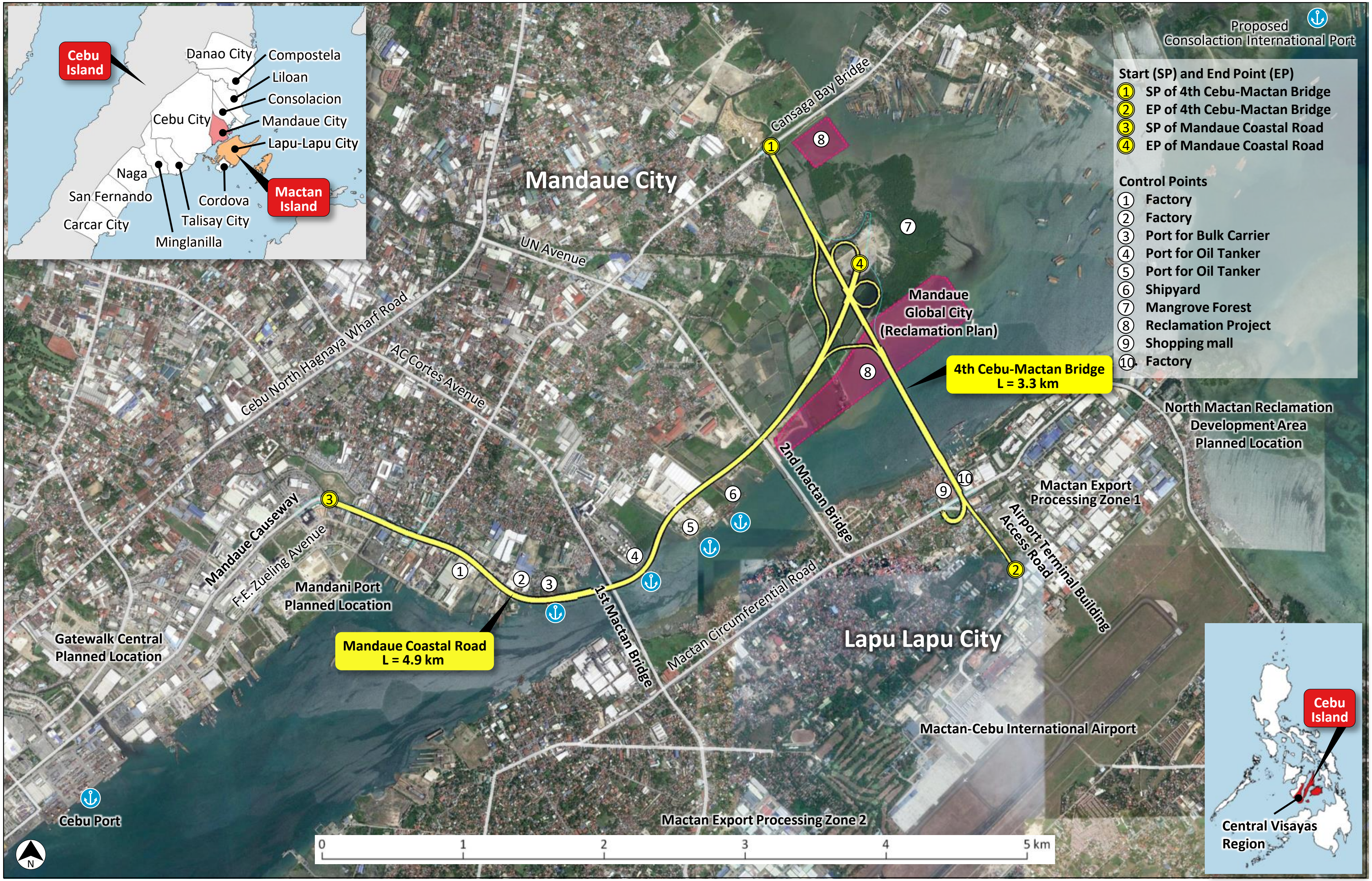
PREPARATORY SURVEY
FOR
CEBU-MACTAN BRIDGE AND COASTAL ROAD
CONSTRUCTION PROJECT
(NEW MACTAN BRIDGE CONSTRUCTION PROJECT)
IN
THE REPUBLIC OF THE PHILIPPINES

DRAFT FINAL REPORT

SEPTEMBER 2019

JAPAN INTERNATIONAL COOPERATION AGENCY

ORIENTAL CONSULTANTS GLOBAL CO., LTD.
CHODAI CO., LTD.
NIPPON KOEI CO., LTD.
ALMEC CORPORATION



Base Map: Google Earth©

Project Location Map

EXECUTIVE SUMMARY

1. INTRODUCTION AND BACKGROUND

(1) Background

In the Republic of the Philippines (hereinafter referred as "the Philippines"), the population has rapidly increased in recent years yet the infrastructure development such as road and public transport has lagged behind. This has led to serious traffic congestion in urban areas and economic loss. The sluggish infrastructure development is thus a significant bottleneck for further economic development of the Philippines.

The Project Area, Metro Cebu, belongs to the Central Visayas Region, on one of the Visayan Islands located in central Philippines and consists of 13 local governments including Cebu City. Metro Cebu is the second largest metropolitan area after Metro Manila with a population of 2.85 million in 2015. Numerous domestic and international companies are clustered in the area as a base of trade in central Philippines. Cebu Island is also a popular tourist destination in the Philippines. Out of the 4.86 million foreign tourists nationwide, Cebu Island accounted for 1.15 million.

The population of Metro Cebu increased at an annual average growth rate of 2.2% between 2010 and 2015 and is projected to reach around 3.8 million people in 2030. Road traffic congestion is expected to be more serious due to such rapid urbanization and population increase. Cebu Island, where houses, companies and population are concentrated, and Mactan Island, where Mactan-Cebu International Airport and industrial areas (Mactan Export Processing Zones) are located, are connected by two bridges, namely: 1st and 2nd Cebu-Mactan Bridges (or officially called as Sergio Osmeña Bridge and Marcelo Fernan Bridge). The traffic congestion at these bridges is getting worse every year due to traffic demand increase that exceeds traffic capacity of the bridges. This is considered to be a major obstacle to the future development of Metro Cebu. According to "The Roadmap Study for Sustainable Urban Development in Metro Cebu" conducted by JICA from 2014 to 2015 (hereinafter referred to as "Roadmap Study"), economic loss due to traffic congestion in Metro Cebu is estimated to be 394 million Philippines Peso per day.

Under these circumstances, Philippine Government regards infrastructure development in urban and local areas as one of the top priority issues in "*Philippines Development Plan 2017-2022*" for sustainable economic growth and improvement of quality of life, with particular focus on the development of the Metro Cebu as the metropolitan area next to Metro Manila. According to "*Regional Development Plan 2017-2022*" in Central Visayas, reduction of traffic congestion is considered as a top priority issue with the New Mactan Bridge Construction Project which consists of the construction of a new bridge linking Cebu Island and Mactan Island as well as construction of a coastal road connecting to the bridge (hereinafter referred to as "the Project") listed in the priority projects. The early implementation of the Project was recommended by the Roadmap Study and "*Project on Master Plan Study and Institutional Development on Urban Transport System in Metro Cebu (MCUTMP)*". The feasibility of implementation of the Project was discussed in the Meeting of the Japan-Philippines Joint Committee on Infrastructure Development held in February, 2018. In June, 2018, the Department of Public Works and Highways of the Philippines (DPWH) issued a request for the feasibility study to be undertaken.

(2) Objective of the Survey

This Project will be composed of i) construction of 4th Cebu-Mactan Bridge and ii) construction of Mandaue Coastal Road. The objectives of the Survey is i) to conduct review of existing studies and objectives of the Project, ii) to examine outline of the Project, project cost, implementation schedule, construction plan, application of advanced technology (if required), project implementation organization, operation and maintenance system, environmental and social consideration etc., for implementation of the Cebu-Mactan Bridge and Coastal Road Construction Project (or formerly called as New Mactan Bridge Construction Project) as Japanese ODA Loan project.

The Project is expected to contribute to socio-economic development of Metro Cebu through improvement of transport capacity and efficiency, and reduction of traffic congestion by construction of bridge connecting Mandaue City in Cebu Island and Lapu-Lapu City in Mactan Island and coastal road connecting to the bridge.

(3) Survey Schedule

The Survey was commenced in December 2018 and the initial studies such as traffic demand forecast and route selection of the Project Road have been carried out. The results of the study were discussed with DPWH and relevant LGUs (Mandaue City, Lapu-Lapu City and MCDCB) and the final alignments of the Project Roads and the bridge type for the 4th Cebu-Mactan Bridge were determined by the Joint Coordinating Committee (JCC) held on March 13, 2019.

As the result of finalization of the road alignments of the Project, it has been identified that the expected number of the Project Affected Persons (PAPs) will be increased and the environmental category of the Project needs to be changed from Category B to Category A. Therefore, the contents of the Project including Environmental Impact Assessment (EIA) and Resettlement Action Plan (RAP) reports need to be reviewed by JICA's Environmental and Social Considerations (ESC) Advisory Committee. The first Advisory Committee was held on April 26th, 2019. The second Advisory Committee is expected to be held in the end of August 2019.

Draft Interim Report containing some part of the Preliminary Design was submitted to DPWH and was finalized on May 10, 2019. Comments and suggestions given from Bureau of Design, Bureau of Construction and Planning Services were incorporated into this Draft Final Report.

The Preliminary Design of the Project is in accordance with the requirements of Philippine Coast Guard and Civil Aviation Authority of the Philippines. Coordination with National Commission for Culture and Arts was also carried out in order to assure that the Project will not affect any cultural heritage in the Project site.

A series public hearing and individual public consultation meetings have been held at Mandaue City and Lapu-Lapu City since March 2019 and some minor adjustments for the alignment was made in close coordination with DPWH and LGUs. Basic consent for the final alignment and the scope of the Project were obtained from local people including Project-Affected Persons (PAPs) and affected business entities at the 2nd public hearing held on June 4, 2019.

Draft EIA report was submitted to DENR on July 3, 2019 and DENR's review committee was held on July 10, 2019. The second review committee was held on July 30, 2019 and all the requirements were complied with. Draft RAP report was submitted to DPWH-ESSD on July 16, 2019 and finalized on July 29, 2019. This Draft Final Report includes the outline of the Preliminary design including the preliminary cost estimates and the EIA and RAP reports.

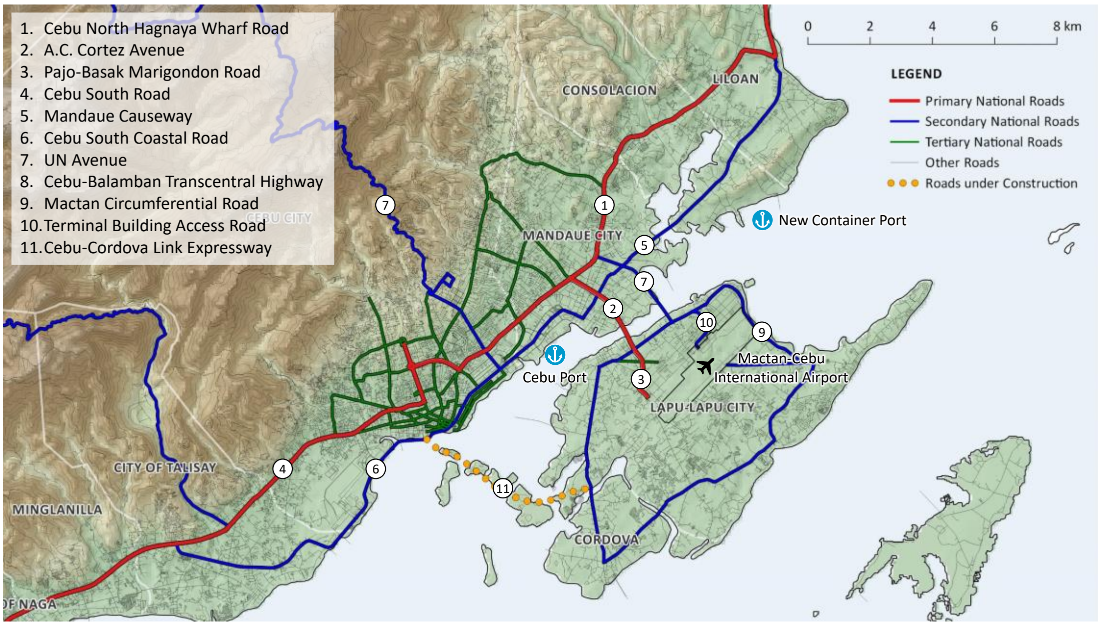
After incorporating all the comments and recommendations from DPWH, relevant institutions of the Philippines, JICA and JICA's Advisory Committee, the Final Report will be finalized and submitted by the middle of November, 2019.

2. EXAMINATION OF PROJECT SCOPE

(1) Current Road Network in Metro Cebu

The main island of Cebu Province stretches 225 km from north to south and is surrounded by 167 neighboring smaller islands that includes Mactan Island. The terrain of the island is dominated by rugged mountain ranges that constraint urban expansion. The urban core of Cebu Province is Metro Cebu, which is located along the central eastern portion of the province and includes the nearby Mactan Island. Cebu, Mandaue, and Lapu-Lapu Cities are highly urbanized central areas of Metro Cebu.

The total length of the road network in Metro Cebu including the local roads (i.e. city, municipal, and barangay roads) is 1,398.2 km and the national roads account for 30% of it (Primary National Road: 121.0 km, Secondary National Road: 191.0 km and Tertiary National Road: 105.6 km). The most roads are generally narrow with two (2) lanes and a few of the roads are four (4) lanes in the urban core areas. Moreover, the traffic capacities of these roads are decreased by roadside and on-road activities such as jeepneys' or taxis' waiting for or loading/unloading passengers. 46% of roads are not paved, which are mostly barangay roads.



Source: JICA Survey Team

Figure 2.1 Current Road Network in Metro Cebu

Currently, there are two (2) bridges linking between Cebu Island and Mactan Island. The 1st Cebu-Mactan Bridge (or called Sergio Osmeña Bridge) is a truss bridge built in 1973. The 2nd Cebu-Mactan Bridge (or called Marcelo Fernan Bridge) is an extradosed bridge built in 1999.

Sergio Osmeña Bridge

Marcelo Fernan Bridge

Source: JICA Survey Team

Figure 2.2 Existing Cebu-Mactan Bridges

Currently, 3rd Cebu-Mactan Bridge, which is called Cebu-Cordova Link Expressway (CCLEX), is under construction at the west side of Mactan Island. This bridge is designed as a cable-stayed bridge with its main span of 390 m. The construction of the 3rd Cebu-Mactan Bridge is expected to be completed by 2022.

(2) Current Road Traffic Situation

The traffic situation in Metro Cebu has deteriorated in recent years. Traffic congestion occurs on many roads and intersections not only during peak hours, but also off-peak hours, due to i) increase of traffic demand (population growth, economic development and motorization), ii) insufficient road network and public transport services, and iii) inadequate traffic management.

According to the final report of "Project for Master Plan Study and Institutional Development on Urban Transport System in Metro Cebu" (or called Metro Cebu Urban Transport Master Plan: MCUTMP), the majority of the traffic through 1st Cebu-Mactan Bridge was the trips from/to Cebu City or Mandaue City. The majority of the traffic through 2nd Cebu-Mactan Bridge was the trips from/to Mandaue City, Cebu City and Liloan.

1st Cebu-Mactan Bridge **2nd Cebu-Mactan Bridge**

Source: MCUTMP (JICA, 2019)

Figure 2.3 Trip Distribution

The available mode of public transportation in Metro Cebu are jeepneys, buses, taxis, and tricycles and the majority of them are jeepneys that are technically registered as public utility vehicles (PUVs). There are also the "trisikads" from areas where there is demand for public transportation, but are not registered as PUVs. Another service that later emerged is the motorcycle-for-hire or called "habal-habal." Like the "trisikads", the service is illegal but thrive to cater to the mobility requirements of people outside the formal public transport service areas. Urban rail transit does not exist in Metro Cebu although this has been considered since 1990s. A Bus Rapid Transit (BRT) system is currently being implemented for Cebu City, but suffered some delays.

(3) Related Development Plans

There are three (3) manufacturing special economic zones in Lapu-Lapu City. Mactan Export Processing Zones (MEPZ) 1 and 2 have 119 ha and 63 ha of lands respectively and these have been fully occupied by 158 and 54 companies. Cebu Light Industrial Park is relatively new economic zone with 63 ha of land and currently 35 companies are located but it is expected that this economic zone will be fully occupied within 5-6 years.

Several residential and mixed use developments are also planned in central Metro Cebu. Development of Mandaue Global City, which will be a 130 ha reclamation project, is planned within the vicinity of the Project site in Cansaga Bay. For finalization of the road alignment of the Project Road, coordination with the reclamation project may be necessary depending on the position of the alignment.

Cebu is a historical port city where the port supports its local economy. Cebu International Port is the main domestic shipping port in the Philippines and home to about 80% of domestic and international shipping operators and shipbuilders. Due to its shallow depths, the average overseas ship size is severely restricted to 11,929 gross registered tonnage (GRT). Despite such capacity constraint, container traffic has steadily increased by 8.1% per annum since 2012. In order to meet the increasing international container movement and to decongest the existing Cebu International Port, development of a new international container port in the Municipality of Consolacion was approved by the national government of the Philippines. The new port is proposed to be on a 25 ha reclaimed island designed to handle 500,000 twenty-foot equivalent units (TEU).

The Mactan-Cebu International Airport (MCIA) located in Lapu-Lapu City is recognized as the southern air transport hub of the Philippines. The terminal, which was originally designed for 4.5 million passengers per annum, was renovated to handle 8 million as response to the rapid increase in passengers. An additional new international terminal opened in July, 2018 to accommodate a total of 12.5 million passengers per annum. Plans for the construction of a second runway has been discussed, but stands as an unsolicited proposal and has not been made official. The proposed location of the second runway is north east of the existing airport where Mactan Export Processing Zone 1 (MEPZ1) is located. This indicates that the proposed second runway may be constructed by demolishing many factories and warehouses are currently built in MEPZ1.

(4) Road Network Development Plan

Majority of the current traffic issues stem from the road network includes the following:

- Congestion is primarily caused by weak road network, particularly limited construction of new roads. The drastically increasing number of vehicles cannot be accommodated;
- New roads are not adequately planed in accordance with the appropriate land use plan formulated under a long-term vision;
- Inefficient use of roads by the current public transport system that requires higher capacity;
- Many vehicles on the roads are inadequately maintained, particularly buses, jeepneys, and trucks. These vehicles contribute to the deterioration of air quality because of poorly controlled emissions; and
- In addition to the lack of infrastructure development, traffic management to utilize the existing infrastructure capacity to the maximum extent to mitigate traffic congestion is not sufficient.

In order to solve these issues, a series of studies, such as Metro Cebu Land Use and Transportation Study (MCLUTS), JICA’s Roadmap Study and MCUTMP, has been conducted. MCUTMP proposed medium- and long-term road transport development plan in order to achieve the following targets:

- To reduce through traffic from northern to southern area of Metro Cebu;
- To increase road network capacity and travel speed would be increased at 10 km/h;
- To make an alternative route to prevent unnecessary intrusion to central Metro Cebu from northern and southern part of Metro Cebu;
- To provide safe, convenient, and comfortable access for pedestrians and bicyclists; and
- Smooth connection to and from Mactan Island through the bridges across Mactan Channel.

The basic concept of strategic urban road network plan in Metro Cebu is to establish an outer diversion road connecting to the coastal road at the central area of Metro Cebu that suffers from serious traffic congestion. It is expected that the proposed three roads, namely Metro Cebu Circumferential Road (or called Metro Cebu Expressway), Mandaue-Liloan Diversion Road and Mandaue Coastal Road, will form the proposed the outer diversion road. In addition to the new road construction, road widening and improvement of existing intersections are also proposed to mitigate traffic congestion.

Table 2.1 summarizes the proposed medium- to long-term road development projects in Metro Cebu. Out of these proposed projects, the following two road projects are evaluated as the high priority road projects by MCUTMP:

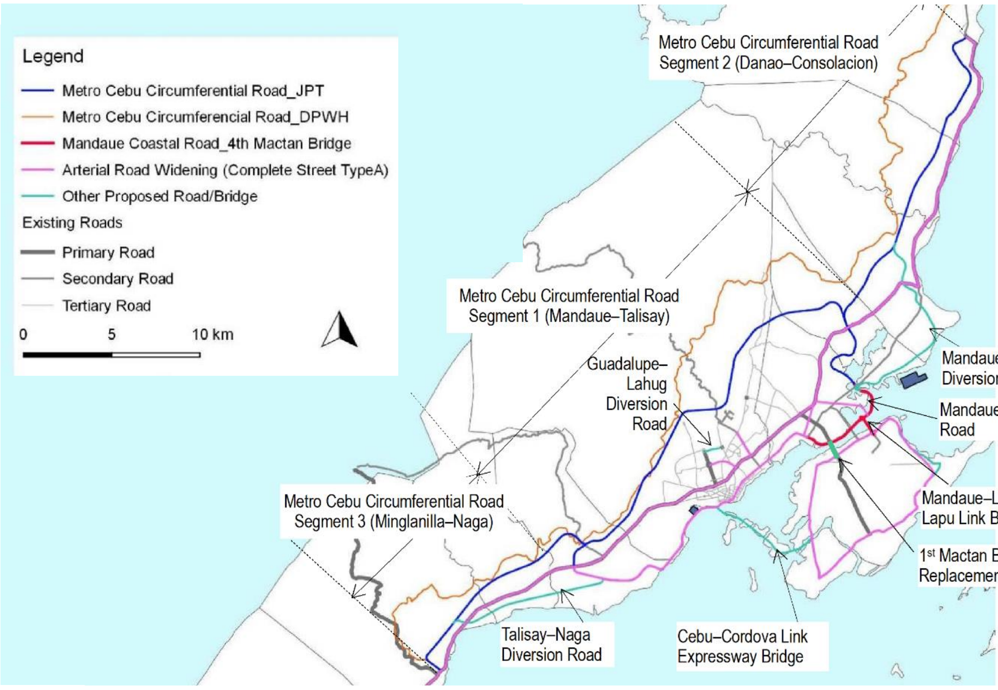
- 4th Cebu-Mactan Bridge with Mandaue Coastal Road
- Metro Cebu Circumferential Road

Therefore, undertaking of feasibility study on construction of the 4th Cebu-Mactan Bridge with Mandaue Coastal Road were requested from the Government of the Philippines through DPWH to the Government of Japan.

Table 2.1 Proposed Medium-Term to Long-Term Road Projects in Metro Cebu

	Medium-Term Plan Toward Year 2030	Long-Term Plan Toward Year 2050
Road Projects	• Metro Cebu Circumferential Road • Talisay-Naga Diversion Road • Mandaue-Liloan Diversion Road • Cebu Arterial Road Widening • Cebu Coastal Road Widening • Mactan Circumferential Road Widening • Metro Cebu Intersection Improvement	• Metro Cebu Coastal Road Expressway • Metro Cebu Circumferential Expressway
Bridge Projects	• Cebu-Cordova Link Expressway (on-going) • **Mandaue Coastal Road (viaduct)** • **4th Cebu-Mactan Bridge** • Replacement of 1st Cebu-Mactan Bridge	

Source: MCUTMP (JICA, 2019)



Source: MCUTMP (JICA, 2019)

Figure 2.4 Proposed Future Road Network in Metro Cebu

(5) Route Selection of Project Roads

<u>Traffic Analysis on Interconnectivity with Cebu-Mactan Bridges</u>

The MCUTMP estimated the future traffic volume across Mactan Channel in 2030 (without UMRT) as 249,700 PCU/day in total. In order to analyze the traffic pattern at the vicinity of the Project site depending on the interconnectivity between Mandaue Coastal Road and Cebu-Mactan Bridges, traffic demand forecasts were carried out using the six (6) road network cases summarized in Table 2.2.

The growth rate of the future traffic demand across Mactan Channel from 2017 to 2030 is calculated as 7.7% per annum. This growth rate is much higher than that of the total generated trip estimated in Metro Cebu (2.8%) because this traffic demand forecast considered all of the proposed and planned development plans to be located near the Project area.

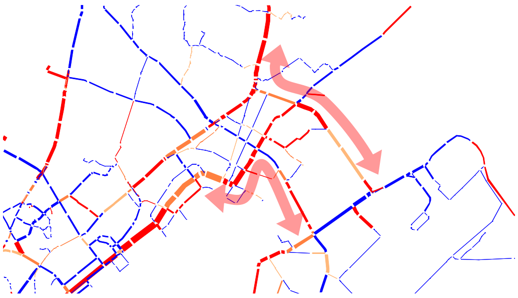
Table 2.2 Different Road Network Cases for Traffic Demand Forecast

		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Projection Year		2017	2030				
Road Network		Current Road Network		Proposed Road Network by 2030 (M/P)			
Interconnection with Mandaue Coastal Road	1st Bridge	N/A	N/A	✓	N/A	✓	N/A
	2nd Bridge	N/A	N/A	✓	✓	N/A	N/A
	4th Bridge	N/A	N/A	✓	✓	✓	✓

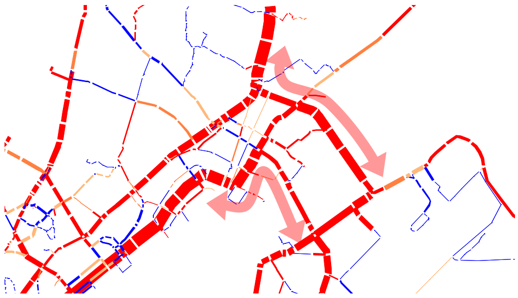
Source: JICA Survey Team

As the result of the traffic analysis, the following findings were obtained as the recommendations for road planning of the Project Road:

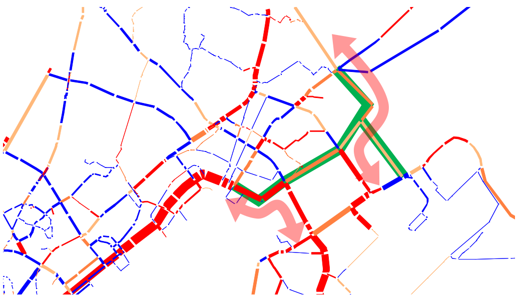
- Mandaue Coastal Road should be connected with 1st Cebu-Mactan Bridge in order to decongest the traffic on the roads in Mandaue and Cebu Cities.
- Mandaue Coastal Road and the proposed Metro Cebu Circumferential Road should be seamlessly connected in order to decongest the traffic on the roads in Mandaue City and Consolacion.



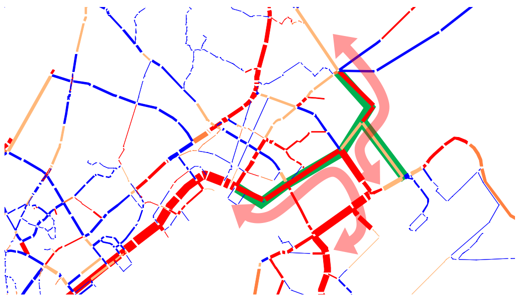
Case 1



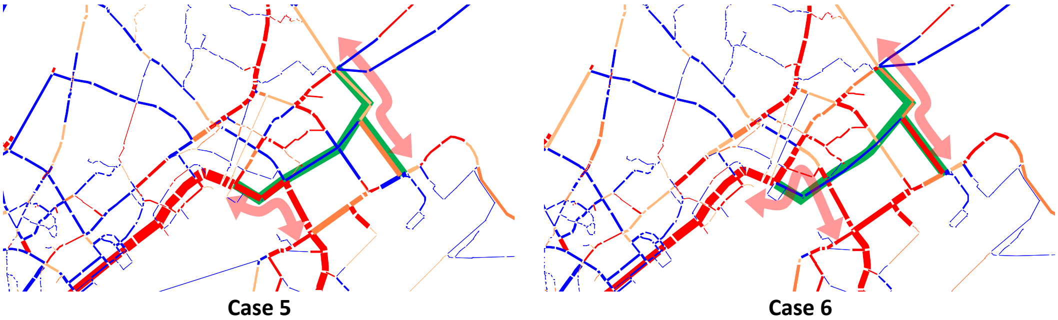
Case 2



Case 3



Case 4



Note) : VCR < 1.00、 : VCR < 1.20、 : VCR < 1.50、 : 1.50 < VCR
Source: JICA Survey Team

Figure 2.5 Result of Traffic Assignment for Different Road Network Cases

Route Selection of 4th Cebu-Mactan Bridge

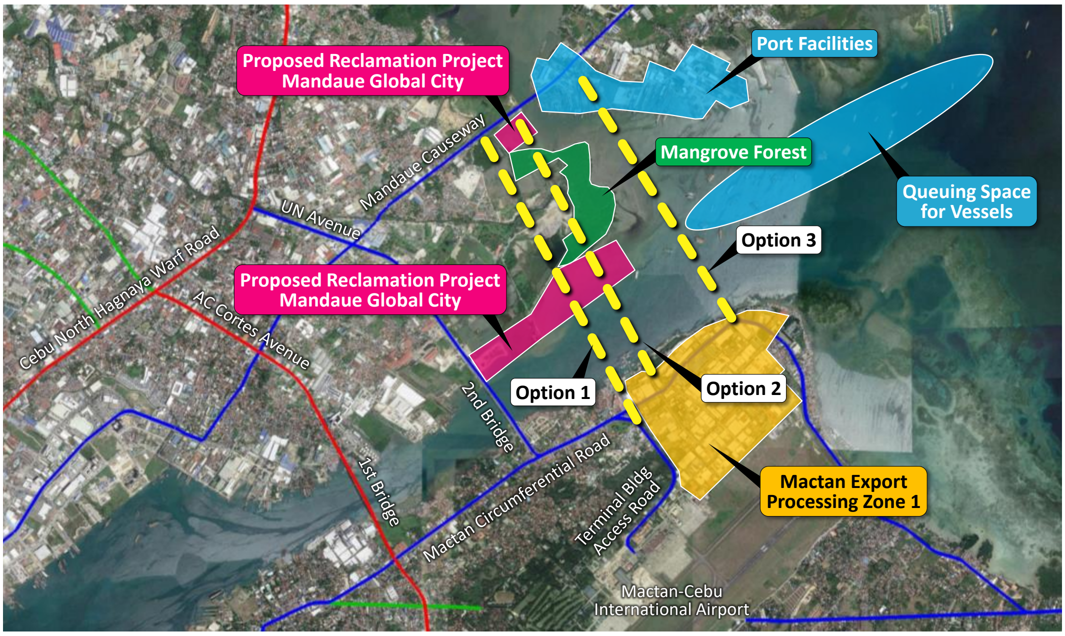
The possible location for bridge construction of 4th Cebu-Mactan Bridge was determined only at the area east of the 2nd Cebu-Mactan Bridge because of the following reasons:

- The channel at the west side of the 1st Cebu-Mactan Bridge needs to maintain a navigational clearance of 40 m above sea level in order to allow bigger ships transportation. On the other hand, structures cannot be built any higher than 45 m from the runway level of Mactan-Cebu International Airport due to its aviation limit.
- The distance between the 1st and 2nd Cebu-Mactan Bridges is 1.4km but port facility is located within this area making it difficult to secure enough space for bridge construction.
- The 1st and 2nd Cebu-Mactan Bridges are expected to meet the traffic demand from the centers of Cebu City and Mandaue City while the 3rd Bridge is expected to meet that from the western side of Cebu Island. The 4th Cebu-Mactan Bridge is therefore expected to meet the demands from the eastern side of the main land Cebu.
- Although, there was a recommendation that 4th Cebu-Mactan Bridge should be constructed at the symmetric position against the 3rd Cebu-Mactan Bridge, the idea was rejected because of the aviation limit of Mactan-Cebu International Airport and the navigational clearance of new container port to be constructed in Consolacion.

Based on the above conditions, the following three alternative options were analysed:

- Option 1: Connect with Mactan Circumferential Road and airport access road
- Option 2: Connect with Mactan Circumferential Road at the entrance of a economic zone
- Option 3: Connect with Mactan Circumferential Road at the east end of Mactan Island

Table 2.3 summarizes the comparision result on the three alternative options. Option 1 was recommended as the optimum location for 4th Cebu-Mactan Bridge from the view points of good connectivity to the existing road newtork, less impact to the mangrove forest and economic zone and economic efficiency.



Source: JICA Survey Team

Figure 2.6 Alternative Options for Bridge Location (4th Cebu-Mactan Bridge)

Table 2.3 Comparison of Bridge Location (4th Cebu-Mactan Bridge)

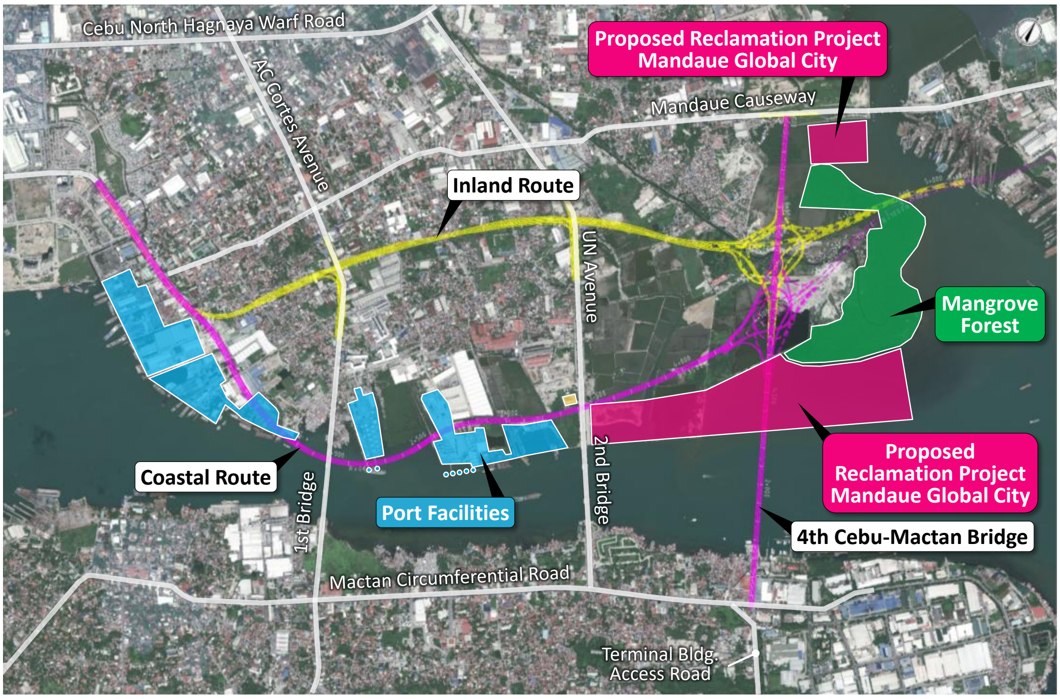
Evaluation Criteria		Option 1	Option 2	Option 3
Cebu Side	Affected Area of Mangrove Forest	Approx. 0.75 ha (300m × 25m)	Approx. 0.85 ha (350m × 25m)	None
	Affected Area of Tideland	Approx. 0.5 ha (200m × 25m)	Approx. 0.6 ha (250m × 25m)	None
	Affected Houses	Approx. 10 houses (50 PAPs)	Approx. 10 houses (50 PAPs)	Approx. 20 houses (100 PAPs)
	Reclamation Plan	Passes at one location	Passes at two locations	No interference
	Port Facilities	No interference	No interference	Interfere occurs
Mactan Side	Industrial Area	Few interference	Few interference	Few interference
	Number of Lanes of Mactan Circumferential Road	6	4	4
	Connecting Road	Secondary National Road	Economic zone	No road
Construction Cost		Low because the length built in the sea is shorter (land: 1.6 km; sea: 1.0 km)	low because the length built in the sea is shorter (land: 1.6 km; sea: 1.0 km)	high because the length built in the sea is longer (land: 0.6 km; sea: 2.0 km)
Overall Evaluation		Recommended • construction cost is low • some level of negative impact on the natural and social environment is expected • good access to airport and other road networks on Mactan Island	• construction cost is low • some level, a level greater than Option 1, of negative impact on the natural and social environment is expected • bad access to airport and other road networks on Mactan Island	• construction cost is high • interferes with port facilities and scale of resettlement is the greatest • impact on natural environment is limited • bad access to airport and other road networks on Mactan Island

Source: JICA Survey Team

Route Selection of Mandaue Coastal Road

For the Mandaue Coastal Road, the following two route options were identified as the possible route options:

- Coastal Route: Based on the alignment recommended by MCUTMP, the route position was modified in order to avoid the port facilities, the proposed reclamation project, mangrove forest and tideland. This route can provide interconnectivity to 1st and 4th Cebu-Mactan Bridges.
- Inland Route: This route can provide interconnectivity to all Cebu-Mactan Bridges but passes through the residential area in Mandaue City.



Source: JICA Survey Team

Figure 2.7 Alternative Route Options for Mandaue Coastal Road

Coastal Route is modified from the alignment recommended by MCUTMP in order to avoid the port facilities, the proposed reclamation project, mangrove forest and tideland. This route can provide interconnectivity to 1st and 4th Cebu-Mactan Bridges. Due to the steep vertical gradient of the 2nd Cebu-Mactan Bridge, this route cannot have the interconnectivity with the 2nd Cebu-Mactan Bridge. Although this route can avoid highly populated residential area, resettlement of over 100 houses would be required.

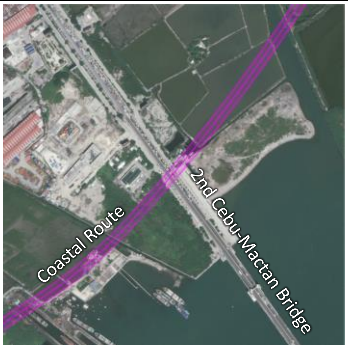
Inland Route has higher functionality of road than Coastal Route but would require an enormous number of resettlement of houses because the route needs to be located about 1 km inland side from the coastal line in order to secure the enough distances for construction of interchange ramps.

Table 2.4 and Table 2.5 summarize the outlines of the alternative route options for Mandaue Coastal Road and evaluation result of the options respectively. As the result of comparative analysis, the Coastal Route was recommended as the optimum location for Mandaue Coastal Road from the viewpoints of good functionality of road and less adverse social environment.

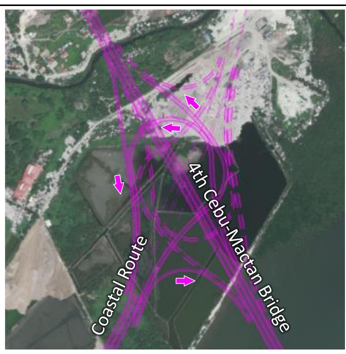
Table 2.4 Comparison of Possible Routes for Mandaue Coastal Road

<table>
<tr><th colspan="2"></th><th>Coastal Route</th><th>Inland Route</th></tr>
<tr><td colspan="2">General Description</td><td>• Based on the alignment recommended by MCUTMP, port facilities, the proposed reclamation project, mangrove forest and tideland are avoided.
• Interconnection with 1st and 4th Bridges.</td><td>• The route passing through residential areas.
• Interconnection with 1st, 2nd and 4th Bridges.</td></tr>
<tr><td rowspan="3">Road Length (km)</td><td>Approach</td><td>0.25</td><td>0.25</td></tr>
<tr><td>Viaduct</td><td>4.55</td><td>4.00</td></tr>
<tr><td>Total</td><td>4.80</td><td>4.25</td></tr>
<tr><td rowspan="5">Land Use (km)</td><td>Roadway</td><td>0.90 (19%)</td><td>0.71 (17%)</td></tr>
<tr><td>Factory</td><td>0.55 (11%)</td><td>0.60 (14%)</td></tr>
<tr><td>Port Facility</td><td>1.75 (36%)</td><td>0.00 (0%)</td></tr>
<tr><td>Residences</td><td>0.00 (0%)</td><td>1.65 (39%)</td></tr>
<tr><td>Unused</td><td>1.60 (33%)</td><td>1.29 (30%)</td></tr>
<tr><td rowspan="3">Interconnection with the Bridges</td><td>1st Bridge</td><td>

Grade separation with free flow interchange ramps only for western side of coastal road.</td><td>

Combination of grade separation with interchange ramps for western side of coastal road and at-grade intersection for eastern side of coastal road.</td></tr>
<tr><td>2nd Bridge</td><td>

None
Because the route would cross with UN Avenue at the steep gradient (5.5%) section of the bridge approach, interconnection with 2nd Bridge cannot be provided.</td><td>

Combination of grade separation with interchange ramps for western side of coastal road and at-grade intersection for eastern side of coastal road.</td></tr>
<tr><td>4th Bridge</td><td>

Grade separation with 4-leg interchange ramps.</td><td>

Grade separation with 4-leg interchange ramps.</td></tr>
</table>

	Coastal Route	Inland Route

Source: JICA Survey Team

Table 2.5 Evaluation of Possible Routes for Mandaue Coastal Road

Criteria		Base Score		Coastal Route			Inland Route		
Functionality of Project Road	Balancing traffic volume across Mactan Channel	**12**	**30**	1st Bridge 95,000 (45%) 2nd Bridge 46,200 (22%) 4th Bridge 71,300 (34%)	**6**	**24**	1st Bridge 83,100 (39%) 2nd Bridge 75,000 (35%) 4th Bridge 54,300 (26%)	**12**	**30**
	Reduction of traffic volume in city center	**18**		• Cebu N Road: -42% • Mandaue Causeway: -56% Note: The most of traffic from western side of Cebu will use Coastal Road.	**18**		• Cebu N Road: -42% • Mandaue Causeway:-59% Note: The most of traffic from western side of Cebu will use Coastal Road.	**18**	
Constructability	Construction duration*	**6**	**10**	5 years Construction of viaduct in channel would take time and requires skilled contractor.	**3**	**6**	3 years Construction of viaduct on land would not take time.	**6**	**8**
	Accessibility to construction site	**2**		Temporary jetty or barge would be required for construction of piers of viaduct.	**1**		There are many crossing roads and accessibility to site is good.	**2**	
	Easiness of traffic management	**2**		Few crossing roads	**2**		More crossing roads than Option 1.	**0**	
Project Cost	Coastal Road	**18**	**30**	2.47 (Steel Box Girder w/ Steel Deck Slab)	**9**	**21**	1.00 (PC-I Girder Bridge)	**18**	**18**
	4th Bridge			0.79 (Steel Box Girder w/ Steel Deck Slab)			1.00 (Steel Box Girder w/ Steel Deck Slab)		
	Construction Cost (Rate)			1.50			1.00		
	Land Acquisition	**12**		Smaller area of land acquisition Is necessary	**12**		Larger area of land acquisition is necessary	**0**	
Natural Environmental Impact	Conservation of mangrove forest and tideland	**6**	**10**	The mangrove forest and the tideland (where roosting and feeding areas for migratory birds) can be avoided and the adverse impact would be minimal.	**6**	**8**	The mangrove forest and the tideland (where roosting and feeding areas for migratory birds) can be avoided and the adverse impact would be minimal.	**6**	**8**
	Roadside air/noise pollution	**2**		Minimal impact because this route does not pass through residential area.	**2**		The highest negative impact for residential area.	**0**	
	Water quality pollution	**2**		Drainage water from viaduct may deteriorate water quality.	**0**		Water quality pollution is limited.	**2**	
Social Environmental Impact	Number of affected houses (PAPs)	**7**	**20**	Minimal number of PAPs would be expected. (Assumed to be 500 PAPs)	**7**	**17**	The greatest number of PAPs would be expected. (Assumed to be 2,000 PAPs)	**0**	**9.5**
	Number of affected business entities	**7**		Coordination with few factories would be needed. 6 Factories	**7**		Coordination with few factories would be needed. 10 Factories	**3.5**	
	Necessity of special care for port facilities	**3**		Coordination with port facilities would be needed.	**0**		Coordination with port facilities would NOT be needed.	**3**	
	Effect to Proposed Reclamation Project	**3**		Coordination with Reclamation Project is NOT needed.	**3**		Coordination with Reclamation Project is NOT needed.	**3**	
Overall Evaluation				• Good functionality with minimal scale of resettlement of houses. • However, implementability of Project would be depending on the negotiation with port facilities and reclamation project. • Reconstruction of 1st Bridge is prerequisite.		**76**	• Functionality of Project road is the highest but requires large-scale of resettlement of houses		**73.5**
				Recommended					

Note: * Duration for land acquisition process is not considered.

Criteria	Base Score	Coastal Route	Inland Route

Source: JICA Survey Team

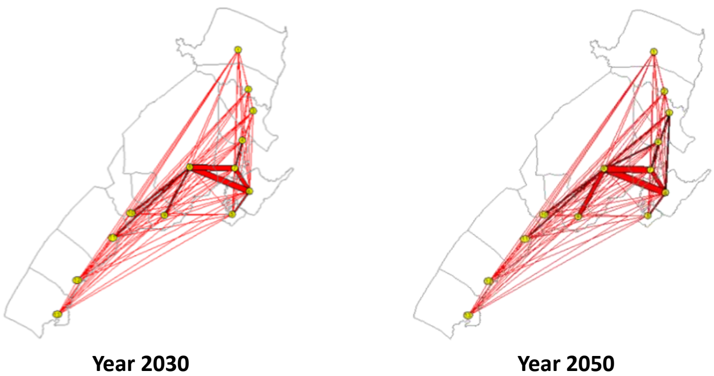
3. TRAFFIC DEMAND FORECAST

(1) Database for the Analysis

In order to analyze the future traffic demand within the vicinity of the Project Site, this Survey utilized the existing database such as origin-destination (OD) tables, transport network and models developed for the demand forecast in the "Project on Master Plan Study and Institutional Development on Urban Transport System in Metro Cebu (MCUTMP)" conducted by JICA from 2017 to 2019. In MCUTMP, the future demand analysis was conducted for the target years of 2030 and 2050 based on the traffic situation in 2017.

In MCUTMP, the total generated trip in 2030 was estimated at 7.1 million trips/day based on the trip production rate and the future population, which is almost 1.5 times the current condition. By year 2050, the total generated trip will become 9.3 million trips/day which is almost twice the current condition.

OD tables were estimated by applying the Frater Method based on the present OD trips. Among the OD trips across LGU boundaries in 2030 and 2050, the trip between Cebu City and Mandaue City is the highest except in the internal trip. Meanwhile, the trips between Cebu City and Lapu-Lapu City, Mandaue City and Lapu–Lapu City, and Cebu City and City of Talisay are also high as shown in Figure 3.1.



Source: MCUTMP (JICA, 2019)

Figure 3.1 Trip Distribution between LGUs in Metro Cebu

In this Survey, the planning target year was determined in 2039, 20 years after the start of project preparation. Therefore, the OD table for the year 2039 was prepared by interpolating the OD tables in 2030 and 2050. The transport network data for the year 2039 was also prepared based on the implementing schedule of the master plan transport projects. Considering the access to the New International Container Terminal to be developed in Consolasion, the alignment of Metro Cebu Circumferential Road was modified to be connected to the Mandaue-Liloan Diversion Road.

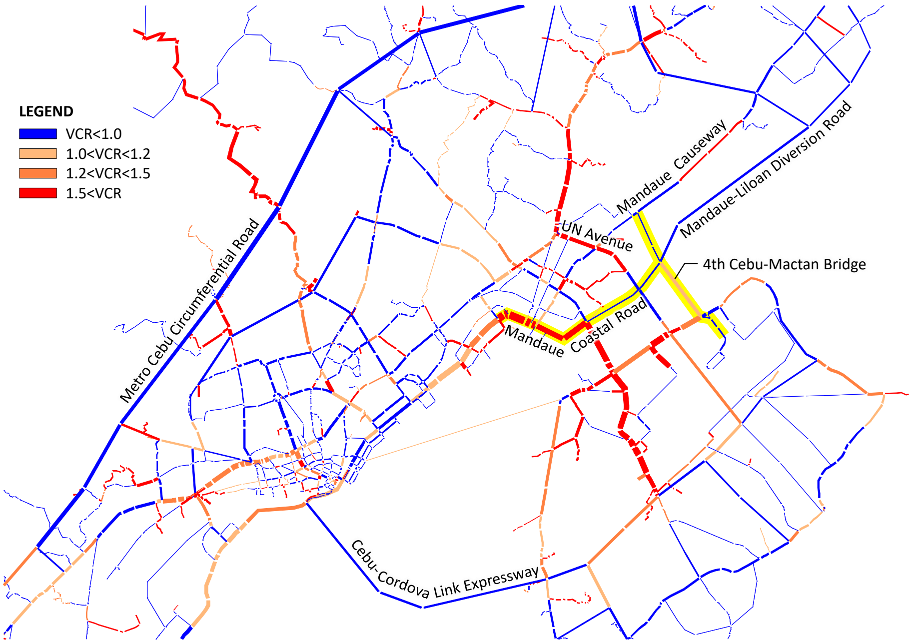
(2) Results of Future Demand Forecast

As the result of traffic demand forecast for the year 2039, traffic volume on the 4th Cebu-Mactan Bridge and Mandaue Costal Road (at the west side of the 1st Cebu-Mactan Bridge) is estimated as presented in Table 3.1. Figure 3.2 shows the future transport network with traffic volume excluding UMRT links.

