is expected during the operation stage.
2) Local economy such as employment and livelihood	B-	B-	Beneficial impact such as creation of employment opportunity for construction work is expected.
3) Fishing activity	B-	B-	Through the construction of Bago River Bridge, existing traffic congestion will be greatly relieved in Greater Yangon. This improved road network may raise the living condition and make social services easily accessible, leading to the enhancement of the local economy. There are small scale fishing activities in the Bago River. Thus, construction work including dredging and excavation may disturb their environment. No negative impact is expected.
4) Mitigation of flood and local resources	B-	B-	1) Quays and/or levee walls will be utilized for procurement of construction materials. 2) Water for construction work and worker's camp may compete with the existing water supply. No negative impact is expected.
5) Existing social infrastructure and services: 1) Road and railway traffic	B-	B-	1) Heavily traffic condition will not be changed by using the existing Thantabin Bridge during the construction stage. However, the delivery of construction materials and materials as well as traffic caused by construction vehicles may cause temporary closure of trunk one-way traffic, and restriction of vehicle speed. Therefore, using diversion route will be required in this situation. From this, some road traffic congestion and restriction of access to public facilities. Road traffic condition will be improved significantly by the operation of the new bridge and approach road.
6) Existing social infrastructure and services: 2) Water transport	B-	B-	Bridge construction work such as reworked dredging may disturb the water level and navigation channel. Bridge foundation and pier may change the flow condition if resulting in disturbance of navigation channel.
7) Existing social infrastructure and services: 3) Other	B-	B-	1) There are utility lines such as high voltage electrical lines, telephone lines, underground the bridge and road. 2) Water use work may compete with the community water supply. Improvement of traffic condition around Yangon City, Thantabin Bridge SEZ will greatly enhance the economic and industrial activities in Yangon as well as improve the accessibility to coastal area.
8) Social institutions such as social infrastructure and local decision-making organizations	B-	B-	If the disclosure of the project plan and review process are not properly conducted, people's activities and occur an impact over the communities resulting in different theories. Considering of the Project and consensus among the 2
9) Vulnerable groups such as the poor, women, children, elderly, and disabled	B-	B-	The Project create employment opportunities for the vulnerable groups such as children and women are also expected. However, the impact on Yangon City due to the improvement of condition of traffic condition.
10) Indigenous people or other minority	D	D	Myanmar is an ethnic diverse nation with 135 ethnic groups, neither indigenous people or other minority group are found in the project area.
11) Mitigation of benefits and damage	B-	B-	There is some possibility for the improvement of benefit and time plan including procedure for the implementation and avoid impact are not properly designed and considered with road and other stakeholders.
12) Local conflicts of interest	B-	B-	There is some possibility of local conflicts of interest if the press implementation procedures and necessary resettlement matters (documented) and consulted with the Myanmar community, and of 1) In Greater Yangon Region, there are many religious facilities (temples, pagodas and monasteries, Hindu, Buddhist, and mosque
13) Cultural, historical, archaeological and	B-	B-	

- Abbreviated resettlement action plan (ARP) was examined assuming the present project plan (for 3 land, 8 structures and 160 trees)
- Stakeholders meeting was held on 24th January, 2014



- Environmental monitoring plan was prepared



Left Bank (Thanlyin Township)

Right Bank (Thaketa Township)

Result of Inventory Survey of Affected Land, Structure

Item	Administrative Division	Present Use	Size, Buildings, Materials, etc.	PAPs
(1) Land (Public Land)				
1) Land-1	Thaketa TS	Storage site for railway bridge materials and beautification space of Myanmar Railways	65,000 m ²	-
2) Land-2	Thaketa TS	Road section	2,700 m ²	-
3) Land-3	Thanlyin TS	Storage site for railway bridge materials and beautification space of Myanmar Railways	90,000 m ²	-
(2) Structures and Business Activities				
1) Stall-1	Thaketa TS	Selling of soft drinks and snacks	2.4 m ² , single story bricks	4
2) House-1	Thaketa TS	Residence (YCDC officer)	3 m ² , 1 room, single story wooden terrace house	7
3) House-2	Thaketa TS	Residence (staff of Myanmar Gas and Oil Enterprise)	3 m ² , 1 room, single story wooden terrace house	5
4) House-3	Thaketa TS	Residence (bus driver)	3 m ² , 1 room, single story wooden terrace house	3
5) House-4	Thaketa TS	Residence (Goldsmith)	3 m ² , 1 room, single story wooden terrace house	5
6) Small Praying Facility-1	Thaketa TS	Praying facility of traditional religion for workers	5 m ²	-
7) Small Praying Facility-2	Thanlyin TS	Buddhist praying facility for residents	30 m ²	-
8) Small Praying Facility -3	Thanlyin TS	Praying facility of traditional religion for residents	5 m ²	-
(3) Trees				
1) Trees	Thaketa TS	Planted for protecting and beautification of compounds of Myanmar Railways	46 trees	-
2) Trees	Thanlyin TS	Planted for protecting and beautification of compounds of Myanmar Railways	114 trees	-

13. Proposed Implementation Program

Assumptions

- Loan Agreement (L/A): early 2015
- Construction period: 28months (by PW instruction)
- Scheme of Japanese ODA loan
- Detailed Design by Japanese grant

Financial Year	2015				2016				2017				2018				2019				2020				Total Month
	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	
Pledge, E/N and L/A	△	△																							
Procurement of D/D Consultant	■	■																							4
Detailed Design		■	■	■	■	■	■	■																	12
Procurement of C/S Consultant			■	■	■	■	■	■																	9
Pre-construction Services (Tender Period)					■	■	■	■	■	■	■	■													12
Construction Supervision									■	■	■	■	■	■	■	■	■	■	■	■					28
Post Construction Services (Defect Liability Period)																					■	■	■	■	12
Land Acquisition/ Resettlement	■	■	■	■	■	■	■	■																	12

14. Conclusions and Recommendations

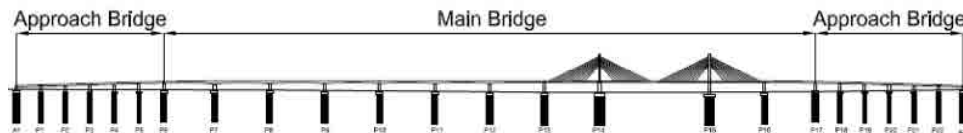
Conclusions (1)

- “Proximity of the existing Thanlyin Bridge” route was recommended for Bago River Bridge in three alternatives
- Natural condition surveys were conducted
 - Topographic survey
 - Geological survey
 - Hydrological survey

Conclusions (2)

- Road alignment, bridge type was designed

Assumed bridge type (tentative)	Steel Continuous Box Girder Bridge with Steel Deck Plate Steel Cable-stayed Bridge PC Precast Box Girder Bridge
Construction period	about 30 months
1) Right bank of the Bago River	
Jurisdiction	Thaketa Township (YCDC)
Road linked to the Project	Shukhinthar-Mayopat Road and Thanlyin Chin Kat Road
Length of approach road	539 m
2) Bridge - Total length 1,927 m	
Main Bridge: 1,223 m, approach roads: 300 m and 404 m	
3) Left bank of the Bago River	
Jurisdiction	Thanlyin Township (YRDC)
Road linked to the Project	Kyaik Khauk Pagoda Road
Length of approach road	647 m



Conclusions (3)

- Project cost was estimated to 288millionUSD
- Project effects were evaluated;
EIRR: 13.5%, NPV=54millionUSD, B/C: 1.29
- Project implementation program was prepared
- Environmental and social consideration survey was conducted

Thank you very much
for your attention.

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