Table 3.1 Estimated Traffic Volume in 2039

Unit	Section	Direction	Motorcycle	Car	Public Veh.	Truck	Total
PCU/day	4th Cebu-Mactan Bridge	To Mactan	4,700	15,400	5,400	5,200	30,700
		To Mandaue	5,300	16,000	4,700	3,500	29,500
		Total	**10,000**	**31,400**	**10,100**	**8,700**	**60,200**
	Mandaue Coastal Road	To East	9,400	24,200	8,300	7,600	49,500
		To West	10,400	27,900	8,800	7,400	54,500
		Total	**19,800**	**52,200**	**17,200**	**15,000**	**104,200**
Vehicles/day	4th Cebu-Mactan Bridge	To Mactan	14,100	15,400	3,900	2,300	35,700
		To Mandaue	16,200	16,000	3,400	1,500	37,100
		Total	**30,300**	**31,400**	**7,300**	**3,800**	**72,800**
	Mandaue Coastal Road	To East	28,400	24,200	5,800	3,300	61,700
		To West	31,600	27,900	6,100	3,200	68,800
		Total	**60,000**	**52,200**	**12,000**	**6,500**	**130,700**

Source: JICA Survey Team



Source: JICA Survey Team

Figure 3.2 Estimated Traffic Volume in 2039

4. NATURAL CONDITION SURVEYS

(1) Meteorological Conditions

The climate of Cebu Mactan area is categorized as tropical rainforest climate, being high temperature and high humidity throughout the year. There is no significant difference between seasons in the Cebu Mactan area all the year round, and the fluctuation of temperature is small. The highest monthly mean temperature at the station was 32.6 °C in May, and the lowest was 24.0 °C in February.

The dry season from November to April has low rainfall, and its averaged monthly mean rainfall was 91.7 mm/month. On the other hand, averaged monthly mean rainfall from May to October was 168.3 mm/month. Annual mean rainfall at the Mactan Station from 1982 to 2018 was 1,636.3 mm/year.

Although the monthly mean humidity was below 80% from March to May due to low rainfall, there is no significant difference between humidity at each month throughout the year. The average value of humidity for 30 years was 81%.

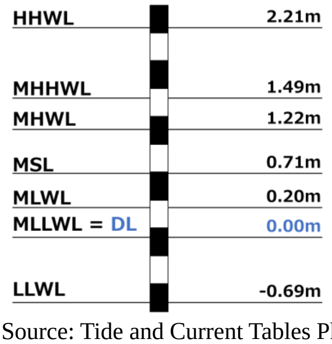
The annual average wind speed observed from 1981 to 2010 was 2.8 m/s, and the wind speed exceeding the annual average was recorded from December to April. The past maximum wind speed (10 minutes averaged wind speed) from 1972 to 2017 was 55.0 m/s when typhoon MIKE landed on November 12th, 1990.

According to the National Structural Code of the Philippines, the maximum wind gust speed of return period 300-year, 700-year and 1,700-year in the Project area are determined as 270 km/h (75 m/s), 270 km/h (75 m/s) and 280 km/h (78 m/s) respectively.

A total of 41 typhoons landed in Cebu Island during the 35 years from 1983 to 2017 (1.2 on average a year), of which 49% hit the island in November and December. Among them, the maximum wind speed of Typhoon MIKE (RUPING) which hit Cebu Island in 1990 was 150 kts (77.2 m/s), and the lowest central pressure was 885 mb. In addition, the maximum wind speed of typhoon HAIYAN (YOLANDA) which landed in November 2013 was 170 kts (87.5 m/s), and the lowest central pressure was 895 mb. The maximum wind speed of HAIYAN was the fastest typhoon recorded since 1983, and its maximum wind speed was 56 m/s at the Mactan Station. Typhoon HAIYAN passed the Medellin district in the northern part of Cebu Island, and many houses were destroyed. However, it was reported that there were almost no human or structural damage by storm surge or strong wind caused by typhoon HAIYAN in the project area.

(2) Oceanographical Conditions

Based on "Tide and Current Tables Philippines 2019" published by National Mapping and Resource Information Authority (NAMRIA), the tide conditions in the project site are summarized in Figure 4.1. As tide levels are arranged from the Mean Lower Low Tide Level (MLLWL) as the Datum Level (DL) in “Tide and Current Tables Philippines 2019”, MLLWL is used as DL in this project as well.



- HHWL: Highest High Water Level
- MHHWL: Mean Higher High Water Level
- MHWL: Mean High Water Level
- MSL: Mean Sea Level
- MLWL: Mean Low Water Level
- MLLWL: Mean Lower Low Water Level
- DL: Datum Level
- LLWL: Lowest Low Water Level

Source: Tide and Current Tables Philippines 2019, arranged by JICA Survey Team

Figure 4.1 Tidal Conditions and Historical Maximum/Minimum Tide Records in the Project Area

According to "Tide and Current Tables Philippines 2019", the tidal current at Mactan Channel where 1st and 2nd Cebu-Mactan Bridges are located becomes faster than that of “Cebu Harbor Station” near 3rd Cebu-Mactan Bridge due to the narrowed topography, and velocity of tidal current is to be estimated at 1.8 times. In “Cebu Harbor Station”, the maximum value of tidal current is estimated at 0.73 m/s for both flood and ebb tides, and the average velocity of tidal current is estimated at 0.46 m/s. The maximum tidal current in the project area is converted to be 1.31 m/s for both flood and ebb tides, and the average velocity of tidal currents is converted to be 0.82 m/s.

As the project area is located at inland from the location of wave prediction, the influence of waves is estimated to be less impact than that of the location of wave prediction. Therefore, the significant wave height $H_{1/3}$ in the project area is assumed to be 2.03 m or less.

In “Identification of storm surge areas in the Philippines through the simulation of Typhoon Haiyan-induced storm surge levels over historical storm tracks” (Natural Hazards and Earth System Sciences, 2015), the predicted tide level is analyzed by storm surge simulation considering the Typhoon HAIYAN. According to the result of analysis, it is estimated that the maximum storm surge deviation in the project area is at most 3 m.

(3) Topographic Survey

In order to secure the necessary accuracy of the preliminary design for the Project, topographic survey was conducted along the proposed routes of the 4th Cebu-Mactan Bridge and a part of Mandaue Coastal Road. The survey work was sublet to a local survey company and was performed under the supervision of JICA Survey Team.

Topographic survey includes bench mark settings, land topographic survey, bathymetric survey, video taking by drone and utility survey (underground utilities). Table 4.1 summarizes the contents and the exact locations/areas covered by these surveys and Figure 4.2 shows the result of the topographic survey.

Table 4.1 Contents of Topographic survey

	Unit	Quantity
Topographic (plane) survey on site		
• near Cansaga Bay Bridge	km	0.8
• near Mactan side	km	1.2
• along A. Soriano Ave.	km	1.4
Existing Bride Topo Survey		
• two existing bridges of Cebu–Mactan Bridge	km	1.0
Cross Section Survey	section	10
Bathymetry Survey 600m x 6 lines	has	9
Utility Survey (underground utilities)	utility	3
Drone Video	km	7.5
BM Setting	km	7.5

Source: JICA Survey Team

Source: JICA Survey Team

Figure 4.2 Result of Topographic Survey

(4) Geotechnical Investigation

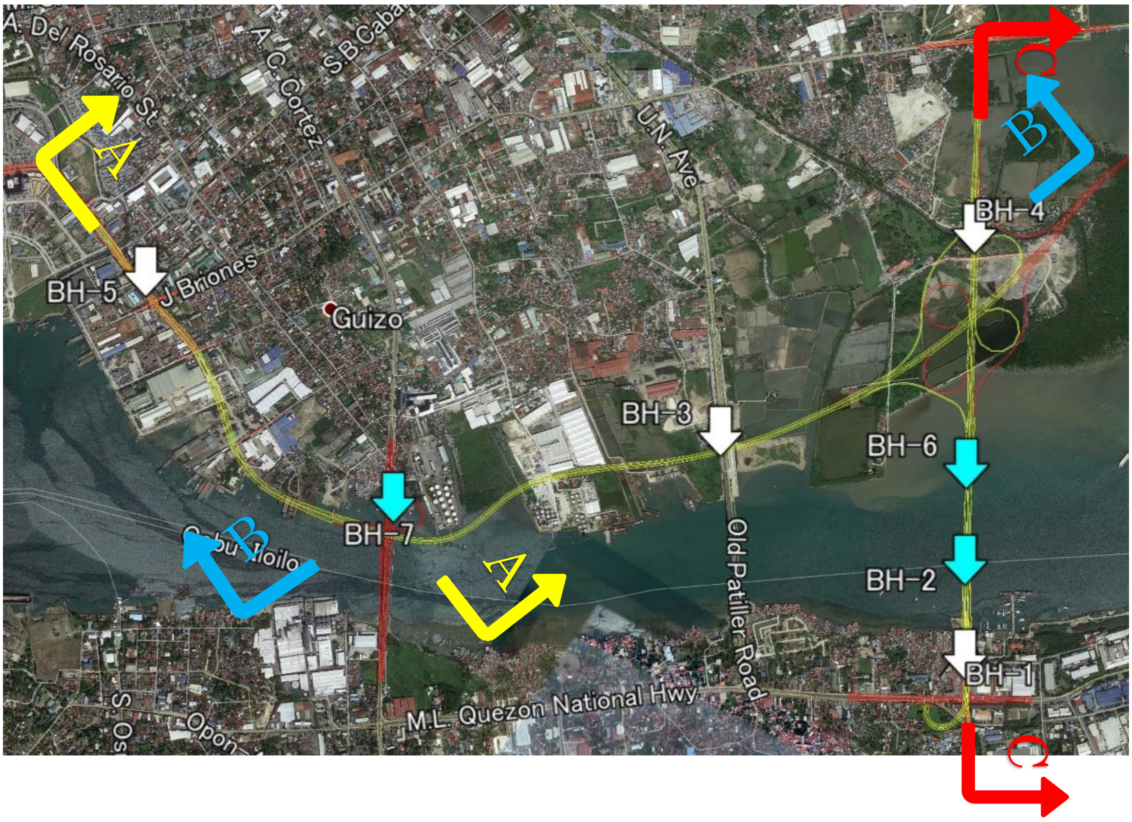
In order to secure the necessary accuracy of the preliminary design for the Project, geotechnical investigation was conducted along the proposed routes of the 4th Cebu-Mactan Bridge and a part of Mandaue Coastal Road. The survey was sublet to a local firm and was performed under the supervision of JICA Survey Team.

The geotechnical investigation includes borehole drilling (includes standard penetration test, undisturbed soil sampling and rock coring) and laboratory soil tests. Table 4.2 and Figure 4.3 summarize the contents and the exact locations of the boreholes. The SPTs were conducted at every one (1) meter depth and were continued until confirmation of bearing strata having at least five (5) meter depth of N-value of 50 or more. UD samplings were obtained by using hydraulic piston samplers from the selected depths ranging from very soft to soft soil layers equivalent to the N-value of 4 or less.

Table 4.2 Schedule of Drilling Position

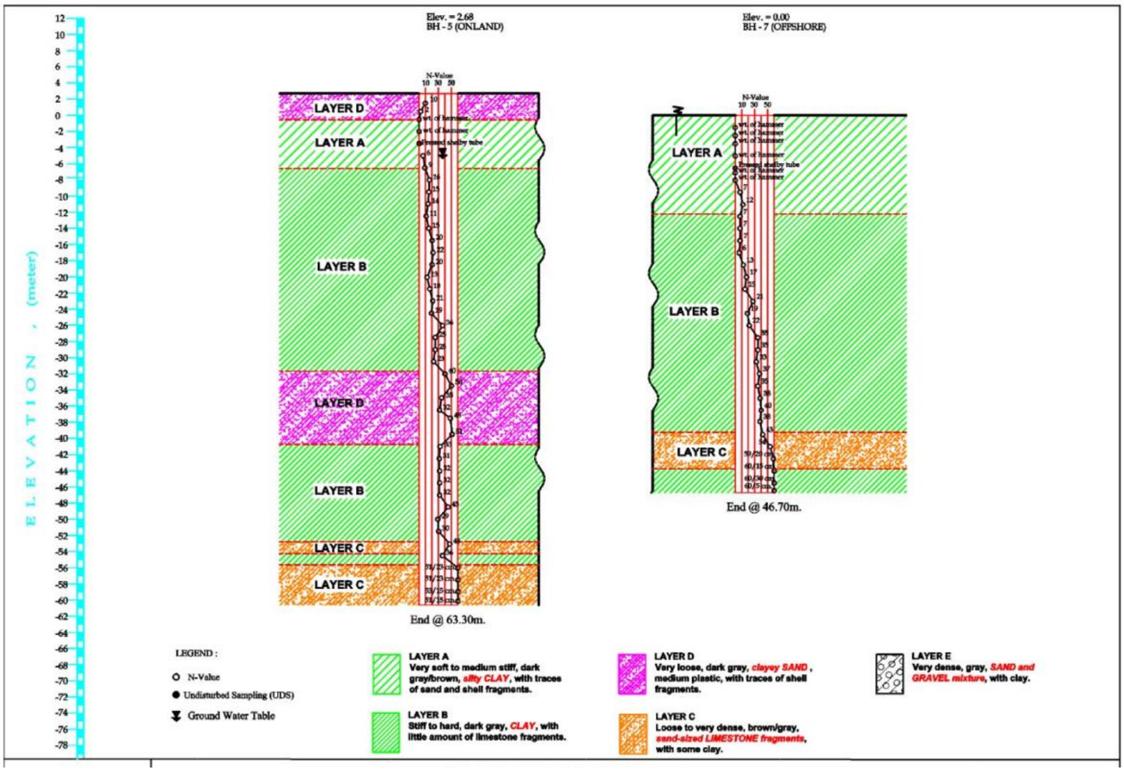
No.	Location	Site Condition	Easting	Northing	Elevation	Final Depth
BH 1	Land	PEZA Road Side	606890.659	1141690.242	11.00	25.70
BH 2	Sea	In the Sea for 4th Cebu-Mactan Bridge Lapu-Lapu side	607608.462	1142009.378	-9.06	42.15
BH 3	Land	Near 2nd Mactan Bridge Mandaue side	605592.378	1141959.878	1.82	54.30
BH 4	Land	Bush in Dump Site	606062.266	1143178.362	7.72	37.70
BH 5	Land	Space in Mandaue City Hospital	603264.272	1141347.831	2.68	63.30
BH 6	Sea	In the Sea for 4th Cebu-Mactan Bridge Mandaue side	606515.812	1142346.628	-2.77	40.70
BH 7	Sea	In the Sea for Coastal Road	604588.207	1141066.131	0.00	46.70

Source: JICA Survey Team



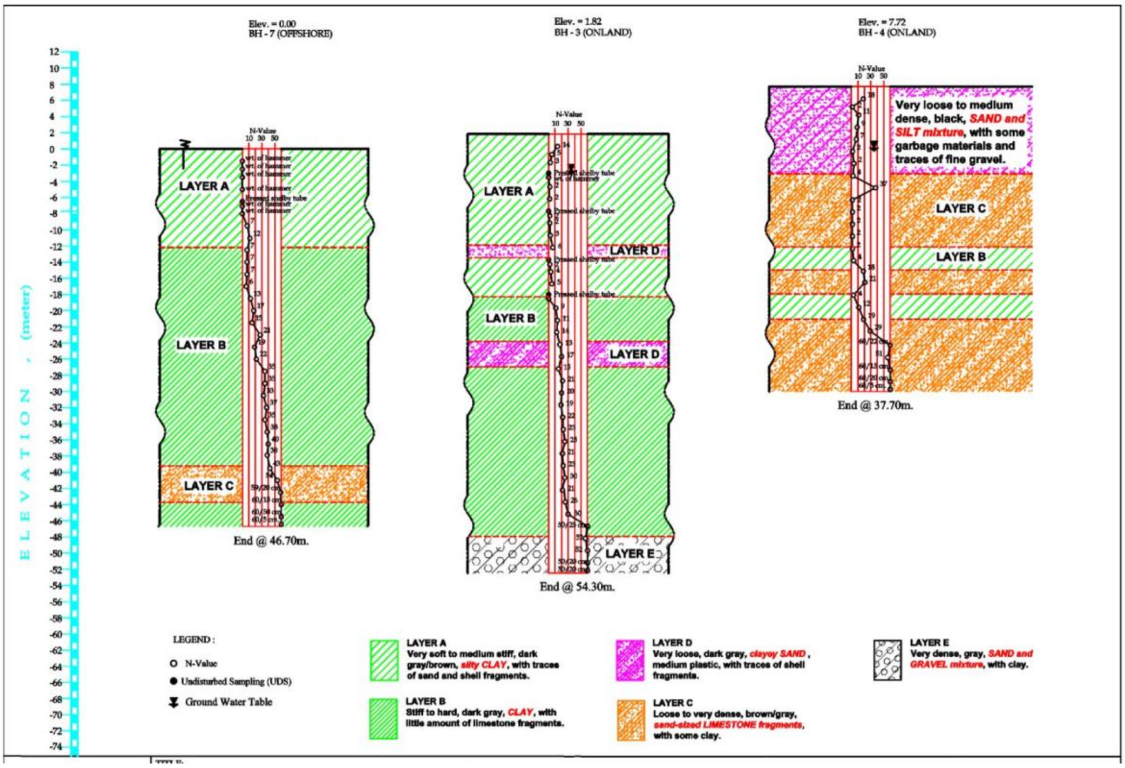
Source: JICA Survey Team

Figure 4.3 Index map of Geotechnical Investigation



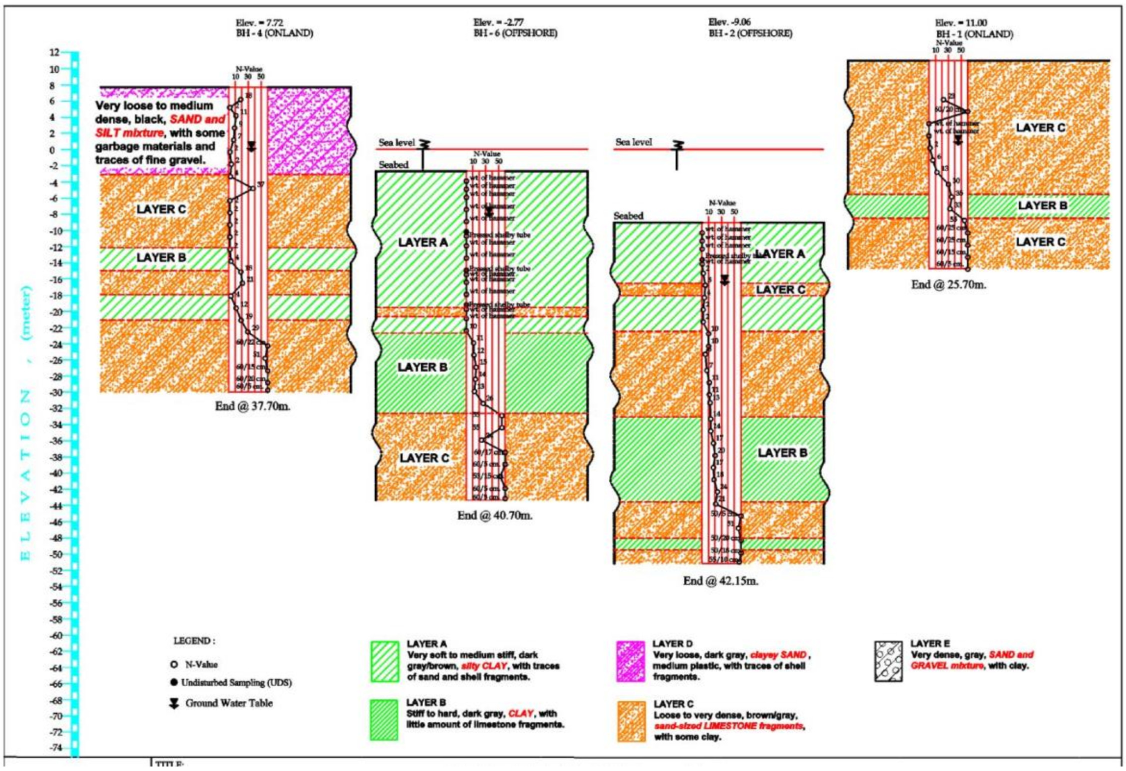
Source: JICA Survey Team

Figure 4.4 Geological Profile (A-A)



Source: JICA Survey Team

Figure 4.5 Geological Profile (B-B)



Source: JICA Survey Team

Figure 4.6 Geological Profile (C-C)

5. PRELIMINARY DESIGN

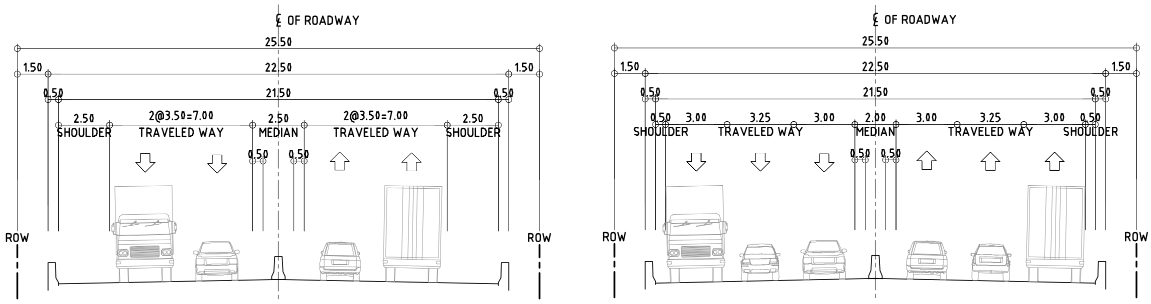
5.1 Highway Design

(1) Design Conditions

In reference to the design standards of DPWH, AASHTO and Japan, the design criteria and standards for designing of 4th Cebu-Mactan Bridge and Mandaue Coastal Road are determined.

(2) Typical Cross Sections

The cross section width of the 4th Cebu-Mactan was determined in consideration of the possibility to expand the number of lanes from 4-lane to 6-lane in future (beyond the design period of the Project). Although the width of each cross section elements in future would become narrow, the widths are still within the minimum requirement of design standard.

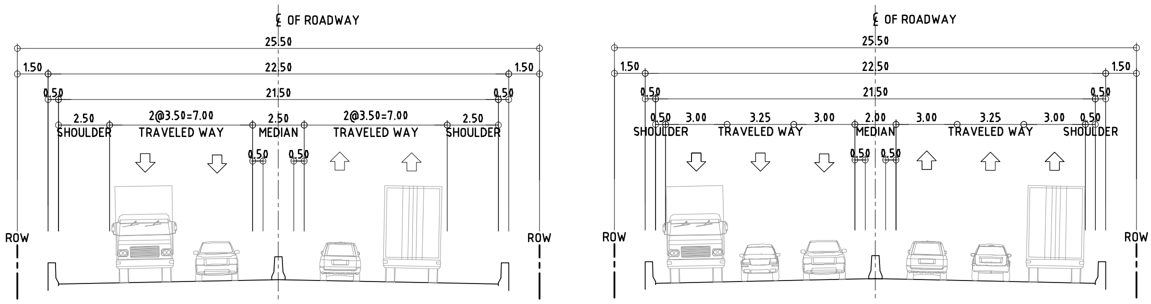


Within Design Period (until Year 2039) **Future beyond Design Period (after Year 2039)**

Source: JICA Survey Team

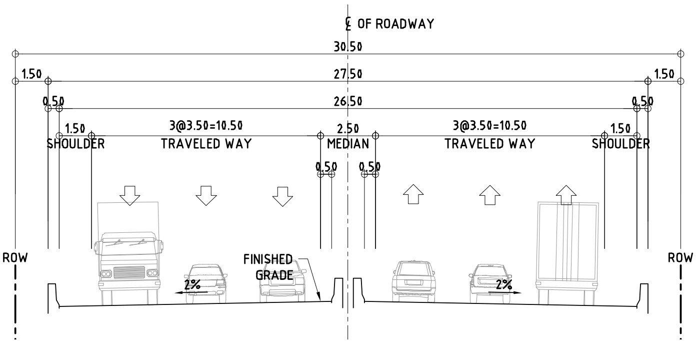
Figure 5.1 Typical Cross Sections of 4th Cebu-Mactan Bridge

The cross section width of Mandaue Coastal Road was also considered the possibility to expand the number of lanes from 4-lane to 6-lane in future (beyond the design period of the Project). However, the expansion from 6-lane to 8-lane was not considered because of the width of the existing road to be connected with Mandaue Coastal Road does not have such wide space.



Within Design Period (until Year 2039) **Future beyond Design Period (after Year 2039)**

Section from 1st Cebu-Mactan Bridge to 4th Cebu-Mactan Bridge



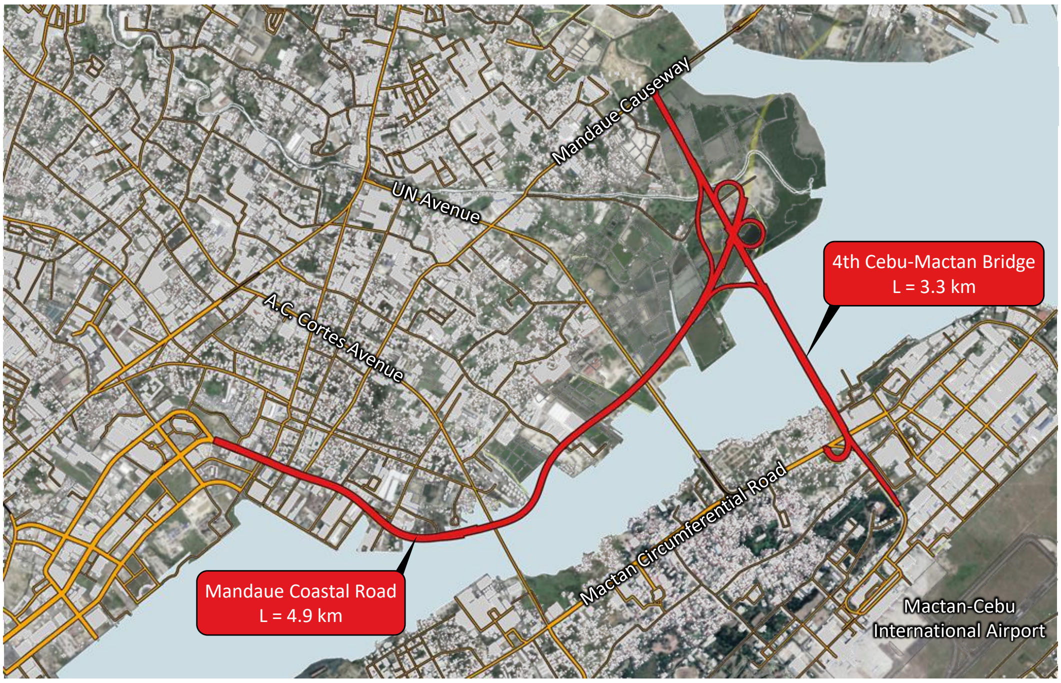
Section from Beginning Point to 1st Cebu-Mactan Bridge

Source: JICA Survey Team

Figure 5.2 Typical Cross Sections of 4th Cebu-Mactan Bridge

(3) Horizontal and Vertical Alignments

Horizontal alignments of 4th Cebu-Mactan Bridge and Mandaue Coastal Road are determined as shown in Figure 5.3. The alignments of 4th Cebu-Mactan Bridge and Mandaue Coastal Road are designed in accordance with the geometric design conditions for the design speed of 60 km/h and 80 km/h respectively with minimizing the adverse impact of natural and social environment.



Source: JICA Survey Team

Figure 5.3 Horizontal Alignment of the Project Roads

4th Cebu-Mactan Bridge will start from the at-grade intersection with Mandaue Causeway where approximately 80 m south-west of the abutment of Cansaga Bay Bridge. The alignment will avoid the residential area and the mangrove forest in Mandaue City and will link to Airport Terminal Building Access Road, which is a Secondary National Road, in Lapu-Lapu City. For the vertical alignment at Mactan Channel crossing, navigational clearance of 22.86 m above mean water level and 143 m width with 20 m margin on both sides of navigable waterway is considered. Due to the high traffic demand of the direction between 4th Cebu-Mactan Bridge and Mactan Circumferential Road, the interconnection with Mactan Circumferential Road was designed as grade separated interchange.

Mandaue Coastal Road will start from the corner of Mandaue Causeway and Mantawe Avenue and will be constructed as an elevated viaduct all the way to Cansaga Bay. The beginning section will pass through an industrial area. The alignment was designed by avoiding structures as much as possible but relocation of some factories and warehouses are inevitable. Mandaue Coastal Road will cross under the 1st Cebu-Mactan Bridge and interchange ramps for west side of Mandaue Coastal Road will be provided in future at the timing of reconstruction of the 1st Cebu-Mactan Bridge. After passing through the pipeline jetty, the alignment will divert to the inland side behind the tank farm and shipyard. Mandaue Coastal Road will cross over the 2nd Cebu-Mactan Bridge and will interconnect with 4th Cebu-Mactan Bridge through Cloverleaf-type Interchange (or called Mandaue Interchange).

5.2 Bridge Design

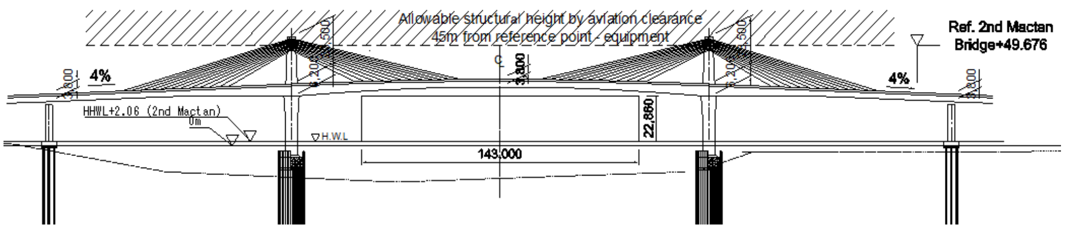
(1) Design Conditions

In reference to the design standards of DPWH, AASHTO and Japan, the design criteria and standards for bridge design of 4th Cebu-Mactan Bridge and Mandaue Coastal Road are determined:

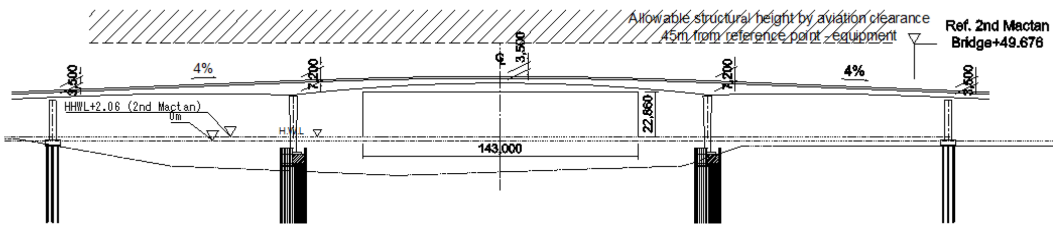
- Live Load: HL-93 (combination of the Design Truck: HS20-44 or Design Tandem, and Design Lane Load) is applied for Design of main girder and substructures and HS25 is applied for designing of deck slab.
- Wind Load: Design wind speed of 88.5 m/s (3-second gust, h=10m)
- Earthquake Load: Type II soil type is applied the determination of acceleration coefficient
- Temperature Load: The uniform temperature range of ± 15 °C is considered from the basic temperature of 28.0 °C. The temperature gradient of 15°C difference also considered for steel deck.
- Navigational Clearance: Horizontal clearance of 143 m with safety margin of 20 m on both sides of navigable waterway and vertical clearance of 22.86 m above highest water level of 2.21 m.
- Aviation Limit: 45 m height from the elevation of the runway of Mactan-Cebu International Airport (elevation of aviation limit is +51.00 m).
- Ship Collision Force
- Overburden Depth of Pile Cap: 1.5 m for factory, commercial and unused areas or 1.0 m for reclamation area.

(2) Design of 4th Cebu-Mactan Bridge

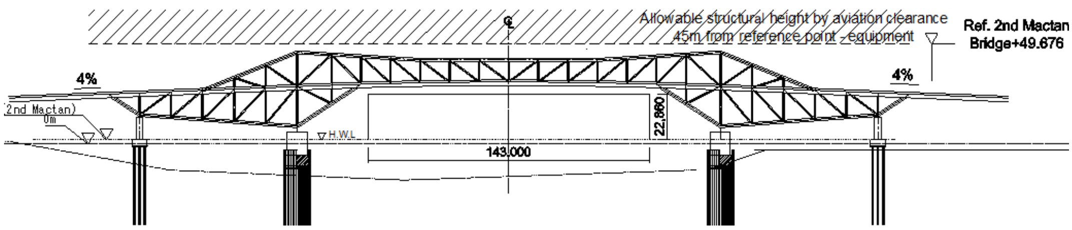
The applicable bridge types for the span length of 185 to 215 m over the navigable waterway of Mactan Channel under the aviation limit of Mactan-Cebu International Airport are extradosed bridge, steel box girder bridge and truss bridge. As the result of comparative analysis shown in Table 5.1, steel box girder bridge with orthotropic steel deck is recommended.



Extradosed Bridge



Steel Box Girder Bridge



Truss Bridge

Source: JICA Survey Team

Figure 5.4 Applicable Bridge Types

Table 5.1 Comparison of Bridge Type for 4th Cebu-Mactan Bridge

		Evaluation	
Case 1. Extradosed bridge	Overview	・Employs concrete towers and PC girders. Same type as 2nd Mactan Bridge. ・Span length is limited to less than 185m considering aviation clearance.	
	Construction cost	0.90	◎ 20 Pt.
	Landscape	・The bridge towers can be designed so that the bridge stands out as a landmark. ・Not as appealing as other bridge types since there is a extra-dosed bridge and new cable-stayed bridge over the Mactan strait.	○ 10 Pt.
	Design innovation	・Not very innovative since there are already similar bridges of the same type over the strait and elsewhere in Philippine. ・Would be the longest extra-dosed bridge in Philippine.	△ 5 Pt.
	Aviation clearance / Navigation safety	・Pylon height is high and it is difficult to design the bridge securing aviation clearance if span length is more than 185m. Height of tower/Center span of past experience = 1/9.17	△ 5 Pt.
	Constructability	・Cantilever erection method is suitable for construction of superstructure.	○ 10 Pt.
	Construction period	・Approximately 48 months.	○ 10 Pt.
	Maintenance	・Cable anchorages require periodic re-painting. ・Inspection of high locations is required.	◎ 20 Pt.
	Overall evaluation	・Difficult to apply span length more than 185m ・Longer construction period	80 Point
Case 2. Steel box girder bridge	Overview	・To reduce the cost of foundation, steel box with steel deck bridge is selected. ・In order to shorten the construction period, large block erection can be applied.	
	Construction cost	1.00	○ 10 Pt.
	Landscape	・The slender curved structure makes the bridge stand out as a landmark. ・Has symbolic value as the elegant shape is very different from other bridges over the Mactan strait. ・Welding structure using high performance steel provide beautiful surface.	◎ 20 Pt.
	Design innovation	・Would be the longest-span steel box girder bridge in Philippine. ・High performance steel (SBHS), wind resistance design and hybrid pier would be applied.	◎ 20 Pt.
	Aviation clearance / Navigation safety	・Structure height is low and it is possible to secure aviation clearance. ・No projected structure under girder and it is safety to navigation clearance.	◎ 20 Pt.
	Constructability	・Large block erection method is suitable for construction of superstructure. ・The navigational channel only has to be closed once since large block erection with jacks can be used.	◎ 20 Pt.
	Construction period	・Approximately 36 months. ・Main girder are pre-fabricated so the substructure can be constructed simultaneously with superstructure fabrication. ・Large block erection makes the on-site construction period shorter than for the other alternatives.	◎ 20 Pt.
	Maintenance	・Since this is constructed above sea, Heavy Duty Painting should be applied. ・Periodic inspection and re-painting is requied.	◎ 20 Pt.
	Overall evaluation	・Shortest Construction Period ・Possible to apply latest technology	130 Point
Case 3. Truss bridge	Overview	・To reduce the cost of foundation, steel truss with steel deck bridge is selected. Same type as 1st Mactan Bridge. ・In order to reduce the construction period, large block erection can be applied.	
	Construction cost	1.24	△ 5 Pt.
	Landscape	・The truss pattern can be designed so that the bridge stands out as a landmark. ・Not as appealing as other bridge types since there is a similar truss bridge over the Mactan strait.	○ 10 Pt.
	Design innovation	・Not very innovative since there are already similar bridges of the same type over the strait and elsewhere in Philippine. ・High performance steel (SBHS) would be applied.	○ 10 Pt.
	Aviation clearance / Navigation safety	・Structure height is low and it is possible to secure aviation clearance. ・There are truss member under deck and it has possibility of ship collision as 1st Mactan Bridge.	△ 5 Pt.
	Constructability	・Cantilever erection method or large block erection method can be applied for construction of superstructure. ・Large block erection method can be applied in order to shorten construction period.	◎ 20 Pt.
	Construction period	・Approximately 40 months. (In case of Cantilever erection, but can be shorten to 36 months if large block erection method is applied.)	◎ 20 Pt.
	Maintenance	・Since this is constructed above sea, Heavy Duty Painting should be applied. ・This bridge type is composed many members, periodic inspection and re-painting is requied and take longer time.	△ 5 Pt.
	Overall evaluation	・Most expensive alternative	75 Point

Evaluation ◎: Good, ○: Fair, △: Poor

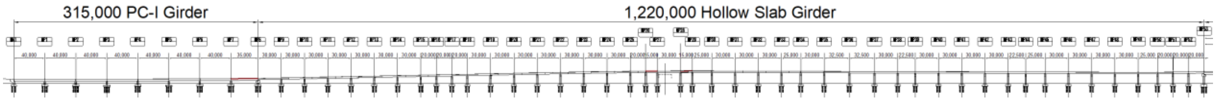
Source: JICA Survey Team

Table 5.2 summarizes the bridge type of the viaduct of 4th Cebu-Mactan Bridge and Figure 5.5 shows the side view of the viaduct.

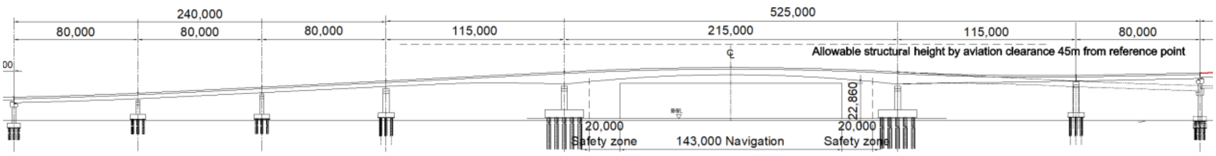
Table 5.2 List of Bridges of 4th Cebu-Mactan Bridge

Name of bridge	Station	Total length	Structure type	Span arrangement
North approach bridge Land section	0+40~1+575.0	1,535m	PC-I girder PC Hollow Slab	7@40+35=8span 7@30+3@20+7@30+20+15+30+15+25+3@30+25+30+2@32.5+30+22.5+4@30+22.5+25+4@30+25 +3@20=45span
North approach bridge Water section	1+575.0~1+815.0	240m	Steel box girder with composite slab	3@80m
4th Cebu-Mactan Bridge Main Bridge	1+815.0~2+340	525m	Steel box girder with orthotropic steel deck	115+215+115+80m
Total		2,300m	60 spans	

Source: JICA Survey Team



Overall Side View



Side View at Mactan Channel

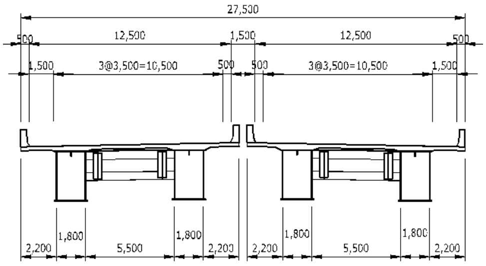
Source: JICA Survey Team

Figure 5.5 Side View of 4th Cebu-Mactan Bridge

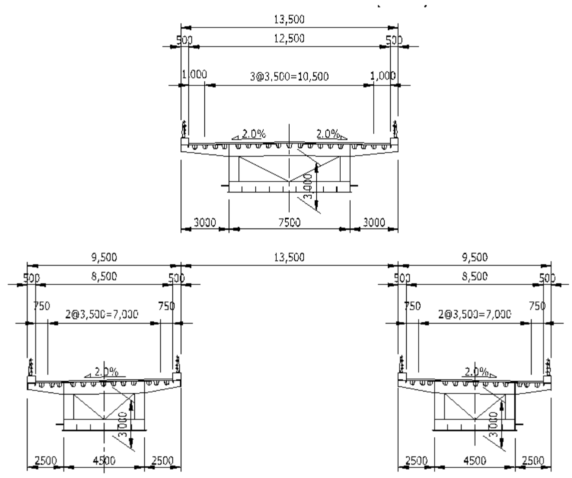
The following points are considered in the design of the bridge.

- In consideration of the navigational safety of small vessels and utilization of the waterfront of Mandaue Global City, the pier locations of the approach bridge are determined so that the piers are not arranged immediately close to the coastline.
- The side span piers of the main bridge consider the nose position of the Interchange Ramps. When determining the side piers, the deflection of the center span is taken into consideration to prevent it from becoming excessively large.

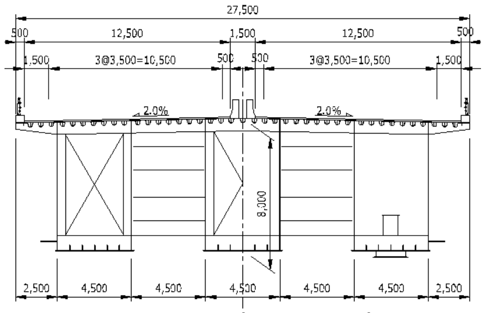
The steel box girder type is selected as a suitable structure for the main bridge, and the narrow steel box girder type with composite slab is selected for the approach bridge.



Approach Bridge (Mandaue Side)



Approach Bridge (Lapu-Lapu Side)



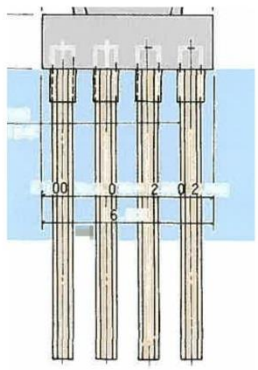
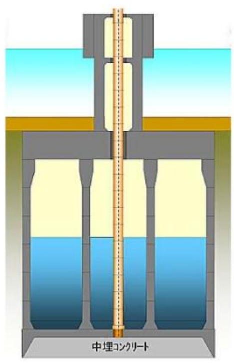
Main Bridge (Center Span)

Source: JICA Survey Team

Figure 5.6 Road Width and Cross Section of 4th Cebu-Mactan Bridge

The applicable foundation types for the main bridge of 4th Cebu-Mactan Bridge are i) cast-in-situ concrete pile (pile vent type), ii) steel pipe sheet pile foundation and iii) cason foundation. However, it was found out by the geotechnical investigation that there is limestone layer at Lapu-Lapu side as bearing layer. Since it is difficult to install steel pipe to rock layer, thus, Steel Pipe Sheet Pile Foundation cannot be applied. Therefore, comparison study is made between Cast-in-Situ Concrete Pile (Pile Vent Type) and Cason Foundation. Table 5.3 shows the result of comparative analysis of the foundation type.

Table 5.3 Comparison of Foundation Type for 4th Cebu-Mactan Bridge

	Cast-in-Situ Concrete Pile (Pile Bent Type)	Cason Foundation
Sketch		
Characteristic	- Same foundation type as 2nd Mactan Bridge - No difficulty for construction since pile cap locate above water level - Superiority against load level in proposed New (4th) Mactan Bridge	- Rare foundation type in Philippine - Necessity to apply large scale facilities to construct this foundation type, especially, construction at 10m below water level
Evaluation	Superior	Inferior

Source: JICA Survey Team

In the Philippines, cast-in-situ concrete pile (pile bent type) is commonly used for foundation such as 1st, 2nd and 3rd Cebu-Mactan Bridges. A caisson foundation is a suitable foundation type for relatively large loads. However, large construction facilities would be necessary to construct foundations of 10 m or more in depth for the sections that are over water. Therefore, cast-in-situ concrete pile (pile bent type) was adopted for the foundations of 4th Cebu-Mactan Bridge.

(3) Design of Mandaue Coastal Road Viaduct

General Section

Since the length of the viaduct of Mandaue Coastal Road will be very long and located in a coastal area, it should be considered that the viaduct will be exposed to sea water in a severely corrosive environment. Considering that periodical maintenance against corrosion has to be considered for steel materials, and maintenance work such as repainting for the long section involves significant work, concrete bridges would be appropriate in order to mitigate maintenance work, except where lightweight steel material is required for long spans and bridges with high piers located at a sufficient distance from the sea water.

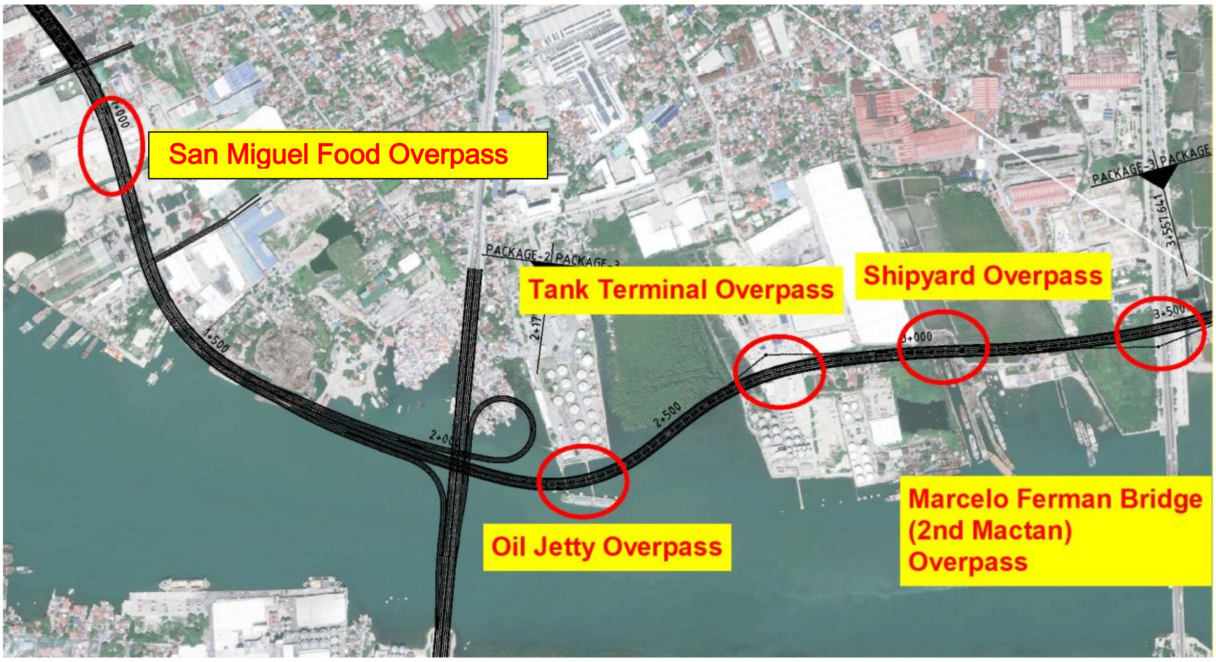
Since there is no special condition for span length on the general section, the most economical span length was calculated as 40 m by assumptions of average column height of 15 m and average foundation depth of 45 m. For 40 m span bridge, three bridge types (namely PC-T girder, PC-I girder and Steel I-girder) were compared. As the result of the comparative analysis, PC-I girder bridge was adopted.

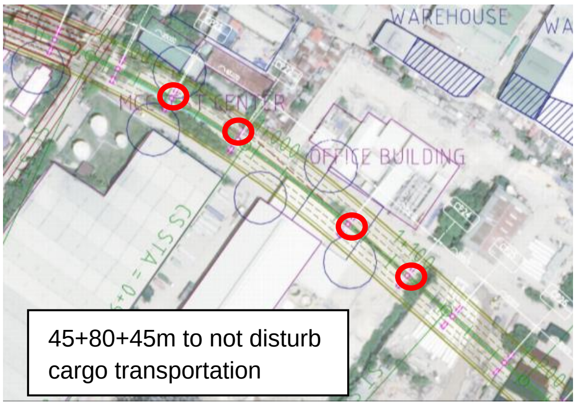
However, PC hollow slab was applied since IC area has many changes of width due to connection to ramp way and this type has flat girder soffit desirable to be applied in consideration of landscape.

Section through Port Facilities

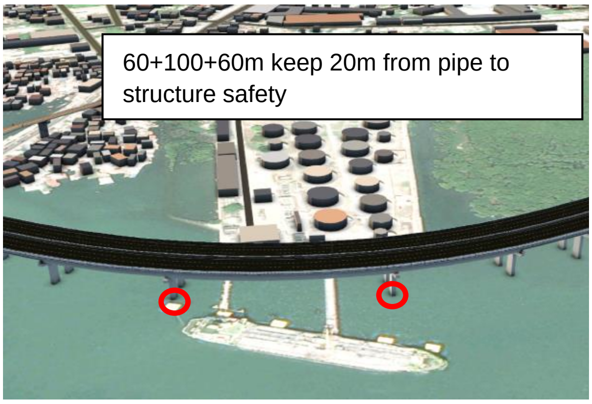
In the section between 1st Cebu-Mactan Bridge and 2nd Cebu-Mactan Bridge, Mandaue Coastal Road will intersect with some port facilities and long span bridges are required to cross over such facilities. Each bridge should be planned in accordance with the following concepts. Discussions with the owners of these facilities are needed for finalization of bridge design.

- San Miguel Food factory: The bridge alignment passes on San Miguel Food factory. In order to enable cargo transportation of the factory, location of piers avoids the road in factory and cargo loading area. 45+80+45m span bridge is planned in accordance with this condition.
- Oil jetty of Petron Corporation: The bridge alignment passes on the sea away from the oil tanks, and the bridge crosses over an oil pipe line which transfers oil from ships to the tanks. A 20m security distance between the oil pipe and the piers is required in order to ensure the safety of the bridge. A 100m span bridge is planned in accordance with this condition.
- Arctura Corporation Tank Terminal: The bridge alignment passes on the city side of the tanks. In order to enable vehicles which carry flammable liquid to pass under the bridge and prevent collisions with the piers, the bridge is planned so that the piers are not located in the area where vehicles pass. A 95m span bridge is planned in accordance with this condition.
- V.M. Cabahug Shipyard: The bridge alignment passes over the dock. For this reason, an 80m span bridge is planned in accordance with this condition.

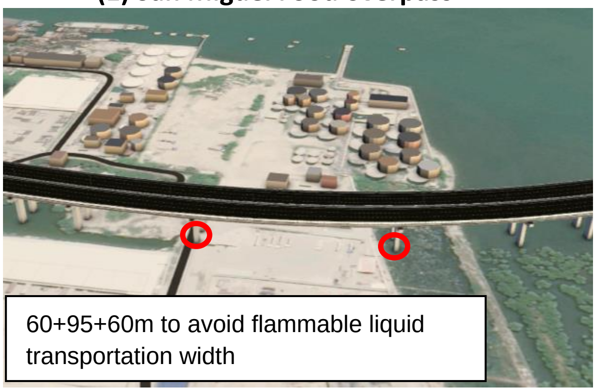




(1) San Miguel Food overpass



(2) Oil jetty overpass



(3) Tank terminal overpass

(4) Shipyard overpass

Source: JICA survey team

Figure 5.7 Facilities along Coastal Road and Bridge Spans

<u>Overpass Bridge of 2nd Cebu-Mactan Bridge</u>

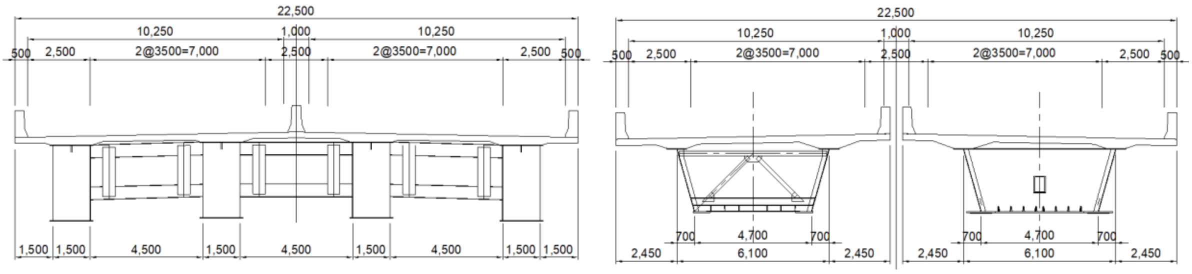
The overpass of 2nd Cebu-Mactan Bridge should be designed with the following considerations:

- The traffic closure period during construction should be minimized;
- Necessity of future maintenance work should be minimized; and
- Since it is always seen by passing traffic, the aesthetics of the structure should be excellent.

Based on these conditions, the steel box girder bridge with composite girder would be recommended.

Overpass Bridge of 4th Cebu-Mactan Bridge

A steel box girder bridge would also be recommended for the overpass of 4th Cebu-Mactan Bridge for the same reason as the overpass bridge of 2nd Cebu-Mactan Bridge. Since the overpass crosses over the 4th Cebu-Mactan Bridge at a skewed angle, the pier positions of the road in each direction are different. Moreover, since the widening and separation of the road for the rampway continues, the bridge is divided in each direction. A variation of the steel box girders are shown in Figure 5.8. A suitable type should be selected according to the span length and construction conditions.



Source: JICA Survey Team

Figure 5.8 Cross Section of Long Span Bridge of Coastal Road

Table 5.4 summarizes the bridge types of viaduct of Mandaue Coastal Road.

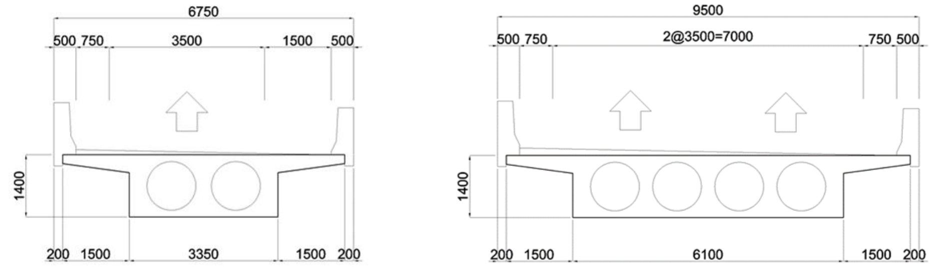
Table 5.4 List of Bridges of Mandaue Coastal Road

Name of bridge	Chainage	Total length	Structure type	Span Number
Coastal road bridge	0+132.7~0+942.7	810m	PC-I girder	13@40+35+2@30+4@40+35 =21span
Coastal road bridge (FMC overpass)	0+942.7~1+112.7	170m	Steel box girder with composite slab	45+80+45
Coastal road bridge	1+112.7~2+177.7	1,065m	PC-I girder	35+4@40+30+21@40 =27span
Coastal road bridge (Oil jetty overpass)	2+177.7~2+397.7	220m	Steel box girder with composite slab	60+100+60
Coastal road bridge	2+397.7~2+622.7	225m	PC-I girder	3@40+3@35 =6span
Coastal road bridge (Tank terminal overpass)	2+622.7~2+837.7	215m	Steel box girder with composite slab	60+95+60
Coastal road bridge	2+837.7~2+977.7	140m	PC-I girder	2@30+2@40 =4span
Coastal road bridge (Shipyard overpass)	2+977.7~3+157.7	180m	Steel box girder with composite slab	50+80+50
Coastal road bridge	3+157.7~3+417.7	260m	PC-I girder	2@30+5@40 =7span
Coastal road bridge (2nd Cebu-Mactan Bridge overpass)	3+417.7~3+557.7	140m	Steel box girder with composite slab	40+60+40
Coastal road bridge	3+557.7~4+522.7	965m	PC-I girder PC hollow slab	30+9@40 =10span 22.5+3@30+22.5+25+30+25+27.5+5@30+27.5+5@25 =21span
Coastal road bridge (4th Cebu-Mactan Bridge overpass)	4+522.7~4+723.7	201m	Steel box girder with composite slab	31+35+60+35+40 (North) 40+40+60+35+26 (South)
Coastal road bridge	4+723.7~4+883.7	160m	PC hollow slab PC-I girder	20+4@30+20 =6span
Total	-	4,751m	-	122 spans

Source: JICA survey team

(4) Design of Interchange Ramp Bridge of Mandaue IC

For the Rampway Bridge, cast in-situ PC hollow slabs are planned to be used since experience of their construction is extensive and they have high applicability to curved sections. The IC area has no restrictions regarding ground conditions and it is expected that concrete bridges constructed with ground support are most economical.



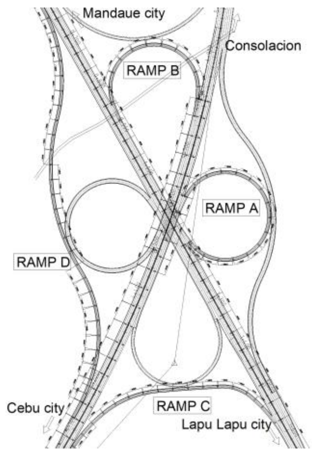
1 Lane Ramp **2 Lane Ramp**

Source: JICA survey team

Figure 5.9 Bridge Type of Interchange Ramp Bridges

Table 5.5 summarizes the bridge types of interchange ramp bridge of Mandaue IC.

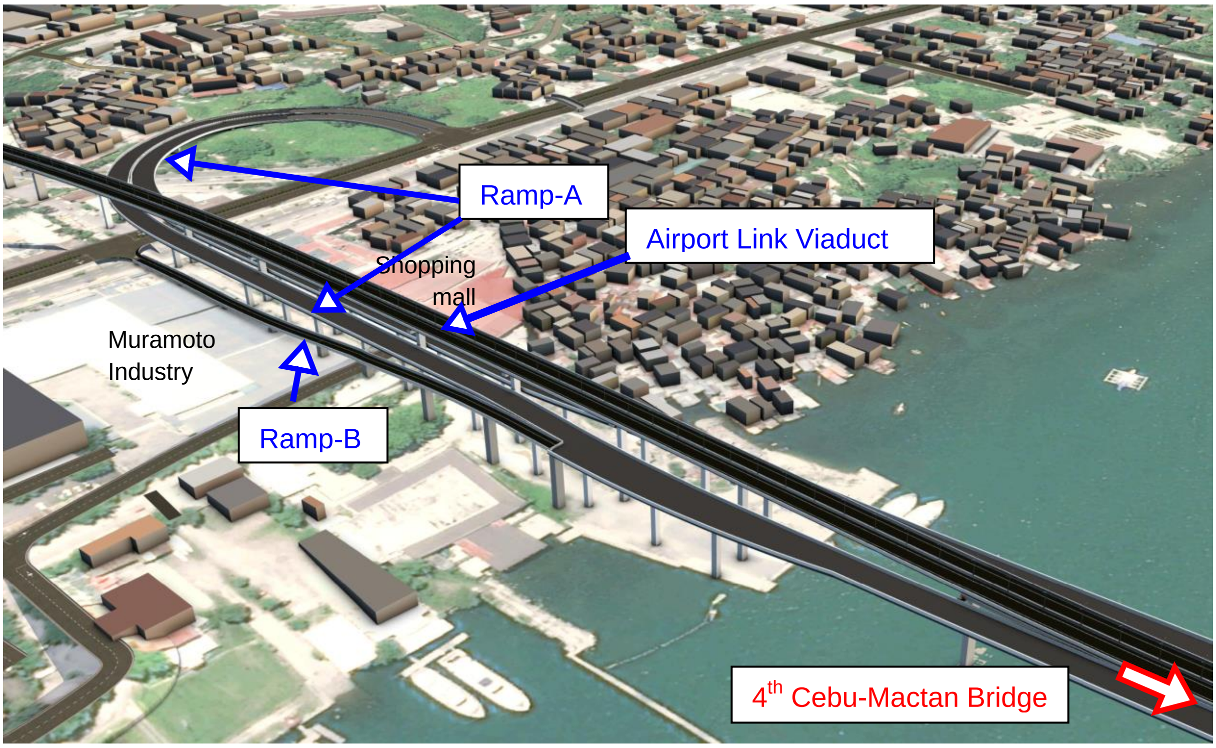
Table 5.5 List of Bridges of interchange ramp bridge of Mandaue IC

Name of Interchange Ramp	Direction	Rampway length	Structure type	Span arrangement	Map
Ramp A	From Cebu city to Mandaue	455.5m	Hollow slab girder	25+2@30+2@25+2 @30+25+4@30+26 +2@30+28.06 =16span	
Ramp B	From Lapu-Lapu city to Cebu city	327.3	Hollow slab girder	3@30+25+2@30+2 5+3@30+30.76 =11span	
Ramp C	From Cebu city to Lapu-Lapu city	483.4m	Hollow slab girder	15@30+27.948 =16span	
Ramp D	From Mandaue city to Cebu city	891.2m	Hollow slab girder	6@30+2@25+5@30 +25+10@30+27+4 @30+27.106 =30span	
Other ramp way		(2nd stage construction)			
Total		2160.1m	73 spans		

Source: JICA survey team

(5) Design of Interchange Ramp Bridge of Lapu-Lapu IC

Lapu-Lapu IC consists of three routes. Bridge layout is shown in Figure 5.10.

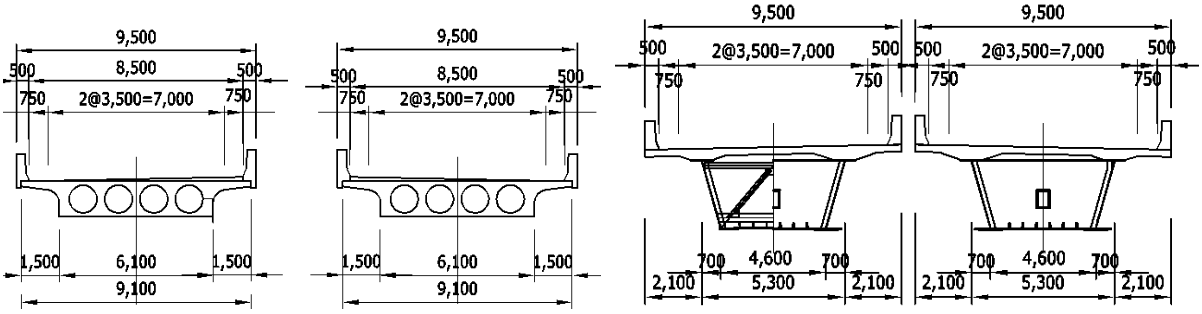


Source: JICA survey team

Figure 5.10 Bridge Layout of Lapu-Lapu IC

Superstructure type of Ramp-A and Ramp-B Bridge

For the general part of the Interchange Ramp, the same hollow slab girders as for Mandaue IC which excel in esthetics and economical are proposed. For the bridge over the existing road, an open section steel box girder bridge with composite slab is proposed.



Ramp-A General section **Ramp-A Bridge over existing road**

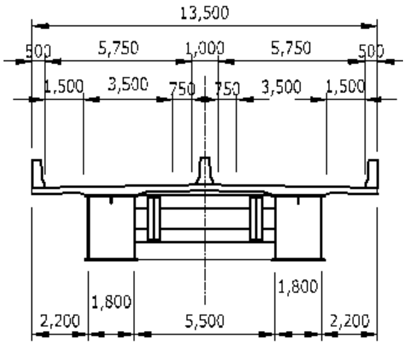
Source: JICA survey team

Figure 5.11 Cross Section of Rampway Bridge and overpass of Existing Road

Superstructure type of Airport Link Viaduct

Lapu-Lapu IC next to 4th Cebu-Mactan Bridge is planed 2-layered bridge which consists of Ramp-A bridge in lower layer and Airport link viaduct in upper layer.

Airport link viaduct in 2 layer section has hollow slab bridge in lower. And steel box girder is applied in higher layer since full scaffolding for construction of the upper bridge cannot be installed and long and complex construction method is not preferable at the narrow area close to buildings.

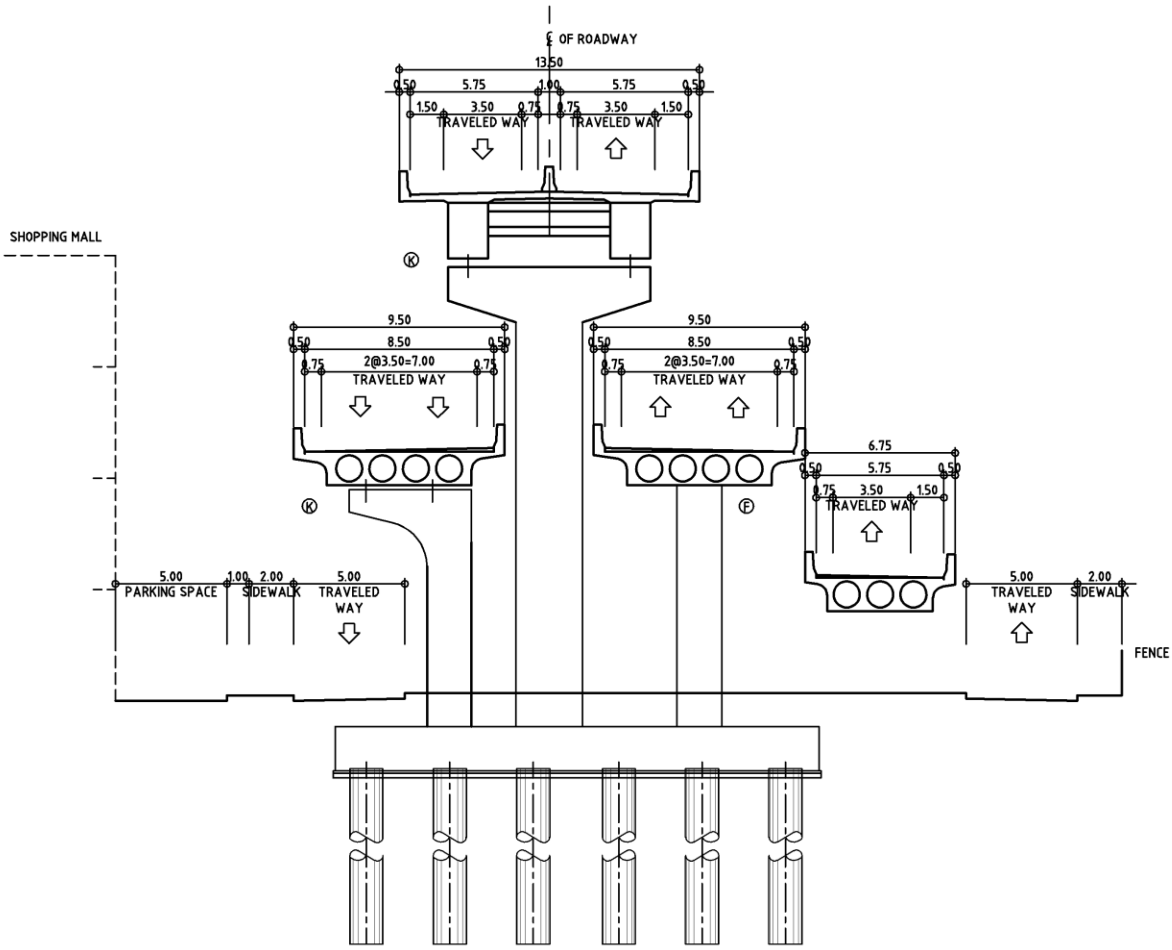


Source: JICA survey team

Figure 5.12 Cross Section of Airport Link Viaduct at upper layer section and overpass of existing road

<u>Substructure type of Ramp-A and Ramp-B Bridget</u>

Lapu-Lapu IC section is planned as 2-layered bridge and superstructure types are proposed as steel box girder as upper layer bridge and PC hollow slab as lower layer bridge. However, since area of Lapu-Lapu IC section is limited and there is not enough space to have separate foundation for both upper layer bridge and lower layer bridge, therefore, foundation is shared by both upper layer bridge and lower layer bridge as shown in Figure 5.13.



Source: JICA Survey Team

Figure 5.13 Cross Section of Lapu-Lapu IC Section (Ramp-A and Ramp-B)

Table 5.6 summarizes the bridge types of interchange ramp bridge of Lapu-Lapu IC.

Table 5.6 List of Bridges of interchange ramp bridge of Lapu-Lapu IC

Name of bridge	Chainage	Total length	Structure type	Span arrangement
Airport link viaduct	2+340~2+580	240m	Steel box girder with composite slab	5@48
Airport link viaduct (Overpass)	2+580~2+735	155m	Steel box girder with composite slab	50+60+45
Airport link viaduct	2+735~2+970	205m	Hollow slab girder	25+6@30
Ramp-A Bridge	2+340~2+580	210m	Hollow slab girder	24+30+26+30+34+4@24 (North) 24+24+32+30+34+4@24 (South)
Ramp-A Bridge (Overpass)	2+580~2+735	155m	Steel box girder with composite slab	50+65+40
Ramp-A Bridge	2+735~2+795	60m	Hollow slab girder	2@30
Ramp-B Bridge	2+420~2+532	112m	Hollow slab girder	30+34+2@24
Total		1137m	33span	

Source: JICA survey team

6. CONSTRUCTION PLANNING AND PRELIMINARY COST ESTIMATES

(1) Construction Planning

The majority of the construction works under the Project would be at sea and scale of the project is large and therefore, Special Terms for Economic Partnership (STEP) Loan will be applied. The Project road was tentatively divided into four (4) contract packages as following:

- Package-1 : 4th Cebu-Mactan Bridge, STA 0+000 – STA 3+263, L=3,263 km
- Package-2 : Mandaue Coastal Road, STA 0+000 – STA 2+177.647, L=2,178 km
- Package-3 : Mandaue Coastal Road, STA 2+177.647 – STA 3+557.647, L=1,380 km
- Package-4 : Mandaue Coastal Road, STA 3+557.647 – STA 4+883.647, L=1,326 km

The segmentation of the contract packages will be decided during the Detailed Design Stage based on the combination of the above segments and the following items:

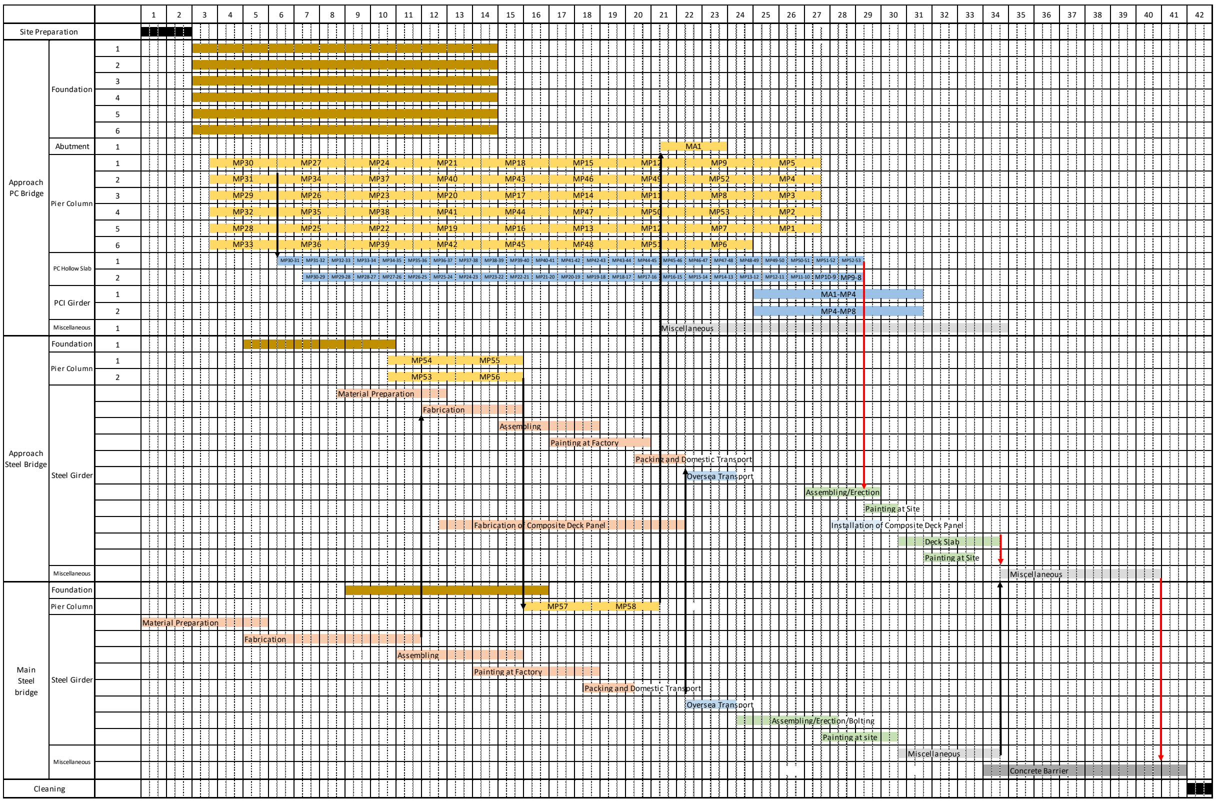
- Conditions at the Construction Site: The Location of construction site is on the sea or coastal area and coastal area and there are limited space due to the width of the construction yard and the one-way construction procedure required because of the limited access to the construction site and longer longitudinal structures, a smaller number of packages will be more advantageous
- Construction Cost: Construction cost per package will be based on the capability of contractors. If invitation and participation will be extended to small capability contractor, the proposed cost per package should be smaller and become many packages. If Special Terms for Economic Partnership (STEP) Scheme will be applied, it would be depend on the capability of Japanese contractor.
- Geopolitical Conditions: In case the existing political boundaries will restrict or affect construction activities, the boundary of contract packages should be determined based on such conditions.
- Uniformity of Structural Types: Packaging can also be determined by the types of structures and in case if there are interchange, it is also considered near the interchange will be one of the boundary.
- Scale of Merits (Size of Precast Segment and Size of Steel Structure Segment): The number of contract packages is also expected to be minimized by same sizes of precast segments that will be applied for longer sections, and also size of structure segment will be made one package which has also the advantage of reducing construction cost.

Construction plan of the project will be prepared based on the following conditions:

- Construction Plan: Based on the result of the Preliminary Design, JICA Survey Team will prepare construction plan. The Project site is located on the sea and coastal line where is susceptible to typhoons. The construction plan will be considered such seasonal characteristics of the Project site.
- Construction Schedule: The construction schedule did not take into consideration ROW acquisition-related activities such as demolition and movement of houses and structures, which means that the construction schedule assumes that ROW acquisition for the Project has been completed and that each section has been cleaned up. Based on the above condition, total construction period will be estimated.
- Procurement of Material and Equipment: The major materials and equipment would be procured in the Philippines but steel members, steel pipe sheet piles, rotating steel pipes and floating crane to be used for large-scale one-time casting of superstructure may need to be imported from outside of the Philippines.
- Application of Advanced Japanese Technology: Depending on the necessity, Japanese advanced technology for bridge construction may need to be considered which would be

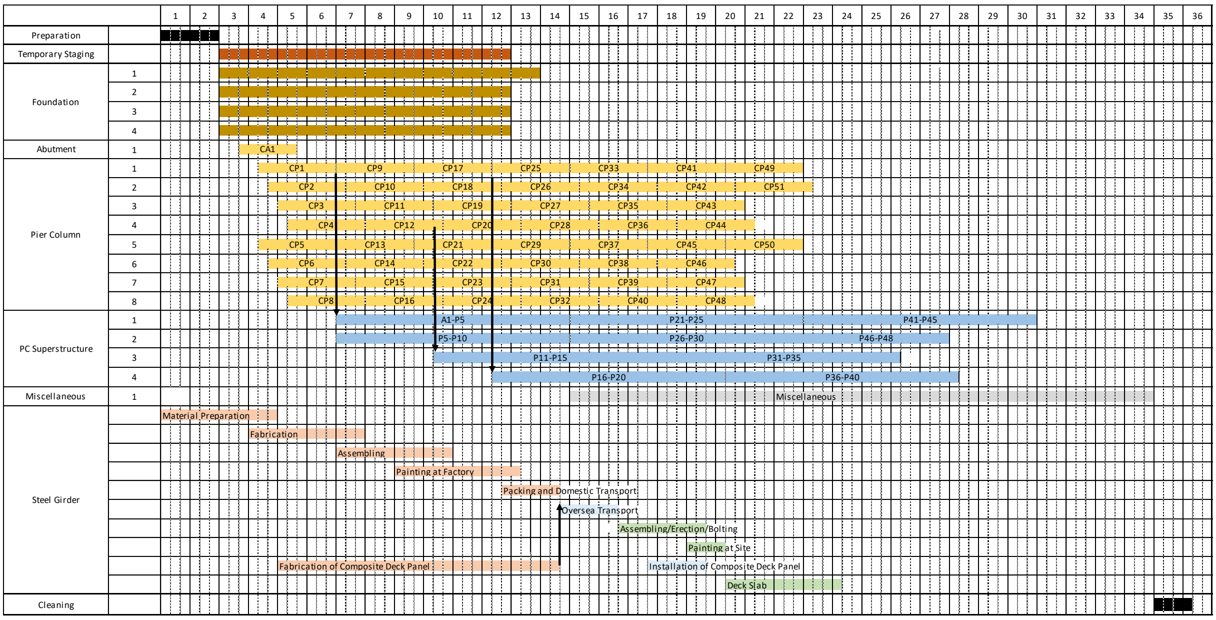
eligible for STEP Loan.

Based on the result of the Preliminary Design, construction plan is prepared in consideration of the seasonal characteristics whereas the Project site is located at sea and coastal area where is susceptible to typhoons.



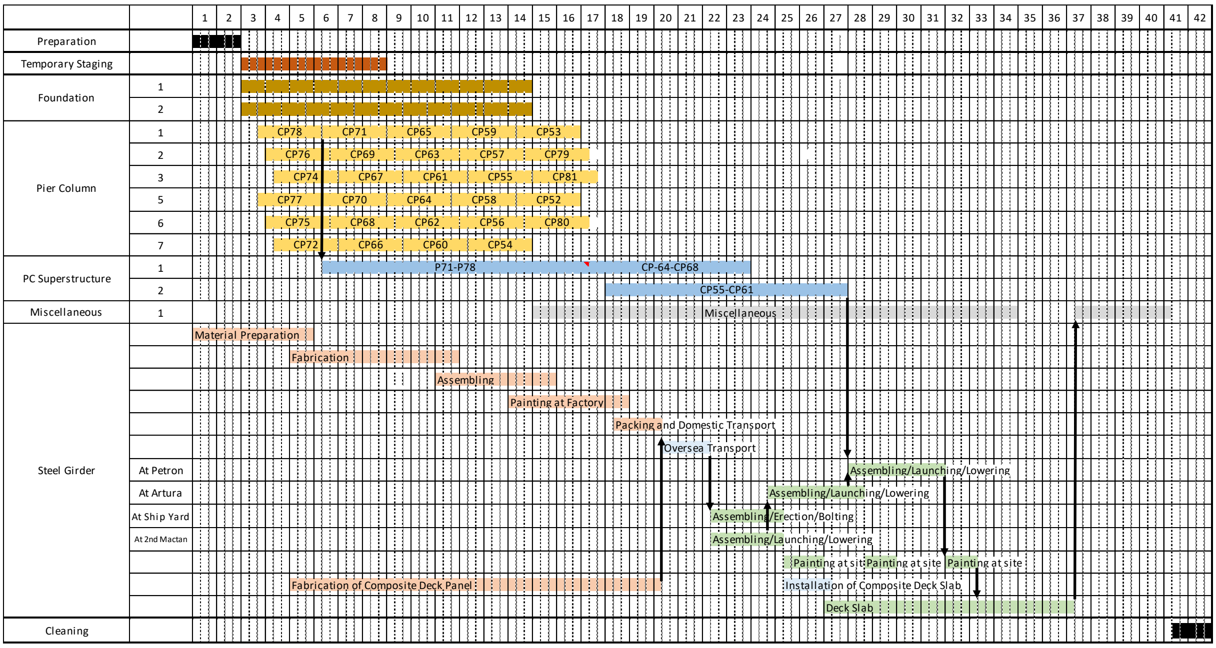
Source: JICA Survey Team

Figure 6.1 Construction Schedule for Package 1



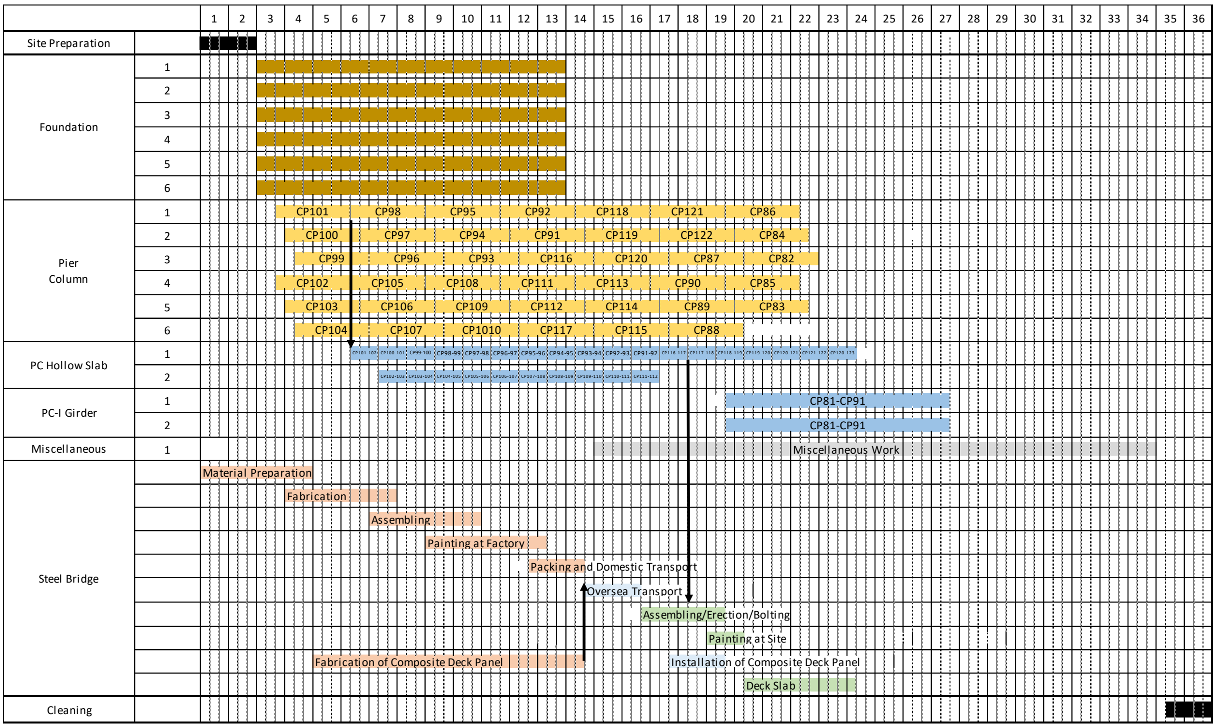
Source: JICA Survey Team

Figure 6.2 Construction Schedule for Package 2



Source: JICA Survey Team

Figure 6.3 Construction Schedule for Package 3



Source: JICA Survey Team

Figure 6.4 Construction Schedule for Package 4

(2) Preliminary Cost Estimates

The Civil Works cost was estimated based on several factors, as follows:

- Unit prices used were based from similar GOP and BOT projects implemented or tendered by DPWH from 2010-2019 and unit prices for major items were estimated based on 2019 prices.

- Procedures and composition for the derivation of base construction cost were patterned from similar projects.

The following procedures to derive the base construction cost are used:

- Assumptions necessary for the estimate shall be established based on the results of the preliminary studies, market research, site investigation, and unit prices of recent similar projects;
- Three (3) direct cost elements are identified:
  - Labor Costs
  - Material Costs (foreign/imported materials and local materials)
  - Equipment Costs (Association of Carriers and Equipment Lessors, ACEL)
- The project was broken down into its component activities and a list of corresponding work items including field activities are prepared in accordance with internationally accepted specifications and concept designs proposed for the Project Road.
- Based on the constraints or requirements as well as the results obtained from the site investigation, standard construction sequences and methods for each work item are studied and formulated. The construction technology, sequences and method to be employed including the approximate number of labor and equipment requirements, and other subsidiary items are therein considered.

The construction cost estimate is composed of the direct cost and indirect cost. The computations are in accordance with the DPWH Standard Specifications implementing guidelines and memorandum orders relative to unit price computation and analysis.

- Cost of Material: Materials are classified into two groups: commercial materials, available in the international and/or local markets (referred to as purchased materials) and material produced by the contractor (referred to as processed materials). The price of purchased materials are based on the quotations of various suppliers or agencies such as the Price Stabilization Council, the local markets, international and/or local prices of selected materials; the National Steel Corporation, and other private sector sources. The cost of transportation to the site is added to these costs. The cost of processed materials are estimated based on the analysis of outputs of necessary equipment, labor, royalties, and other items in accordance with recommended construction procedures.
- Cost of Equipment: The cost of equipment is based on "The Association of Construction Equipment Lessors, Inc. (ACEL)" rental rates which include operator's wages, fringe benefits, fuel, oil, lubricants and equipment maintenance.
- Cost of Labor: Labor costs used in the analysis are the wages authorized by the Department of Labor and Employment. All fringe benefits such as vacation and sick leaves, Workmen's Compensation Act, GSIS and SSS contributions, allowances, bonus, etc. are also taken into account.

According to the Department Order No. 197, Series of 2016 of DPWH, the indirect cost considers the following conditions:

- Mobilization and demobilization (1 % of Direct cost)
- Value Added Tax (VAT) (5% of total Direct and Indirect Costs)
- Marked Up (16% of Estimated Direct Cost)
  - Overhead Expenses: 7% of Estimated Direct Cost
  - Contingencies: 0.5% of Estimated Direct Cost
  - Miscellaneous Expenses: 0.5% of Estimated Direct Cost

- Profit: 8% of Estimated Direct Cost

Based on the above premises, Civil works cost for Cebu-Mactan Bridge and Coastal Road Construction Project was estimated as shown in Table 6.1.

Table 6.1 Preliminary Civil Work Cost Estimates for the Project (All Package)

Unit: PHP

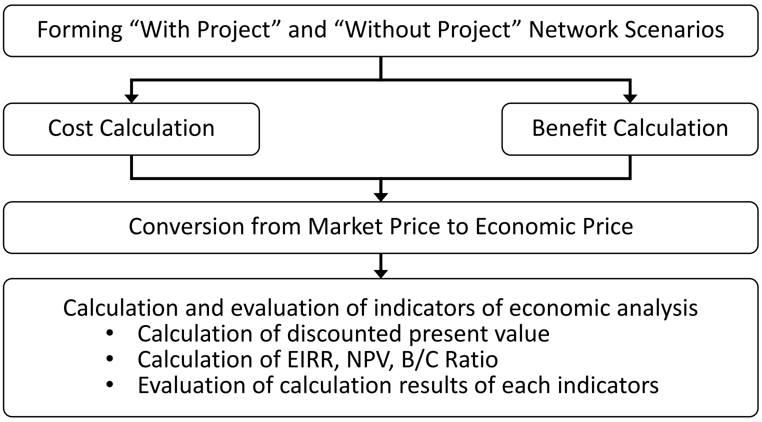
Item No.	Description	Amount	Foreign Currency (FC)	Local Currency (LC)	Taxes
Part A	Facilities For The Engineers	CONFIDENTIAL			
Part B	General Requirement				
Part C	Earthwork				
Part D	Subbase And Base Courses				
Part E	Surface Courses				
Part F	Bridge Construction				
Part G	Drainage				
Part H	Miscellaneous Items				
Part J	Electrical Works				
	Grand Total Amount				

Source: JICA Survey Team

7. ECONOMIC ANALYSIS

(1) Methodology

Economic analysis was conducted through an incremental discounted cash-flow analysis to evaluate the economic viability of the proposed project after completion of the preliminary design and cost estimates. The economic internal rates of return (EIRRs) and economic net present value (ENPVs) will be calculated to determine the viability of the proposed project. The analysis will focus on the "With Project" and "Without Project" network scenarios to measure the incremental impact of the project. Project life is assumed to be 50 years from 2021 and 2070. Analysis will be conducted based on the flowchart shown in Figure 7.1.



Source: JICA Survey Team

Figure 7.1 Process of Economic Analysis

A sensitivity analysis will also be carried out to assess the responsiveness of the viability indicators to changes in critical variables such as economic costs and economic benefits.

- The economic costs were determined by deducting all taxes included in the financial cost and by applying the shadow wage rate to the unskilled labor component of investment cost. Economic cost was estimated to be equivalent to 85% of financial cost in reference to the ICC Project Evaluation Procedures and Guidelines prepared by NEDA, which applies 1.2 of shadow exchange rate, and other Japanese ODA Loan projects implemented in the Philippines. The conversion factor applied to the operation and maintenance (O&M) costs was also be 85%. Details and basis for calculation of project cost and O&M cost were calculated based on the preliminary design and cost estimates.
- Economic Benefits of the Project: The main economic benefits of the project are the savings owing to the reduction in vehicle operating cost (VOC) and travel time cost (TTC). The implementation of the proposed project is expected to reduce traffic volume, which in turn will result in shorter travel times and faster vehicle operating velocity. The shorter travel time translates into lower travelling time costs, while the faster vehicle velocity implies lower operating costs. The values of these economic benefits will be based on the willingness to pay for time cost and VOC per trip. Reduction in CO_2 emission is included for additional benefits of mentioned above benefits. Negative benefits of traffic congestion during construction period are not considered in this Survey.

(2) Calculation of the Project Benefit

For the calculation of the benefit, the future traffic demand forecast was conducted on two network scenarios of "With Project" and "Without Project" in each of 2030 and 2050. "With Project" network is same as the master plan network proposed by MCUTMP. "Without Project" network exempted the link of proposed project from the master plan network.

Based on the result of demand forecast, VOC, TTC and CO2 were estimated for each case in 2030 and 2050. The daily project benefit was calculated as shown in the table below and converted as yearly benefit. For the economic analysis, the benefit of each year during project life was calculated by interpolating and extrapolating of the figures in 2030 and 2050.

Table 7.1 Daily Project Benefit Estimated by Traffic Demand Forecast

Year	Case	VOC (Mil. PHP/day)	TTC (Mil. PHP/day)	CO_2 (ton/day)
2030	With Project (A)	524.63	479.95	8,616
	Without Project (B)	530.83	486.19	8,691
	Benefit (B-A)	6.20	6.24	75
2050	With Project (A)	682.02	594.78	10,553
	Without Project (B)	695.77	609.89	10,718
	Benefit (B-A)	13.75	15.11	165

Source: JICA Survey Team

(3) Results of Cost-Benefit Analysis

Calculation conditions are as follows:

- Price and cost: Constant price in 2019
- Computation period: 50 years (45 years starting from operation)
- VAT are not considered.
- Social discount rate is 10%.

The proposed project yielded an EIRR of 10.9%, so it is larger than 10% of social discount rate set by the National Economic and Development Authority (NEDA). Thus, this proposed project brings about positive economic effects for national economy of the Philippines.

- EIRR: 10.9%
- B/C: 1.13 (at discounted rate of 10%)
- NPV: PHP 5,708.54 million (at discounted rate of 10%)

A sensitivity analysis was carried out to verify the sensitivity of EIRR in accordance with the change of cost and benefit as shown in the table below. All cases show that it is economically viable in terms of national economy, except the case with 10% cost increase and 10% benefit decrease.

Table 7.2 Sensitivity Analysis of the Project

			Project Cost		
			10% Decrease	Base Case	10% Increase
Benefit	10% Increase	EIRR (%)	12.6%	11.7%	10.9%
		B/C	1.38	1.24	1.13
		NPV (Mil. PHP)	15,101.47	10,690.43	6,279.40
	Base Case	EIRR (%)	11.8%	10.9%	10.2%
		B/C	1.25	1.13	1.03
		NPV (Mil. PHP)	10,119.58	5,708.54	1,297.51
	10% Decrease	EIRR (%)	10.9%	10.1%	9.4%
		B/C	1.13	1.02	0.92
		NPV (Mil. PHP)	5,137.69	726.65	-3,684.38

Source: JICA Survey Team

8. ENVIRONMENTAL IMPACT ASSESSMENT

(1) Environmental Baseline Condition

Administrative Boundary

Mandaue City is one of the three (3) urbanized cities located in Cebu Island with a land size of 3,284 ha. It consists of 28 barangays including the City South Special Economic Administrative Zone (CSSEAZ) and six (6) barangays out of the 28 need to be involved in the Project. The land size of Lapu-Lapu City, on the other hand, is 6,424 ha among which approximately 1,300 ha falls within the Mactan-Cebu International Airport. Lapu-Lapu City consists of 30 barangays out of which two need to be more closely engaged.

Climate

The climate in Metro Cebu (which includes the Mandaue) belongs to the Type IV of the Modified Coronas Classification of Philippine Climates. It also belongs to the "tropical monsoon climate" under Koeppen's Climate Classification Map. The temperature observed at PAGASA Mactan Station reaches its lowest point in January with a minimum and maximum temperature of approximately 24 decrees and 30 degrees Celsius, and its highest point in May where the minimum and maximum temperatures are approximately 26 decrees and 33 degrees Celsius. The past maximum temperature was 37.0 degrees observed on 31st May 2010 and the lowest temperature was 19.2 degrees on 16th January 1992. The difference between the minimum and the maximum temperatures is 17.8 degrees. In general, however, it can be said that it is warm throughout the year.

The area has a rainy and dry season and the average precipitation level in a month during the rainy season (i.e. June to December) is just above 150 mm while that in the dry season (i.e. January to May) is approximately 50 to 100 mm. The annual mean rainfall at the Mactan Station from 1982 to 2018 was 1,636.3 mm/year. According to the records at the Mactan Station, the past highest daily rainfall was 276.1 mm/day on 12th November 1990 when Typhoon Mike landed on Cebu Island.

There is no significant difference between humidity at each month throughout the year. The average value of humidity for 30 years from 1988 to 2017 was 81%.

The annual average wind speed for 30 years from 1981 to 2010 was 2.8 m/s, and the wind speed exceeding the annual average was recorded from December to April. The past maximum wind speed (10 minutes averaged wind speed) from 1972 to 2017 was 55.0 m/s when Typhoon Mike landed. From June to October, the wind from southwest was dominant due to the influence of the southwest monsoon. On the other hand, from November to May, the wind from north and northeast was dominant due to the influence of the northeastern monsoon.

According to the "Disaster Management Reference Handbooks 2015 and 2018 edition" published by the Center for Excellence in Disaster Management & Humanitarian Assistance (CFE-DM), annually, approximately 80 typhoons develop above tropical waters, 20 of them enter the Philippine region, and 6 to 9 of them make landfall on Cebu island. A total of 41 typhoons landed in Cebu during the 35 years from 1983 to 2017 (1.2 on average a year), of which 49% hit the island in November and December. However, according to DPWH Region VII Office, Mandaue City and PAGASA Mactan Office, there were almost no human or structural damage by storm surge or strong wind caused by typhoon in the project area.

Air Quality

According to an inventory survey carried out in 2015 by the Environmental Management Bureau (EMB) of DENR, the source of air pollution in Central Visayas (Region VII), which includes the project site, is mainly the transportation sector. The share of such mobile sources accounts for approximately 77% of the total emissions level. This is much higher than the share of stationary sources (i.e. 10%). Nevertheless, the level of air pollution in the project area is considered generally favorable and values for PM10 and TSP have been both below the standards set under the Republic Act No. 8749.

According to Sinogaya et al. (2019), the medium value measured for NO_2 over a six (6) month period between December and June in Mandaue City and Lapu-Lapu City are 15 ppb and 20 ppb respectively. And that measured for SO_2 over a nine (9) month period between December and September in both Mandaue and Lapu-Lapu City are 30 ppb and 20 ppb. All values are below the environmental standards of the Philippines (80 ppb for NO_2 and 70 ppb for SO_2).

Water Quality

The entire Metro Cebu area has no centralized Water Treatment Facility (WTF) or Sewage Treatment Plant (STP) and most of the establishments including households conveniently use the waterways as outfalls for untreated wastewater, thus, the poor environmental quality of the waters of Mandaue and Lapu-lapu. Largo (2002) noted *"nutrient levels of samples taken from the three stations within the channel, indicate high values for nitrogen (ammonia, nitrite and nitrate) and phosphorus (as phosphate). Possible sources of these nutrients could be from sewage effluents from domestic households and from agricultural fertilizers that wash out into the sea through river channels and from direct land run-off during rainy periods"*.

Protected Areas

Among the protected areas designated under the Republic Act No. 7586 (National Integrated Protected Areas System/NIPAS Act of 1992), Olango Island Wildlife Sanctuary located at approximately 5 km east-south of Mactan Island, Central Cebu Protected Landscape (CCPL) located in the center of Cebu City, and Guadalupe Mabugnao Mainit situated in Carcar City of Cebu Island are the closest from but not within the project site. Since these protected areas are located distant from the project site (i.e. approximately 10km, 20km and 40km, respectively), no adverse impact of the project is expected.

Tidal flat is located at the outer edge of the mangrove forest that grows along Cansaga Bay with its area being approximately 50 hectare. These tidal flats have been found to be providing a habitat for herons, snipes and terns and to be offering to more than 300 birds a feeding ground. Hence, the possibility cannot be denied that endangered species also use these areas and these tidal flats should be considered important for birds. However, the state of tidal flats' environment has been found to be degrading due to development and the associated garbage and driftwood.

Population

According to a census survey, the population in 2015 was 362,654 in Mandaue City (out of which 182,715 was male and 179,939 female) and 408,112 in Lapu-Lapu City (out of which 202,089 was male and 206,023 female). The rate of annual population growth between 2000 and 2010, and 2010 and 2015 were 2.46% and 1.73% in Mandaue City, and 4.91% and 2.94% in Lapu-Lapu City, respectively. This is high compared to the population growth rate in Cebu City (1.88% and 1.21%, respectively).

Of the project affected Barangays in Mandaue City, it is Barangay Looc, having the highly densely populated with 189.32 pop/ha. Barangay Looc has also the highest number of Project Affected Families (PAF). Barangay Pusok in Lapu-Lapu is also the highly densely populated of the affected barangays in Lapu-Lapu City.

Industry

Commercial activities such as manufacturing and trading play a major role in Mandaue City's economy. As of 2013, there were a total of 13,372 commercial establishments and 1,317 industrial establishments located in the city's 27 barangays. The annual revenue from these commercial and industrial establishments were approximately Php 92 billion and Php 49 billion in 2014. Further, there are five shopping malls and the largest brewery in the country (i.e. San Miguel Corporation) as well as several middle and high-end residences, townhouses and condominiums. There are 16 major agricultural crops produced in Mandaue City. As of 2013, 407 metric tons of these major crops were produced for local sales and consumption. Among the 16 crops, four are staple crops (i.e. corn and fruit-bearing trees such as banana, mango and jackfruit). 150 metric tons were produced. The existing livestock activities in 2012 were piggery, cattle and goat-raising while the poultry products were broilers and eggs. Most of these livestock-raising are backyard activities except for the poultry farms. There are still some small areas for fishing grounds and aquaculture farming in Mandaue City. Fishing/Aquaculture products counted for approximately 807 tons in 2013. The number of local fishermen was approximately 167 out of which only 47 of them were registered. The catch is either sold at different satellite markets within the city, the public market and neighborhood or consumed locally (Mandaue City Comprehensive Land Use Plan 2014).

Lapu-Lapu City makes a significant contribution to the overall development of Cebu Province and to Region VII as a whole. The Mactan-Cebu International Airport serves as the gateway in the region from the rest of the world by offering a transshipment point by air of cargoes and people flying to and from neighboring provinces in the Visayas and Mindanao. The historic significance of the city and its attractive coastline with world-class resort hotels make the area a prime destination to foreign and domestic tourist. Naturally, the service sector, dominated by hotel and restaurants, wholesale and retail, real estate renting, transportation and storage, play an important role in the City's employment and production. Except for fishery, the development potential of agriculture for Lapu-Lapu City is limited due to land constraints. With only 6,424 ha of land area, the geology of the Mactan Island is mostly coral-based, with little top soil for crop cultivation. Nevertheless, a relatively large number of its population is still dependent on fishery and livestock production as their livelihood (CLUP 2014).

<u>Labor Force</u>

The population in Mandaue City was 323,400 in 2012. Among them, 144,660 were employed accounting for approximately 45% of the population. Among the 144,660 people employed, 71.7% were engaged in the service sector, 27.7% in the industrial sector and 0.7% in the agriculture sector including fisheries (Mandaue City Comprehensive Land Use Plan 2014).

In Lapu-Lapu City, 184,232 people or approximately 63% of the total population of 292,530 were employed as of 2007 in the service (65.6%), industrial (29.8%) and agricultural and fisheries (4.5%) sectors (Mandaue City Comprehensive Land Use Plan 2014). According to CLUP (2014), 7,393 people were making a living in 2008 by working in the agricultural sector including fisheries and livestock industry. Among them, the fisheries and livestock industry take the lion's share.

<u>Livelihood</u>

In Mandaue City, the predominant number of workers is those working in the "plant and machine operators and assemblers". Similarly, Lapu-Lapu City has also most of the workers are in "plant and machine operators and assemblers".

<u>Land Use</u>

A large part of the project site in Mandaue City falls under a commercial zone. Aquacultures can be seen in the eastern side of the city with areas designated for recreation and tourism. There is an area for industrial park development in the more inland area and a relatively small area of parks/open spaces. A green corridor is also located within the project site. The proposed Mandaue Coastal Road will run along its southern coast. The western side of the road is an industrial park with facilities such as factories and oil tanks. There is also a high school located approximately 1 km east of the starting point of the planned route.

A bulk of the project area in Lapu-Lapu City is considered as 'commercial area' and 'tourism area' under the land use plan. Other land includes 'industrial/special economic' and 'environmental protection'. Mactan-Cebu International Airport is located within Lapu-Lapu City.

Education Opportunity

There are 27 publicly-run primary schools and 17 middle schools in Mandaue City. In addition, there are a number of private schools (i.e. primary schools, middle schools and higher educational institutions). One high school located approximately 1 km from the starting point of Mandaue Coastal Road in the west is situated close to the project site. The literacy rate was 96% as of 2014.

All barangays in Lapu-Lapu City, on the other hand, has a public primary school and most of the barangays have a public high school. The literacy rate in Lapu-Lapu City was 95% in 2000 (CLUP 2014).

Health Status

Table 8.2.14 shows the average birth rate, morbidity rate and mortality rate in 2009-2013 in Mandaue City and Lapu-Lapu City. Among the ten leading causes of morbidity in Mandaue City, upper respiratory tract infection, animal bites, wounds, tuberculosis and pneumonia were the top five causes in the recorded three years (2011–2013). Upper respiratory tract infection shared approximately 41% of all causes of morbidity.

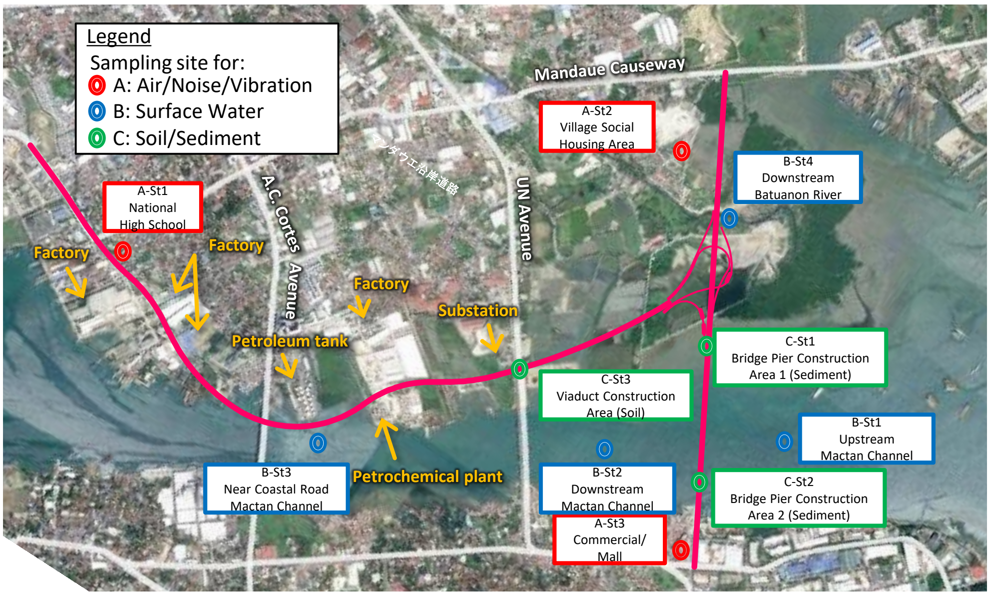
(2) Legal and Institutional Framework

Any private or public project or activity that is likely to have foreseeable adverse effects on the natural and social environment is required to conduct an EIA in accordance with the Philippine Environmental Impact Statement System (PEISS). The Philippine EIA Process has six sequential stages: 1) Screening, 2) Scoping, 3) EIA Study and Report Preparation, 4) EIA Review and Evaluation, 5) Decision Making, and 6) Post ECC Monitoring, Validation and Evaluation/Audit Stage. In accordance with the EMB Memorandum Circular 005 (2014), the project, composed of a bridge and its approach road as well as a coastal road, is required to obtain an ECC by preparing an EIS and having it approved by EMB. No notable gap was identified between the relevant regulations in the Philippines and the JICA Environmental Guidelines with regards to EIA.

(3) Scoping and Terms of Reference of the Environmental Survey

Scoping was carried out based on the results of a secondary data review, an initial environmental survey conducted in December 2018, and the technical scoping held by EMB on March 6, 2019. While most of the impacts were considered to be insignificant, involuntary resettlement, which is expected to take place at a scale of approximately 110 households is considered to have a significant impact.

Based on the results of scoping and reviews of the literature and relevant laws and guidelines in the Philippines, the Terms of Reference (TOR) for the environmental baseline survey was drafted with actual measurements to be carried out for air, surface water, and soil (sediment) quality as well as noise and vibration levels in the locations shown below. Similarly, the TOR for the RAP survey that consists of census, lost asset inventory and socio-economic survey was prepared.



Source: JICA Survey Team

Figure 8.1 Location of Air, Noise and Vibration Measurements and Water and Soil Sampling

(4) EIA Survey Result

The following are the result of EIA survey result:

Air Quality

All the parameters (PM10, PM2.5, NO2, SO2 and CO) passed within the standard limit set by the National Ambient Air Quality Standards for Source Specific Air Pollutants from Industrial Sources / Operations of the Department of Environment and Natural Resources Administrative Order No. 2000-81 (Implementing Rules and Regulations of the Philippine Clean Air Act of 1999) except for the analysis of Particulate Matter 10 conducted at Mandaue City Comprehensive National High School, Village/Social Housing Area and Commercial Area in Lapu-Lapu City, Cebu.

Water Quality

The baseline water quality survey was conducted at four (4) sites crossed and aligned by the proposed Project. The water quality benchmarks are prescribed Class D Waters for Butuanon River (Downstream), which is primarily used for the Navigable Waters, and Class SC Waters is used for Mactan Channel, which is primarily used for Fishery Water, Recreational water and Marshy and /or mangrove areas declared as fish and wildlife sanctuaries under DAO 2016-08. Almost all parameters are within the standard except BOD of Butuanon River (Downstream). This result might be associated to solid waste generated at the Umapad umping site.

Waste

According to the Waste Analysis and Characterization Study (WACS) of Mandue City was conducted in November 2016, the total waste generation of the City was 240,364.20 kgs. /day and the per capita generation was 0.6270 kgs/day" from major sources such as residential, commercial and institutions. The total waste generated contained 27.17% biodegradable, 34.86% residual waste, 35.50% recyclable waste, and 2.48% special waste. Presently, the segregated wastes are collected by the barangay garbage truck from the households and are brought/disposed directly to Guun Plastic Recycling Facility. The City has a newly constructed materials recycling facility (MRF) for composting facility manage/supervise by the City Agriculture Office. Another facility that the City has a partner or with a joint agreement with is the Asian Energy Sanitary Landfill, a private sanitary landfill operator in

Barangay Polog, Consolacion Cebu. The said facility accepts the unaccepted wastes and or not be processed by Guun Plastic Recycling Facility.

Soil

According to the Bureau of Soils and Water Management, the study area and its vicinities consist of one (1) soil type "the Mandaue Clay", which is the result of weathering of the underlying Quaternary Alluvium. It has a surface soil color of light brown to dark, depending on the amount of organic matter and moisture content. It is friable when just moist, thick and sticky, soft when wet, and hard when dry. The substratum is made up of compact clay loam. Baseline survey for soil /Sediment quality was performed at four (4) sampling sites along the project road alignment and soil contamination was not confirmed, except the value of cupper at the sampling site "C-St1" near Umapad Dumpsite.

Noise and Vibration

Noise samplings were collected at three (3) areas representing a school, a residential area and a commercial area. Two areas (the school and residential areas) resulted in noise values exceeding the noise standards. The school area (Mandaue Comprehensive National High School) is directly facing a light industrial area and this could have contributed to additional noise generation. Since it is expected that the proposed route will be a four-lane road the noise values will be increased. In addition, it can also be expected that higher noise values will be generated within these areas in the future.

Ecosystem (Terrestrial Flora and Fauna or Bird)

Preliminary bird surveys were undertaken in December 2018 from the sidewalk of Cansaga bay bridge, and from the sea side on boat. The survey found 360 individuals that fall under 11 species. If we include those that have been identified in the surrounding areas, the number grows to 540 birds (i.e. 19 species including some unidentifiable ones). Based on the survey, it has been confirmed that the tidal flat facing the mangrove forest located adjacent to the development area in Cansaga Bay is likely to be offering a habitat for herons, snipes and terns. However, threatened species namely Great Knot, Chinese Egrets and Grey-tailed Tattler were not observed.

Assessment of all terrestrial fauna in mangrove and terrestrial vegetation was conducted in March, 2019 following the pre-identified road alignment in the area. A total number of 175 individuals of bird species (a total of twenty-one (21) species belonging to nineteen (19) families) have been identified in the mangrove forest and a terrestrial area. Of the twenty-one (21) species, Egret species (most probably, either Great Egret, Intermediate Egret or Little Egret) recorded the highest number of individuals with a total of 38 followed by Eurasian Tree Sparrow (Passer montanus) with 35 number of individuals, Terns species (25 number of individuals) and Glossy swiftlet (Collocalia esculenta) with 21 number of individuals, respectively. The rest of the species identified had registered below 15 numbers of individuals. All the species identified in the area belong to Least Concern (LC) under the IUCN Red List. The similar characteristics of egrets demonstrates the difficulty of taxonomic identification. With the assistance of local and international bird experts, it is concluded that the Egret species observed in this assessment are, most probably, either Great Egret, Intermediate Egret or Little Egret. Nevertheless, it should be noted that no sighting of threatened species such as Chinese Egret in a single-shot survey does not prove that they do not exist.

Interview surveys to local experts on birds and their habitats were also conducted. All of the interviewee highlighted the higher importance of Olango Island and Jugan area as birds' roosting and feeding grounds relative to the Cansaga Bay area, as the Cansaga Bay area is highly degraded as birds' habitat due to development carried out over years since 1980s. Although there is no observation record of migratory endangered species or their nests such as Chinese Egret near the Cansaga Bay area, there is a possibility that some individuals of endangered species including Chinese Egret may fly to the Cansaga Bay area to look for alternative feeding ground, when Olango Island is not utilizable due to, for example, high tide time. This is likely not only in the peaks of migration seasons (i.e. December-February towards north and September-October towards south), but also in period other than those seasons, as some individuals are recorded to overstay in the Central Visayas area, including Olango Island, Cansaga Bay area and Jugan area, not flying over to their general destinations in the northern hemisphere (i.e. Siberia and Polustrov Kamchatka) and Southern hemisphere (i.e. Australia and New Zealand). This demonstrates how important it would be conduct regular bird monitoring.

Hydrogeology

The 4th Cebu-Mactan Bridge and Mandaue Coastal Road alignments are generally located at the coastal area and most portions hugged the coastlines of Mactan channel. Not only the offshore viaduct, but also the inland routes will have an impact on the Marine environment of these areas. The Mactan Channel is the strait between main island of Cebu and the Mactan Island. The channel receives water and wastewater from several principal rivers and creeks such as Batuanon River and its brunch.

The main water source of Metro Cebu is groundwater, which constitutes 98% of the water supply. Surface water accounts for only a small fraction of 2% (MCWD databook, 2013). The identified aquifer in the area is within the underlying Carcar coralline limestone. This type of aquifer belongs to the second major hydrogeologic groups, rocks with major flow of the groundwater is through fractures and joints, secondary spaces and/or solutional cavities created by solvent action of the groundwater in the limestone rocks. Another identified minor aquifer in the area is within the overlying Quaternary Alluvium consisting of unconsolidated sediments of sand, silt, clay and gravel deposits of variable thickness and extent. This type of aquifer belongs to the first major hydrogeologic groups, rocks in which flow is dominantly intergranular. Metro Cebu's water need is supplied by MCWD, which also covers the areas of Mandaue City, and Lapu-lapu City. It gets most of its water from the underground aquifer through its network of pumping stations.

The drainage system in Metro Cebu is divided into the same categories for draining rainwater, such as (i) river, (ii) creek, and (iii) drainage. The flood-prone areas in Metro Cebu are identified by the respective LGUs. There are many flood-prone areas in the metropolis although flooding happens only when high tide and heavy rain occur at the same time. One of the major problems regarding rivers, creeks and drainages are the presence of informal settlements and irresponsible private property owners along the riverbanks, which generate an enormous amount of garbage that obstructs the flow of natural and man-made waterways.

The hydrogeologic and hydrologic hazards that were identified to have potential impacts on the proposed project include flooding, coastal hazards such as coastal erosion, storm surge/tsunami and coastal subsidence/sea level rise.

Geographical Features

Metro Cebu is located at the center of Cebu Island. High land and mountains rise behind the more urbanized area that is largely limited to the coastal areas. The altitude in Cebu Island is approximately 0 m above sea level in the coastal areas in the east while it reaches over 500 m above sea level in the highlands in the west. The general topography of 4th Cebu-Mactan Bridge and Mandaue Coastal Road alignments and surrounding areas are generally flat to nearly level being in the lowlands coastal regions.

The Cebu Island geologically falls within the Central Physiographic Province of the Philippines, which is composed of cordilleras, lowlands, troughs and offshore basins. The island lies towards the central portion of the Visayan Basin and moderately interrupted by the uplift of the Cebu geoanticline in Late Miocene to Pliocene. The basement is mainly Cretaceous to lower Tertiary metavolcanics and metasediments. These are intruded by diorite stocks and batholiths (BMG, 1982).

The complex geological development of Cebu Island is produced by periodic magmatism and forearc basin deposition. Arc magmatism is believed active until Pliocene time. The development of the Visayan Sea Basin during Eocene-Pleistocene time provided a suitable environment and ample space for periodic deposition of the clastics and non-clastic units/formations. The latest episodic event of submarine deposition before the final stage of uplift is the building up of algal-reefal limestone of the Carcar Formation, which is presently fringing the entire Cebu Island.

Project Affected Families and Establishments

The survey revealed that there were 42 land owners, two (2) lessees (companies), 33 non-residential structure and improvement (e.g. fences) owners that belong to mainly private companies and government bodies, eight tenants and 243 persons that belong to 69 households affected by the project. A bulk of the people, companies and government bodies affected are located in Mandaue City including all affected households while 10 land owners and 10 improvement owners are located in Lapu-Lapu City. All of the 69 households (i.e. informal settlers) are all expected to be relocated.

A total of 21 households (30.43% of the total PAFs) has a monthly income range of PhP 1,001-5,000 while 13 households (18.84% of the total PAFs) is on the range of PhP 5,001-10,000. 12 households (17.37% of the total PAFs) have an income range of PhP 10,001-15,000, and four households (5.80% PAFs) have a monthly income range of less than PhP 1,000. Three households (4.35% of the total PAFs) has PhP 30,001-50,000 and two (2) households have an income range of PhP 15,001-20,000. It means 38 households fall under the poverty threshold of PhP 10,481 per month set by NEDA.

Indigenous People

The PAHs socio-economic survey results indicated that no project-affected persons belong to any IPs (none checked the known IPs in the ethnicity list). Verbal inquiry with resource persons (HUDO, local officials, etc) noted the absence of IPs in the affected barangays. A list of identified IPs and their locations indicated that there are no IPs in Mandaue and affected barangays. The National Commission on Indigenous Peoples (NCIP), Cebu Provincial Office issued, on July 29, 2019, a Certificate of Non-Overlap proving that the alignment of the proposed bridge and road and its vicinities has no presence of IPs living within the area, or does not overlap with any ancestral domain area of any Indigenous Cultural Communities or Indigenous Peoples (ICCs/IPs).

Local Economy

According to Comprehensive Land Use Plan (CLUP) of Mandaue City, there are some small areas for fishing grounds and aquaculture farming in Mandaue City. In the year 2012, about 91 tons of fishing/aquaculture products were produced: marine fishing ground 35 ton, inland fishing ground (i.e. river, lake, macrsh/swamp) 6 ton, and fispond/cages 50 ton. However, since this catch is sold for local consumption only as explained in CLUP and by a fisherman at the focus group discussion meeting, it is safe to say that this industry does not play a significant role in the local economy.

According to CLUP of Lapu-Lapu City, the fishing grounds of the city are classified as off-shore and inland. The offshore fishing grounds are the sea waters of Olango Island, Pusok, and Punta Engano. The inland fishing grounds are the marshes of Barangay Babag, and Calawisan and the fishponds in Canjulao and fish cages in Caubian. No production data are currently available.

There is one operational aquaculture farm (i.e. Batiller Fish Pond) in Barangay Umapad, Mandaue City that is located within the ROW of the project whose land size is approximately 2.35 ha (23,500 m^2). On the other hand, there is no existing fishpond operation within the project and its adjacent areas in Lapu-Lapu City.

Broom-making using buri tree (palm tree) is known to be done in Barangay Paknaan, Mandaue City. One of the steps for making broom is to soak buri stem in pond until the fibers come loose, and this activity is said to be carried out in mangrove and abandoned fishponds in Barangay Paknaan. Based on the interviews to the Captain of the Barangay Paknaan, Mandaue City and the broom-making operators, it is found out that the soaking area for the broom-making activities is largely confined at a single location set-aside by the barangay with an area of approximately 5,000 m^2, and there are no soaking activities within the ROW of the 4th Cebu-Mactan Bridge and the Mandaue Coastal Road.

Existing Social Infrastructures and Services

The alignments of the 4th Cebu-Mactan Bridge and Mandaue Coastal Road will pass an industrial area, where hazardous facilities of private companies such as petrochemical factories and oil tanks are located. If the clearance between these facilities and the coastal road is unsatisfactory and any physical barrier is not installed along the road, there may be a risk of casting flammable items into these hazardous facilities. Hence, appropriate mitigation measures are necessary to be taken.

Cultural Heritage

Bantayan sa Hari, designated by the National Commission Culture and Arts (NCCA) as a historic site, is located near the project site in Mandaue City. It is considered to have been built in the early 19th century to serve as a watch tower to protect the local people from the Moro Pirates. The distance between Bantayan sa Hari and the project site is about 200 m.

In accordance with the DPWH Department Order No. 12, Series of 2019 titled “Strict Preservation and Conservation of National Cultural Heritage”, a consultation/coordination meeting with NCCA was held on May 22, 2019. The NCCA indicated that in principle they have no objections with the project as the ROW/Alignment will not directly nor has significant impact on nearby identified historical/heritage sites/structures. The clearance for the project, or the Certification for Non-Coverage of National Cultural Treasure (NCT)/ Important Cultural Property (ICP) was issued on July 9, 2019 by the NCCA.

Generate the Traffic Congestion

During the construction phase of the 4th Cebu-Mactan Bridge and Mandaue Coastal Road will result in temporary traffic disruptions or disturbances especially works undertaken on existing routes that is within the road alignment (both at grade and terrestrial viaduct). A Traffic Management Plan (TMP) that details the activities to adequately manage traffic flow will be developed in the detailed design phase and strictly implemented in the implementation phase.

Gender and Children’s rights

Two (2) sessions of focus group discussions with women’s associations were carried out, and their opinions, concerns, and recommendations in relation to the project were directly collected. Women constituted at least 30% of the total participants at every public consultations and focus group discussions held, and not a few female participants spoke out at the question and answer sessions. Furthermore, twelve (12) female household heads out of 69 were identified and answered to the perception survey.

Based on the information collected through the aforementioned activities, there were no perceived impacts related to gender inequality or children’s right abuse including the employment of children below 15 years old. It is thus important for the project proponents to follow acts and regulations on gender and human rights in order to prevent future problems in these aspects.

Greenhouse Gas (GHG) Emission

Greenhouse Gas (GHG) Emissions from heavy construction equipment (e.g., trucks, front-end loaders, pavers, and other equipment) will occur from the operation of internal combustion engines, which are typically diesel-fueled. The amount of greenhouse gas emissions by construction activities of the

Project was calculated as 30,218 tons of CO_2. However, because of the traffic improvement by the Project, reduction of CO2 emission at the volume of 720,662 ton is forecasted.

(5) Environmental Impact Assessment

The result of Environmental Impact Assessment is shown in Table 8.1.

Table 8.1 Environmental Impact Assessment after EIA Study

Environmental Item (JICA Guidelines)	Evaluation: Scoping: Pre/During Construction	Evaluation: Scoping: Operation	Evaluation: EIA: Pre/During Construction	Evaluation: EIA: Operation	Reason for Evaluation
Air Quality	B-	B-/ B+	B-	D	**Construction Phase:** Temporary negative impacts are expected on air quality due to exhaust gas (NOx and PM) resulted from operation of construction machines and equipment, and traffic congestion by traffic regulations. **Operation Phase:** No serious impact is expected because the baseline and forecast results are almost equal.
Water Quality	B-	B-	B-	B-	**Construction Phase:** Turbid water may be generated in the channel and river as a result of piling for installation of piers and other earth works for constructing a new road. In case the construction period of the reclamation project planned on the southern coast of Cebu Island overlaps with that of the subject project, water in Mactan Channel may be polluted. **Operation Phase:** Wastewater from the bridge may cause seawater pollution.
Waste	B-	D	B-	B-	**Construction Phase:** Construction waste such as construction residual and cut trees may be generated by civil engineering work and excavation. General waste and manure is expected to be generated from the base camp. **Operation Phase:** There is a possibility that solid waste will be disposed at roadside.
Soil pollution	B-	D	B-	D	*[Soil Erosion]* **Construction Phase:** Impacts is limited as the structure of the project will be viaduct mainly, so that modification of topography due to cut-and-fill work will be limited and the design and the construction plan of viaduct columns will be optimized in the detail design stage. **Operation Phase:** There will be no change in topography and soils in the project site. *[Soil Quality]* **Construction Phase:** There is a possibility that excavated soil at the landfill site is contaminated; this may lead to contamination of other soils. The landfill site has been permanently shut down and started rehabilitation by the City of Mandaue, so excavation soil at landfill site will be separated and followed the instruction by the City of Mandaue. **Operation Phase:** There is a possibility that soil contamination from accidental releases of chemicals, fuel, oil, lubricants will occur due to the maintenance work, but it will be managed by the contractor, so that serious impact is not expected.
Noise and vibrations	B-	B-/ B+	B-	B-/ B+	**Construction Phase:** Noise and vibration levels are expected to heighten temporarily due to the operation of construction vehicles and machineries, concrete placement work and the traffic congestion resulted from traffic regulations. **Operation Phase:** Noise and vibration levels are expected to heighten around newly constructed bridge and road, whereas they are expected to be reduced due to a decrease in traffic volume around existing highways and bridges.
Ground subsidence	D	D	D	D	**Construction Phase / Operation Phase**: No serious impact is expected because there is no activity planned that may lead to ground subsidence such as large scale embankment and pumping.
Offensive odors	B-	D	B-	D	**Construction Phase:** General wastes from the construction yard may generate offensive odors. **Operation Phase:** No serious impact is expected because there is no activity planned that may generate offensive odor.
Bottom sediment	B-	D	D	D	**Construction Phase:** No serious impact is expected because the bottom sediment near the construction site of the new Mactan bridge is not polluted and thus there is no possibility of the bottom sediment stirred up by the installation of piers pollute the surrounding bottom sediment. **Operation Phase:** No serious impact is expected because there is no plan that may affect bottom sediment.
Protected Area	D	D	D	D	**Construction Phase / Operation Phase:** There are no legally-designated protected areas in and around the project site.
Ecosystem	B-	B-	B-	B-	*[Environmentally Critical Areas]* **Construction Phase / Operation Phase:** As the whole project area is included in the important bird area (IBA) and key biodiversity area (KBA), there is concern about the negative impact on mangrove forests, tidal flats, and the organisms that use them (especially birds).

Environmental Item (JICA Guidelines)	Evaluation				Reason for Evaluation
	Scoping		EIA		
	Pre/During Construction	Operation	Pre/During Construction	Operation	
					[Terrestrial Ecology] **Construction Phase:** Construction of interchanges that occupy a relatively large area may bring negative impacts to the surrounding ecosystem including mangrove forests.
					Construction of bridges and approach roads is expected to cause tree cuttings. Approximately 700 mangrove trees and 1400 terrestrial trees along the project alignment will be affected.
					Construction will disturb IBA/ KBA consisting mangrove, tidal flat and migratory birds.
					Terrestrial trees to be possibly removed includes Molave classified under endangered category of the DAO No.1-2007 and under vulnerable category of IUCN Red list, Narra and Mahogany classified under IUCN Red list's endangered and vulnerable categories, respectively.
					Operation Phase: Land use changes of the surrounding areas into commercial-residential development will impact on the environment.
					The presence of bridges and traffic flow and noise generated from them may affect the ecology of the main species that feed on tidal flats located around the bridge construction area.
					[Freshwater Ecology] **Construction Phase:** Release of contaminants, such as fuel and hydraulic fluid from equipment/vehicles for construction, chemicals, liquid wastes, and sediment-laden run-off from uncleaned/dirty area of construction work sites will affect the habitat condition.
					Operation Phase: The presence of bridges and traffic flow and noise generated from them may affect the ecology of the main species that feed on tidal flats located around the bridge construction area.
					[Marine Ecology] **Construction Phase:** Removal of or direct physical injury to aquatic flora and fauna (e.g. seagrasses and sea weeds in Cansaga Bay and Mactan channel) through activities associated with construction of offshore viaduct and bridge.
					Turbidity, siltation/sedimentation of Mactan Channel due to movement of loose underwater sediments, soil from construction of viaduct footings/columns will occur.
					Vibration/disturbance from pile-driving will occur.
					Operation Phase: The presence of bridges and traffic flow and noise generated from them may affect the ecology of the main species that feed on tidal flats located around the bridge construction area.
					[Loss of Habitat] **Construction Phase / Operation Phase:** Release of contaminants, such as fuel and hydraulic fluid from equipment/vehicles for construction, chemicals, liquid wastes, and sediment-laden run-off from uncleaned/dirty area of construction work sites will affect the habitat condition.
Hydrology	B-	B-	B-	D	*[Hydrology/Hydrogeology]* **Construction Phase:** Changes in the flow conditions of seawater due to bridge construction may affect the distribution of the tidal flats.
					Operation Phase: There is no activity in operation of road and bridge to impact for Hydrology.
					[Drainage Morphology] **Construction Phase/ Operation Phase:** The modifications of topography/terrain will be limited, but there is a possibility that it will disrupt drainage pattern, causes erosion/transport of sediments to surface waters.
					[Flooding] **Construction Phase:** Increase in run-off due to reduction of infiltration caused by decrease in vegetation and road pavement which may result in localized flooding, sedimentation, etc.;
					Operation Phase: No serious impact is expected because there is no land acquisition in the operation phase.
					[Oceanography] **Construction Phase / Operation Phase:** Changes in the flow conditions of seawater due to bridge construction may affect the distribution of the tidal flats.
					The modifications of topography/terrain will be limited, but there is a possibility that it will disrupt drainage pattern, causes erosion/transport of sediments to surface waters which are considered adverse impacts to coastal processes and change of the characteristics of beach.
Geographical features	C	D	B-	D	*[Change in sub-/surface landform]* **Construction Phase:** Modification of topography, soil disturbance and loss of top soil due to excavation (mostly of viaduct columns) will have negative and irreversible impacts, however the magnitude is considered as minor to moderate.
					Operation Phase: There will be no change in topography and soils in the project site.
					[Inducement of Landslide] **Construction Phase / Operation Phase:** Historical seismic data from PHIVOLCS

Environmental Item (JICA Guidelines)	Evaluation: Scoping Pre/During Construction	Scoping Operation	EIA Pre/During Construction	EIA Operation	Reason for Evaluation
					show that only small magnitude earthquakes occur in Cebu Island and the project area. Even though, the design of the structure will be considered the probability of occurrence of earthquakes.
Resettlement	A-	D	A-	D	**Pre-/Construction Phase:** Resettlement of 69 households (243 persons) is expected within the affected area. **Operation Phase:** No serious impact is expected because there is no land acquisition in the operation phase.
Local economies, such as employment, livelihood, etc.	C	C	B-/ B+	B+	**Pre-/Construction Phase:** Local economy is expected to be developed through creation of employment opportunities in construction work and business for construction workers. Livelihood of residents may be affected by land acquisition and resettlement. New construction of bridge and road may affect the livelihoods of fishery/aquaculture/broom-making workers. **Operation Phase:** Positive benefits are anticipated through the creation of opportunities of bringing clients/markets, in particular tourists to the community.
Local Institutions, decision making	B-	D	D	D	**Construction Phase / Operation Phase:** According to the system of public involvement, the social structure and decision making will not affected by the project. Thus, no serious impact on local institutions and decision making is expected.
Misdistribution of benefits and damages	D	D	D	D	**Construction Phase / Operation Phase:** Misdistribution of benefits and damages is expected to be minor because the benefit of improved convenience by the bridge and road construction will be equally distributed. In addition, the damage by the construction will be compensated properly.
Local conflicts of interest	B-	D	B-	D	**Construction Phase:** Impacts on the accessibility/hindrance to port/docking facilities and operations will occur due to the bridge and road construction. In addition, there are several projects to be coordinated with the construction of bridge and road. **Operation Phase:** No serious impact is expected as explained in "Misdistribution of benefits and damages".
Existing social infrastructures and services	B-	B-	B-	B-	**Construction Phase / Operation Phase:** Hazardous facilities such as petrochemical factories and oil tanks located along the coastal road may be affected (e.g. casting flammable items into the tanks).
Poor	B-	D	B-	D	**Pre-/Construction Phase:** There are 38 PAFs whose monthly income is less than the poverty threshold set by the Philippine Statistics Authority (PSA). **Operation Phase:** No serious impact is expected because there is no land acquisition in the operation phase.
Indigenous, or ethnic people	C	C	D	D	**Construction Phase / Operation Phase:** Neither the existence of ethnic minorities and indigenous people, nor impacts to them have been identified.
Land use and utilization of local resources	C	C	B-	B-/ B+	*[Change/Inconsistency in land use]* **Pre-/Construction Phase:** Construction of bridge may affect negatively land use and utilization of local resources including fishery/ recreational activities, etc. **Operation Phase:** With improve transportation and mobility, the cities of Mandaue, Lapu-lapu will open-up to investment opportunities and sustain economic growth and development. But, uncontrolled development along roadside may hinder proper land use and make it difficult for the people to use local resources. *[In-migration]* **Construction Phase:** During the construction phase, land may be required for providing construction workers and staff with temporary housing in the vicinity of the project site. **Operation Phase:** There is a possibility that new informal settler will in-migrate to the project area, especially at the bottom of the elevated structures.
Cultural heritage	B-	B-	D	D	**Construction Phase / Operation Phase:** There are no existing materials of cultural, historical nor archaeologic significance present in the area that could be impacted by the project.
Landscape	C	C	D	D	**Construction Phase:** No serious impact is expected because there is no legally-designated landscape to be protected around the project site. **Operation Phase:** Presence of a bridge and viaduct may change the landscape, so the design and lightning system should be considered to harmonize with local land scape. .
Gender	B-	D	D	D	**Construction Phase / Operation Phase:** No serious impact is expected because no activity that may affect gender is planned in the construction and operation phases.
Children's rights	C	D	D	D	**Construction Phase / Operation Phase:** No serious impact is expected because no activity that may affect children's rights is planned in the construction and operation phases.
Water usage	B-	D	B-	D	*[Water resources competition]* **Construction Phase:** Land acquisition and construction work may not affect the accessibility to drinking water resources such as wells. **Operation Phase:** No serious impact is expected because there is no activity that may affect water resource in the operation phase. *[Reduction/Depletion of ground water flow]* **Construction Phase:** There is a possibility that is construction activities which may

Environmental Item (JICA Guidelines)	Evaluation				Reason for Evaluation
	Scoping		EIA		
	Pre/During Construction	Operation	Pre/During Construction	Operation	
					affect groundwater flows such as excavation for viaduct.
					Operation Phase: No serious impact is expected because there is no activity that may affect groundwater flow in the operation phase.
					[Threat to delivery of basic services] **Construction Phase:** There will be demand for water supply for utilization in the construction works.
					Operation Phase: No serious impact is expected because there is no activity that may affect water usage in the operation phase.
Infectious diseases such as HIV/AIDS	B-	B-	B-	B-	**Construction Phase:** Infectious diseases such as STD may possibly spread due to an inflow of construction work
					Operation Phase: The improved access from the airport to the urban area due to the newly constructed bridge and road may increase the number of travelers and spread infectious diseases such as STD.
Working conditions (Health)	B-	D	B-	D	**Construction Phase:** If the contractor fails to take appropriate safety measures, the worker's health and safety are expected to deteriorate.
					Operation Phase: No serious impact is expected because construction of bridge and road is considered to bring no significant change to the working environment of the surrounding local inhabitants.
Accidents (Safety)	B-	B-	B-	B+	**Construction Phase:** Operation of construction machines and equipment may cause accidents in the project site.
					Operation Phase: Long term environmental effects of the project will be positive with an improved transportation network and an increase in public safety.
The impacts to transboundary or global issues	B-	C	B-	B+	*[Change in the local climate]* **Construction Phase / Operation Phase:** Construction of bridges and roads is expected to cause tree cuttings, and the pavement of road will disturb the natural drainage. It will cause the change in the local climate, in particular, local temperature.
					[Contribution to Global greenhouse gas] **Construction Phase:** Construction of bridges and roads is expected to cause tree cuttings. It is expected to decrease greenhouse gas absorption. Operation of construction machines and construction of structures are expected to lead to emission of greenhouse gases.
					Operation Phase: Greenhouse gas emissions are expected to increase in the new bridge and road area, while reduction in greenhouse gas emissions are expected in the whole area by reducing traffic congestion.
Note 2: Rating based on JICA ES Guideline A±: Significant positive/ negative impact is expected. B±: Some positive/ negative impact is expected. C: Extent of positive/ negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses.) D: No impact is expected. IEE/ EIA is not necessary.					

Source: JICA Survey Team

(6) Environmental Management Plan

The Environmental Management Plan (EMP) covers the construction and operations of 4th Cebu-Mactan Bridge-Mandaue Coastal Road Project. The EMP is inclusive of the enhancement/mitigation measures as exhibited in the abbreviated EMP matrix shown in Table 8.2

Table 8.2 Abbreviated Environmental Management Plan Matrix

Environmental Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures
I. PRE-CONSTRUCTION PHASE		
Soil pollution (near Umapad Dumpsite)	• Soil contamination due to excavation work near Umapad Dumpsite	• Conduct a comprehensive soil quality survey in the D/D and provide the results to the Mandaue City as a contribution to the rehabilitation of the dump site. • Rehabilitation of soil in consultation with the concerned LGU
Ecosystem / The impacts to transboundary or global issues	• Removal of up to 2,000 trees (approx. 470 terrestrial trees possibly relocatable and approx. 700 mangrove trees and 900 terrestrial trees inevitably cut) • Possible earth-ball and relocation of Molave classified under endangered category of the DAO No.1-2007 and under vulnerable category of IUCN Red list, Narra and Mahogany classified under IUCN Red list's endangered and vulnerable categories, respectively· • Change in the local climate, in particular, local temperature • Decrease of greenhouse gas absorption due to removal of trees. • Increase of greenhouse gas emission due to operation of construction machines	• Compliance with the conditions stipulated in the permits / clearances (e.g. ECC, Tree Cutting Permit, etc.) issued for the Project • Providing a temporary fencing to vegetation for their protection to minimize clearing of vegetation as much as possible • Replantation of approx. 470 terrestrial trees, less than 1.5m height, including threatened species Molave, Narra and Mahogany • Compensatory plantation of mangrove and terrestrial trees in accordance with DENR relevant regulation(s) (Plant approx. 70,000 seedlings of mangrove and approx. 90,000 seedlings of other terrestrial tree species)
	• Disturbance to KBA	• Conduct the Biodiversity Survey (detailed bird survey) two (2) times during the migration seasons during Detailed Engineering Design as an input to the design of coastal road, interchange and bridge and for consideration of further measures to minimize the disturbance to IBA/KBA (i.e. development of wetland park and installment of bird-car collision prevention poles/fences)
Geographical features	• Damage to components of the construction work (Ground shaking, ground rupture)	• Undertake site-specific seismic risk characterization and estimates of how the ground beneath the structure will move; and Design and construct structures that will address seismic hazards
Resettlement/Poor	• Loss of land, property and establishments along/within the ROW of Bypass road alignment	• Resettlement, compensation, assistance and rehabilitation of affected residents (PAFs) & establishments; implementation of RAP
	• Improvement of living conditions	• Livelihood rehabilitation assistance in the form of skills training and other development activities shall be provided in coordination with other concerned government agencies if the present means of livelihood is no longer viable and the PAP will have to engage in a new income activity; and • Financial assistance to augment loss of income during initial months of relocation
Misdistribution of benefits and damages/Local conflicts of interest	• Informed/empower the public to participate in the decision-making process	• Transparent and participatory approaches and methodologies, Consideration of community needs/aspirations (Conduct of IEC, public consultations)
Existing social infrastructures and services	• Relocation of utilities (e.g. electric poles, water lines, communication lines, etc.) along right of ways	• Necessary planning and coordination with concerned authority and local body; Prior notice to and consultation with concerned authority, local body and public to be affected so as to ensure that work does disrupt services
II. CONSTRUCTION PHASE		
Air quality	• Movement of construction vehicles and equipment's will generate fugitive dusts • Exhaust emissions from construction machineries and equipment	• Regular sprinkling of water of areas considered as dust generators • Use only new or properly maintained vehicles, equipment and conduct regularly check to regulate emissions within standard levels • Transport of excess materials should be undertaken during off-peak traffic periods • Hauling trucks should be covered with tarpaulin or canvass • Conduct quarterly TSP, PM10, NO2, SO2 level monitoring

Environmental Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures
Water Quality	• Increase turbidity and sediment load due to transport of wastes and sediments to surface water, Mactan Channel, Cansaga Bay and Silot Bay, waters	• Prepare temporary drainage plan with sump pits/sedimentation pond to trap sediments and wastes; • Use of silt fences and sediment traps, cover exposed earth especially before heavy rains are expected. • Conduct a quarterly Total Suspended Solids (TSS) and heavy metal level monitoring
	• Pollution of receiving water bodies due to fuel and oil leaks from vehicles and other equipment	• Proper handling of oil and lubricants to prevent spillage and contamination of surface and ground waters; (Storage of oil and lubricants in secure areas/places) • Heavy equipment's and machineries shall be well-maintained to prevent discharges from engines and regularly checked for fuel and oil leaks. • During repair/maintenance of equipment and machinery, containers/drip trays shall be used to collect leakage • Paint residues and paint containers shall be handled & disposed properly and arrangement will be made with the suppliers to be return for their proper disposal • Conduct quarterly oil & grease content monitoring
	• Further bacteriological contamination of the esteros due to improper management of domestic and solid wastes	• Contractor/Project Management provides toilet/washroom facility for construction workers and require proper sanitation practices; • Provision of garbage bins at the construction areas; • Regular disposal of wastes generated by the personnel to city approved disposal sites; • Conduct weekly inspection of the construction areas to ensure proper management of the wastes generated by the construction personnel • Conduct quarterly total coliform monitoring
Waste/ Offensive odors	• Wastes generation, consisting of the following types: ・ Surplus and const. wastes: scrap metals, concrete rubble etc. (estimated volume: around 18,500 m3) ・ Domestic wastes (Biodegradable): food and kitchen wastes from temp. canteen ・ Sanitary wastes from office and workers toilets, bathrooms • Others (Packaging wastes such as plastics, wood pallets, crates, metal wires, cardboard, sacks, containers, etc.)	• Detailed waste management program will be prepared by contractor including the following; ・ Solid wastes to be moved/transported to materials recycling facility (MRF) for sorting and diversion of wastes to recycles and re-utilization ・ Concrete rubbles and other excess materials to be reused for backfilling of the project sites/areas ・ Secure hauling permits and dispose excess earth materials to approved-suitable disposal sites ・ Residuals to be segregated into biodegradable, recyclable, residual, and special waste and disposed through the City garbage collectors • Temporary stockpiles of excavated materials from foundation works must be properly covered and regularly hauled to DENR-approved disposal sites; • No stockpiling of construction debris as these will not be utilized anyway; • Litters and other types of domestic garbage from construction sites and camps must be properly kept in trash bins and regularly disposed through the City garbage collectors
Soil pollution	• Slope failure • Soil runoff due to cut and fill areas, and waste soil disposal sites • Movement of excavated soil to waterways	• Take appropriate soil protection measures when doing excavation for foundation works • Ensure slope protection such as stone pitching or vegetation to prevent soil runoff • Keep excavated soil (road sub-base, base, foundation works for viaduct columns, etc) away from waterways • Provide drainage sump pits and silt traps
Soil pollution	• Soil contamination due to excavation work near Umapad dumpsite • Soil contamination due to leaks and spills of fuels, lubricants, solvents • Endangerment of health and safety of worker and community by exposure to hazards	• Establish and implement health and safety management plan and emergency and contingency plan in case of spills; • Excavation soil near Umapad Dumpsite will be separated from other excavation materials and followed the instruction of DENR-EMB, DGS and CENRO. • Store bulk hazardous chemicals in an impermeable area and with appropriate secondary containment; • Comply with environmental requirements for the storage, transport, treatment and handling of hazardous substances and wastes • Conduct a semi-annual soil quality monitoring

Environmental Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures
Noise and Vibrations	• Noise from movement of vehicles (trucks, cars) coming-in and out of the facility—disturbance to residents along Access St.	• Provision of temporary noise barriers such galvanized iron sheets, particularly in noise-sensitive receptor areas • Schedule heavy noise generating activities from 7am-7pm. • Use only new or properly maintained vehicles, equipment • Minimize the use of impact devices • Installation of noise abatement devices such as mufflers and suppressors to all construction vehicles, machineries, and heavy equipment • Locate stationary equipment, such as compressors as far as possible from noise sensitive areas.
	• Noise from Pile driving activities	• Avoid impact-type pile driving and employ appropriate pile-driving technology in noise-sensitive receptor areas and bird habitats • Conduct quarterly noise level monitoring at sensitive receptor areas
Ecosystem (Terrestrial Flora and Fauna)	• Small-scale loss of bird habitat such as mangrove, fishpond and tidal flat • Noise from construction work frightening migratory birds away from the IBA/KBA.	• Conduct awareness campaign to all relevant construction workers about the careful consideration for IBA/KBA • Adoption of lower noise and vibration construction method and machines • Adoption of temporary jetty construction road to minimize adverse impacts on mangrove and tidal flat • Conduct bird monitoring every two (2) months
Ecosystem (Aquatic Flora and Fauna)	• Removal of or direct physical injury to aquatic flora and fauna (e.g. seagrasses and sea weeds) through the construction of offshore viaduct and bridge • Vibration/disturbance from pile-driving	• Monitor the distribution and health of surrounding intertidal habitats along or near the vicinity of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road alignment. • Position the water borne equipment in a manner that will minimize damage to identified fish habitat (mangrove, seagrasses, and coral reefs) • Avoid pile-driving methodology with sound & vibration impacts destructive to marine env/ habitats & disruptive to fish spawning • Coordinate with Bureau of Fisheries and Aquatic Resources (BFAR) on pile-driving schedule • Monitoring of sound and vibration level during driving any type of piles with in mind its impacts on fish and their habitat.
Hydrology	• Disruption of natural drainage pattern • Increase in run-off due to alteration of topography and reduction of infiltration resulting to localized flooding	• Setting the adequate drainage system such as the crossing drainage pipe; • Limiting the area of exposed soil, • Building of bund/dikes effectively enclosing water-areas prior to landfilling for coastal road • Implementation of erosion control measures such as temporary sandbagging, drainage swales and siltation basins • Loose earth materials stockpile be kept away from banks and near waters (waterways, sea)
Geographical features	• Alteration in topography due to site development (inland areas): clearing, backfilling, grading, foundation works, etc.: • Soil disturbance and loss of top soil due to excavation	• Limiting land clearing and excavation within the affected areas of the primary impact area and excavating within the desired level only • Proper and appropriate excavation and embankment protection techniques, such as sheet piles.
Local economies, such as employment, livelihood, etc.	• Enhancement of employment and /or livelihood opportunity that will lead to economic growth.	• Provide the priority for local hiring • Encourage patronage for local goods & services
Misdistribution of benefits and damages/Local conflicts of interest	• Loss/limitations and hindrance of access by vessels to establishments with port/docking facilities	• Bridge design to accommodate/consider higher clearance to allow vessels to access and dock to establishments, such as shipyards, oil depot/fuel terminals and other establishments with docking facilities
Existing social infrastructures and services	• Risk of casting flammable into hazardous facilities	• Install temporary noise barrier along the alignment as a physical barrier
Land use and utilization of local resources	• Change/Disturbance in land use pattern due to road construction & ancillary facilities	• Scheduling heavy construction works during the daytime; • Construction activities that necessitate utilizing portion of the road/street should be undertaken upon permission by the City Traffic MGT and outside of traffic rush-hours; • Construction activities should not be a hindrance to the operations in neighboring area.

Environmental Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures
Land use and utilization of local resources (Cumulative Impacts from Mandaue Reclamation Project)	• Increased land use change, noise, water pollution, dust and emissions • Increased traffic by construction vehicles • Increased restriction of access to sea water by local fisher folks	• Mitigation measures on air quality, noise level and water quality described in this EMP. • Implementation of the Traffic Management Plan (TMP) and rerouting plans in coordination with Mandaue Reclamation Project • Securing a route for small vessels of fisher folks during the bridge pier construction
Land use and utilization of local resources (In-migration)	• Construction workers and staff will require temporary housing	• To the extent possible, local labor will be hired to minimize the need to provide housing for the construction crew.
Water usage	• Wastage of water resource through improper usage during construction • Competing use with the community	• Sourcing of water from outside of the communities within the project area • Implement water saving/conservation measures of water use for construction works/activities • Recycled water or water from waterways and marine waters shall be used for ground sprinkling or dust-suppression measures
Infectious diseases such as HIV/AIDS/ Working conditions	• Increased risk of accidents due to improper work ethics, which may threat health and safety of workers and local residents	• Contractors shall submit an Occupational Health and Safety Management Plan prior to commencement of work • Appropriate personal protective equipment (PPE) must be provided to all construction workers • Safety guideline and signs will be prepared for workers • First aid stations supervised by the Environment and Safety Health Officer (ESHO) of the Contractor will be located within the construction site; and • Emergency vehicles will be on stand-by within the construction area at all times
	• Hazards of communicable and infectious diseases	• Contractors shall submit an Occupational Health and Safety Management Plan. • Medical certificates will be requested to ensure workers are fit to work; • Appropriate sanitary facilities shall be provided at all construction sites.
Accidents (Safety)	• Increase traffic density due to movement of vehicles/trucks hauling construction materials to site, causing traffic congestion along access roads • Safety of pedestrians, passersby, as well as residents	• Strict implementation of the Traffic Management Plan (TMP) and rerouting plans; • Traffic flow restrictions will be minimized during daytime hours; • Schedule equipment move-in to blend with regular non-peak hour day-time vehicular traffic; • Placement of traffic decking will be done in stages; • Work will be performed during night time to the extent possible; • The minimum width of lanes will be maintained in accordance with the requirements of City Traffic MGT; • Parking time of idle dump trucks and the other construction vehicles along constricted areas will be limited; and • Well-trained traffic aides and flagmen duly deputized by City Traffic MGT will be designated at critical construction areas to direct traffic • All excavation sites and the storage site of hazardous substances will be enclosed with corrugated metal sheet barriers to limit access to public, especially children; • Installation of adequate lighting and reflectorized warning signs along the entire stretch of the construction site
III. OPERATION PHASE		
Air quality	• Dust re-suspension due to abandoned construction spoils/debris	• Conduct a site inspection at the work sites to ensure that construction spoils/debris are properly disposed to approved disposal sites and not abandoned in the construction areas
Water quality	• Further contamination of the waterways crossed by the alignments due to abandoned wastes and construction spoils	• All temporary sanitation facilities, especially the portable toilets are properly dismantled and no domestic wastes are abandoned; and • Conduct a site inspection at the work sites to ensure that construction spoils/debris, solid, and domestic wastes are properly disposed to approved disposal sites and not abandoned in the construction areas

Environmental Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures
Waste	• Excess soil generation from earthwork activities such as excavation, backfilling and embankment • Disposal of a total of around 18,500 m^3 of construction debris	• Detailed waste management program and Demobilization plan for the construction yards will be prepared which including the following; • Reuse excavated excess soil to backfill depressed areas within or nearby the area; • Recycle construction debris through sorting and stockpiling; • Take appropriate measures, such as covering hauling trucks with tarpaulin or canvass, in transporting excess/excavated earth materials to disposal site; and • Take proper and diligent management of solid waste, such as covering temporary stockpiles of excavated materials and hauling regularly to DENR-approved disposal sites.
Existing social infrastructures and services	• Possible long-term interruption of basic social service utilities such as power and water supplies	• Contractors/Sub-Contractors must ensure that all affected service utilities are immediately and properly restored to their normal operation; and • Conduct a joint site inspection involving the ESHO of the Contractors, leaders of affected barangays, and representatives of concerned utility companies to ensure immediate restoration of affected service utilities
Infectious diseases such as HIV/AIDS	• Possible spread of communicable diseases due to abandoned wastes	• Ensure that all temporary sanitation facilities, particularly portable toilets, are properly dismantled and all residual wastes are properly disposed to the disposal sites duly-approved by the DPS; and • Conduct a joint site inspection at the work sites involving the ESHO of the Contractors, community leaders, and representatives of Health and Sanitation Office, DPS to validate compliance of the Contractor
Water Quality	• Accidental releases of fuel, oil, lubricant and other chemicals due to maintenance work finding its way to waterways • Wastewater from maintenance works	• Proper handling of oil and lubricants to prevent spillage and contamination of surface and ground waters; (Storage of oil and lubricants in secure areas/places) • Paint cans, containers of oil, lubricants should be clean and chips, residues should be properly disposed
	• Contamination/degradation of water quality due to drainage outfall	• Adequate maintenance of drainage line/canal (e.g. desilting) and putting-up of catch basins (silt trap) at regular interval.
	• Contamination/degradation of water quality due to storm water run-off/discharge	• Care and maintenance of greeneries, ground cover – specifically, those along the riverbanks and shorelines that would retard storm water run-off and screen discharge of pollutants to surface waters • Set up filters and catch basins for storm drains, to prevent possible pollutants from being flushed into the sea • Conduct a semi-annual water quality monitoring
Water Quality (Marine water)	• Sedimentation of marine water • Contamination of marine water by pollutants	• Regular maintenance of drainage system (e.g. desilting) • Care & maintenance of greeneries, ground cover –specifically, those along the shorelines that would retard run-off from flowing into open waters
Waste	• Pollution from littered uncollected garbage	• Improvement/enhancement of current wastes disposal practices and implementation of the Solid Waste Management (SWM) plan
Soil pollution	• Soil contamination from accidental releases of chemicals, fuel, oil, lubricants will occur due to the maintenance work	• Immediately collect and contain spilled oil, lubricants and other chemicals • Proper management of wastes • Secure storage of oil, lubricants • Proper handling and maintenance of equipment, machineries, vehicles • Conduct semi-annual soil quality monitoring
Noise and vibrations	• Traffic Noise	• Installment of 2m-height noise barriers on the 1m height handrails • Conduct a semi-annual noise level monitoring
Ecosystem (Terrestrial Flora and Fauna)	• Road kill of birds caused by car-bird collision especially at the interchange section in the vicinity of fishpond and mangrove forest • Lighting in the interchange area may give adverse impacts on the mangrove forest facing the Cansaga Bay, which is considered a potential birds roosting area	• Install road sign warning with birds and KBA • Install recessed lighting system at the interchange area near the mangrove forest • Consider the installment of bird-car collision prevention poles/fences based on the results of the Biodiversity Survey (detailed bird survey) planned at the early stage of DD • Consider the development of wetland park based on the results of the Biodiversity Survey (detailed bird survey) planned at the early stage of DD • Conduct a semi-annual bird monitoring
Ecosystem (Aquatic Flora and Fauna)	• Lighting along the bridge may give adverse impacts on fish in the ocean • Deterioration of habitat due to release of contaminants, chemicals, liquid wastes, and sediment-laden run-off from uncleaned/dirty area of maintenance work sites	• Set up a type of light which does not irradiate the sea surface and outside of the bridge • Proper handling of oil and lubricants to prevent spillage and contamination of sea water (i.e. storage of oil and lubricants in secure areas/places)

Environmental Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures
Infectious diseases such as HIV/AIDS/Working conditions (Health)	• Health/Accident	• Submission of medical certificate of workers to the contractors

Source: JICA Survey Team

(7) Environmental Monitoring Plan

Section 9 of the DAO 2003-30 Implementing Rules and Regulations prescribed the monitoring of projects with ECCs through the following: Self-monitoring and Third Party Audit, and the Multi-Partite Monitoring Team. It also prescribed the establishment of an Environmental Guarantee Fund (EGF). The Abbreviated Environmental Monitoring Plan (EMoP) for the project is shown in Table 8.3.

Table 8.3 Abbreviated Environmental Monitoring Plan (EMoP)

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling Methodology and Measurement Plan	
			Frequency	Location
I. PRE-CONSTRUCTION PHASE				
Soil Pollution	Soil pollution near the dump site	Aldrin, Chlordane, Total DDT (DDT+DDE+DDD), Diedrin, Endrin, Heptachlor, HCB, Mirex, Toxaphese, PCBs Total, Dioxins (I-TEQ)	Semi-Annual during the DD	At one (1) sampling location: Umapad dumpsite
Ecosystem	Cutting of trees along the alignment	Locations of trees cut, species and numbers of trees cut, volume of trees cut	Daily during site clearing along the ROW	All the project affected area (along the ROW)
	Replacement of cut trees along alignment (incl. relocation and compensatory plantation)	Locations reforested, species and numbers of trees relocated and planted, survival rate of the relocated trees and seedlings planted	Quarterly (until the 3-year maintenance period is completed)	Designated tree planting site and/or reforestation area designated by the DENR
	Disturbance to KBA	Population Count, Flying Route & Altitude, Roosting Area, etc.	Semi-annual during the DD (two migration seasons)	KBA/IBA
Geographical features	Ground shaking, ground rupture	Situation of ground	Once during the DD	All the project affected area (at the buildings along the ROW)
Resettlement	Displacement of commercial establishments along the proposed alignment	Compensation for affected land, structures and improvements	Monthly until resettlement is fully completed	Affected families
	Improvement of living conditions	Resettlement of Informal Settlers Families (ISFs) to the relocation sites	Semi-annually until the end of livelihood restoration program	Affected barangays
Misdistribution of benefits and damages Local /conflicts of interest	Informed/empower the public to participate in the decision-making process	Number of participants, attributes (sex, age, occupation, etc.)	Monthly or as needed	All the project affected area
Existing social infrastructures and services	Relocation of utilities along right of ways	Relocation of electric poles, water lines, communication lines, etc.	Annual	Affected utilities along right of ways
II. CONSTRUCTION PHASE				
Air Quality	Increase in particulate matter and gaseous air contaminants	TSP, PM10, NO_2, and SO_2,	Quarterly	At three (3) sampling locations: A-St1: National High School A-St2: Village Social Housing Area A-St3: Commercial/Mall
Water Quality	Water contamination	pH, Oil & Grease, BOD, Total and Coliform Fecal, COD, TSS, Chromium (Cr), Cadmium (Cd) and Lead (Pb)	Quarterly	At four (4) sampling locations: B-St1: Upstream Mactan Channel B-St2: Downstream Mactan Channel B-St3: Near Coastal Road Mactan Channel B-St4: Downstream Butuanon River

Waste/ Offensive odors	Generation of solid waste; Land and water contamination; aesthetic impacts; spread of diseases	Proper waste management and disposal	Weekly	All construction sites
Soil Pollution	Slope failure, soil runoff and movement of excavated soil to waterways	Situation of soil runoff and movement on slopes	Quarterly (until the 3-year maintenance period is completed)	All the project affected area (Slopes and waterways)
	Soil pollution	Cu Other parameters to be decided in consultation with DENR-EMB	Semi-Annual (dry and wet season)	At three (3) sampling locations: 1. Northern side of fishpond 2. Southern side of fishpond 3. C-St1: Landfill
	Soil contamination due to oil on lubricant spill	Oil spill	Weekly Immediately after the spills	All construction sites
Noise and vibrations	Increase in noise level	Noise level (dBA)	Quarterly	At three (3) sampling locations: A-St1: National High School A-St2: Village Social Housing Area A-St3: Commercial/Mall
Ecosystem	Continued use of wetland area as feeding ground by migratory birds	Species and number of migratory birds	Every two months	Wetland areas near the interchange section
Ecosystem(aquatic flora and fauna)	Removal of direct physical injury to aquatic flora and fauna	Result of monitoring for aquatic flora and fauna	Monthly or as needed	All the project affected area
	Vibration/disturbance from pile-driving	Vibration during construction	Monthly or as needed	All the project affected area
Hydrology	Disruption of natural drainage pattern and increase in run-off	Situation of soil runoff and movement on slopes	Quarterly (until the 3-year maintenance period is completed)	All the project affected area (Slopes and waterways)
Geographical features	Alteration in topography, soil disturbance and loss of top soil	Rate of land modification	Quarterly (until the 3-year maintenance period is completed)	All the project affected area
Local economies, such as employment, livelihood, etc.	Enhancement of employment and /or livelihood opportunity that will lead to economic growth.	Number of workers and means of livelihood	Monthly or as needed	All the project affected area
Misdistribution of benefits and damages/ Local conflicts of interest	Loss/limitations and hindrance of access by vessels to establishments with port/docking facilities	Content of the complaint	Monthly or as needed	All the project affected area
Existing social infrastructures and services	Possible long-term interruption of basic social service utilities	Power and water supplies	Monthly or as needed	All the project affected area
Land use and utilization of local resources	Change/Disturbance in land use pattern	Change of land use	Monthly or as needed	All the project affected area
Land use and utilization of local resources (Cumulative Impacts from Mandaue Reclamation Project)	Cumulative impacts including increased land use change, noise, water pollution, dust and emissions, traffic by construction vehicles, restriction of access to sea water by local fisher folks	According to monitoring data of land use change, noise, water pollution, dust and emissions, traffic	According to each monitoring data	All the project affected area
Land use and utilization of local resources (In-migration)	Construction workers and staff will require temporary housing	Situation of temporary housing	Monthly or as needed	All the project affected area
Water usage	Competing use with the community	Usage situation of water supply	Monthly or as needed	All the project affected area
Infectious diseases such as HIV/AIDS/Working conditions (Health)	Possible spread of communicable diseases due to abandoned wastes	Number of patients with communicable diseases	Monthly or as needed	All the project affected area
Accidents (Safety)/Working conditions (Health)	Increased risk of accidents due to improper work ethics	Number of accidents	Monthly or as needed	All the project affected area
Accidents (Safety)	Aggravation of existing traffic problem	・Implementation of TMP approved by City Traffic Management, etc.	Weekly	At critical traffic areas
III. OPERATION PHASE				

Water Quality	Accidental releases of fuel, oil, lubricant and other chemicals, contamination/degradation of water quality	Accidental releases record	Semi-annual or as needed	All the project affected area
Water Quality	Sedimentation of marine water	Water quality	Semi-annual or as needed	All the project affected area
Waste	Pollution from littered uncollected garbage	Situation of uncollected garbage on roadside	Semi-annual or as needed	All the project affected area
Soil pollution	Soil contamination from accidental releases of chemicals, fuel, oil, lubricants	Situation of soil contamination	Semi-annual	All the project affected area
Noise and vibrations	Traffic Noise	Noise level (dBA)	Semi-annual or as needed	At three (3) sampling locations: A-St1: National High School A-St2: Village Social Housing Area A-St3: Commercial/Mall
Ecosystem (Terrestrial Flora and Fauna)	Replacement of cut trees	Survival rate of the seedlings planted	Quarterly (until the 3-year maintenance period is completed)	Designated tree planting site and/or reforestation area designated by the DENR Central Office
	Continued use of wetland area as feeding ground by migratory birds	Species and number of migratory birds	Semi-annual (northward and southward migration periods)	All the project affected area
Ecosystem (Aquatic Flora and Fauna)	Deterioration of habitat due to lighting along the bridge and release of contaminants, chemicals, liquid wastes, etc.	lighting system and water quality management	Semi-annual or as needed	All the project affected area
Infectious diseases such as HIV/AIDS / Accidents (Safety)	Health/Accident	Situation of health and accident	Annual	All the project affected area

Note:
ESHO – Environment Safety and Health Officer, TMP – Traffic Management Plan, PCO – Pollution Control Officer, DPWH – Department of Public Works and Highways, DENR-EMB – Department of Environment and Natural Resources-Environmental Management Bureau, LGU – Local Government Unit, DAO – DENR Administrative Order, BOD – Biochemical Oxygen Demand, TSP – Total Suspended Particulates, TSS – Total Suspended Solids, IEC – Information. Education, and Communication

Source: JICA Survey Team

(8) Stakeholder Meetings

As a process of EIA, the following stakeholder meetings were undertaken during the Survey:

Preparatory and Coordination Meetings

- January 24, 2019 LGUs, MCDCB, NEDA
- January 25, 2019 Coast Guard Cebu
- March 27, 2019 Mandaue City Planning and Development Office
- April 11, 2019 Lapu-Lapu City Engineering Office
- April 13, 2019 Barangay Opao
- April 16, 2019 Barangay Umapad
- April 16, 2019 Barangay Paknaan
- April 16, 2019 Barangay Pusok
- April 16, 2019 Barangay Ibo
- April 17, 2019 Barangay Centro
- May 27, 2019 Regional Development Council-Economic Development Committee (RDC-EDC)

Public Scoping Meetings/Stakeholder Meeting at Scoping Stage

- March 6, 2019 Barangay officials and representatives of private companies/establishments who will be affected by the Project in Mandaue City
- April 12, 2019 Barangay officials, representatives of private companies/establishment and individual households who will be affected by the Project in Lapu-Lapu City

- April 26, 2019 — Barangay officials, representatives of private companies/establishment and individual households who will be affected by the Project in Mandaue City

Public Hearing/Stakeholder Meeting at Draft Final Report Stage

- June 4, 2019 — Barangay officials, representatives of private companies/establishment and individual households who will be affected by the Project in Lapu-Lapu City
- June 4, 2019 — Barangay officials, representatives of private companies/establishment and individual households who will be affected by the Project in Mandaue City

Focus Group Discussions

- May 21, 2019 — PWDs, women, senior citizens and fisheries in Mandaue City
- May 23, 2019 — PWDs, women, senior citizens and fisheries in Lapu-Lapu City
- June 4, 2019 — PWDs, women, senior citizens and fisheries in Mandaue City
- June 11, 2019 — PWDs, women, senior citizens and fisheries in Lapu-Lapu City

9. LAND ACQUISITION AND INVOLUNTARY RESETTLEMENT

(1) Necessity of Land Acquisition and Resettlement

The survey revealed that a total number of 86 plots that belong to private individuals, companies and public (i.e. Mandaue City and the Philippine Economic Zone Area) will be affected. 69 households (i.e. 243 people) are living on this land all of which may be subject to relocation under the project. There is no individual household expected to be affected in Lapu-Lapu City and all affected households are located in Mandaue City.

(2) Policy and Legal Framework on Land Acquisition and Resettlement

Legal Framework on Land Acquisition and Resettlement in the Philippines

Table 9.1 below presents the principle laws and regulations governing issues concerned with land acquisition and involuntary resettlement in the Philippines.

Table 9.1 Legal Framework concerning Land Acquisition and Resettlement in the Philippines

Item	Law and Regulations
Resettlement, Land Acquisition, Land Use	The Philippine Constitution of 1987
	Republic Act No. 10752 (An Act to Facilitate the Acquisition of Right-of-Way, Site or Location for National Government Infrastructure Projects and other purposes of 2016)
	Republic Act No.7160 (Local Government Code of 1991)
	Commonwealth Act 141 (Public Land Act) and Presidential Decree 635
	Executive Order No. 1035, Series of 1985
	Executive Order No. 113 (1995) and 621 (1980)
	Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy (LARRIPP), 2007
	DPWH Right-of-Way Acquisition Manual (DRAM)
	Republic Act (Comprehensive Agrarian Reform Law) No. 6657 (1988)
Compensation on Agricultural Land	Republic Act No. 6389 (Agricultural Land Reform Code of 1971)
	Executive Order No. 1035
Housing	Republic Act No.7279 (Urban Development and Housing Act: UDHA of 1992)
	Republic Act No. 9679 (Home Development Mutual Fund Law of 2009)
	Executive Order No. 272, Series of 2004
	NHA Memorandum Circular No. 2427 Series of 2012
	HLURB Memorandum Circular No. 13, Series of 2017
Employment	Republic Act No. 6685 (December 1988)
Gender and Human Rights	The Philippine Constitution of 1987
	Republic Act 9710 and Implementing Rules and Regulations (series of 2010) known as the "Magna Carta of Women"
	Executive Order No.153 (2002)
	National Commission on Indigenous Peoples (NCIP) Administrative Order No. 1, Series of 2006
	Department Order No. 130, Series of 2016 (Guidelines for the Implementation of the Provisions of RA6685 and RA9710 or the Magna Carta of Women)
	A Tool Kit for Making Road Infrastructure Projects Gender Responsive
Historical and Cultural Heritage	Republic Decree No. 4365
	Republic Decree No. 4346
Indigenous People	Indigenous Peoples 'Rights Act/Republic Act 837 (1997)

Source: JICA Survey Team

Gap Analysis between Philippine Legal Framework and JICA Guidelines

A gap analyses was carried out by comparing the laws and regulations in the Philippines and the JICA Guidelines for Environmental and Social Considerations (April 2010). While some relatively large gaps were identified as shown below, by adopting appropriate countermeasures, the gaps are expected to be filled:

- absence of a law in the Philippines that necessitates payment of compensation against lost livelihood per se including loss attributed to impact on business activities;
- absence of a law in the Philippines that necessitates providing full compensation and other kinds of support to the PAPs prior to displacement;
- absence of a law in the Philippines that gives preference to land-based resettlement strategies for displaced persons whose livelihoods are land-based; and
- absence of a law in the Philippines that necessitates providing sufficient level of assistance to the PAPs during their relocation and restoration of livelihood

(3) Scope of Land Acquisition and Resettlement

Cut-Off-Date of Eligibility

The cut-off-date (COD) of eligibility was set on the commencement day of the census survey in accordance with the DPWH ROW Acquisition Manual (2017) and announced publicly through different means such as stakeholder meetings, public consultations and leaflets. The COD for the affected barangay is shown in Table 9.2.

Table 9.2 Cut-off Dates per Barangay for Eligibility

Barangay	Cut-off Date	Barangay	Cut-off Date
North Reclamation Area (NRA), Mandaue City	April 26, 2019	Umapad, Mandaue City	April 23, 2019
Centro, Mandaue City	April 24, 2019	Paknaan, Mandaue City	April 26, 2019
Looc, Mandaue City	May 2, 2019	Ibo, Lapu-Lapu City	April 22, 2019
Opao, Mandaue City	April 16, 2019	Pusok, Lapu-Lapu City	April 22, 2019

Source : JICA Survey Team

Project-affected Persons and Entities

The survey revealed that there were 42 land owners, 33 non-residential structure and other asset (e.g. fences) owners that belong to mainly private companies and government bodies, eight tenants and 243 persons that belong to 69 households affected by the project. A bulk of the people, companies and government bodies affected are located in Mandaue City including all affected households while nine land owners and 10 asset owners are located in Lapu-Lapu City (refer to Table 9.3). Excluding any duplication among the land owners and structure and asset owners, the total number of affected persons and entities, considering each company to be one entity, is 322 in total as shown in Table 9.4. All individuals that have their dwelling affected are informal settlers, or people that are living in the project-affected area without legal rights. All land owners and non-residential structure and asset owners, on the other hand, have permits to operate in the area hence can be considered formal owners and businesses. All of the 69 households (i.e. informal settlers) are expected to be relocated.

Table 9.3 Number of Project-affected Entities by Type of Ownership and Location

Location/ Entities	Mandaue City						Lapu-Lapu City		Total
	NRA/ CSSEAZ[1]	Centro	Looc	Opao	Umapad	Paknaan	Pusok	Ibo	
Households	-	-	5 (23)*1	11 (59)*1	12 (33)*1	41 (128)*1	-	-	69 (243)*1
Land Owners	9 (8)*2	1	9 (8)*2	11	4	1 (0)*2	7 (5)*2	5 (4)*2	47 (42)*2
Asset Owners*3	5	7	8	2	1	-	9	1	33
Tenants	-	-	-	-	-	-	-	8	8

*1 Number in brackets are that of PAPs.
*2 Number in brackets are that when excluding duplicates.
*3 excluding households
Source : JICA Survey Team

Table 9.4 Number of Project-affected Entities by Category

Affected Entities		Number	Remarks
Individuals	ISFs	243	69 HHs
	Land and Asset Owners	21	20 land owners and one aquaculture farmer
Private Companies		46	incl. eight tenants
Public Entities		12	
TOTAL		**322**	

Source: JICA Survey Team

<u>Land to be Acquired by the Project</u>

86 plots of land (i.e. 28 plots of public land and 58 plots of private land) with a total land area of 549,190 m2 are expected to be acquired for the project.

<u>Project-affected Structures, Assets and Trees</u>

A total number of 115 structures are expected to be affected by the project. A large proportion of them belong to private entities including all houses that belong to informal settlers. In addition, 31 assets (e.g. fences) that belong to individual households and a number of other assets including one aquaculture farm are expected to be affected. 71 trees that belong to the informal settlers and 1,494 trees that belong to other private and public entities were also found to be affected by the project.

<u>Socio-economic Status of the PAPs</u>

General profile of the 69 households expected to affected are as follows:

- Household Composition: 37 have a size of household that range from one to four members. 24 PAFs have a household size of five to seven while two PAFs have a household size of 8-10 members. The average number of children of the project-affected households is 2.1. A majority (69.57%) of the household heads are male while 17.69% are female.

- Age Structure: 56.62% or 39 household heads belong to an age group of 30 to 60 years old. Approximately 17.39% or 12 household heads are 18-30 years old while 10.14% of the PAFs' household heads were over 60 years old.

- Educational Attainment: 17 or 24.64% are high school graduates, 14 or 20.29% are high school undergraduate, 11 or 15.94% are elementary undergraduates, nine or 13.04% are college graduate, six are elementary graduate, three are college undergraduate, and two PAFs were vocational graduate and had no educational attainment, respectively.

- Linguistic Characteristics and Ethnicity: 45 belong to the Binisaya ethno-linguistic while 18

[1] City Special South Economic Administrative Zone

of the interviewed speaks Cebuano. There is no indigenous group of people included in the project-affected households.

- Primary and Secondary Source of Income: The occupation with the largest group of respondents were unskilled labor (i.e. 23.19%) followed by skilled labor (i.e. 11.59%) and government employee (10.14%). 11 (15.95%) of the households have secondary source of income as livestock farmer, habai-habai trike driver, waste picker and so on.

- Household Income: 21 or 30.43% of PAFs have a monthly income range of PhP 1,001-5,000 while 13 or 18.84% is on the range of PhP 5,001-10,000. 12 or 17.37% of the PAFs have an income range of PhP 10,001-15,000. 38 households fall under the poverty threshold of PhP 10,481 per month set by NEDA.

- Household Expenditures: Respondents' monthly expenses were mainly on food and utilities. Except for Brangay Opao, households' food expenses comprise approximately 87-91% of the total monthly expenditures. The total monthly expenses range from PhP 4,433 in Barangay Umapad to PhP 15,938 in Barangay Opao.

- Land Use Status and Title: While more than 75% of the respondents answered that it is an agricultural land, in fact, none of the ISFs is a farmer and very few crops were found to be grown in the area. One person claimed to be having ownership over the land but no evidence could be provided that suggests the respondents' ownership nor does the official data provided by Mandaue City show the respondent's possession. While a majority of the occupants are said to be staying in the area without consent from the land owner, approximately 15% of them claim to have such consent. None of them have been paying any fee to the land owners. While three respondents claimed to have evidence to prove their ownership, none of them were able to show any evidence or even provide information on what kind of documents or other proofs they possessed.

- Attitude towards the Project: 58 or 84.06% of them were in favor of the project while one household or 1.45% was not in favor of the project.

- Preference for Compensation and Relocation: 79% were in favor of the option of resettlement housing. Those that chose this option all preferred row houses and lot package as opposed to the low-rise buildings (LRBs). Their preference for the location of the housing package was within 10 km radius from their existing residence.

- Vulnerable Groups: Vulnerable groups have been defined to be the following groups of people: poor people whose combined income falls within the poverty threshold set by NEDA except for professional squatters and members of the squatting syndicates[2]; female-headed households; elderly people; and persons with disabilities. The number of households that belong to at least one of these groups is 44.

(4) Compensation Policy, Package and Procedures

Eligibility for Compensation and Other Entitlements

All qualified affected people, which are judged based on the conditions described below, are eligible for compensation, either in cash or in-kind, and for rehabilitation/resettlement assistance irrespective

[2] Not only those informal settlers that meet the conditions set forth in RA10752 and RA7279 but those who do not meet the requirements will also be entitled to compensation and relocation in this project unless they have been found to be coming back to the original site of dwelling for unlawful reasons. The project proponent or DPWH and LGUs will jointly examine the resettlement qualifications of the affected people.

of tenure status, social or economic standing, or any such factors. All PAPs will be entitled to compensation for their lost assets (i.e. land and/or non-land assets) at replacement cost, and to restoration of incomes and businesses. They will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels. The conditions based on which affected people's eligibility will be judged are:

- cut-off date of eligibility
- legal and socio-economic status
- type of loss incurred by the project
- impact on livelihood; and
- severity of project impacts

<u>Livelihood Restoration Program</u>

The following groups of people are considered to have their livelihood hindered as a result of the project and hence be eligible to participating in the program.

- Business entities and employees;
- Displaced persons; and
- Vulnerable groups

The following measures will be taken with an aim to restore and improve the livelihood of business entities and their employees affected by the project.

Table 9.5 Livelihood Restoration Measures for Business Entities and Employees

Affected Entities	Assistance
PAPs who own affected fixed micro businesses (e.g. small shops)	・ Assistance in securing government soft loans that offer lower transaction costs and interest rates, and long-term and flexible payment schedule
PAPs who own affected small, medium or large businesses	・ Assistance in securing government soft loans that offer lower transaction costs and interest rates, and long-term and flexible payment schedule
PAPs who are employed in displaced establishments and lose job due to the project	・ Priority in employment during construction and operation stage of the project ・ Rehabilitation assistance in the form of skills training and other development activities

Source: JICA Survey Team

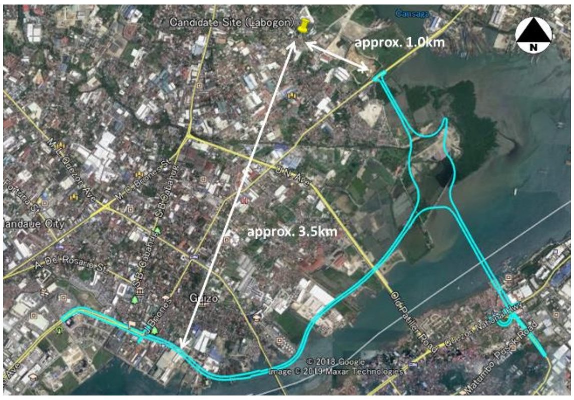
The livelihood restoration program for individuals including displaced employees is designed based on the existing relevant programs at the national, regional, provincial and LGU levels and includes the following:

- vocational trainings;
- mainstream employment information and referral;
- project employment opportunities;
- financial management and entrepreneurial trainings; and
- additional support for vulnerable persons

<u>Resettlement Site Development Plan</u>

All qualified informal settlers that are affected by the project are eligible to be relocated into relocation sites. Those project-affected ISFs that do not meet the criteria will be compensated in cash for their affected assets such as structures at replacement cost. There are two types of housings that can be expected in resettlement sites developed for the PAHs namely, row house and low-rise building (LRB). Low-rise building has as many as five floors. Among the two housing types, the row house, given that a larger land area is required is, in general, more feasible in areas where the cost of land is not so high. In areas within Mandaue City where land for socialized housing is scarce, on the other hand, LRBs become more viable.

Two candidate sites have been identified during the survey: one is located in Mandaue City (i.e. Labogon, Mandaue City); and the other in the adjacent municipality of Consolacion (i.e. Pulog, Consolacion). Basic infrastructure (e.g. potable water; power and electricity and an adequate power distribution system; sewerage facilities and an efficient and adequate solid waste disposal system; and access to primary roads and transportation facilities) will be developed in both sites. The time required for site development may be as much as three and a half years. A comparison of the two sites is presented in Table 9.6.



Candidate Resettlement Site in Labogon, Mandaue

Candidate Resettlement Site in Pulog, Consolacion

Source: JICA Survey Team

Figure 9.1 Location of the Candidate Resettlement Sites

Table 9.6 Comparison of Candidate Resettlement Sites

Category	Labogon, Mandaue	Pulog, Consolacion	Remarks
Land Classification	commercial land	agricultural land	Agricultural land requires conversion while commercial land does not. Both are private land as of July, 2019
Land (buildable) Area	3,600 (1,600) m2	18,000 (14,400) m2	
Topography	flat	rolling	
Distance from Original Dwelling	approx 1.0-3.5 km	approx 8-11 km	
Existing Infrastructure	electricity, water supply and concrete road	electricity, gravel and concrete road	
Infrastructure to be Developed	sewage and waste disposal system	water supply, road, sewage and waste disposal system	
Transportation	public transportation	none (only accessible by bikes or “habal-habal”)	
Social Infrastructure	school, health facilities, and community center nearby	no school, health facilities, and community center nearby	
Cost for Site Development	low	high	
Housing Type	LRBs	Row Houses	
Amortization Fee/Month	approx PhP600-1,000	approx PhP500	
Issues to be Addressed	・ approx 20 ISFs reside in the area ・ selling price is higher than appraised price	・ land conversion required ・ infrastructure development required ・ accessibility not ideal ・ belongs to Consolacion	

Source: JICA Survey Team

Entitlement Matrix

Table 9.7, referred to as the entitlement matrix, depicts the compensation and assistances that need to be provided under the project to the PAPs depending on their eligibilities described above. It should be noted that all compensation and support will be provided to the PAPs prior to resettlement. It is aimed under this entitlement matrix that impact on the business activities be avoided by providing full compensation prior to dislocation and allowing the business entities to continue with their businesses at the original location for a period that is sufficient to build, relocate and resume the business in the new site using the compensation.

Table 9.7 Entitlement Matrix

Type of Loss	Entitled Person	Compensation/Entitlements	Responsible Organization
Land (Classified as Agricultural, Residential, Commercial, or Institutional)	PAPs with Original Certificate of Title (OCT), Transfer Certificate of Title (TCT), emancipation patents (EP), or Certificates of Land Ownership Award (CLOA) granted under Comprehensive Agrarian Reform Act PAPs who are not original patent holders of lands granted through CA 141 (i.e. those who have bought the patent for land previously granted through CA 141 and where any previous acquisition is not through gratuitous title (e.g. donation or succession) For untitled land, PAPs with a) Tax Declaration showing 30 or more years of continuous possession; b) DENR certification showing that land is alienable and disposable; or c) other documents that show proof of ownership · PAPs who were formerly ISFs but now hold title of land as a result of social government housing program	[Severely Affected[3]] Cash compensation for the loss of entire land based on the current market value free of taxes including capital gain tax (CGT), documentary stamps tax (DST), transfer tax and registration fees AND Transaction costs (e.g. administrative charges and registration or title fees) *Payment of Real Property Tax (RPT) is a condition to be entitled. PAPs can request DPWH to: support the PAPs in preparing documents necessary to complete tax payment; and pay RPT in arrears to LGUs, which will be deducted from the amount of compensation except when the arrears are higher than the total amount of compensation. [Marginally Affected] Cash compensation for the affected portion of the land based on the current market value free of taxes including CGT, DST, transfer tax and registration fees. *Payment of RPT is a condition to be entitled. PAPs can request DPWH to: support the PAPs in preparing documents necessary to complete tax payment; and pay RPT in arrears to LGUs, which will be deducted from the amount of compensation except when the arrears are higher than the total amount of compensation.	DPWH-UPMO (RMC I)
	PAPs who were formerly ISFs and government social housing program beneficiaries whose titles are still under the name of the organization	Same as PAPs with OCT with less any amount still owing to the title	
	PAPs whose properties are mortgaged	Same as PAPs with OCT with less any amount still owing to the title or the mortgage bank or other financial institutions	
	PAPs who are original patent holders of lands granted through CA 141 which has not been subject to previous government exercise of its lien	No compensation for land up to 20 m width if patent was granted prior to 1975 or up to 60 m width for patents granted thereafter. For area in excess of government lien, same as PAPs with OCT	
Structures (Residential, Commercial, Industrial/ Institutional)	PAPs that own affected structures including absentee owners	[Severely Affected] Cash compensation for entire structure at replacement cost including transaction costs without deduction for depreciation or salvaged materials AND In case affected structures are used as dwelling, permission to stay for one month or a longer time between delivery of compensation and other assistance, and demolition of the dwelling AND	

[3] Refer to · for the definition of severely and marginally affected land and structures.

Type of Loss	Entitled Person	Compensation/Entitlements	Responsible Organization
		In case PAPs are ISFs and affected structures are used as dwelling, option of living in a resettlement site. [Marginally Affected] Cash compensation for affected portion of structure at replacement cost	
	Tenants of structures	Three months or longer prior notice to the tenants before evacuation *Not applicable to lease contracts that will expire at the time of taking	DPWH-UPMO (RMC I)
Improvements/Assets	PAPs that own affected improvements/assets	Cash compensation for affected improvements/assets at replacement cost AND Transportation assistance if improvements/assets need to be transferred and requires cost	
Crops, Trees and Perennials	PAPs that own land directly involved in farming	Cash compensation for affected crops at replacement cost	DPWH-UPMO (RMC I) with support from MAO and DENR
	PAPs that are lessees directly involved in farming	Disturbance compensation equivalent to five times the average of gross harvest over the last five years	
	Displaced tenants and settlers on agricultural land	Financial assistance equivalent to the average gross harvest over the last three years and not less than PhP15,000/ha	
	PAPs growing crops, trees and perennials informally	Permission to harvest crops prior to commencement of construction AND Cash compensation for affected crops at replacement cost	
Income Earning/Business Activities	PAPs who own affected fixed micro businesses (e.g. small shops)	In case affected business entities move to new locations and continue with their business there, permission to continue with the business activities at the original location for a period that is sufficient to build, relocate and resume the business in the new site at a production level no less favorable than pre-project level AND Cash compensation for relocation costs and transaction costs (e.g. payment of taxes due to the government) AND Assistance in securing government soft loans that offer lower transaction costs and interest rates, and long-term and flexible payment schedule OR Income rehabilitation assistance AND Assistance in securing government soft loans that offer lower transaction costs and interest rates, and long-term and flexible payment schedule	DPWH-UPMO (RMC I) with support from concerned government agencies
	PAPs who own affected small, medium or large businesses	In case affected business entities move to new locations and continue with their business there, permission to continue with the business activities at the original location for a period that is sufficient to build, relocate and resume the business in the new site at a production level no less favorable than pre-project level AND Cash compensation for relocation costs and transaction costs (e.g. payment of taxes due to the government) AND Assistance in securing government soft loans that offer lower transaction costs and interest rates, and long-term and flexible payment schedule	DPWH-UPMO (RMC I) with support from concerned government agencies
	PAPs who are employed in displaced establishments and lose job for reasons reasonably	Compensation equivalent to one month pay or at least one-half a month pay for every year of service, whichever is higher	

Type of Loss	Entitled Person	Compensation/Entitlements	Responsible Organization
	attributable to the damages caused by the project	AND One month or longer prior notice to the establishments AND Priority in employment during construction and operation stage of the project AND Rehabilitation assistance in the form of skills training and other development activities	
Government Structure and Utilities	Government agencies that own affected structures	Compensation to the government agencies based on mutual agreement between DPWH and the government agencies	
Vulnerable Groups	PAPs that are classified as any of the following groups: poor (whose combined income falls within the poverty threshold set by NEDA); female-headed households; elderly people, and persons with disability	[Severely Affected] Compensation allowance of PhP10,000 per family AND Rehabilitation assistance in the form of skills training and other development activities AND Participation in the Livelihood Restoration Program AND For PAPs that need special assistance and/or medical care, respective LGUs to provide support before and during resettlement	DPWH-UPMO (RMC I) with support from NHA and LGUs

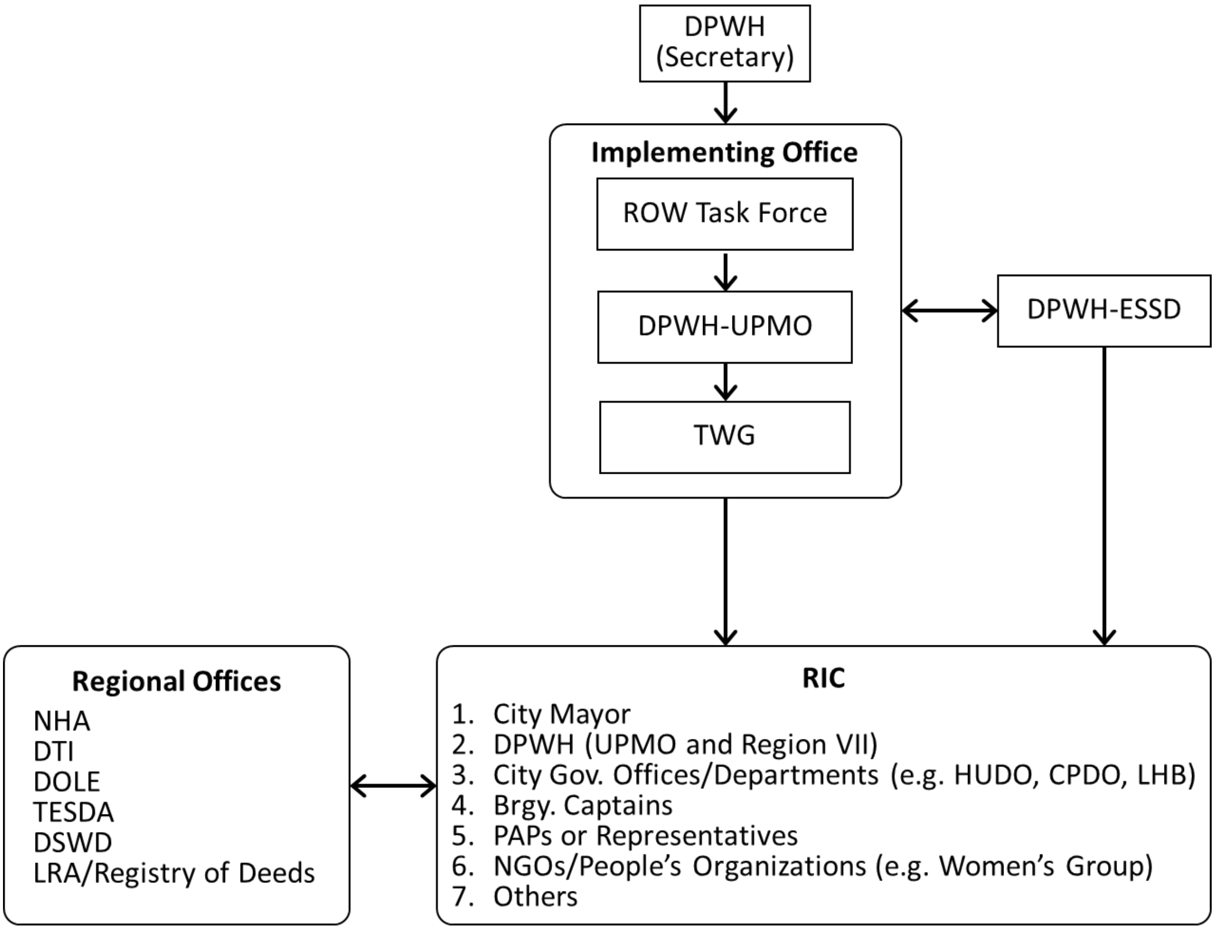
Source: JICA Survey Team

(5) Grievance Redress Mechanism

Under the project, the resettlement implementation committee (RIC), a coordinating and consultative body organized to assist DPWH in the validation and implementation of the RAP, established by UPMO through a Memorandum of Understanding (MOU) with concerned parties during the D/D, will play a key role. One of their responsibilities is to receive and record the voices, complaints opinions and suggestions provided by the PAPs, except complaints and grievances that specifically pertain to the valuation of affected assets since such will be decided upon by the proper courts, and to address them as the first stage of the decision-making body (cf. until the RIC is formed, complaints can be directly addressed to DPWH Region VII). If the response to the complaint is deemed inadequate in the view of the PAPs, they may elevate their grievance to the ROW Task Force that consists of higher level officials of DPWH Central Office before resorting the case finally to the court.

(6) Institutional Framework

A number of entities/organizations will be actively involved in implementing this RAP. Among them, DPWH, the project proponent, carries overall responsibility for the project. The managerial and supervisory body of DPWH is its UPMO (RMC I) which works closely with the ROW Task Force and the technical working group (TWG) to implement the RAP. At the local level, a RIC will be set up in both Mandaue City and Lapu-Lapu City to assist DPWH in implementing the RAP in close coordination with relevant national government agencies such as the National Housing Authority (NHA), the Department of Trade and Industry (DTI), the Department of Labor and Employment (DOLE), the Technical Education and Skills Development Authority (TESDA) and the Department of Social Welfare and Development (DSWD). The following organizational chart depicts the institutional framework for implementing the RAP.



Source: JICA Survey Team

Figure 9.2 Organizational Chart of RAP Implementation

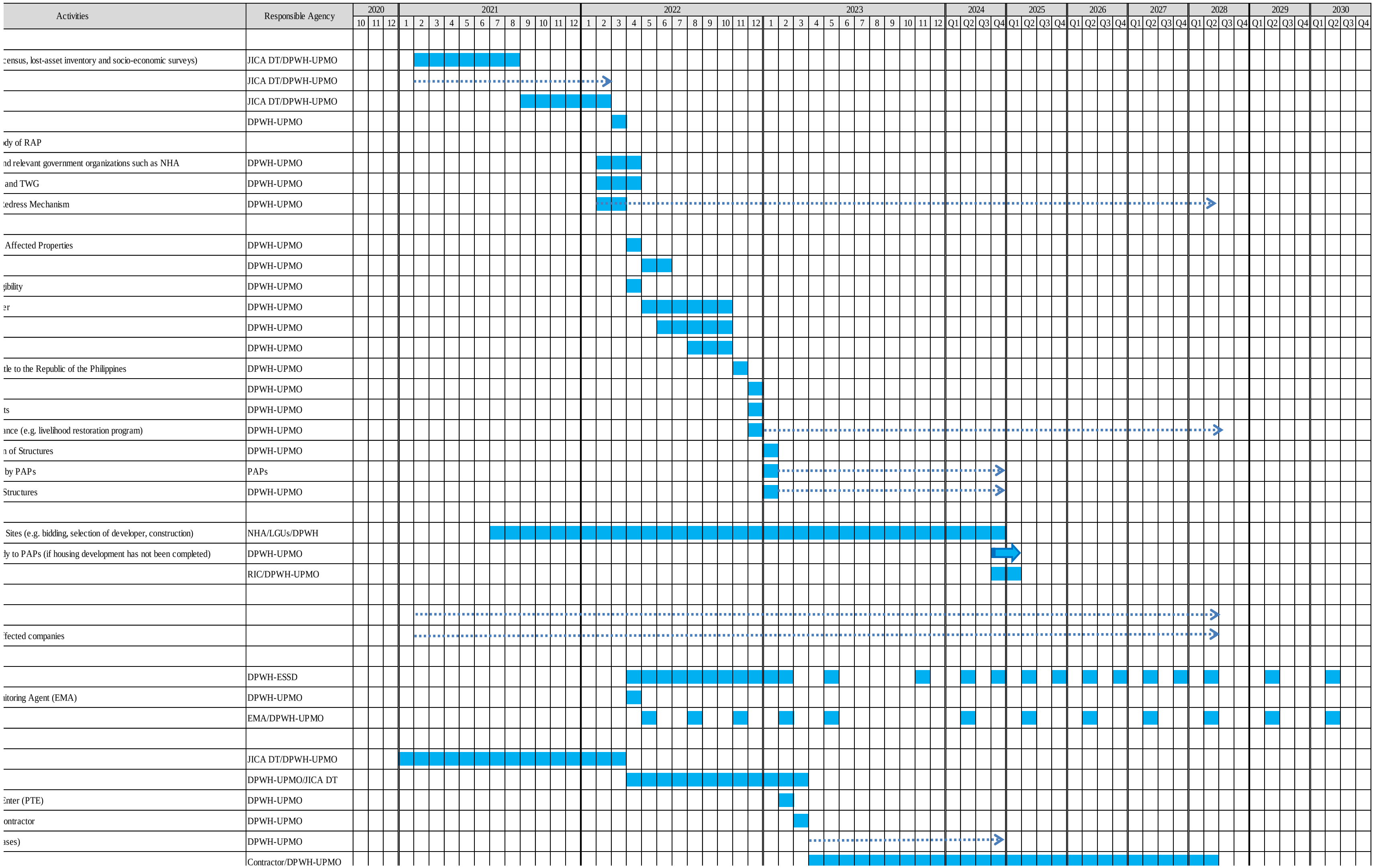
(7) Monitoring and Evaluation

DPWH undertakes monitoring on RAP implementation through internal monitoring, which is conducted by the Environmental and Social Safeguard Division (ESSD) of DPWH as well as through external monitoring, which is carried out by either a qualified individual or a consulting firm to ensure neutrality in its monitoring. The evaluation and in-house monitoring of RAP implementation will be conducted by ESSD and will serve as the internal monitoring agent supported by the consultants. UPMO will commission an external monitoring agent to undertake independent monitoring and evaluation. External monitoring and evaluation will entail random observations/visits and consultations with the PAPs at their current pre-project residence and their relocation site.

(8) Schedule for Implementation

The schedule for implementing the RAP is presented in Table 9.8.

Table 9.8 Implementation Schedule of RAP



Source: JICA Survey Team

(9) Cost and Budget

The total cost for implementation of land acquisition and resettlement is estimated to be approximately PhP 14.26 billion, which covers the costs for compensating affected structures/assets and land/property, that for developing the resettlement site, the cost for implementing the livelihood restoration program, resettlement and assistance for vulnerable groups, and the cost for monitoring.

Table 9.9 Total Cost for Implementation of the RAP

No.	Items	Amount (PhP)	Remarks
1	Compensation Cost for Land	10,471,708,050	
2	Compensation Cost for HH Structures	9,088,660	
3	Compensation Cost for Other Structures	1,776,270,960	
4	Compensation Cost for Trees	99,510	
5	Compensation Cost for Assets	49,350,690	
6	Cost for Development of Resettlement Site	66,162,800	
7	Cost for Implementing LRP	-	
8	Cost for Resettlement and Assistance to Vulnerable Groups	1,820,000	
9	Cost for Monitoring	25,000,000	
Sub-total		**12,399,500,670**	
10	Administrative Cost and Contingency	1,859,925101	15%
TOTAL		**14,259,425,771**	

Source: JICA Survey Team

(10) Public Consultation

In addition to the public scoping, public hearing and focus group discussions which are described under the chapter on EIA, a series of group consultations were held with both individual households and other entities affected by the project as summarized in Table 9.10 below. While voices of disagreement were heard from some companies at the beginning, consent was obtained towards the end of the consultation process to proceed with the project.

Table 9.10 Overview of Group Consultations with Project-affected Households and Entities

Date	Venue	Agenda	Participants	
			by Affiliation	by Sex
June 4, 2019	Barangay Paknaan Gym	First Consultation with PAHs (Mandaue City)	Local People: 21 DPWH-ESSD: 1 DPWH Region VII: 2 JICA ST: 4	Male: 9 Female: 19
June 6, 2019	Mandaue City Mayor's Office Conference Room	First Consultation with Project-affected Entities (Mandaue City)	Private: 16 DPWH Region VII: 4 LGU: 2 JICA ST: 6	Male: 20 Female: 8
June 11, 2019	Lapu-Lapu City Tourism Building	First Consultation with Project-affected Entities (Lapu-Lapu City)	Private: 10 DPWH Region VII: 3 LGU:1 PEZA: 3 JICA ST: 4	Male: 12 Female: 9
July 11, 2019	Mandaue City Social Welfare Services Conference Room	Second Consultation with Project-affected Entities (Mandaue City)	Local People: 4 Private: 20 DPWH-UPMO: 1 DPWH-ESSD: 1 DPWH Region VII: 4 LGU: 3 JICA ST: 8	Male: 29 Female: 12
July 11, 2019	Lapu-Lapu City ABC Building	Second Consultation with Project-affected Entities (Lapu-Lapu City)	Private: 12 DPWH-UPMO: 1 DPWH-ESSD: 1 DPWH Region VII: 5 LGU:1 PEZA: 5 JICA ST: 7	Male: 19 Female: 13
July 24, 2019	Paknaan Barangay Multi-Purpose Hall	Second Consultation with PAHs (Mandaue City)	Local People: 49 DPWH Region VII: 7 JICA ST: 5	Male: 29 Female: 32

Source: JICA Survey Team

10. PROJECT IMPLEMENTATION PLAN

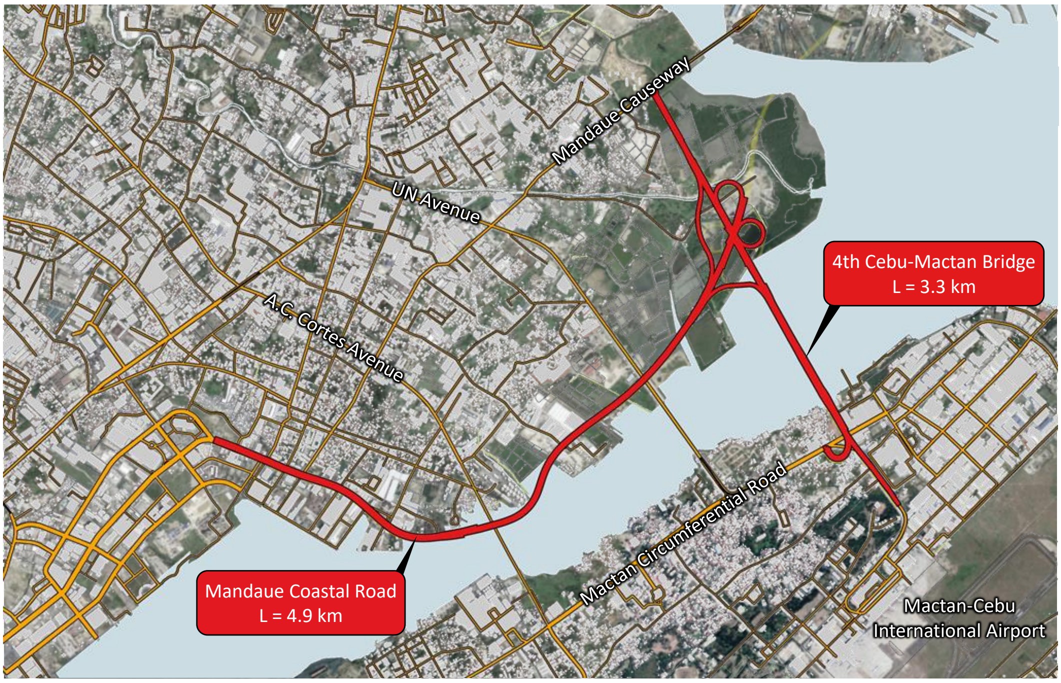
(1) Scope of the Project

The scope of the Project was determined based on the Preliminary Design as shown in Table 10.1 and Figure 10.1.

Table 10.1 Scope of the Project

	4th Cebu-Mactan Bridge	Mandaue Coastal Road
Total Road Length	3.3 km	4.9 km
Number of Lanes	4-lane	4-lane / 6-lane
Design Speed	60 km/h	80 km/h
Structural Type	Elevated viaduct (L=2,930m)	Elevated viaduct (L=4,751m)
PC-I Girder	L=315m	L=3,050m
PC Hollow Slab	L=1,755m	L=575m
Steel Box Girder w/ Composite Slab	L=790m	L=1,126m
Steel Box Girder w/ Orthotropic Steel Deck	L=525m	* * *

Source: JICA Survey Team



Source: JICA Survey Team

Figure 10.1 Scope of the Project

As described in earlier, the procurement of contractor for the Project will be split into four (4) contract packages. Procurement method for each contract package is summarized in Table 10.2. As the result of cost estimation based on the preliminary design, the ratio of goods and services from Japan is 44% by the entire project cost and Special Terms for Economic Partnership (STEP) Loan condition can be applied to the Project.

Table 10.2 Expected Contract Packages

Package No.	Package name	Procurement method (ICB/LCB, with/without PQ)	Applicable Standard Bidding Documents
Package-1	Construction - Civil works 4th Cebu-Mactan Bridge	ICB without PQ	JICA's Standard Bidding Documents (Works)
Package-2	Construction - Civil works Mandaue Coastal Road (STA 0+000-STA 2+177.647)	ICB without PQ	JICA's Standard Bidding Documents (Works)
Package-3	Construction - Civil works Mandaue Coastal Road (STA 2+177.647-STA 3+557.647)	ICB without PQ	JICA's Standard Bidding Documents (Works)
Package-4	Construction - Civil works Mandaue Coastal Road (STA 3+557.647-STA 4+890.000)	ICB without PQ	JICA's Standard Bidding Documents (Works)

Source: JICA Survey Team

(2) Implementation Schedule

The total duration of the Project is expected to be 105 months including 12 months of defects notification period. As shown in Figure 10.2, the civil works of the Project will be completed by June 2028.

	Start	End	Months	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Procurement of Consultant	2020/01/01	2020/12/31	12										
Consulting Services	2021/01/01	2029/09/30	105										
Detailed Design	2021/01/01	2022/03/31	15										
Procurement of Contractor	2022/01/01	2023/04/30	16										
Civil Works (Package 1)	2023/05/01	2026/10/31	42										
Civil Works (Package 2)	2025/01/01	2027/12/31	36										
Civil Works (Package 3)	2025/01/01	2028/06/30	42										
Civil Works (Package 4)	2025/01/01	2027/12/31	36										
Defects Notification Period (Package 1)	2026/11/01	2027/10/31	12										
Defects Notification Period (Package 2)	2028/01/01	2028/12/31	12										
Defects Notification Period (Package 3)	2028/07/01	2029/06/30	12										
Defects Notification Period (Package 4)	2028/01/01	2028/12/31	12										

Source: JICA Survey Team

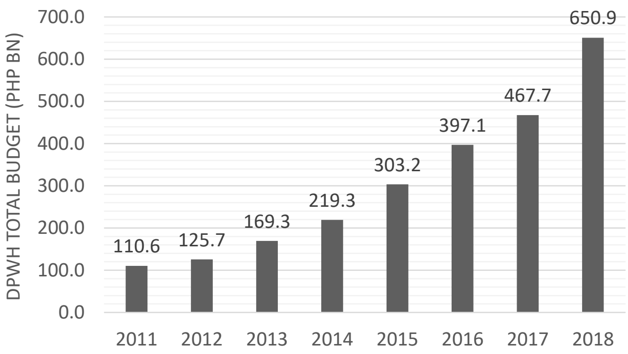
Figure 10.2 Expected Implementation Schedule of the Project

(3) Implementation Framework

The Project Road will be registered as a National Road and thus DPWH would be the executing agency from the design, construction and finally maintenance stages. Under Japanese ODA Loan Projects, a Unified Project Management Office (UPMO) - Roads Management Cluster I (Bilateral), formerly known as Project Management Office for Philippine Japan Highway Loan (PMO-PJHL), has managed implementation of many road and bridge construction projects for the several decades.

The technical level of DPWH is high and Regional Offices have established an organizational structure to design roads and bridges on their own. At the DPWH Head Office, the Bureau of Design is responsible for design review and establishment of design standards while the Bureau of Construction is responsible for construction supervision and review of construction costs and Bureau of Maintenance is in charge of routine maintenance. Regional Offices (RO) are responsible for operation and maintenance of the roads and District Engineering Offices (DEO) are in charge of routine maintenance under supervision of RO.

According to the latest DPWH's Strategic Infrastructure Programs and Policies (August 31st, 2018), the annual budget of DPWH has risen at an annual growth rate of approximately 30% and more funding has been allocated for infrastructure investments under the "Build Build Build" program of the Philippine Government. The Project implementation budget originates from the General Appropriations Act (GAA) and donor funds. Generally, the road development budget under GAA is requested by the Regional Offices from the Head Office of DPWH and thereafter allocated by Department of Budget and Management (DBM). The GAA operates on a single-year budget and the construction contract is also expected to be a one-year contract. Therefore, even for large-scale national road improvement projects, contractors are selected for different sections every year. It was noted that only registered national highways receive maintenance budgets therefore it is crucial that the Project Road is registered to ensure an adequate routine maintenance.



Source: DPWH Strategic Infrastructure Programs and Policies (2018)

Figure 10.3 Transition of Annual Budget for DPWH

The Cebu 6th District Engineering Office under the DPWH Region VII Office is mandated to manage the operation and maintenance works of 1st and 2nd Mactan Bridges and will do the same for the Project Road. After completion of the 4th Cebu-Mactan Bridge, the engineering office will need to increase on its operation and maintenance capacity to manage the three bridges across Mactan Channel.

DPWH Engineering Offices have carried out periodic inspection based on the Philippine Highway Maintenance Management Manual that was developed under JICA's Technical Cooperation Project. Advanced repair methods including reinforcing of slabs with carbon fiber was introduced. During the MCUTMP Study stage, it was observed that there was a lack of understanding for maintenance of steel bridges (e.g.: deterioration of critical components was overlooked, accumulation of sediment which leads to corrosion and, inadequate processing of surfaces before painting).

The JICA-assisted Project on the Study of Improvement of the Bridges through Large Scale Earthquakes Disaster Mitigating Measures (Dec 2013) inspected the 1st Cebu-Mactan Bridge and observed that its superstructure had seriously deteriorated.

The annual maintenance budget for operation and maintenance of roads and bridges has been increased 30% since 2013. Operation and maintenance cost is covered by GAA and Motor Vehicle Users Charge (MVUC) and it includes the budget for routine and periodic maintenance. The annual budget for maintenance cost and Equivalent Maintenance Kilometer (EMK) unit price has also risen.

(4) Operation and Maintenance Cost for the Project

In order to maintain the project road in good condition, the following maintenance activities should be carried out during the operation and maintenance stage:

- Inspection of the road: weekly

- Partial resurfacing of pavement: every year
- Full resurfacing of pavement: every 10 years
- Full resurfacing of bridge pavement: every 15 years
- Replacement of bridge expansion joints: every 15 years
- Replacement of waterproofing layer on bridge decks: every 30 years
- Repainting of steel bridge coating: every 30 years

The operation and maintenance cost for the Project was roughly estimated as shown in Table 10.3.

Table 10.3 Required Budget for Operation and Maintenance of the Project Road

	Estimation of Required Cost	Estimated Cost
Routine Maintenance	0.1% of Construction Cost	CONFIDENTIAL
Periodic Maintenance (every 5 years)	1.0% of Construction Cost	
Periodic Maintenance (every 15 years)	2.0% of Construction Cost	

Comparing the required budget for operation and maintenance of the Project and the actual performance of budget allocation to the district engineering office, there is a shortage of budget. However, the maintenance budget for whole nation is increasing and there would be a possibility to increase the allocation. For more details, is should be re-examined during the Detailed Design Stage.

Damages of bridge pavement and slab have been reported in the Philippines and DPWH is facing some difficulty on maintenance of large scale bridge such as the 2nd Cebu-Mactan Bridge. There would not be much experience in the Philippines on applying pavement on the orthotropic deck, technology transfer on operation and maintenance of steel girder bridge should be incorporated in the project implementation.

11. CONCLUSION AND RECOMMENDATIOSN

The following are the conclusion of the Survey:

- The component of the Project is comprised of the construction of 4th Cebu-Mactan Bridge (L = 3.3 km) and Mandaue Coastal Road (L = 4.9 km);
- The 4th Cebu-Mactan Bridge will start from Mandaue Causeway at approximately 80 m west side of the abutment of Cansaga Bay Bridge. The main bridge of the 4th Cebu-Mactan Bridge will be a steel box girder bridge with orthotropic deck with its main span of 215 m over the navigable waterway of Mactan Channel. The bridge will be directly connected with Airport Terminal Access Road and Mactan Circumferential Road by the separate interchange ramps;
- Mandaue Coastal Road will start from Mandaue Causeway at the corner of Mantawe Avenue in front of Bai Hotel. The alignment of the Coastal Road avoids the establishments in the industrial area in Barangays Centro and Looc as much as possible but some establishments along Mandaue Causeway need to be relocated. The Coastal Road will pass under the 1st Cebu-Mactan Bridge and pass over the 2nd and 4th Cebu-Mactan Bridges. This road will be extended into Consolacion and Liloan in future (not included in the scope of the Project under Japanese ODA Loan);
- The Mandaue Coastal Road will be connected with 1st Cebu-Mactan Bridge (Sergio Osmeña Bridge) via grade separated interchange but the construction of this interchange requires reconstruction of the 1st Cebu-Mactan Bridge. Therefore, construction of this interchange will not be included in the scope of works of the Project and it will be constructed in future;
- The Mandaue Coastal Road will not be connected with the 2nd Cebu-Mactan Bridge (Marcelo Fernan Bridge) because the bridge type of the 2nd bridge is extradosed bridge at the main span supported by cables and the vertical gradient of the approach bridge is steep at 5.5%;
- Interconnection between Mandaue Coastal Road and 4th Cebu-Mactan Bridge will be via a grade separated interchange (Mandaue Interchange). The designed type of the interchange is cloverleaf type because this type is the simplest interchange configuration and has advantage for phased construction where the half of the interchange will be constructed under the Project and the remaining half portion will be constructed in future when the Coastal Road will be extended to Consolacion.
- Because of the limited available space for ROW in highly urbanized area in Mandaue and Lapu-Lapu Cities, elevated viaduct type was applied to the most of the section of both 4th Cebu-Mactan Bridge and Mandaue Coastal Road. The Applied superstructure types are i) PC-I girder bridge, ii) PC hollow slab bridge, iii) steel box girder with composite slab bridge and iv) steel box girder with orthotropic steel deck depending on the requirement of span length and the site condition;
- Navigational clearance of Mactan Channel is 143 m in horizontal direction and 22.86 m in vertical direction above high water level (2.21 m MSL) in accordance with the instruction from Philippine Coast Guard;
- Aviation limit of Mactan-Cebu International Airport is 45 m above its runway elevation (6 m MSL) since the project site is located within the range of 4 km radius from the airport;
- The design traffic volume with its projection year in 2039 is 60,000 PCU/day and 24,000-104,000 PCU/day for 4th Cebu-Mactan Bridge and Mandaue Coastal Road respectively. The section from the beginning point to the interchange with 1st Cebu-Mactan Bridge (Sergio

Osmeña Bridge) of Mandaue Coastal Road has the highest traffic demand at 104,000 PCU/day and the traffic volume of the section from the interchange with 1st Cebu-Mactan Bridge to the interchange with 4th Cebu-Mactan Bridge of Mandaue Coastal Road will be 24,000 PCU/day. With this situation, the former section of Mandaue Coastal Road was designed with 6-lane (3-lane for each direction) and the latter section of Mandaue Coastal Road and 4th Cebu-Mactan Bridge were designed with 4-lane. However, the main bridge of the 4th Cebu-Mactan Bridge was designed with 6-lane due to the short distance (approximately 580 m) between two merging and diverging noses of Mandaue Interchange and Lapu-Lapu Interchange;

- Several mitigation measures for environmental considerations are proposed in the Project, for example, installation of 2 m height noise barrier on top of bridge railing and installation of bird-car collision prevention poles. During construction stage, use of silt fences and lower noise and vibration construction method will be adopted. In addition to such mitigation measures, development of a wetland park at the inside of the Mandaue Interchange is also proposed for betterment of the ecosystem at Cansaga Bay;
- The total area of project-affected land is calculated as 354,800 m^2 and number of the project-affected households and companies are 69 and 23 respectively. The total number of project-affected persons is 243;
- CONFIDENTIAL
- The estimated land acquisition cost including all compensations is PhP 14.26 billion (or JPY 30.09 billion);
- The economic internal rate of return (EIRR) of the Project was calculated as 10.9% based on the inflation rate of 3.5% per annum and Gross Domestic Product (GDP) per capta in 2014 and 2019. As the result of the sensitivity analysis, the EIRR of Project will be still over 10% in cases that the project cost will be increased 10% or the project benefit will be decreased at 10%. Therefore, the Project would have a certain viability for implementation; and
- A major challenge facing the project from a social environmental point of view is the lack of land that is readily available for the affected people and companies, a situation that has significant implications for the overall implementation schedule of the project. The project is expected to entail dislocation of some relatively large companies as well as resettlement of a number of ISFs. Qualified ISFs are entitled by the law in the Philippines to moving into a resettlement site yet no such site is readily available to date nor is there abundant available space in Mandaue City where development can be initiated. The companies, on the other hand, are operating in an economic zone yet there is no other unoccupied land that belongs to an economic zone. If these companies are provided with a land that is not part of the economic zone, they would lose some of the preferential treatments they are currently enjoying and hence would most likely be worse off compared to pre-project level. These constraints of land pose a major challenge in providing suitable places to live and do business for the ISFs and companies under the tightly set timeline between the detailed design and the construction of the project.

Based on the abovementioned conclusion, the following matters should be taken into consideration during the implementation stage:

(1) Highway Design

- Vertical clearance under the viaduct of Mandaue Coastal Road should be reviewed especially at the industrial area passing over the factories, oil pipelines and shipyards in close coordination with the project-affected companies.
- Location of Mandaue Interchange may need to be reviewed in close coordination with Mandaue City. The size of the interchange should also reviewed in consideration of the traffic safety and the design speed. Whereas the design speed of interchange ramps of Mandaue Interchange was determined as 50 km/h in this survey, it may be worth to reconsider to adopt 40 km/h from the viewpoint of cost reduction.
- Traffic safety at the consecutive intersections at Lapu-Lapu Interchange was confirmed in this survey by analyzing directional traffic flow during peak hour and the traffic capacities of the intersections. However it should be reexamined during the detailed design stage based on the final plan.

(2) Bridge Design

- The construction of 4th Cebu-Mactan Bridge is restricted by navigational clearance and aviation limit. These restrictions needs to be incorporated in the design especially on the construction method. In case some part of the restricted area needs to be occupied temporarily by construction works, close coordination with concerned agencies such as Philippine Coast Guard and Cebu Port Authority would be required in early stage of the construction works.
- The adopted design wind speed of 88m/s seems very high. Since wind resistance is critical to finalize the fundamental dimension and its system of 4th Cebu-Mactan Bridge, the wind stability should be examined at the early stage of detailed design. Furthermore, construction of a bridge structure having branch girders at side span of the 215 m main would be the first experience in the world. Three-dimensional wind tunnel test must be carried out.
- In case the construction of Mandaue Global City reclamation project would be overlapped with the Project, close coordination with the reclamation project would be required specifically on construction schedule and plan.
- Damages of bridge pavement and slab have been reported in the Philippines and DPWH is facing some difficulty on maintenance of large scale bridge such as the 2nd Cebu-Mactan Bridge. Since there would not be much experience in the Philippines on applying pavement on the orthotropic deck, technology transfer on operation and maintenance of steel girder bridge should be incorporated in the project implementation.
- Difficulty on construction of Lapu-Lapu Interchange is high because construction of the two-layered bridge structure shall be carried out over the existing road with high traffic volume and limited space beside shopping malls. The construction plan such as construction procedure and traffic management should be carefully considered in order to minimize the adverse impact for the activities outside of the construction site.

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CHAPTER 9 LAND ACQUISITION AND INVOLUNTARY RESETTLEMENT

LIST OF ABBREVIATIONS

A	AKPF	Abot-Kaya Pabahay Fund
B	BIR	Bureau of Internal Revenue
	BSP	The Bangko Sentral ng Pilipinas
C	CA	Commonwealth Act
	CENRO	City Environment & Natural Resources Office
	CFARMC	City Fishery Aquatic Resource Management Council
	CHB	Concrete Hollow Blocks
	CLOA	Certificates of Land Ownership Award
	CLUP	Comprehensive Land Use Plan
	CMP	Community Mortgage Program
	COD	Cut-off Date
D	DBM	Department of Budget and Management
	DENR	*Department of Environment and Natural Resources*
	DepEd	Department of Education
	DPWH	Department of Public Works and Highways
	DPWH CO	DPWH Central Office
	DPWH-ESSD	DPWH Environmental Social Safeguards Division
	DPWH RO	DPWH Regional Office
	DPWH-UPMO	DPWH Unified Project Management Office
	DRAM	DPWH Right-of-Way Acquisition Manual
	D/D	Detailed Design
	DOLE	Department of Labor and Employment
	DSWD	Department of Social Welfare and Development
	DTI	Department of Trade and Industry
E	ECC	Environmental Compliance Certificate
	EMA	External Monitoring Agent
	EMB	Environmental Management Bureau
	EO	Executive Order
	EP	Emancipation Patents
F	FGD	Focus Group Discussion
	FPIC	Free, Prior and Informed Consent
	F/S	Feasibility Study
G	GFI	Government Financial Institution
	GI	Galvanized Iron
	GIS	Geographic Information System
	GSIS	Government Service Insurance System
H	HLURB	The Housing and Land Use Regulatory Board
	HUDO	*Housing* and Urban Development Office
I	IMA	Internal Monitoring Agent
	IA	Implementing Agency
	IPA	Independent Property Appraiser
	IPRA	Indigenous Peoples' Right Act
	IRR	Implementing Rules and Regulations
J	JICA	Japan International Cooperation Agency
	JBIC	Japan Bank for International Cooperation
L	LARR	Land Acquisition, Resettlement and Rehabilitation
	LARRIPP	Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy
	LGU	Local Government Unit
	LHB	Local Housing Board
M	MCDCB	Metro Cebu Development and Coordinating Board

	MCUTMP	Project on Master Plan Study and Institutional Development on Urban Transport System in Metro Cebu
	MCWD	Metropolitan Cebu Water District
	MOA	Memorandum of Agreement
N	NCIP	National Commission on Indigenous Peoples
	NEDA	National Economic and Development Authority
	NGO	Non-Government Organization
	NHA	National Housing Authority
	NRIMP	National Road Improvement and Management Program
O	OCT	Original Certificate of Title
	ODAPA	Office of the Differently-Abled Persons Affairs
	OFW	Overseas Filipino Workers
P	PAF	Project-affected Family
	PAP	Project-affected Person
	PEZA	Philippine Economic Zone Area
	PD	Presidential Decree
	Php	Philippine Peso
	PWD	Persons with Disabilities
R	RA	Republic Act
	RAP	Resettlement Action Plan (*RAP is referred to as "Right-of-Way Action Plan" under the DPWH ROW Acquisition Manual (2017).)
	RIC	Resettlement Implementation Committee
	ROW	Right of Way
S	SHFC	Social Housing Finance Corporation
	SMED	Small and Medium Enterprise Development
T	TCT	Transfer Certificate of Title
	TESDA	Technical Education and Skills Development Authority
T	TOR	Terms of Reference
W	WB	World Bank

COMMENTS ON INTERIM REPORT

<table>
<tr><th>DPWH Comments</th><th>JICA Survey Team's Response</th></tr>
<tr><td>May 2, 2019 Bureau of Construction</td><td></td></tr>
<tr><td>1. In terms of construction, the consultant might consider identifying locations to be used as staging areas for equipment, materials, etc. during the construction phase, simultaneously during the preparatory survey considering that the proposed location is near urbanized areas (especially in the Mactan side).</td><td>The existing reclamation area near Cansaga Bay is the candidate of the construction camp yard. Transportation of equipment and materials can be done by large barge from the camp yard to the construction site..</td></tr>
<tr><td>2. In terms of cost estimates and evaluation, it was stated in Table 2.5 Evaluation of Possible Routes for Mandaue Coastal Road (page Executive Summary-11) that the reconstruction of the 1st Cebu-Mactan Bridge is a prerequisite prior to the implementation of this project hence, the cost of the said reconstruction should also be considered as part of the cost evaluation and the status of the said reconstruction project should also be included in the Draft Final Report.</td><td>"Reconstruction of 1st Bridge is prerequisite." means that
• Interconnection between Mandaue Coastal Road and the 1st Cebu-Mactan Bridge is required for maximizing the functionality of Mandaue Coastal Road (decongesting traffic in city center);
• But construction of the interchange between Mandaue Coastal Road and the 1st Cebu-Mactan Bridge is capable only with the reconstruction of the 1st Cebu-Mactan Bridge due to the bridge type and number of lanes of the bridge.
• However, reconstruction of the 1st Cebu-Mactan Bridge would require total closure of the bridge for several years and the traffic need to be diverted to the other bridges.
• Therefore, JICA Survey Team recommends to implement the reconstruction project after opening of the 4th Cebu-Mactan Bridge.</td></tr>
<tr><td>3. In terms of environmental impact, mitigation measures in order to minimize the impact of the project in the mangrove area where majority of the Mandaue Interchange construction will commence should be considered in the feasibility study following this preparatory survey.</td><td>JICA Survey Team has acknowledged that the mangrove forest and the wetland near the interchange should be conserved for maintaining the ecosystem in the area and feeding and roosting for migratory birds.
Therefore, the following mitigation measures have been considered:
• To construct all the road section by viaduct instead of constructing by embankment for maintaining the tidal condition at the area;
• To improve the natural environmental condition inside of the interchange by balancing tree planting and wetland conservation.</td></tr>
<tr><td>4. It was observed that there are several typographical errors and incomplete sentences highlighted in yellow in paragraphs and captions, blank tables, and blank figures/photographs all throughout the document such as in pages 5-35, 5-50, 5-62, 5-63, Figures 5.2.14, 8.1.5, 8.1.23, and Tables 5.2.1, 5.2.15, 7.4.1, etc. Inasmuch as this is only a draft interim report it is still expected that the consultant thoroughly proofread the said document prior to submission to the concerned offices/officials.</td><td>Draft Final Report will be delivered after proofreading.</td></tr>
<tr><td>May 3, 2019 Bureau of Design (Bridge Division)
Bridge Aspect</td><td></td></tr>
<tr><td>1. Provide estimated cost per lineal meter for all recommended bridge types.</td><td>Estimated cost per liner meter for all bridge type (Superstructure cost) is as follows;
<table><tr><th></th><th>PHP thousand</th></tr><tr><td>4th Cebu-Mactan Bridge</td><td></td></tr><tr><td>• Steel box girder bridge (main)</td><td rowspan="6">CONFIDENTIA L</td></tr><tr><td>• Steel box girder bridge (approach)</td></tr><tr><td>Mandaue Coastal Road</td></tr><tr><td>• PC-I girder bridge</td></tr><tr><td>• PC hollow slab bridge</td></tr><tr><td>• Steel box girder bridge</td></tr></table></td></tr>
<tr><td>2. Consider the following in the selection of bridge types:
• Pre-stressed concrete box girder or hollow core slab bridges for the North Approach Bridge (land section)
• Similar bridge superstructure for the North and South</td><td>• PC Hollow Slab was applied to the North and South Approach Bridge (land section).
• Continuous steel box girder was applied to the North and South Approach Bridge (within Mactan Channel).</td></tr>
</table>

Approach Bridges • Continuous steel box girder for the long spans of the Coastal Road Bridge	
3. Verify wind speed adapted for the design of the Cebu-Cordova Link Expressway.	JICA Survey Team requested CCLEX to provide the design condition but they refused to disclose such information.
4. Other comments are indicated in ink on draft interim report.	
May 6, 2019 Bureau of Design (Highway Division) Highway Aspect	
1. Submit the traffic impact analysis, forecast and management to the Bureau of Quality and Safety of this Department, for further study/evaluation of the proposed signalization at Lapu-Lapu Airport Road/M.L. Quezon National Highway Intersection, At-grade intersection of Mandaue Causeway-Mandaue Coastal Road, At-grade intersection of 4th Cebu-Mactan Bridge and Mandaue Causeway, Mandaue Interchange and Coastal Road-Osmeña Bridge (1st Cebu-Mactan Bridge) connection, among others, and the overall performance of the road network within the area of influence of the proposed project.	Comply with the comment.
2. Verify the following: • Minimum distance requirement between intersections on M. L. Quezon National Highway/ Lapu-Lapu Airport Road Intersection area. • Requirement of access for vehicles from Lapu-Lapu City thru 1st Cebu-Mactan Bridge to Mandaue Coastal Road.	Considering that the designed distance of two consecutive intersection (between two stop lines) is 120 m but there would be not much weaving maneuver within the short section, traffic safety can be ensured. However, it is also possible to cancel providing left-turning lane for entering into the loop ramp of Lapu-Lapu Interchange.
3. Provide blow-up details of all intersections and interchanges layout.	Drawings are attached in the appendix.
4. Include provision of drainage facilities especially on sections prone to flooding.	Comply with the comment but it will be examined in the Detailed Engineering Design.
5. Indicate the pavement and shoulder cross slopes.	2% is applied for both carriageway and shoulder cross slope.

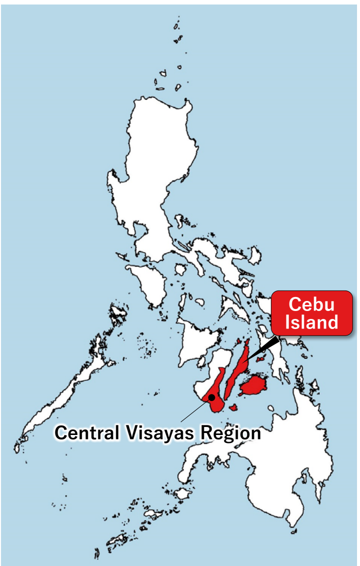
1. INTRODUCTION

1.1 Background

(1) General

In the Republic of the Philippines (hereinafter referred as “the Philippines”), the population has rapidly increased in recent years yet the infrastructure development such as road and public transport has lagged behind. This has led to serious traffic congestion in urban areas and economic loss. The sluggish infrastructure development is thus a significant bottleneck for further economic development of the Philippines.

The Project Area, Metro Cebu, belongs to the Central Visayas Region, on one of the Visayan Islands located in central Philippines and consists of 13 local governments including Cebu City. Metro Cebu is the second largest metropolitan area after Metro Manila with a population of 2.85 million in 2015. Numerous domestic and international companies are clustered in the area as a base of trade in central Philippines. Cebu Island is also a popular tourist destination in the Philippines. Out of the 4.86 million foreign tourists nationwide, Cebu Island accounted for 1.15 million.



Central Visayas

Metro Cebu

Source: JICA Survey Team

Figure 1.1.1 Project Location Map

The population of Metro Cebu increased at an annual average growth rate of 2.2% between 2010 and 2015 and is projected to reach around 3.8 million people in 2030. Road traffic congestion is expected to be more serious due to such rapid urbanization and population increase. Cebu Island, where houses, companies and population are concentrated, and Mactan Island, where Mactan-Cebu International Airport and industrial areas (Mactan Export Processing Zones) are located, are connected by two bridges, namely: 1st and 2nd Cebu-Mactan Bridges (or officially called as Sergio Osmeña Bridge and Marcelo Fernan Bridge). The traffic congestion at these bridges is getting worse every year due to traffic demand increase that exceeds traffic capacity of the bridges. This is considered to be a major obstacle to the future development of Metro Cebu. According to “The Roadmap Study for Sustainable Urban Development in Metro Cebu” conducted by JICA from 2014 to 2015 (hereinafter referred to as “Roadmap Study”), economic loss due to traffic congestion in Metro Cebu is estimated to be 394 million Philippines Peso per day.

Under these circumstances, Philippine Government regards infrastructure development in urban and local areas as one of the top priority issues in “*Philippines Development Plan 2017-2022*” for sustainable economic growth and improvement of quality of life, with particular focus on the development of the Metro Cebu as the metropolitan area next to Metro Manila. According to “*Regional Development Plan 2017-2022*” in Central Visayas, reduction of traffic congestion is considered as a top priority issue with the New Mactan Bridge Construction Project which consists of the construction of a new bridge linking Cebu Island and Mactan Island as well as construction of a coastal road connecting to the bridge (hereinafter referred to as “the Project”) listed in the priority projects. The early implementation of the Project was recommended by the Roadmap Study and “*Project on Master Plan Study and Institutional Development on Urban Transport System in Metro Cebu (MCUTMP)*”. The feasibility of implementation of the Project was discussed in the Meeting of the Japan-Philippines Joint Committee on Infrastructure Development held in February, 2018. In June, 2018, the Department of Public Works and Highways of the Philippines (DPWH) issued a request for the feasibility study to be undertaken.

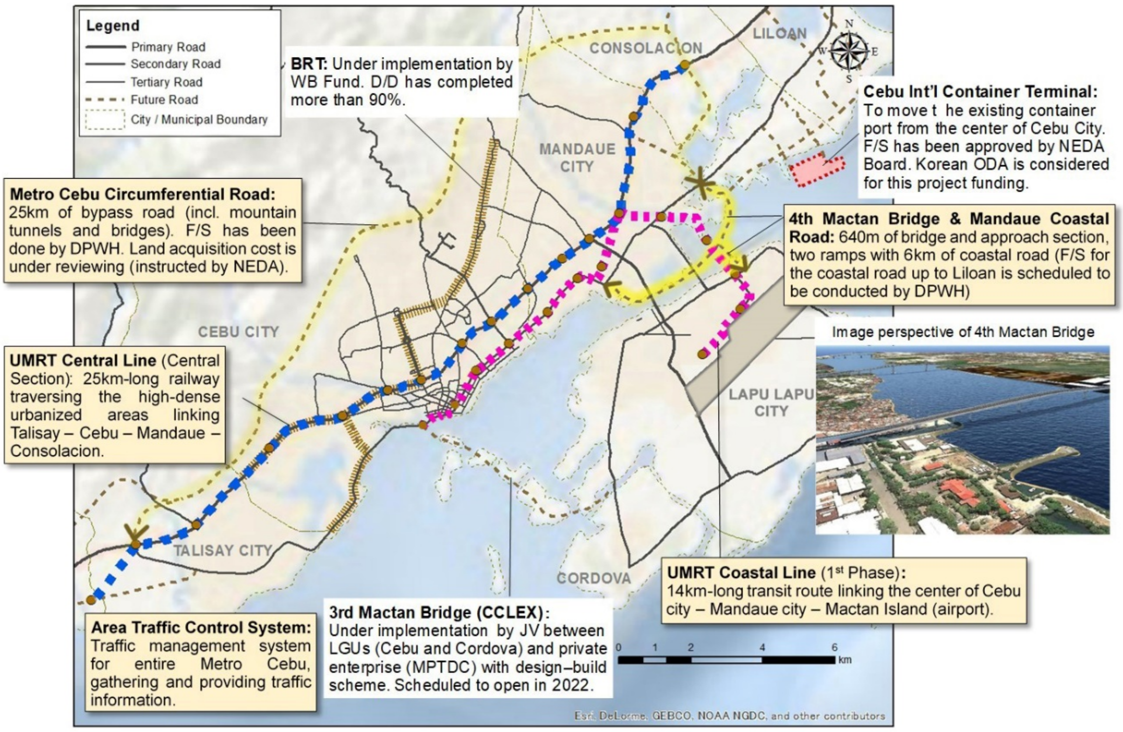
(2) Socio-economic Situation in the Project Area

The economy in Central Visayas Region, where the Project area is located, shows growth trend in all the industrial sectors; with the growth rate higher than the national average. In particular, the secondary industry grew drastically from 2009 to 2012 at an annual rate of 14% which is more than double the national average. As a result, the contribution of secondary industry to the local economy was 36.6% in 2012. Furthermore, the vision for 2030 for the regional development plan of the area aims for the region to become the “core center leading national economic growth”. The rate of growth of employment in the region is higher than the national average. The employment in the tertiary, secondary and primary sectors grew respectively at rates of 4.2%, 0.7% and 2.7%. The total employment of primary and tertiary industries accounts for 85% of the regional employment.

The major target area for foreign direct investment is special economic zone promoted by Philippine Economic Zone Authority (PEZA). While there are 7 Export Processing Zones, 6 IT parks, 21 IT centers, 1 Agro-industry Economic Zone (AIEZ) and 3 Tourism Enterprise Zones (TEZ) in Cebu Island, all the special economic zones are fully occupied. Moreover, land reclamation plans to expand to Lapu-Lapu City and Cordova are currently being implemented. Therefore, it is highly necessary to develop transport infrastructure.

(3) Current Status and Issues for Road Network in the Project Area

In Mandaue City in Cebu Island and Lapu-Lapu City in Mactan Island, where the Project Area is located, the connectivity of road network has not been developed well. The urban area is concentrated in the limited plain area located along the coastal line. Due to this geographical restriction, the width of the roads in the area is narrow. This has led to chronic traffic congestion in the city center and very low average travel speed of about 10 km/h. As traffic volume between Mactan and Cebu Islands has increased, the chronic traffic congestion at 1st Cebu-Mactan Bridge (2 lanes) and 2nd Cebu-Mactan Bridge (4 lanes) which connect the two islands, has worsened. Therefore, the 3rd Cebu-Mactan Bridge (or called Cebu-Cordova Link Expressway: CCLEX) which is considered to serve the traffic generated from the south district of Cebu Island is currently being constructed at the Cordova side of Mactan Island as a public private partnership project. In MCUTMP, it is projected that the traffic demand in the area will continuously increase and the traffic volume between the two islands will reach around 250 thousands PCU/day by 2030. Even if the 3rd Cebu-Mactan Bridge is opened, the whole traffic capacity between the two islands will be 119 thousand PCU/day and is still insufficient. For this reason, MCUTMP proposes the construction of 4th Cebu-Mactan Bridge (New Mactan Bridge), the replacement of 1st Cebu-Mactan Bridge (for increasing number of traffic lanes) and the construction of railway connecting Cebu Island and Mactan Island (UMRT) as the priority projects.



Source: MCUTMP (JICA, 2019)

Figure 1.1.2 Proposed Future Road Network recommended by MCUTMP

1.2 Objective of the Survey

The objectives of the Survey is i) to conduct review of existing studies and objectives of the Project, ii) to examine outline of the Project, project cost, implementation schedule, construction plan, application of advanced technology (if required), project implementation organization, operation and maintenance system, environmental and social consideration etc., for implementation of the Cebu-Mactan Bridge and Coastal Road Construction Project (or formerly called as New Mactan Bridge Construction Project) as Japanese ODA Loan project.

The Project is expected to contribute to socio-economic development of Metro Cebu through improvement of transport capacity and efficiency, and reduction of traffic congestion by construction of bridge connecting Mandaue City in Cebu Island and Lapu-Lapu City in Mactan Island and coastal road connecting to the bridge.

Table 1.2.1 Study Outline and Objectives

Project Name	Preparatory Survey for New Mactan Bridge Construction Project in the Philippines
Project Outline	1) Construction of road bridge (New Mactan Bridge, total length around 2.7 km, 4 lanes road) 2) Construction of coastal road (Mandaue Coastal Road, total length around 4.8 km, 4 lanes road partly 6 lanes road)
Project Area	Metro Cebu, the Philippines
Executing Agency	Department of Public Works and Highways (DPWH)
Study Objective	To conduct review of existing study, objectives, outline, project cost, implementation schedule, construction plan, application of advanced technology, project implementation organization, operation and maintenance system, environmental and social consideration etc., for implementation of the New Mactan Bridge Construction as Japanese ODA Loan project.
Expected Effectiveness	The Project contributes to socio-economic development of Metro Cebu through improvement of transport capacity and efficiency, and reduction of traffic congestion by construction of bridge connecting Mandaue City in Cebu Island and Lapu-Lapu City in Mactan Island (2.7 km) and coastal road connecting to the bridge (4.6 km).

Source: JICA Survey Team

1.3 Survey Schedule

The Survey was commenced in December 2018 and the initial studies such as traffic demand forecast and route selection of the Project Road have been carried out. The results of the study were discussed with DPWH and relevant LGUs (Mandaue City, Lapu-Lapu City and MCDCB) and the final alignments of the Project Roads and the bridge type for the 4th Cebu-Mactan Bridge were determined by the Joint Coordinating Committee (JCC) held on March 13, 2019.

As the result of finalization of the road alignments of the Project, it has been identified that the expected number of the Project Affected Persons (PAPs) will be increased and the environmental category of the Project needs to be changed from Category B to Category A. Therefore, the contents of the Project including Environmental Impact Assessment (EIA) and Resettlement Action Plan (RAP) reports need to be reviewed by JICA's Environmental and Social Considerations (ESC) Advisory Committee. The first Advisory Committee was held on April 26th, 2019. The second Advisory Committee is expected to be held in the end of August 2019.

Draft Interim Report containing some part of the Preliminary Design was submitted to DPWH and was finalized on May 10, 2019. Comments and suggestions given from Bureau of Design, Bureau of Construction and Planning Services were incorporated into this Draft Final Report.

The Preliminary Design of the Project is in accordance with the requirements of Philippine Coast Guard and Civil Aviation Authority of the Philippines. Coordination with National Commission for Culture and Arts was also carried out in order to assure that the Project will not affect any cultural heritage in the Project site.

A series public hearing and individual public consultation meetings have been held at Mandaue City and Lapu-Lapu City since March 2019 and some minor adjustments for the alignment was made in close coordination with DPWH and LGUs. Basic consent for the final alignment and the scope of the Project were obtained from local people including Project-Affected Persons (PAPs) and affected business entities at the 2nd public hearing held on June 4, 2019.

Draft EIA report was submitted to DENR on July 3, 2019 and DENR's review committee was held on July 10, 2019. The second review committee was held on July 30, 2019 and all the requirements were complied with. Draft RAP report was submitted to DPWH-ESSD on July 16, 2019 and finalized on July 29, 2019. This Draft Final Report includes the outline of the Preliminary design including the preliminary cost estimates and the EIA and RAP reports.

After incorporating all the comments and recommendations from DPWH, relevant institutions of the Philippines, JICA and JICA's Advisory Committee, the Final Report will be finalized and submitted by the middle of November, 2019. The work schedule of the Survey is shown in Table 1.3.1.

Table 1.3.1 Survey Schedule

		2018	2019										
		Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Stage 1	1. Preparation of Inception Report, explanation and discussion on the report	▲											
	2. Review of project background, confirmation of project necessity and collection of related data												
	3. Site investigation and identification of technical issues												
	4. Traffic survey and future traffic demand forecast												
	5. Study on optimum routes for 4th Cebu-Mactan Bridge and Mandaue Coastal Road												
Stage 2	6. Natural condition survey												
	7. Study on optimum bridge types for 4th Cebu-Mactan Bridge and Mandaue Coastal Road												
	8. Preliminary Design												
	9. Construction Planning												
	10. Determination of project scope (civil works, consulting services and etc.)												
	11. Preparation of project implementation schedule												
	12. Confirmation of institutional framework of executing agency												
	13. Preparation of Environmental Impact Assessment (EIA)												
	14. Preparation of Resettlement Action Plan (RAP)												
	15. Consideration of Gender Mainstreaming												
	16. Preparation of Interim Report (ITR), explanation and discussion on the report						▲						
	17. Preliminary cost estimates												
	18. Identification of technical issues for project implementation												
	19. Economic Analysis												
Stage 3	20. Preparation of Draft Final Report (DFR) , explanation and discussion on the report								▲				
	21. Preparation of Final Report (FR)												▲

Note: works in Japan, works in the Philippines, ▲ submission of reports
Source: JICA Survey Team

2. EXAMINATION OF PROJECT SCOPE

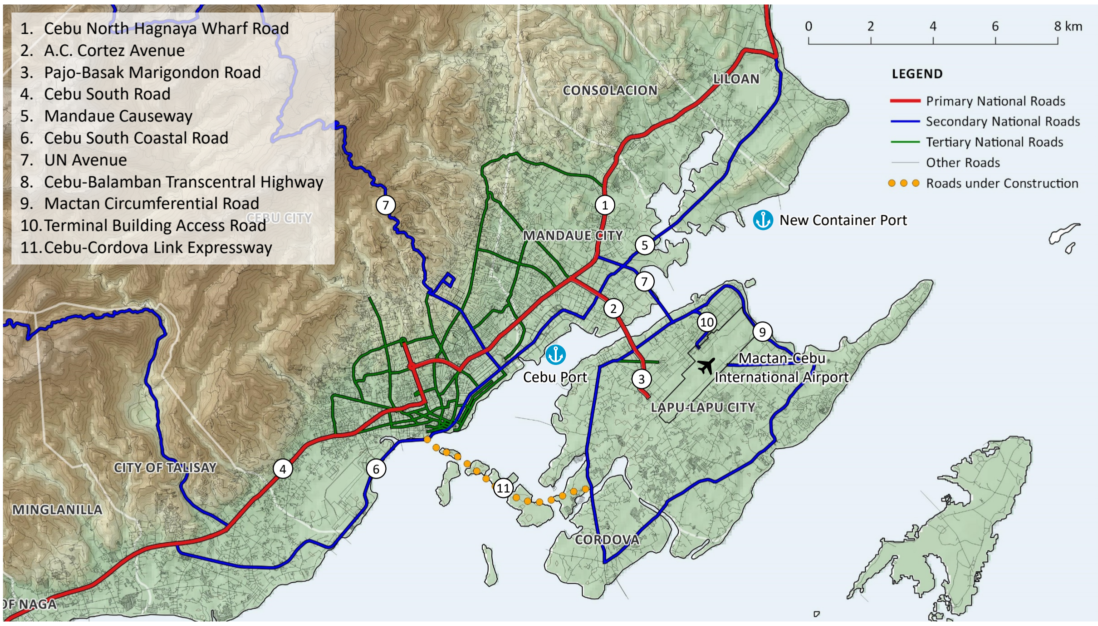
2.1 Current Road Network in Metro Cebu

(1) National Road Network

The main island of Cebu Province stretches 225 km from north to south and is surrounded by 167 neighboring smaller islands that includes Mactan Island. The terrain of the island is dominated by rugged mountain ranges that constraint urban expansion.

The urban core of Cebu Province is Metro Cebu, which is located along the central eastern portion of the province and includes the nearby Mactan Island. Cebu, Mandaue, and Lapu-Lapu Cities are highly urbanized central areas of Metro Cebu. On the Cebu Island side, urban development expanded from Cebu and Mandaue Cities towards LGUs along the coastal line up to Danao City in the north and Carcar City in the south. Lateral development also occurred from the main road significantly in Cebu and Mandaue Cities. With the construction of the First and Second Cebu–Mactan Bridges, the Lapu-Lapu City, Cordova, and Mactan-Cebu International Airport have been integrated with the Cebu Island of the province.

According to the final report of "Project for Master Plan Study and Institutional Development on Urban Transport System in Metro Cebu", the total length of the road network in Metro Cebu including the local roads (i.e. city, municipal, and barangay roads) is 1,398.2 km and the national roads account for 30% of the total network (Primary National Road: 121.0 km, Secondary National Road: 191.0 km and Tertiary National Road: 105.6 km). Most roads are generally narrow with two (2) lanes and a few of the roads are four (4) lanes in the urban core areas. Moreover, the traffic capacities of these roads are decreased by roadside and on-road activities such as jeepneys' or taxis' waiting for or loading/unloading passengers. 46% of roads are not paved, which are mostly barangay roads.



Source: JICA Survey Team

Figure 2.1.1 Current Road Network in Metro Cebu

(2) Road Links between Cebu and Mactan Islands

Sergio Osmeña Bridge (the First Cebu-Mactan Bridge)

The Sergio Osmeña Bridge (hereinafter called as the First Cebu-Mactan Bridge), is a truss bridge that connects Mandaue City with Lapu-Lapu City. This bridge has a total length of 854 m with a center span of 144 m providing navigational channel at approximately 113 m in horizontal direction and 22.35 m in vertical direction above 2.06 m of high water level. The width of the bridge is 10.8 m with two (2) lanes of traveled ways (one lane per direction) and sidewalks on both sides of the bridge. Construction of the bridge began in 1970 and was inaugurated on in July, 1973.

This bridge sits astride the northern end of the Mactan Channel, which is a gateway to the Cebu International Port (managed by the Cebu Port Authority) where about 80% of domestic and international shipping operators and shipbuilders in the Philippines are located. The bridge is accessed via A. C. Cortes Avenue on Mandaue City side and via the Basak–Marigondon Road on Lapu-Lapu City side.

In 1990, one vessel accidentally hit the bridge during Typhoon Ruping. The accident damaged the structure of the bridge that made it only passable by vehicles of less than 5 tons.

Source: JICA Survey Team

Figure 2.1.2 Sergio Osmeña Bridge

Marcelo Fernan Bridge (the Second Cebu-Mactan Bridge)

Marcelo Fernan Bridge (hereinafter called as the Second Cebu-Mactan Bridge) is an extradosed bridge. This bridge has a total length of 1,008 m with a center span of 185 m providing navigational channel at 112.78 m in horizontal direction and 22.86 m in vertical direction above 2.06 m of mean high water level. The width of the bridge is 21.0 m with four (4) lanes of traveled ways (two lanes per direction) and sidewalks on both sides of the bridge. Construction of the bridge began in 1996 and was inaugurated in August, 1999. This bridge was constructed with the assistance from the Japanese Government through Japan International Cooperation Agency (JICA).

On the Mactan Island side of the bridge, there is a park called the Millennium Park at the base of the bridge's piers, and the Filipino Seafarers Memorial is located in that park. The bridge is accessed via United Nations Avenue on Mandaue City side and via the Manuel L. Quezon National Highway on Lapu-Lapu City side. The Second Cebu-Mactan Bridge is located about 1.6 km north-east of the First Cebu-Mactan Bridge.

Source: JICA Survey Team

Figure 2.1.3 Marcelo Fernan Bridge

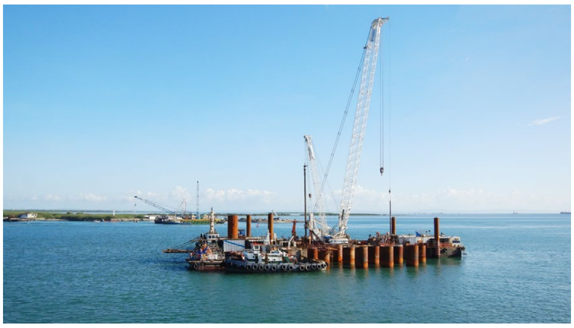
<u>Cebu-Cordova Link Expressway (CCLEX, the Third Cebu-Mactan Bridge)</u>

Cebu-Cordova Link Expressway (CCLEX), which is under construction by the Joint Venture of Metro Pacific Tollways Development Corporation (MPTDC), Cebu City and Municipality of Cordova under the build-operate-transfer (BOT) scheme, will be the third link between Cebu Island and Mactan Island. The official ground-breaking ceremony of the project was held in March 2017, while completion is scheduled in 2022.

The total length of the CCLEX will be 8.5 km (consisting of cable-stayed bridge, viaduct, causeway and short bridges) and the main span of the cable-stayed bridge, which will be located about 7.5 km south-west of the First Cebu-Mactan Bridge, is designed to be 390 m. The expressway will have four (4) lanes of traveled ways (two lanes per direction) and sidewalks on both sides of the bridge. The connection to Cebu City side will be via on-ramp and off-ramp along Cebu South Coastal Road and the connection to Municipality of Cordova will be at-grade intersection with Mactan Circumferential Road.

This project is not based on the BOT Law in the Philippines, but rather on a joint venture agreement between the private firm and LGUs. The concession period is 35 years with an option to extend to 50 years.

Perspective Image of CCLEX



Construction Site of CCLEX

Source: Cebu Cordova Link Expressway Corp., JICA Survey Team

Figure 2.1.4 Cebu-Cordova Link Expressway

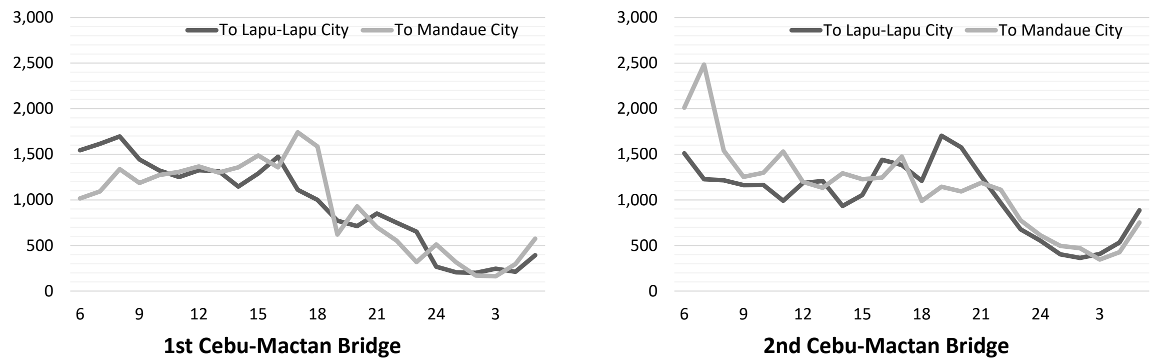
2.2 Current Road Traffic Situation

(1) Current Traffic Volume

The traffic situation in Metro Cebu has deteriorated in recent years. Traffic congestion occurs on many roads and intersections not only during peak hours, but also off-peak hours, due to i) increase of traffic demand (population growth, economic development and motorization), ii) insufficient road network and public transport services, and iii) inadequate traffic management.

Cordon Line and Screen Line Surveys were conducted by MCUTMP in 2017 in order to determine the trip volume and to calibrate the distributed traffic volume obtained from the household interview survey. The 24-hour directional traffic volume at the 1st and 2nd Cebu-Mactan Bridges were obtained by the Screen Line Survey and the daily traffic volume at the two bridges including bicycles and motorcycles were 56,518 vehicle/day (or 45,350 PCU/day) and 59,139 vehicle/day (or 52,099 PCU/day) respectively.

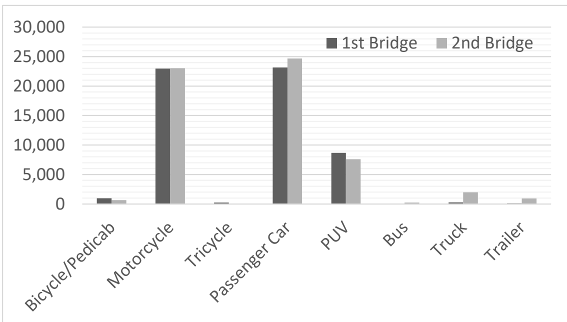
As shown in Figure 2.2.1, the traffic pattern of the two bridges were different. On 1st Cebu-Mactan Bridge, the traffic in direction from Mandaue City to Lapu-Lapu City is higher than that in direction from Lap-Lap City to Mandaue City during morning peak hours (from 6:00am to 8:00am) and the traffic in direction from Lap-Lap City to Mandaue City is higher than that in direction from Mandaue City to Lapu-Lapu City during evening peak hours (from 5:00pm to 6:00pm). On the other hand, the directional traffic pattern in morning and evening peak hours on 2nd Cebu-Mactan Bridge are opposite.



Source: Based on the data obtained by MCUTMP, edited by JICA Survey Team

Figure 2.2.1 Hourly Traffic Volume across Mactan Channel in 2017

Figure 2.2.2 shows the daily traffic volume across Mactan Channel by different vehicle types. Motorcycles (40%), Passenger Cars (41%) and Public Utility Vehicles (PUV, 14%) are the major vehicle types in the traffic.



Source: Based on the data obtained by MCUTMP, edited by JICA Survey Team

Figure 2.2.2 Daily Traffic Volume across Mactan Channel in 2017

According to the origin-destination (OD) table prepared by MCUTMP (see Table 2.2.1 and Table 2.2.2), the current traffic passing through 1st and 2nd Cebu-Mactan Bridges are graphically presented as shown in Figure 2.2.3. The majority of the traffic through 1st Cebu-Mactan Bridge was the trips from/to Cebu City or Mandaue City. The majority of the traffic through 2nd Cebu-Mactan Bridge was the trips from/to Mandaue City, Cebu City and Liloan.

1st Cebu-Mactan Bridge **2nd Cebu-Mactan Bridge**

Source: MCUTMP (JICA, 2019)

Figure 2.2.3 Trip Distribution

Table 2.2.1 OD Table across 1st Cebu-Mactan Bridge

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1 Danao City	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2 Compostela	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3 Liloan	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4 Consolacion	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5 Cordova	0.0	0.0	0.0	0.0	0.0	0.0	0.9	5.2	0.0	0.0	0.0	0.0	0.0	0.0	6.2
6 Lapu-Lapu City	0.0	0.1	0.1	0.0	0.0	0.0	7.0	9.3	0.8	0.0	1.7	0.0	0.0	0.4	19.4
7 Mandaue City	0.0	0.0	0.0	0.0	0.3	5.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3
8 Cebu City	0.0	0.0	0.0	0.0	4.3	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.0
9 City of Talisay	0.0	0.0	0.0	0.0	0.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4
10 Minglanilla	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11 City of Naga	0.0	0.0	0.0	0.0	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7
12 San Fernando	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13 City of Carcar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14 Others	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Total	0.0	0.1	0.1	0.0	5.3	14.4	8.0	14.5	0.8	0.0	1.7	0.0	0.0	0.4	45.3

Unit: Thousand trips/day
Source: MCUTMP (JICA, 2019)

Table 2.2.2 OD Table across 2nd Cebu-Mactan Bridge

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1 Danao City	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
2 Compostela	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
3 Liloan	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	2.1
4 Consolacion	0.0	0.0	0.0	0.0	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.4
5 Cordova	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
6 Lapu-Lapu City	0.1	0.1	6.4	2.2	0.0	0.0	8.0	5.6	0.2	0.1	0.1	0.0	0.0	1.4	24.4
7 Mandaue City	0.0	0.0	0.0	0.0	0.4	8.4	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	9.0
8 Cebu City	0.0	0.0	0.1	0.0	0.3	6.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.2
9 City of Talisay	0.0	0.0	0.0	0.0	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
10 Minglanilla	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11 City of Naga	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
12 San Fernando	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13 City of Carcar	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14 Others	0.0	0.0	0.0	0.0	0.0	1.6	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	1.7
Total	0.4	0.1	6.5	2.2	0.7	22.0	8.4	6.0	0.3	0.1	0.2	0.0	0.0	1.4	48.3

Unit: Thousand trips/day
Source: MCUTMP (JICA, 2019)

(2) Available Public Transportation

Land Transport

In the last 50 years, the backbone of public transportation in Metro Cebu and Cebu Province has always been the jeepneys, buses, taxis, and tricycles. The dominant mode of transport is jeepney that is technically registered as public utility vehicles (PUV). There are also the "trisikads" from areas where there is demand for public transportation, but are not registered as PUVs. Another service that later emerged is the motorcycle-for-hire or "habal-habal." Like the "trisikads", the service is illegal but thrive to cater to the mobility requirements of people outside the formal public transport service areas.

With the implementation of Republic Act No. 7160 (otherwise known as the Local Government Code of 1991), the control and regulation of tricycles was devolved to the LGUs. Cebu City is one of the few cities that have a local ordinance to control and regulate the operation of tricycles on barangay roads only. The operation of tricycles in other cities and municipalities of Metro Cebu (including Mandaue City and Lapu-Lapu City), on the other hand, are tolerated on all roads within the city or municipality itself.

Urban rail transit does not exist in Metro Cebu although this has been considered since 1990s. A Bus Rapid Transit (BRT) system is currently being implemented for Cebu City, but suffered some delays.

695 PUVs are operating on 38 routes in Mactan Island with more than 450,000 people. That is a ratio of 1 PUV for every 647 persons or nearly 20 PUVs per square km. In comparison, the ratio for Cebu City is approximately 10 PUV per square km. A higher number (~853 PUVs) operate between Mandaue and Mactan reflecting stronger economic integration with LGUs outside the island.

Buses play a minor role with only 16 routes and 135 authorized units. Most buses are southbound (i.e. serve towns as far as Carcar City). Only a few operate to the north; the number of buses is similar to cross-town bus service. However, these routes are still classified as provincial in the sense that they connect LGUs to Cebu City.

Water Transport

In the past, ferry services between Mactan and Cebu mainland thrived because of the absence of a bridge. When Osmeña Bridge (the First Cebu-Mactan Bridge) got built and later followed by the construction of Fernan Bridge (the Second Cebu-Mactan Bridge), the channel ferry services dwindled. Now, there is only the Metro Ferry Shipping with terminals in Muelle Osmeña Wharf in Lapu-Lapu City and Pier 3 in Cebu City.

Metro Ferry Shipping uses seven ferry boats of different sizes that operate from 6:00 am to 10:00 pm, although latter hours are reportedly irregular. Travel time is claimed to be 20 minutes, but waiting time at the terminal takes longer. Small boats can transport 112 passengers while big vessels can accommodate 312 passengers. The regular fare is PHP 14.00 for a one-way trip, PHP 12.00 for students and senior citizens, and PHP 8.00 for children. The company is surviving without any government subsidy.

(3) Traffic Control at Intersections

At some major intersections in Metro Cebu, traffic enforcers intervene in managing the traffic flow during peak hours even if the intersection has a working signal. The cycle length of the major intersections observed in the Roadmap Study in 2014 were within a range of 180 seconds to 420 seconds. The average is approximately 300 seconds, which seems to be too long. The optimum cycle length should be set less than 200 seconds and then this will make possible to introduce the functions of actuated signal control.

Some LGUs in Metro Cebu, including Cebu City, Mandaue City and Lapu-Lapu City, have their own traffic control center to manage their signalized intersections. The functions and issues in 3 cities are as follows:

Cebu City

The city's Traffic Control Center (TCC) controls all traffic signals at 70 intersections. The center was built in 1991 and operation started in 1993. The software being used is Sydney Coordinated Adaptive Traffic System (SCATS) last upgraded in 1999. Instead of closed-circuit television (CCTV), there are 649 detectors in the city with only 200 operational and old. Therefore, the optimum harmonized coordination function between and among signals is not achieved. The system has several fixed cycle lengths for each intersection and cycle time changes by time of day.

Mandaue City

The center controls all traffic signals at 21 intersections in Mandaue City that has been operational since 2013. The system has CCTVs at 17 intersections, detectors at 14 intersections, and can store images for a month. Each intersection has several fixed cycle lengths that change by time of day. The cycle length was set during the installation of the system and has not been changed since then.

Lapu-Lapu City

The city is installing signals at 10 intersections by the end of 2018. 3 intersections along National Highway, which is north side of Mactan Island, was already equipped with signals in 2017. After installation of signals, enforcers control the traffic flow like other intersections in Cebu City. Enforcers observes the traffic situation at the intersection and tell the operator in the control room through radio communication to change the signal through the console.

2.3 Related Development Plans

(1) Economic Zones

There are three (3) manufacturing special economic zones in Lapu-Lapu City. Mactan Export Processing Zones (MEPZ) 1 and 2 have 119 ha and 63 ha of lands respectively and these have been fully occupied by 158 and 54 companies. Cebu Light Industrial Park is relatively new economic zone with 63 ha of land and currently 35 companies are located but it is expected that this economic zone will be fully occupied within 5-6 years.

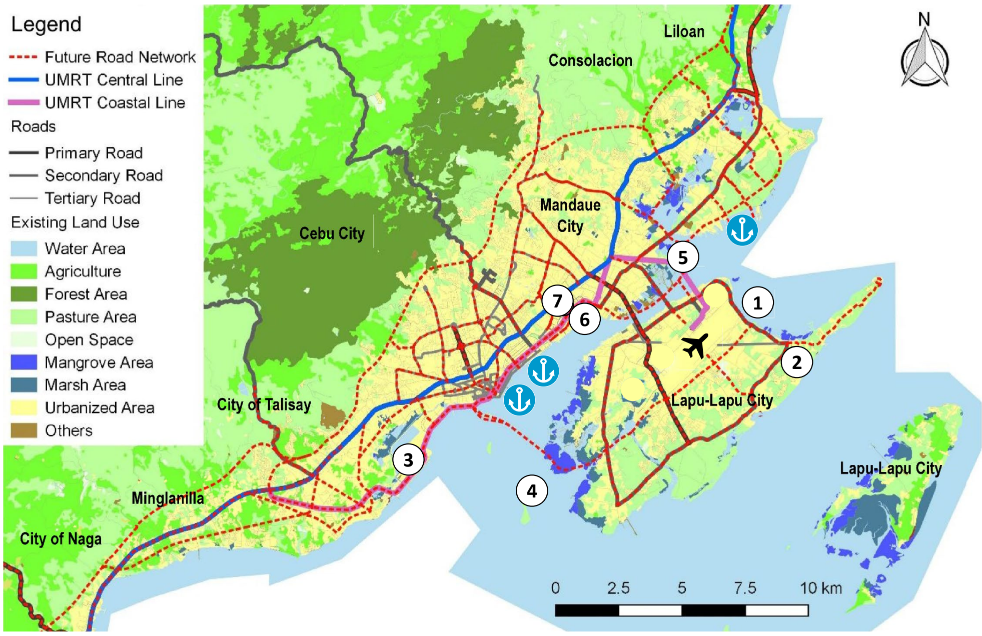
(2) Residential and Mixed Use Developments

According to MCUTMP, the major urban development projects that are expected to include more than 10,000 residents and/or employees concentrate on central Metro Cebu as shown in Table 2.3.1. Development of Mandaue Global City, which will be a 130 ha reclamation project, is planned within the vicinity of the Project site. The investor will be a private company and ownership of the land is Mandaue City. For finalization of the road alignment of the Project Road, coordination with the reclamation project may be necessary depending on the position of the alignment.

Table 2.3.1 Large Scale Urban Development Projects in Metro Cebu

No.	Name	Location	Area (ha)	Description	Completion Year
1	North Mactan Reclamation Development Project	Lapu-Lapu	400	Reclamation project to be implemented by JV consisting of Lapu-Lapu City and private companies.	Phase 1: 2021 Phase 2: 2030 Full completion: 2050
2	The Mactan Newtown	Lapu-Lapu	30	Mixed-use development by a private investor.	Phase 1: 2017 Full completion: 2021
3	South Road Properties (SRP)	Cebu	300	Reclamation project including private investors and PEZA's economic zone.	
4	Cordova Reclamation Project	Cordova	1,800	Mixed use development project (1,420 ha), port facility (80 ha) and three eco-tourism projects (300 ha).	To be determined
5	Mandaue Global City	Mandaue	130	Reclamation project for mixed use development (residential, commercial, office, industrial and tourism).	2030
6	Mandani Bay	Mandaue	20	Mixed-use development	Phase 1: 2021 Full completion: 2030
7	Gatewalk Central	Mandaue	18	Mixed-use development	Phase 1: 2019 Full completion: 2025

Source: MCUTMP (JICA, 2019)



Source: Based on MCUTMP (JICA, 2019), JICA Survey Team edited.

Figure 2.3.1 Large Scale Urban Development Projects in Metro Cebu

(3) New Container Port

Cebu is a historical port city where the port supports its local economy. Cebu International Port is the main domestic shipping port in the Philippines and home to about 80% of domestic and international shipping operators and shipbuilders. The Cebu Port Authority (CPA) manages both international and domestic ports. Due to its shallow depths, the average overseas ship size is severely restricted to 11,929 gross registered tonnage (GRT). Despite such capacity constraint, container traffic has steadily increased by 8.1% per annum since 2012. Along with the increase in logistics, traffic demand on the land side is also increasing.

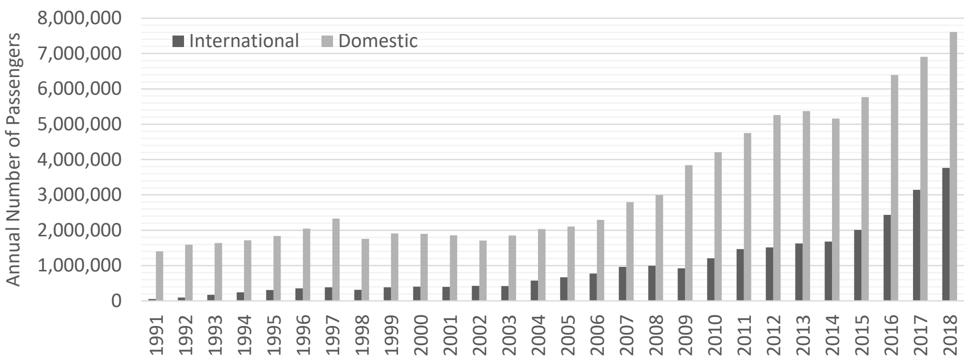
In order to meet the increasing international container movement and to decongest the existing Cebu International Port, development of a new international container port in the Municipality of Consolacion was approved by the national government of the Philippines. The new port is proposed to be on a 25 ha reclaimed island designed to handle 500,000 twenty-foot equivalent units (TEU).

Source: Cebu Port Authority

Figure 2.3.2 Container Traffic (TEUs) at Cebu Port

(4) Expansion Plan of Mactan-Cebu International Airport

The Mactan-Cebu International Airport (MCIA) located in Lapu-Lapu City is recognized as the southern air transport hub of the Philippines. The terminal, which was originally designed for 4.5 million passengers per annum, was renovated to handle 8 million as response to the rapid increase in passengers. An additional new international terminal opened in July, 2018 to accommodate a total of 12.5 million passengers per annum.



Source: Mactan-Cebu International Airport

Figure 2.3.3 Number of Passengers at Mactan-Cebu International Airport

Plans for the construction of a second runway has been discussed, but stands as an unsolicited proposal and has not been made official. The proposed location of the second runway is north east of the existing airport where Mactan Export Processing Zone 1 (MEPZ1) is located. This indicates that the proposed second runway may be constructed by demolishing many factories and warehouses are currently built in MEPZ1.

Source: Cebu Provincial Government

Figure 2.3.4 Proposed 2nd Runway in Mactan-Cebu International Airport

2.4 Road Network Development Plan

(1) Development Concept proposed by Master Plan (MCUTMP)

The basic policy direction is to achieve sustainable mobility in future as well as accessibility. Sustainable transport should prioritize pedestrian accessibility and mobility based on the consideration for inclusive and universal design. The policy is consistent with the transport policies of LGUs in Metro Cebu.

Majority of the current traffic issues stem from the road network includes the following:

- Congestion is primarily caused by weak road network, particularly limited construction of new roads. The drastically increasing number of vehicles cannot be accommodated;
- New roads are not adequately planed in accordance with the appropriate land use plan formulated under a long-term vision;
- Inefficient use of roads by the current public transport system that requires higher capacity;
- Many vehicles on the roads are inadequately maintained, particularly buses, jeepneys, and trucks. These vehicles contribute to the deterioration of air quality because of poorly controlled emissions; and
- In addition to the lack of infrastructure development, traffic management to utilize the existing infrastructure capacity to the maximum extent to mitigate traffic congestion is not sufficient.

In order to solve these issues, a series of studies, such as Metro Cebu Land Use and Transportation Study (MCLUTS), JICA's Roadmap Study and MCUTMP, has been conducted. MCUTMP proposed medium- and long-term road transport development plan in order to achieve the following targets:

- To reduce through traffic from northern to southern area of Metro Cebu;
- To increase road network capacity and travel speed would be increased at 10 km/h;
- To make an alternative route to prevent unnecessary intrusion to central Metro Cebu from northern and southern part of Metro Cebu;
- To provide safe, convenient, and comfortable access for pedestrians and bicyclists; and
- Smooth connection to and from Mactan Island through the bridges across Mactan Channel.

The basic concept of strategic urban road network plan in Metro Cebu is to establish an outer diversion road connecting to the coastal road at the central area of Metro Cebu that suffers from serious traffic congestion. It is expected that the proposed three roads, namely Metro Cebu Circumferential Road, Mandaue-Liloan Diversion Road and Mandaue Coastal Road, will form the proposed the outer diversion road. In addition to the new road construction, road widening and improvement of existing intersections are also proposed to mitigate traffic congestion.

(2) Priority Projects proposed by Master Plan

Table 2.4.1 summarizes the proposed medium-term to long-term road development projects in Metro Cebu. Out of these proposed projects, the following two road projects are evaluated as the high priority road projects by MCUTMP:

- 4th Cebu-Mactan Bridge with Mandaue Coastal Road
- Metro Cebu Circumferential Road

Therefore, undertaking of feasibility study on construction of the 4th Cebu-Mactan Bridge with Mandaue Coastal Road were requested from the Government of the Philippines through DPWH to the Government of Japan.

Table 2.4.1 Proposed Medium-Term to Long-Term Road Projects in Metro Cebu

	Medium-Term Plan Toward Year 2030	Long-Term Plan Toward Year 2050
Road Projects	• Metro Cebu Circumferential Road • Talisay-Naga Diversion Road • Mandaue-Liloan Diversion Road • Cebu Arterial Road Widening • Cebu Coastal Road Widening • Mactan Circumferential Road Widening • Metro Cebu Intersection Improvement	• Metro Cebu Coastal Road Expressway • Metro Cebu Circumferential Expressway
Bridge Projects	• Cebu-Cordova Link Expressway (on-going) • **Mandaue Coastal Road (viaduct)** • **4th Cebu-Mactan Bridge** • Replacement of 1st Cebu-Mactan Bridge	

Source: MCUTMP (JICA, 2019)

Source: MCUTMP (JICA, 2019)

Figure 2.4.1 Proposed Future Road Network in Metro Cebu

2.5 Route Selection of Project Roads

(1) Traffic Analysis by MCUTMP

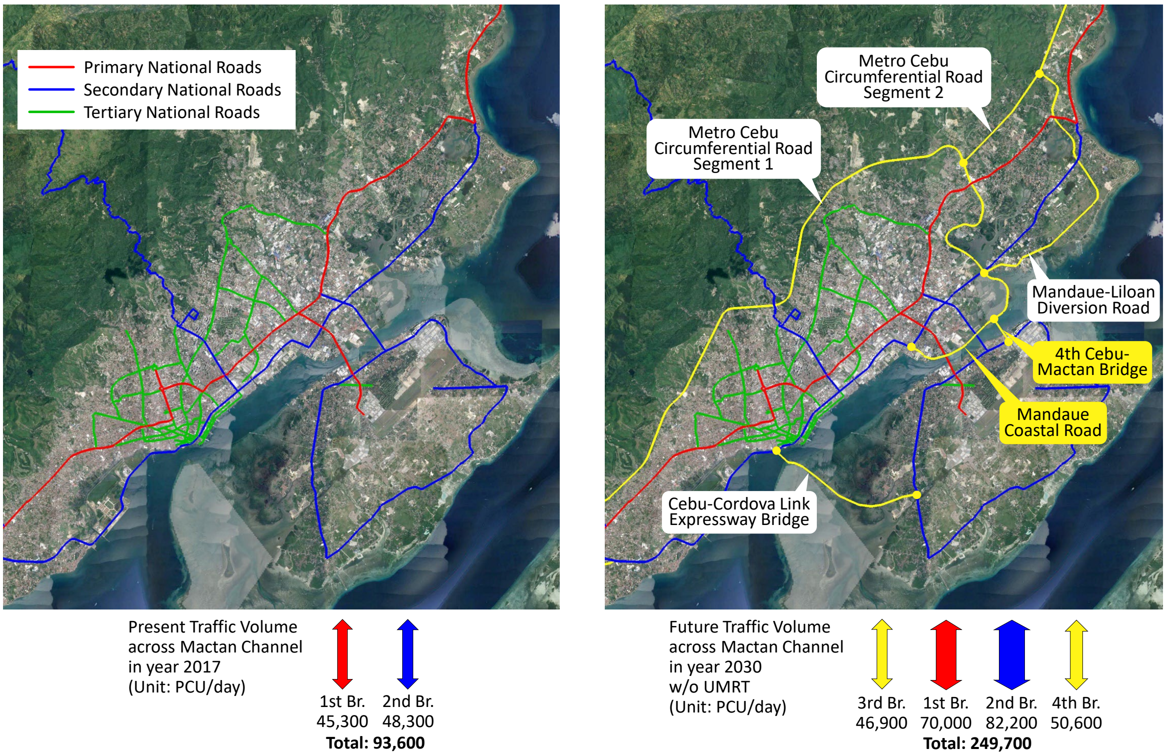
The future traffic volume across Mactan Channel in 2030 (without UMRT) estimated by MCUTMP was 249,700 PCU/day in total as shown in Table 2.5.1 and Figure 2.5.1. 2nd Cebu-Mactan Bridge will cater highest traffic demand (82,200 PCU/day) and 1st Cebu-Mactan Bridge will follow it (70,000 PCU/day). The estimated traffic volumes on 3rd and 4th Cebu-Mactan Bridges are almost the same (46,900 PCU/day and 50,600 PCU/day respectively). If the proposed UMRT would be constructed across Mactan Channel, the road traffic will be approximately 20% decreased.

The growth rate of the future traffic demand across Mactan Channel from 2017 to 2030 is calculated as 7.7% per annum. This growth rate is much higher than that of the total generated trip estimated in Metro Cebu (2.8%) because this traffic demand forecast considered all of the proposed and planned development plans to be located near the Project area shown in Table 2.3.1.

Table 2.5.1 Traffic Demand Forecast by MCUTMP

		Year 2017	Year 2030			Capacity of the Bridges
			Do Nothing (Baseline Scenario)	Implementation of 3rd and 4th Bridges w/ UMRT	Implementation of 3rd and 4th Bridges w/o UMRT	
Traffic Volume (PCU/day)	1st Bridge	45,300	96,500	66,500	70,000	17,000
	2nd Bridge	48,300	149,400	48,100	82,200	50,900
	3rd Bridge	-	-	39,200	46,900	50,900
	4rh Bridge	-	-	43,700	50,600	50,900
	Total	93,600	245,900	197,500	249,700	169,700

Source: MCUTMP (JICA, 2019)



Current Road Network **Proposed Road Network by 2030 (MCUTMP)**

Source: JICA Survey Team

Figure 2.5.1 Projected Traffic Volume across Mactan Channel

(2) Traffic Analysis on Interconnectivity with Mandaue Coastal Road

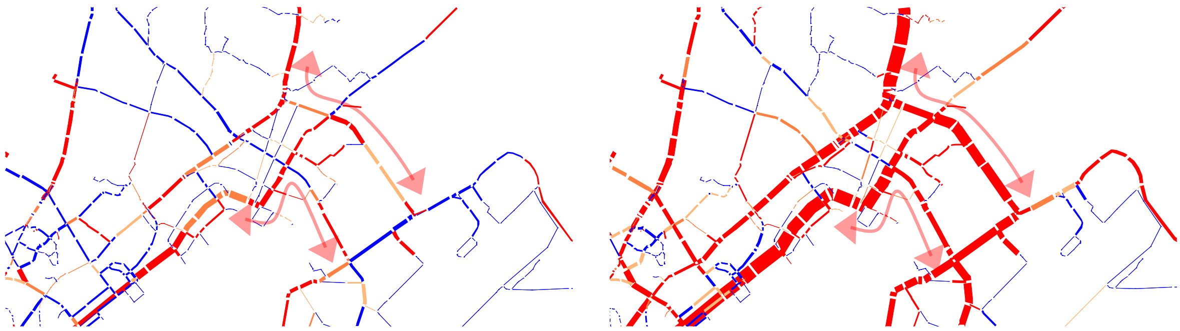
Traffic analysis by MCUTMP didn't consider any restriction of interconnectivity because of its study level but such detailed condition should be considered in the feasibility study stage. In order to analyze the traffic pattern at the vicinity of the Project site depending on the interconnectivity between Mandaue Coastal Road and Cebu-Mactan Bridges, traffic demand forecasts were carried out using the following six (6) road network cases:

Table 2.5.2 Different Road Network Cases for Traffic Demand Forecast

		Case 1	Case 2	Case 3	Case 4	Case 5	Case 6
Projection Year		2017	2030				
Road Network		Current Road Network		Proposed Road Network by 2030 (M/P)			
Interconnection with Mandaue Coastal Road	1st Bridge	N/A	N/A	✓	N/A	✓	N/A
	2nd Bridge	N/A	N/A	✓	✓	N/A	N/A
	4th Bridge	N/A	N/A	✓	✓	✓	✓

Source: JICA Survey Team

Figure 2.5.3 shows the result of traffic assignment for the road network conditions Case 1 and Case 2. From these results, it was found that 1st Cebu-Mactan Bridge mainly caters the traffic from/to Mandaue Coastal Road and Cebu South Coastal Road, and 2nd Cebu-Mactan Bridge mainly caters the traffic from Cebu North Hagnaya Warf Road. This result consists with the OD trip distribution shown in Figure 2.2.3.



Case 1 Case 2

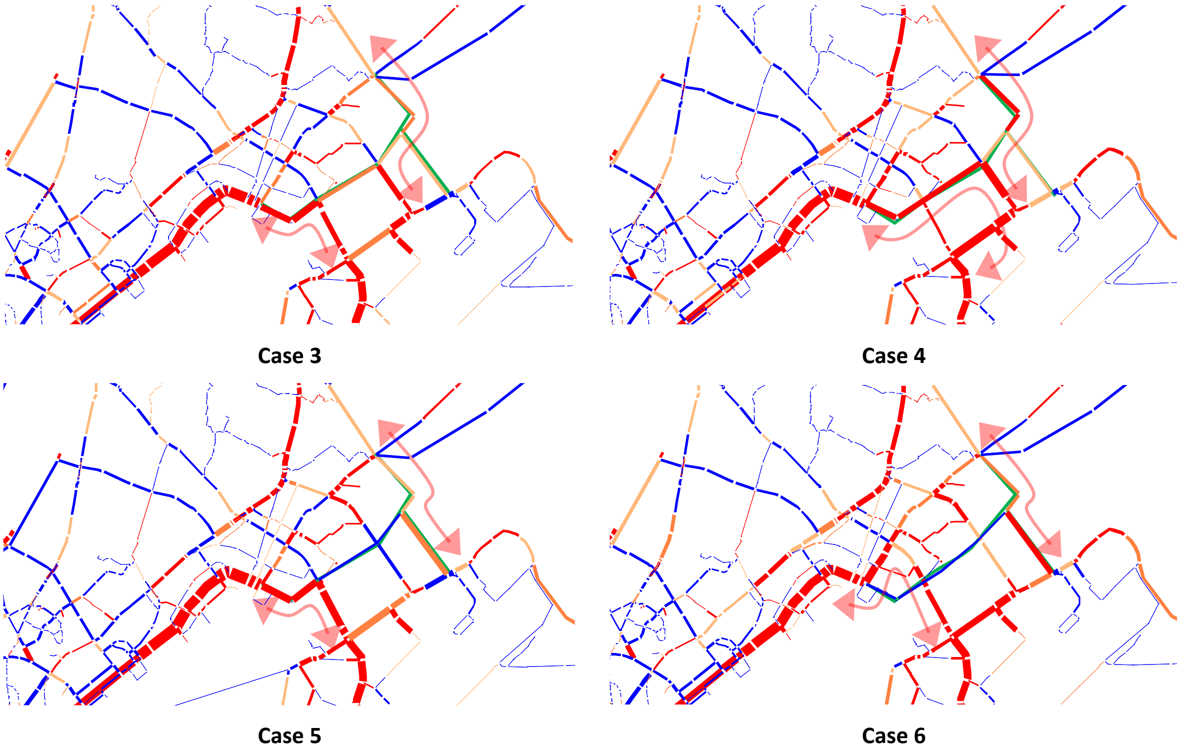
Note) :VCR < 1.00、 :VCR < 1.20、 :VCR < 1.50、 :1.50 < VCR

Source: JICA Survey Team

Figure 2.5.2 Result of Traffic Assignment for Different Road Network Cases (Case 1 and 2)

From the results of Case 3 to Case 6, the following findings were obtained:

- 1st Cebu-Mactan Bridge has the highest traffic demand among the three bridges. If Mandaue Coastal Road would be connected with the 1st Bridge, traffic will divert to the Coastal Road and the traffic congestion on the existing roads will be eased. But if not, traffic will still remain to use the existing roads and the effect of the Project will be limited. Therefore, Mandaue Coastal Road shall have the accessibility to 1st Cebu-Mactan Bridge in order to mitigate traffic congestion in the city center.
- Currently, 2nd Cebu-Mactan Bridges caters the traffic mainly from the north-east of the main land Cebu. After construction of Mandaue Coastal Road and Metro Cebu Circumferential Road, such traffic will divert to such proposed roads. Considering the majority of traffic demand in Lapu-Lapu City occurs in the west side of Lapu-Lapu City, limited traffic capacity of left turning into the 2nd Cebu-Mactan Bridge would become a traffic bottleneck. In order to provide smooth traffic condition in Lapu-Lapu City, such traffic should be divert to the 4th Cebu-Mactan Bridge.



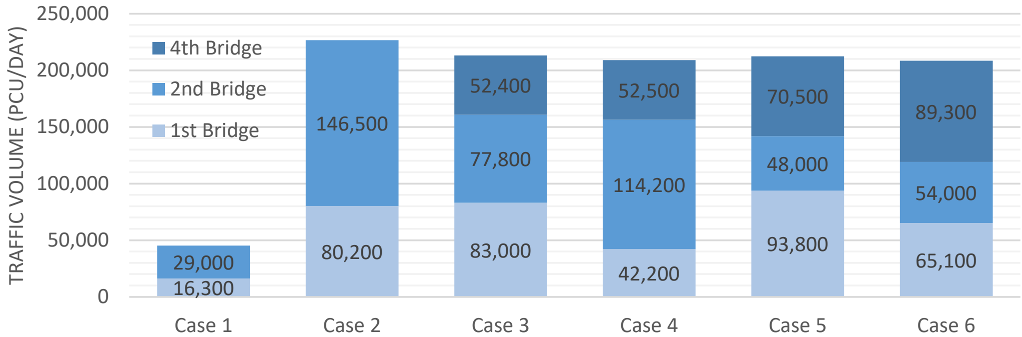
Note) :VCR < 1.00、 :VCR < 1.20、 :VCR < 1.50、 :1.50 < VCR

Source: JICA Survey Team

Figure 2.5.3 Result of Traffic Assignment for Different Road Network Cases (Case 3 to 6)

<u>Traffic Volume on Cebu-Mactan Bridges</u>

The estimated traffic volume on the 1st, 2nd and 4th Cebu-Mactan Bridge in year 2030 varies from 208 thousand to 227 thousand depending on the network condition (mainly on the interconnectivity between Mandaue Coastal Road and Cebu-Mactan Bridges). The balance of traffic in the Case 3 and Case 5 are good.



Source: JICA Survey Team

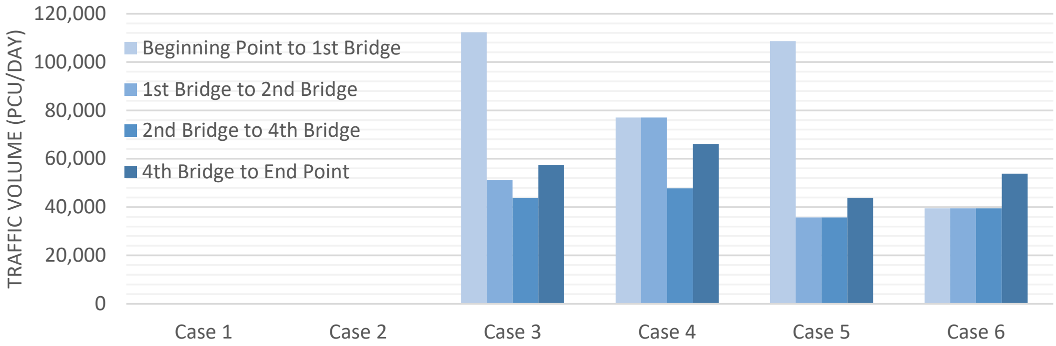
Figure 2.5.4 Estimated Traffic Volume on Cebu-Mactan Bridges (Year 2030)

<u>Traffic Volume on Mandaue Coastal Road</u>

Under the Case 3 and Case 5, the traffic volume at the section from the beginning point to 1st Bridge will be prominent. This implies that the majority of the traffic demand across Mactan Channel occurs mainly at the west side of Lapu-Lapu City.

Under the Case 4, the traffic volume of the Mandaue Coastal Road will be less than Case 1 or Case 5. This implies that some of the traffic will divert to 2nd Bridge and some of the traffic will still remain to use the existing roads.

Under the Case 6, the traffic volume of the Mandaue Coastal Road will be less than other cases due to no accessibility to the 1st and 2nd Cebu-Mactan Bridges. Therefore, the majority of the traffic across Mactan Channel will still remain to use the existing roads instead of diverting to the Mandaue Coastal Road.



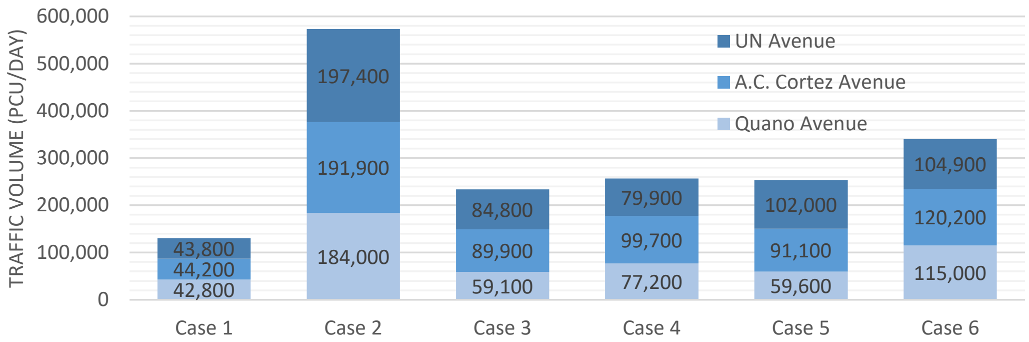
Source: JICA Survey Team

Figure 2.5.5 Estimated Traffic Volume on Mandaue Coastal Road

<u>Traffic Volume at Major Intersections on Mandaue Causeway</u>

Traffic volumes at the major intersections along Mandaue Causeway will be drastically decreased by the road improvements proposed by MCUTMP. Comparing to the Case 2, the reduction of traffic volume in case 3 to 6 are 59%, 55%, 56% and 41% respectively.

From this result, it is obvious that interconnectivity between Mandaue Coastal Road and Cebu-Mactan Bridges is important for decongesting traffic from the city center.



Source: JICA Survey Team

Figure 2.5.6 Estimated Traffic Volume at Major Intersections on Mandaue Causeway

Source: JICA Survey Team

Figure 2.5.7 Major Intersections on Mandaue Causeway

<u>Findings from the Traffic Analysis</u>

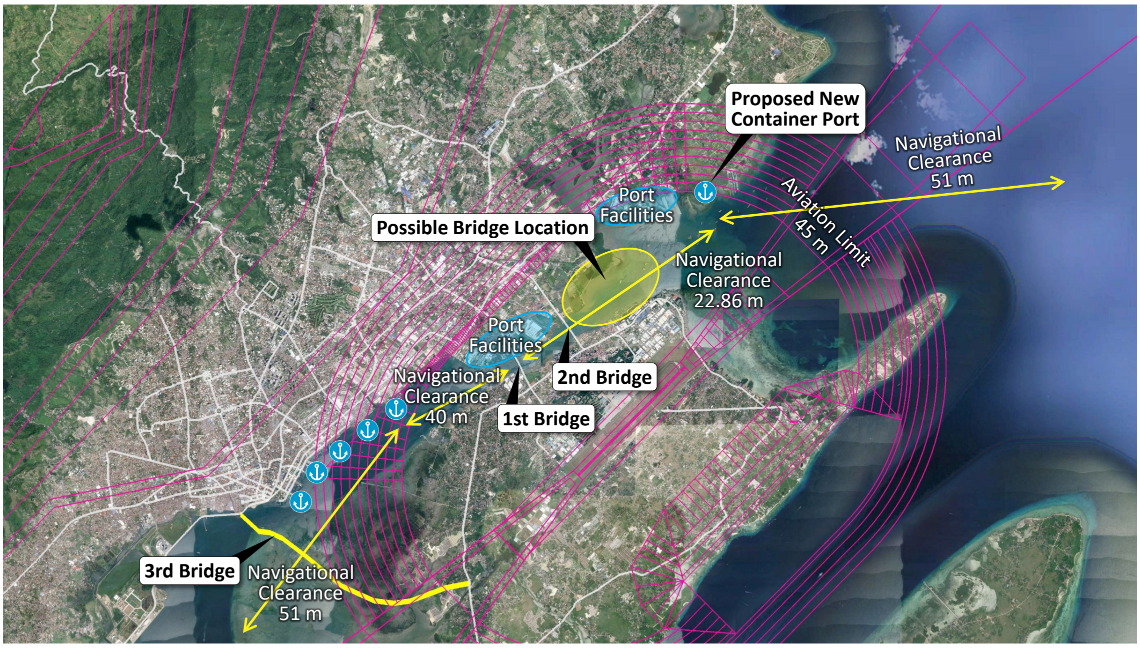
Based on the abovementioned traffic analysis, the following findings were obtained as the recommendations for road planning of the Project Road:

- Mandaue Coastal Road should be connected with 1st Cebu-Mactan Bridge in order to decongest the traffic on the roads in Mandaue City and Cebu City.
- Mandaue Coastal Road and the proposed Metro Cebu Circumferential Road should be seamlessly connected in order to decongest the traffic on the roads in Mandaue City and Consolacion.

(3) Route Selection of 4th Cebu-Mactan Bridge

The possible location for bridge construction of 4th Cebu-Mactan Bridge was determined only at the area east of the 2nd Cebu-Mactan Bridge because of the following reasons:

- The channel at the west side of the 1st Cebu-Mactan Bridge needs to maintain a navigational clearance of 40 m above sea level in order to allow bigger ships transportation. On the other hand, structures cannot be built any higher than 45 m from the runway level of Mactan-Cebu International Airport due to its aviation limit.
- The distance between the 1st and 2nd Cebu-Mactan Bridges is 1.4km but port facility is located within this area making it difficult to secure enough space for bridge construction.
- The 1st and 2nd Cebu-Mactan Bridges are expected to meet the traffic demand from the centers of Cebu City and Mandaue City while the 3rd Bridge is expected to meet that from the western side of Cebu Island. The 4th Cebu-Mactan Bridge is therefore expected to meet the demands from the eastern side of the Cebu Island.
- Although, there was a recommendation that 4th Cebu-Mactan Bridge should be constructed at the symmetric position against the 3rd Cebu-Mactan Bridge, the idea was rejected because of the aviation limit of Mactan-Cebu International Airport and the navigational clearance of new container port to be constructed in Consolacion.



Source: JICA Survey Team,

Figure 2.5.8 Possible Bridge Location

A vessel operated at the west side of 1st Cebu-Mactan Bridge (navigational clearance would be 40 m)

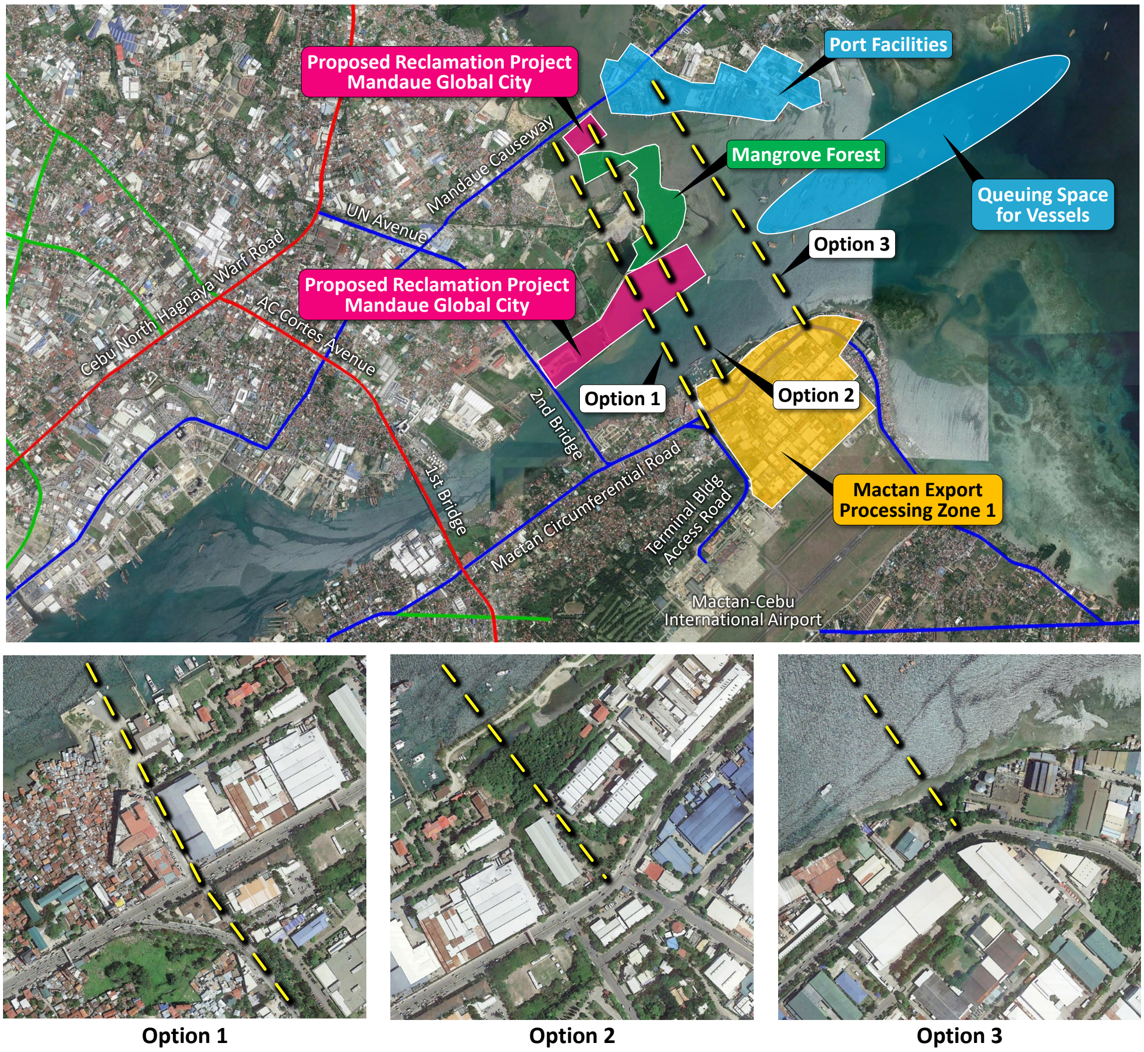
A vessel operated at the east side of 1st Cebu-Mactan Bridge (navigational clearance is 22.83 m)

Source: JICA Survey Team

Figure 2.5.9 Vessels operated in Mactan Channel

Based on the above conditions, the following three alternative options were analysed:

- Option 1: Connect with Mactan Circumferential Road and airport access road
- Option 2: Connect with Mactan Circumferential Road at the entrance of a economic zone
- Option 3: Connect with Mactan Circumferential Road at the east end of Mactan Island



Source: JICA Survey Team

Figure 2.5.10 Possible Bridge Locations

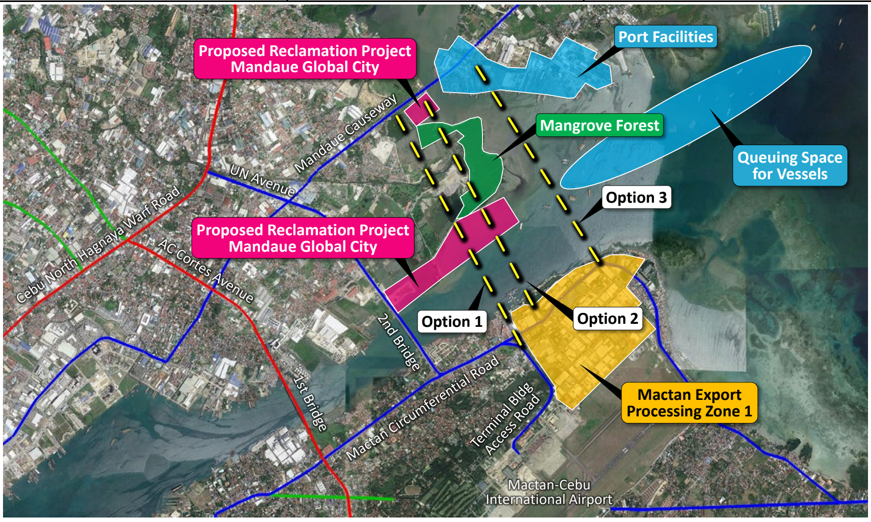
Option 1 is originally recommended by MCUTMP. This alignment can provide direct access between Mactan-Cebu International Airport and 4th Cebu-Mactan Bridge in Lapu-Lapu side. In Mandaue City side, this alignment will pass through the Mandaue City's reclamation project site called "called Mandaue Global City", which is included in the Comprehensive Land Use Plan (CLUP) of Mandaue City and private companies are expected to implement. Although Mandaue City is giving top priority to the construction of 4th Cebu-Mactan Bridge and Mandaue Coastal Road, it is necessary to coordinate with the reclamation project for this option. This alignment can avoid the mangrove forest at the mouth of Cansaga Bay.

Option 2 is an alternative alignment where social environmental impact in Lapu-Lapu City side would not be significant. This alignment does not have good connectivity to the road network in Lapu-Lapu City side because all the connecting roads to Mactan Circumferential Road are the private roads in Mactan Export Processing Zone. In Mandaue City side, this alignment will pass through the above mentioned reclamation project site and the mangrove forest.

Option 3 is another alternative alignment where social environmental impact in Lapu-Lapu City side would not be significant. Same as Option 2, this alignment does not have good connectivity to the road network in Lapu-Lapu City side because it will connect with Mactan Circumferential Road only. This alignment does not pass through both Mandaue City's reclamation site and mangrove forest but will cross both Mactan Channel and Cansaga Bay as well as the port facilities located in Consolacion.

Table 2.5.3 summarizes the comparision on the three alternative options. Option 1 was recommended as the optimum location for 4th Cebu-Mactan Bridge from the view points of good connectivity to the existing road newtork, less impact to the mangrove forest and economic zone and economic efficiency.

Table 2.5.3 Comparison of Bridge Location (4th Cebu-Mactan Bridge)

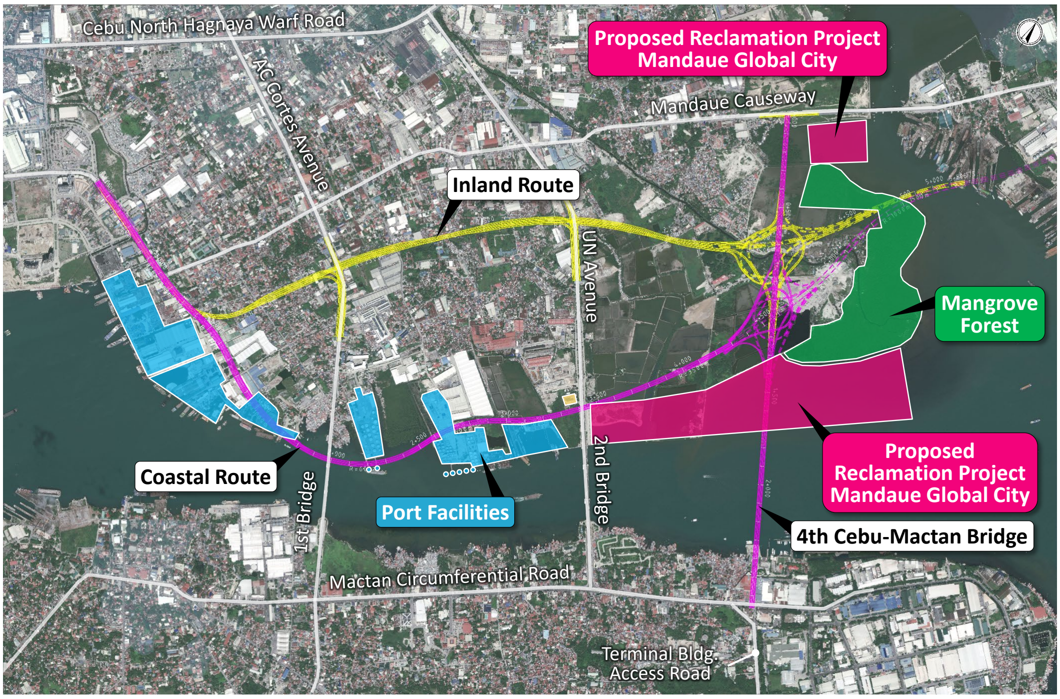
Evaluation Criteria		Option 1	Option 2	Option 3
Location Map				
Cebu Side	Affected Area of Mangrove Forest	Approx. 0.75 ha (300m × 25m)	Approx. 0.85 ha (350m × 25m)	None
	Affected Area of Tideland	Approx. 0.5 ha (200m × 25m)	Approx. 0.6 ha (250m × 25m)	None
	Affected Houses	Approx. 10 houses (50 PAPs)	Approx. 10 houses (50 PAPs)	Approx. 20 houses (100 PAPs)
	Reclamation Plan	Passes at one location	Passes at two locations	No interference
	Port Facilities	No interference	No interference	Interfere occurs
Mactan Side	Industrial Area	Few interference	Few interference	Few interference
	Number of Lanes of Mactan Circumferential Road	6	4	4
	Connecting Road	Secondary National Road	Economic zone	No road
Construction Cost		Low because the length built in the sea is shorter (land: 1.6 km; sea: 1.0 km)	low because the length built in the sea is shorter (land: 1.6 km; sea: 1.0 km)	high because the length built in the sea is longer (land: 0.6 km; sea: 2.0 km)
Overall Evaluation		Recommended • construction cost is low • some level of negative impact on the natural and social environment is expected • good access to airport and other road networks on Mactan Island	• construction cost is low • some level, a level greater than Option 1, of negative impact on the natural and social environment is expected • bad access to airport and other road networks on Mactan Island	• construction cost is high • interferes with port facilities and scale of resettlement is the greatest • impact on natural environment is limited • bad access to airport and other road networks on Mactan Island

Source: JICA Survey Team

(4) Route Selection of Mandaue Coastal Road

For the Mandaue Coastal Road, the following two route options were identified as the possible route options:

- Coastal Route: Based on the alignment recommended by MCUTMP, the route position was modified in order to avoid the port facilities, the proposed reclamation project, mangrove forest and tideland. This route can provide interconnectivity to 1st and 4th Cebu-Mactan Bridges.
- Inland Route: This route can provide interconnectivity to all Cebu-Mactan Bridges but passes through the residential area in Mandaue City.



Source: JICA Survey Team

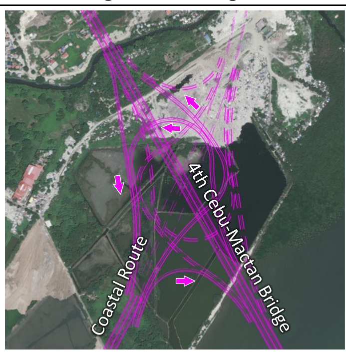
Figure 2.5.11 Alternative Route Options for Mandaue Coastal Road

Coastal Route is modified from the alignment recommended by MCUTMP in order to avoid the port facilities, the proposed reclamation project, mangrove forest and tideland. This route can provide interconnectivity to 1st and 4th Cebu-Mactan Bridges. Due to the steep vertical gradient of the 2nd Cebu-Mactan Bridge, this route cannot have the interconnectivity with the 2nd Cebu-Mactan Bridge. Although this route can avoid highly populated residential area, resettlement of over 100 houses would be required.

Inland Route has higher functionality of road than Coastal Route but would require an enormous number of resettlement of houses.

Table 2.5.4 and Table 2.5.5 summarize the outlines of the alternative route options for Mandaue Coastal Road and evaluation result of the options respectively. As the result of comparative analysis, the Coastal Route was recommended as the optimum location for Mandaue Coastal Road from the viewpoints of good functionality of road and less adverse social environment.

Table 2.5.4 Comparison of Possible Routes for Mandaue Coastal Road

		Coastal Route	Inland Route
General Description		• Based on the alignment recommended by MCUTMP, port facilities, the proposed reclamation project, mangrove forest and tideland are avoided. • Interconnection with 1st and 4th Bridges.	• The route passing through residential areas. • Interconnection with 1st, 2nd and 4th Bridges.
Road Length (km)	Approach	0.25	0.25
	Viaduct	4.55	4.00
	Total	4.80	4.25
Land Use (km)	Roadway	0.90 (19%)	0.71 (17%)
	Factory	0.55 (11%)	0.60 (14%)
	Port Facility	1.75 (36%)	0.00 (0%)
	Residences	0.00 (0%)	1.65 (39%)
	Unused	1.60 (33%)	1.29 (30%)
Interconnection with the Bridges	1st Bridge	 Grade separation with free flow interchange ramps only for western side of coastal road.	 Combination of grade separation with interchange ramps for western side of coastal road and at-grade intersection for eastern side of coastal road.
	2nd Bridge	 None Because the route would cross with UN Avenue at the steep gradient (5.5%) section of the bridge approach, interconnection with 2nd Bridge cannot be provided.	 Combination of grade separation with interchange ramps for western side of coastal road and at-grade intersection for eastern side of coastal road.
	4th Bridge	 Grade separation with 4-leg interchange ramps.	 Grade separation with 4-leg interchange ramps.

Source: JICA Survey Team

Table 2.5.5 Evaluation of Possible Routes for Mandaue Coastal Road

Criteria		Base Score		Coastal Route			Inland Route		
Functionality of Project Road	Balancing traffic volume across Mactan Channel	12	30	1st Bridge 95,000 (45%) 2nd Bridge 46,200 (22%) 4th Bridge 71,300 (34%)	6	24	1st Bridge 83,100 (39%) 2nd Bridge 75,000 (35%) 4th Bridge 54,300 (26%)	12	30
	Reduction of traffic volume in city center	18		• Cebu N Road: -42% • Mandaue Causeway: -56% Note: The most of traffic from western side of Cebu will use Coastal Road.	18		• Cebu N Road: -42% • Mandaue Causeway:-59% Note: The most of traffic from western side of Cebu will use Coastal Road.	18	
Constructability	Construction duration*	6	10	5 years Construction of viaduct in channel would take time and requires skilled contractor.	3	6	3 years Construction of viaduct on land would not take time.	6	8
	Accessibility to construction site	2		Temporary jetty or barge would be required for construction of piers of viaduct.	1		There are many crossing roads and accessibility to site is good.	2	
	Easiness of traffic management	2		Few crossing roads	2		More crossing roads than Option 1.	0	
Project Cost	Coastal Road	18	30	2.47 (Steel Box Girder w/ Steel Deck Slab)	9	21	1.00 (PC-I Girder Bridge)	18	18
	4th Bridge			0.79 (Steel Box Girder w/ Steel Deck Slab)			1.00 (Steel Box Girder w/ Steel Deck Slab)		
	Construction Cost (Rate)			1.50			1.00		
	Land Acquisition	12		Smaller area of land acquisition is necessary	12		Larger area of land acquisition is necessary	0	
Natural Environmental Impact	Conservation of mangrove forest and tideland	6	10	The mangrove forest and the tideland (where roosting and feeding areas for migratory birds) can be avoided and the adverse impact would be minimal.	6	8	The mangrove forest and the tideland (where roosting and feeding areas for migratory birds) can be avoided and the adverse impact would be minimal.	6	8
	Roadside air/noise pollution	2		Minimal impact because this route does not pass through residential area.	2		The highest negative impact for residential area.	0	
	Water quality pollution	2		Drainage water from viaduct may deteriorate water quality.	0		Water quality pollution is limited.	2	
Social Environmental Impact	Number of affected houses (PAPs)	7	20	Minimal number of PAPs would be expected. (Assumed to be 500 PAPs)	7	17	The greatest number of PAPs would be expected. (Assumed to be 2,000 PAPs)	0	9.5
	Number of affected business entities	7		Coordination with few factories would be needed. 6 Factories	7		Coordination with few factories would be needed. 10 Factories	3.5	
	Necessity of special care for port facilities	3		Coordination with port facilities would be needed.	0		Coordination with port facilities would NOT be needed.	3	
	Effect to Proposed Reclamation Project	3		Coordination with Reclamation Project is NOT needed.	3		Coordination with Reclamation Project is NOT needed.	3	
Overall Evaluation				• Good functionality with minimal scale of resettlement of houses. • However, implementability of Project would be depending on the negotiation with port facilities and reclamation project. • Reconstruction of 1st Bridge is prerequisite.		76	• Functionality of Project road is the highest but requires large-scale of resettlement of houses		73.5
				Recommended					

Note: * Duration for land acquisition process is not considered.
Source: JICA Survey Team

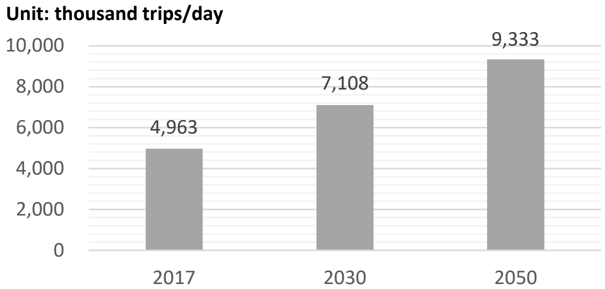
3. TRAFFIC DEMAND FORECAST

3.1 Database for the Analysis

In order to analyze the future traffic demand within the vicinity of the Project Site, this Survey utilized the existing database such as origin-destination (OD) tables, transport network and models developed for the demand forecast in the "Project on Master Plan Study and Institutional Development on Urban Transport System in Metro Cebu (MCUTMP)" conducted by JICA from 2017 to 2019. In MCUTMP, the future demand analysis was conducted for the target years of 2030 and 2050 based on the traffic situation in 2017. For estimation of future traffic volume, JICA STRADA was used.

(1) Transport Demand

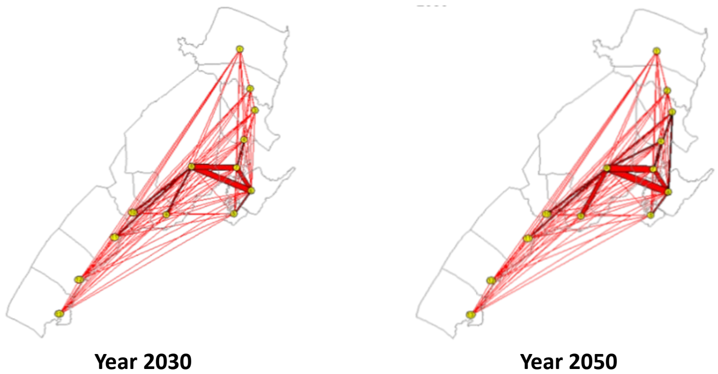
In MCUTMP, the total generated trip in 2030 was estimated at 7.1 million trips/day based on the trip production rate and the future population, which is almost 1.5 times the current condition. By year 2050, the total generated trip will become 9.3 million trips/day which is almost twice the current condition as shown in Figure 3.1.1.



Source: MCUTMP (JICA, 2019)

Figure 3.1.1 Total Generated Trips in Metro Cebu

OD tables were estimated by applying the Frater Method based on the present OD trips. Among the OD trips across LGU boundaries in 2030 and 2050, the trip between Cebu City and Mandaue City is the highest except in the internal trip. Meanwhile, the trips between Cebu City and Lapu-Lapu City, Mandaue City and Lapu–Lapu City, and Cebu City and City of Talisay are also high as shown in Figure 3.1.2.



Source: MCUTMP (JICA, 2019)

Figure 3.1.2 Trip Distribution between LGUs in Metro Cebu

Table 3.1.1 OD Table by LGU in 2030

Unit Thousand Trip/Day

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1	168.1	3.3	3.9	3.3	0.7	10.8	13.1	21.1	1.0	0.3	2.1	1.0	0.3	12.2	241.1
2	3.7	50.3	9.6	1.3	0.4	11.9	9.3	10.9	0.8	0.2	0.5	0.2	0.2	2.2	101.4
3	4.5	10.7	150.8	16.1	1.0	26.0	33.0	38.8	2.0	1.6	2.4	0.8	1.1	1.3	289.9
4	3.0	1.4	25.0	136.6	0.4	22.9	52.7	34.0	1.2	0.2	0.6	0.8	0.3	5.0	284.0
5	2.0	0.1	1.8	0.4	71.4	58.4	13.3	25.1	1.2	0.1	0.3	0.3	0.2	0.1	174.7
6	14.5	10.4	40.6	34.5	57.3	918.3	79.4	130.3	23.0	20.9	22.8	11.0	19.5	9.8	1,392.1
7	17.0	15.5	36.6	58.7	11.8	109.2	461.9	183.0	20.1	14.5	19.8	7.2	12.4	28.8	996.6
8	23.6	11.3	41.0	45.5	26.9	139.3	144.9	1,545.7	86.7	51.9	68.8	27.8	27.7	39.1	2,280.2
9	1.3	0.8	2.2	2.2	1.1	15.9	9.7	75.9	137.0	16.8	19.7	3.0	6.8	6.2	298.7
10	0.4	0.2	3.2	0.4	0.3	14.0	15.4	47.1	16.3	116.2	25.7	2.8	0.4	4.5	246.7
11	2.5	0.6	2.3	1.0	1.0	17.4	11.2	45.6	17.1	19.8	188.0	14.2	3.3	4.5	328.5
12	0.6	0.2	1.5	0.8	0.4	10.8	6.1	30.1	2.7	2.0	13.8	53.5	4.2	1.4	128.1
13	0.4	0.2	1.8	0.3	0.3	14.0	7.8	20.2	1.5	0.3	3.5	5.4	134.2	17.6	207.7
14	14.7	0.9	2.8	2.8	0.1	11.2	14.5	45.3	6.8	6.2	7.3	1.2	20.2	4.8	138.7
Total	256.3	105.9	322.9	304.0	173.2	1,380.1	872.1	2,252.9	317.6	250.9	375.1	129.1	230.7	137.5	7,108.3

Source: MCUTMP (JICA, 2019)
Note: 1. Danao City, 2. Municipality of Compostela, 3. Municipality of Liloan, 4. Municipality of Consolacion, 5. Municipality of Cordova, 6. Lapu-Lapu City, 7. Mandaue City, 8.Cebu City, 9.City of Talisay, 10.Municipality of Minglanilla, 11.City of Naga, 12.Municipality of San Fernando, 13.City of Carcar, 14.Other : over 50,000 trips/day

Table 3.1.2 OD Table by LGU in 2050

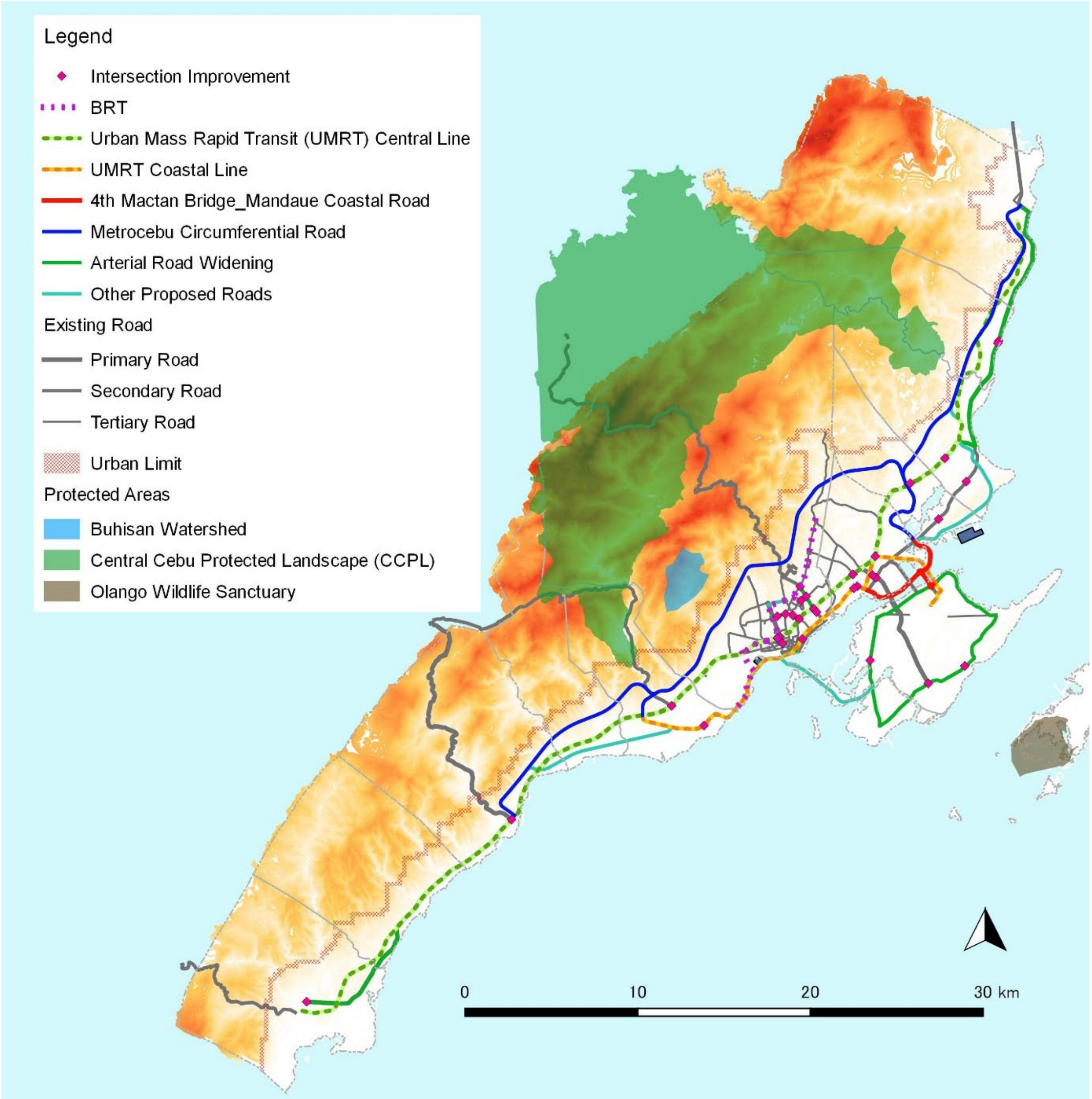
Unit Thousand Trip/Day

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	Total
1	255.4	5.7	6.2	4.4	1.4	15.6	22.8	26.8	1.8	0.4	3.7	1.2	0.4	19.4	365.2
2	5.3	83.3	11.4	1.9	0.8	15.6	12.9	13.3	1.2	0.3	0.6	0.4	0.3	3.1	150.3
3	6.5	13.5	236.2	21.3	2.0	35.7	43.9	52.3	3.3	2.6	3.5	1.0	1.8	1.7	425.3
4	3.6	1.7	34.5	237.6	1.0	32.0	69.2	47.3	2.2	0.3	0.9	1.1	0.3	6.9	438.9
5	2.8	0.3	4.0	0.8	112.4	80.4	18.3	39.1	2.9	0.2	0.5	0.4	0.2	0.1	262.4
6	19.1	15.8	56.8	45.6	65.2	1,160.9	106.5	166.2	34.0	25.9	31.6	15.7	25.8	15.5	1,784.7
7	25.3	21.3	49.3	76.1	14.7	132.3	633.4	219.8	27.6	17.2	26.3	8.6	15.0	40.8	1,307.7
8	30.0	15.6	51.0	55.8	31.8	175.2	177.4	1,830.2	108.5	59.4	82.9	35.9	31.4	53.3	2,738.2
9	1.9	1.7	3.4	3.4	2.1	24.1	14.3	94.7	212.4	25.6	28.7	3.8	10.3	8.4	434.7
10	0.6	0.3	4.8	0.4	0.6	17.0	16.7	52.4	24.5	169.9	30.0	3.9	0.5	6.1	327.7
11	4.7	1.0	3.1	1.6	2.4	22.8	13.5	53.1	23.0	24.2	248.7	16.0	3.7	6.2	423.8
12	0.9	0.3	2.0	1.1	0.7	15.3	7.2	42.3	3.7	2.1	15.5	74.1	4.6	1.9	171.9
13	0.8	0.4	2.6	0.4	0.8	19.8	10.1	26.0	2.5	0.6	3.7	6.6	210.2	24.0	308.6
14	20.8	1.2	3.8	3.9	0.1	18.4	20.2	61.7	9.2	8.5	10.0	1.6	27.6	6.5	193.4
Total	377.6	162.0	469.0	454.1	236.0	1,765.1	1,166.4	2,725.2	456.9	337.3	486.5	170.4	332.3	194.0	9,332.7

Source: MCUTMP (JICA, 2019)
Note: 1. Danao City, 2. Municipality of Compostela, 3. Municipality of Liloan, 4. Municipality of Consolacion, 5. Municipality of Cordova, 6. Lapu-Lapu City, 7. Mandaue City, 8.Cebu City, 9.City of Talisay, 10.Municipality of Minglanilla, 11.City of Naga, 12.Municipality of San Fernando, 13.City of Carcar, 14.Other : over 50,000 trips/day

(2) Transport Network

In MCUTMP, the master plan transport network towards 2030 and 2050 was formulated. The proposed master plan includes the number of transport projects such as roads and bridges, Urban Mass Rapid Transit (UMRT), public transport and traffic management. The proposed transport network towards 2050 is shown in Figure 3.1.3 and implementing schedule of transport projects in the master plan is presented in Table 3.1.3 to Table 3.1.5.



Source: MCUTMP (JICA, 2019)

Figure 3.1.3 Proposed Master Plan Transport Network in 2050

Table 3.1.3 Implementing Schedule of Road and Bridge Projects in MCUTMP

Project Name	Implementing Agency	Status	Length (km)	Implementation Period			
				2022	2028	2040	2050
1. Metro Cebu Circumferential Road (Segment 1)	DPWH	New	24.72	▬			
2. Metro Cebu Circumferential Road (Segment 2)	DPWH	New	29.80		▬		
3. Metro Cebu Circumferential Road (Segment 3)	DPWH	New	17.40	▬			
4. Talisay–Naga Diversion Road	DPWH	New	7.70	▬			
5. Mandaue–Liloan Diversion Road	DPWH	New	10.10	▬			
6. Cebu Arterial Road Widening Phase 1-1 Central Section (Complete Street Type A, 6 lanes)	DPWH	Upgrade	7.31	▬			
7. Cebu Arterial Road Widening Phase 1-2 Central Section (Complete Street Type A, 4 lanes)	DPWH	Upgrade	13.39		▬		
8. Cebu Arterial Road Widening Phase 2-1 North Section (Complete Street Type A, 4 lanes)	DPWH	Upgrade	16.00		▬		
9. Cebu Arterial Road Widening Phase 2-2 South Section (Complete Street Type A, 4 lanes)	DPWH	Upgrade	28.50		▬		
10. Cebu Coastal Road Widening Phase 1 (Complete Street Type A, 6 lanes)	DPWH	Upgrade	13.00	▬			
11. Cebu Coastal Road Widening Phase 2 (Complete Street Type A, 6 lanes)	DPWH	Upgrade	9.70		▬		
12. Mactan Circumferential Road (Road Widening)	DPWH	Upgrade	22.00		▬		
13. Guadalupe–Lahug Diversion Road	DPWH	New	1.60	▬			
14. Metro Cebu Intersection Improvement (33 Intersections)	DPWH	Upgrade, Improvement	8.45	▬	▬	▬	▬
15. Cebu–Cordova Link Expressway Bridge	Joint Venture	New On-going	3.23	▬			
16. Mandaue Coastal Road (Viaduct)	DPWH	New	6.20	▬			
17. Mandaue–Lapu Lapu Link Bridge	DPWH	New	0.64	▬	▬		
18. 1st Mactan Bridge Replacement	DPWH	Replacement	2.50		▬		
19. Metro Cebu Coastal Expressway (elevated highway along existing coastal road)	DPWH	New	79.00			▬	▬
20. Metro Cebu Circumferential Expressway (elevated highway along Metro Cebu Circumferential Road)	DPWH	New	28.80			▬	

Source: MCUTMP (JICA, 2019)

Table 3.1.4 Implementing Schedule of UMRT Projects in MCUTMP

Project Name	Implementing Agency	Status	Length (km)	Implementation Period			
				2022	2028	2040	2050
1. UMRT Central Line (Central Section)	DOTr	New	24.8	▬	▬		
2. UMRT Central Line (North Section)	DOTr	New	17.5			▬	
3. UMRT Central Line (South Section)	DOTr	New	25.2			▬	
4. UMRT Coastal Line (Phase 1)	DOTr	New	13.0	▬	▬		
5. UMRT Coastal Line (Phase 2)	DOTr	New	12.0		▬	▬	

Source: MCUTMP (JICA, 2019)

Table 3.1.5 Implementing Schedule of Other Project Components in MCUTMP

Project Name	Implementing Agency	Status	Implementation Period			
			2022	2028	2040	2050
Traffic Management						
1. Metro Cebu Area Traffic Control (ATC) System (Control center, detectors, CCTV, traffic information provision, etc.)	DPWH/ LGUs	New				
2. Traffic signal optimization with intersection improvement	DPWH/ LGUs	Upgrade				
3. Other traffic management and safety measures (traffic enforcement, asset management, traffic education, promotion of public transport, etc.)	DPWH/ LGUs	Upgrade				
Public Transport						
1. PUV Modernization Program/ PUV Route Plan	DOTr/ LGUs	On-going				
2. Public Transport Terminals	DOTr/ LGUs	On-going				
3. BRT	DOTr	On-going				
4. Water Transport	DOTr	On-going				

Source: MCUTMP (JICA, 2019)

(3) Type of Vehicles

The vehicle type used for the traffic demand forecast is summarized in Table 3.1.6.

Table 3.1.6 Vehicle Type Classification

Vehicle Type used for Demand Forecast	Vehicle Type used for Traffic Count Survey	DPWH Vehicle Classifications (DO No. 22, 2013)
Motorcycle	Bicycle, Motorcycle	Bicycle, Motorcycle
Passenger Car	Passenger Car, Taxi	Passenger Car
Public Vehicle	Jeepney, Multicab, GT-Express, Minibus, Standard Bus, School Bus	Passenger Utility, Small Bus, Large Bus
Tricycle	Pedicab, Tricycle, Others	Motor-Tricycle
Truck	Delivery, Truck, Trailer	Goods Utility, Rigid Truck, Truck Semi-Trailer, Truck Trailers

Source: JICA Survey Team

3.2 Results of Future Demand Forecast

(1) Pre-conditions

In this Survey, the planning target year was determined in 2039, 20 years after the start of project preparation. Therefore, the OD table for the year 2039 was prepared by linear interpolation of the OD tables in 2030 and 2050. The transport network data for the year 2039 was also prepared based on the implementing schedule of the master plan transport projects. Considering the access to the New International Container Terminal to be developed in Consolasion, the alignment of Metro Cebu Circumferential Road was modified to be connected to the Mandaue-Liloan Diversion Road.

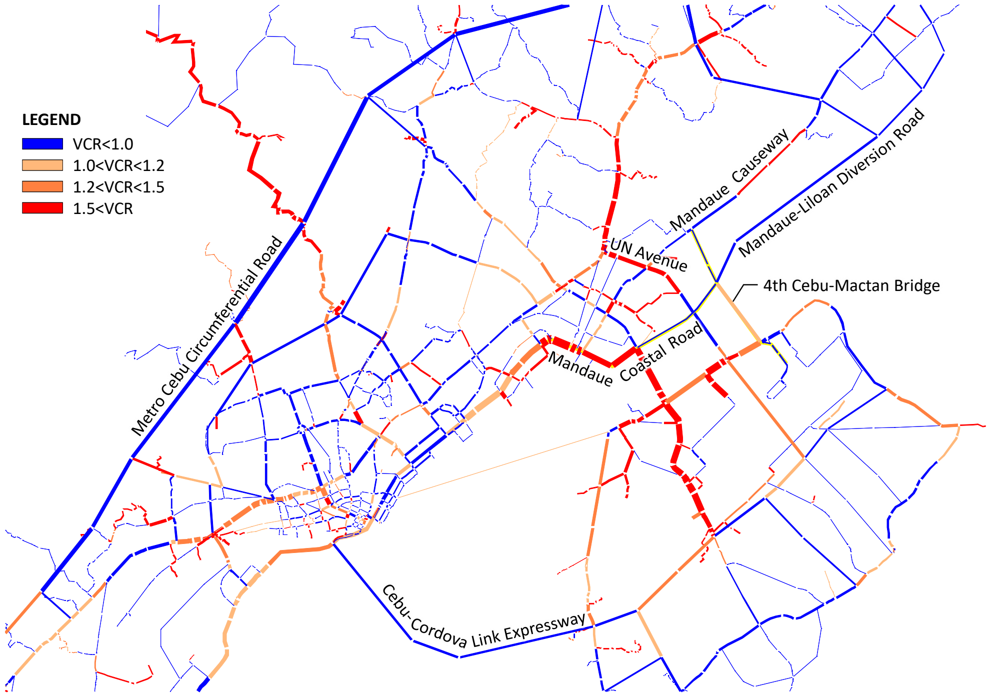
(2) Future traffic demand

As the result of traffic demand forecast for the year 2039, traffic volume on the 4th Cebu-Mactan Bridge and Mandaue Costal Road (at the west side of the 1st Cebu-Mactan Bridge) is estimated as presented in Table 3.2.1. Figure 3.2.1 shows the future transport network with traffic volume excluding UMRT links.

Table 3.2.1 Estimated Traffic Volume in 2039

Unit	Section	Direction	Motorcycle	Passenger Car	Public Veh. (PUB, PUJ)	Truck	Total
PCU/day	4th Cebu-Mactan Bridge	To Mactan	4,700	15,400	5,400	5,200	30,700
		To Mandaue	5,300	16,000	4,700	3,500	29,500
		Total	**10,000**	**31,400**	**10,100**	**8,700**	**60,200**
	Mandaue Coastal Road	To East	9,400	24,200	8,300	7,600	49,500
		To West	10,400	27,900	8,800	7,400	54,500
		Total	**19,800**	**52,200**	**17,200**	**15,000**	**104,200**
Vehicles/day	4th Cebu-Mactan Bridge	To Mactan	14,100	15,400	3,900	2,300	35,700
		To Mandaue	16,200	16,000	3,400	1,500	37,100
		Total	**30,300**	**31,400**	**7,300**	**3,800**	**72,800**
	Mandaue Coastal Road	To East	28,400	24,200	5,800	3,300	61,700
		To West	31,600	27,900	6,100	3,200	68,800
		Total	**60,000**	**52,200**	**12,000**	**6,500**	**130,700**

Source: JICA Survey Team
Note: PCU by vehicle type; car (1.00), motorcycle (0.33), public vehicle (1.57), tricycle (0.41), Truck (2.29)

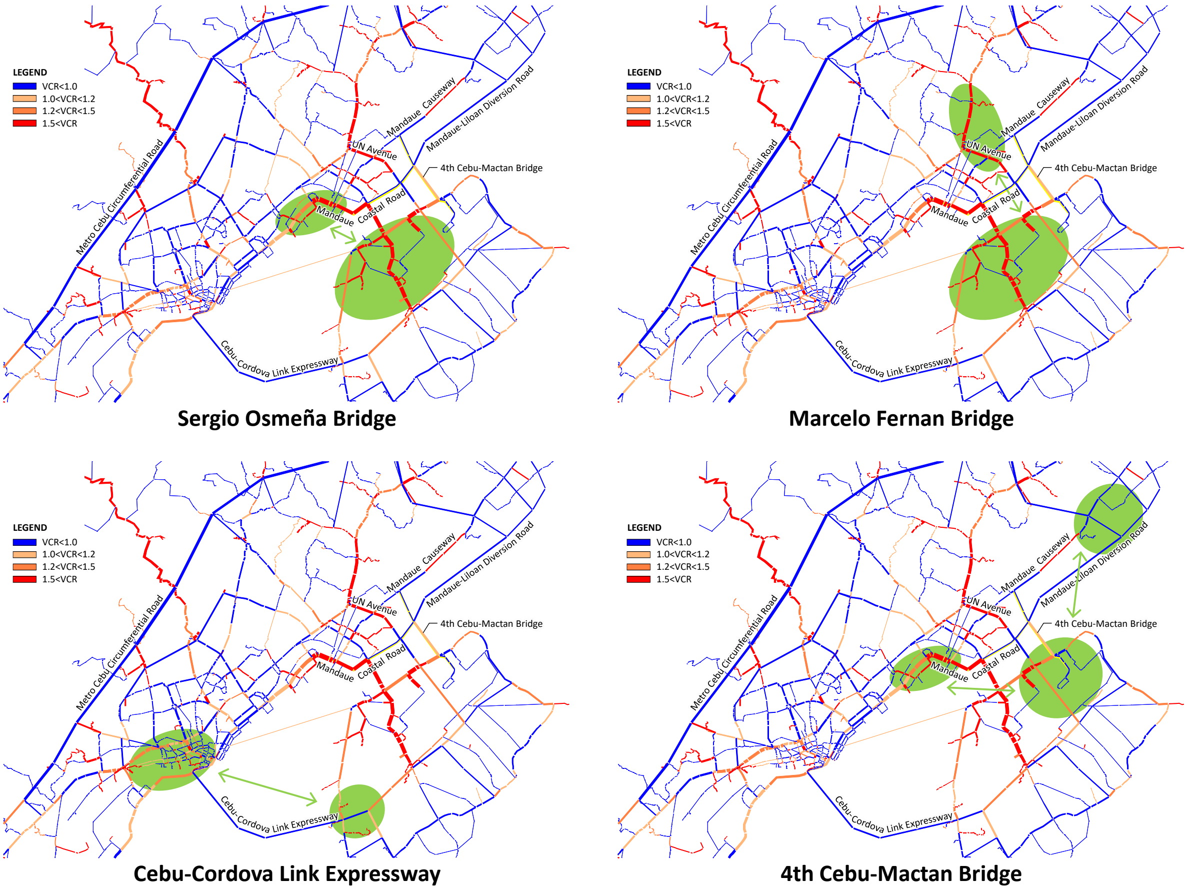


Source: JICA Survey Team

Figure 3.2.1 Estimated Traffic Volume in 2039

From the result of traffic demand forecast, the expected function of each Cebu-Mactan Bridge is assumed as shown in Figure 3.2.2.

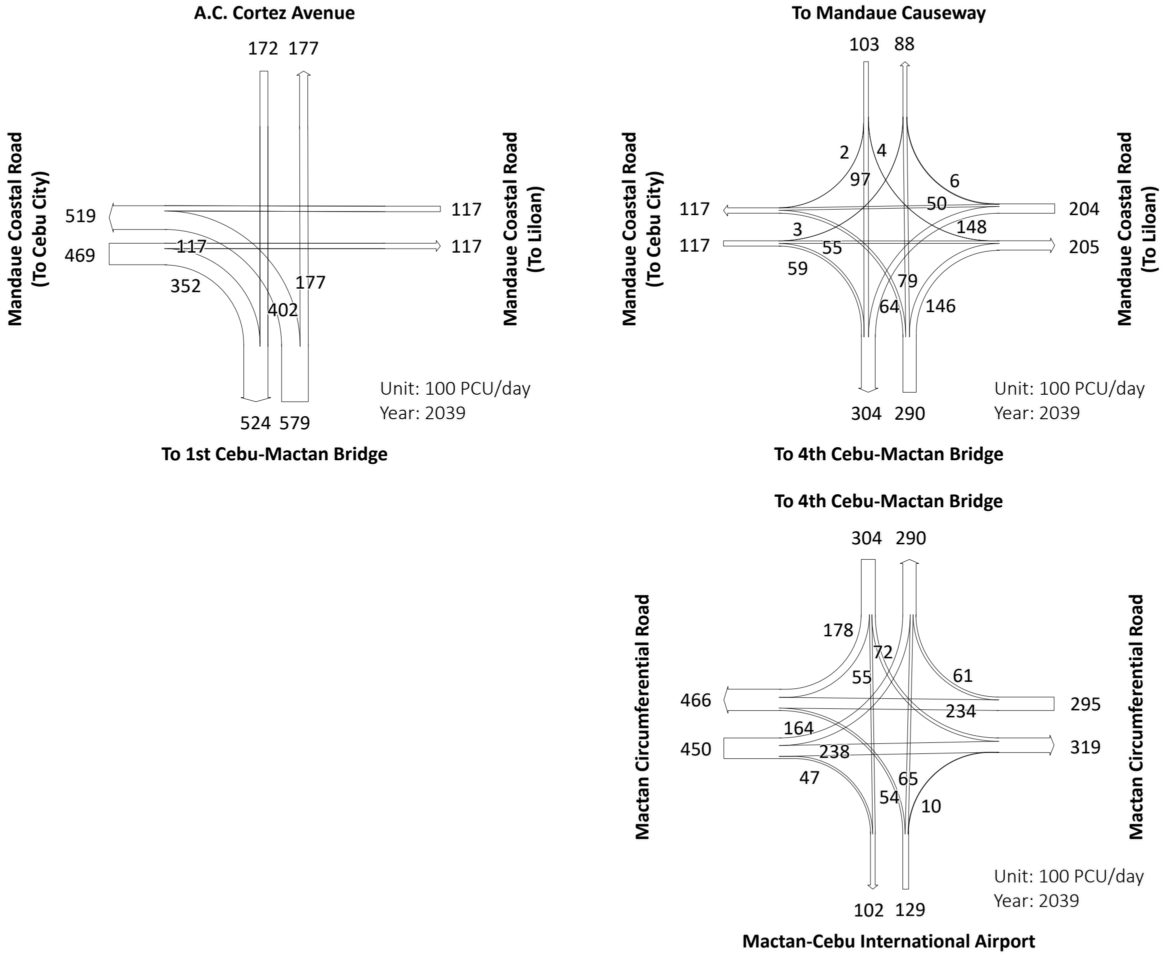
- Sergio Osmeña Bridge will cater the highest traffic demand at approximately 110,000 PCU/day in 2039 between Cebu Port area and west side of Lapu-Lapu City via Mandaue Coastal Road.
- Marcelo Fernan Bridge will cater approximately 50,000 PCU/day in 2039 between inland side of Mandaue City or Consolacion via UN Avenue and Cebu North Hagnaya Wharf Road. Whereas DPWH Region VII is currently implementing underpass construction at the intersection of UN Avenue and Mandaue Causeway, this directional traffic would be improved by this project.
- Cebu-Cordova Link Expressway is a bit far from central areas of Lapu-Lapu City and Mandaue City and the expected future traffic volume is approximately 41,000 PCU/day, which is the lowest among the four (4) bridges. The main road user of this bridge would be west side of Cebu City and Talisay.
- 4th Cebu-Mactan Bridge would cater approximately 60,000 PCU/day in 2039 and the majority of the traffic are the directions i) between Cebu Port area and Lapu-Lapu City and ii) between Consolacion and Lapu-Lapu City via Mandaue Coastal Road.



Source: JICA Survey Team

Figure 3.2.2 Expected Functions of Each Cebu-Mactan Bridge

Figure 3.2.3 shows the directional traffic volume at the interconnection between Mandaue Coastal Road and 1st and 4th Cebu-Mactan Bridges.



Source: JICA Survey Team

Figure 3.2.3 Estimated Traffic Volume at Intersections in 2039

4. NATURAL CONDITION SURVEYS

4.1 Meteorological Conditions

(1) Ambient Temperature

The climate of Cebu Mactan area is categorized as tropical rainforest climate, being high temperature and high humidity throughout the year. There is no significant difference between seasons in the Cebu Mactan area all the year round, and the fluctuation of temperature is small.

The temperature is observed at the Cebu PAGASA (Philippine Atmospheric, Geophysical and Astronomical Services Administration) Complex station (hereinafter, Mactan Station) located near the Mactan-Cebu International Airport. The location of Mactan Station is shown in Table 4.1.1.

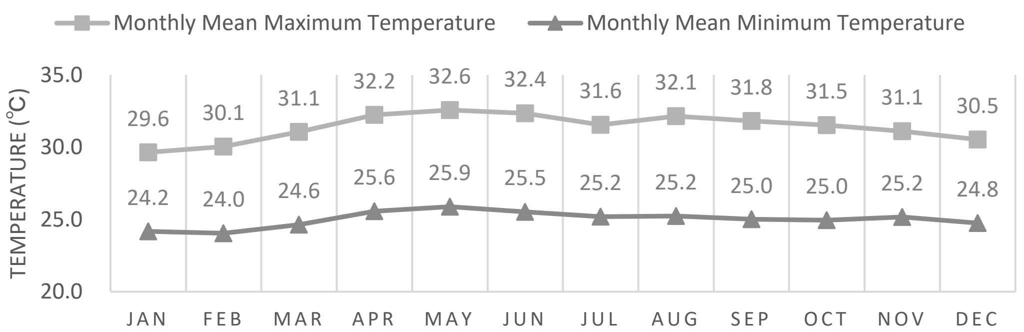
Table 4.1.1 Position of Mactan Station

Name of the observatory	Latitude (North)	Longitude (East)	Elevation (m)
Mactan Station	10.32°	123.98°	23

Source: JICA Survey Team

The data of Monthly Mean Maximum and Minimum Temperatures during the period from 1982 to 2018 in Mactan Station was obtained in this survey. However, only the observation data from 2006 to 2018 was used here, since some data before 2006 has been missing. Figure 4.1.1 shows the Monthly Mean Maximum and Minimum Temperature datum at Mactan Station. "Monthly Mean Maximum and Minimum Temperatures" are defined as monthly average of daily maximum and minimum values during from 2006 to 2018. The highest Monthly Mean Temperature at the station was 32.6℃ in May, and the lowest was 24.0℃ in February. Since the fluctuation of temperature is small throughout the year, the difference between the Monthly Maximum and Minimum Temperatures in the same month is also small at 5℃ to 7℃.

According to the records at the Mactan Station, the past maximum temperature was 37.0℃ observed on 31st May 2010 and the lowest temperature was 19.2℃ on 16th January 1992. The difference between the minimum and the maximum temperatures is 17.8℃.

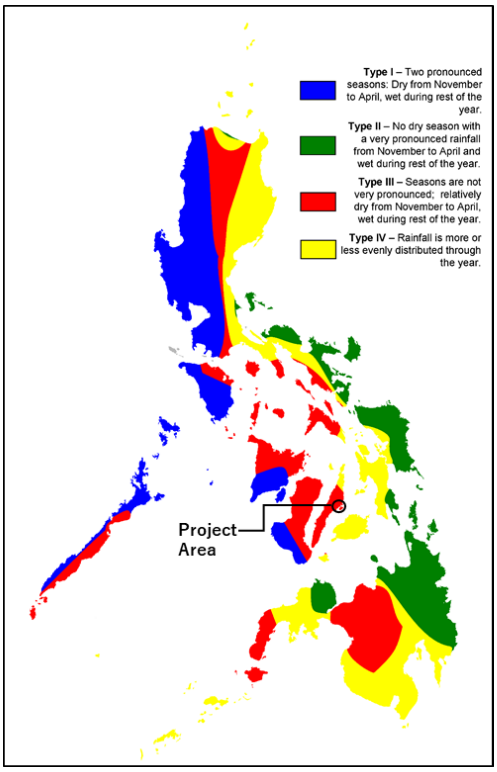


Source: Observed data at Mactan Station, arranged by JICA Survey Team

Figure 4.1.1 Monthly Mean Maximum and Minimum Temperatures during 2006 - 2018

(2) Rainfall

Figure 4.1.2 shows the climate classification map throughout the Philippines. The project area belongs to the category of Type III; "*Seasons are not very pronounced; relatively dry from November to April, wet during rest of the year*".

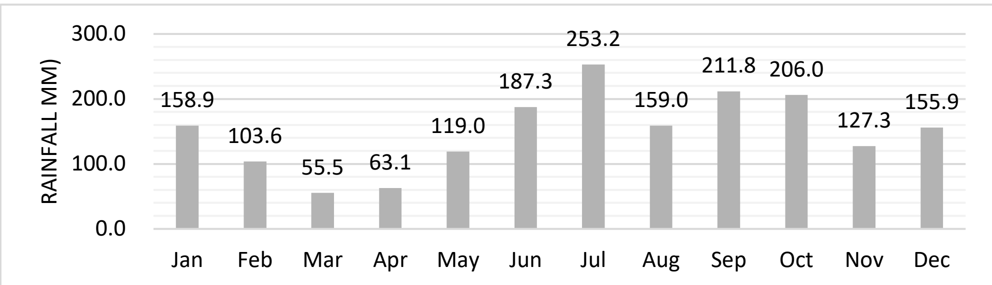


Source: PAGASA

Figure 4.1.2 Climate Classification Map throughout the Philippines

Figure 4.1.3 shows the Monthly Mean Rainfalls observed at Mactan Station during the period from 1982 to 2018. "Monthly Mean Rainfall" is defined as monthly average of the daily rainfall data for 37 years (1982 to 2018). The dry season from November to April has low rainfall, and its averaged Monthly Mean Rainfall was 91.7 mm/month. On the other hand, averaged Monthly Mean Rainfall from May to October was 168.3 mm/month. Annual mean rainfall at the Mactan Station from 1982 to 2018 was 1,636.3 mm/year.

According to the records at the Mactan Station, the past highest daily rainfall was 276.1 mm/day on 12th November 1990 when Typhoon MIKE landed on Cebu Island.

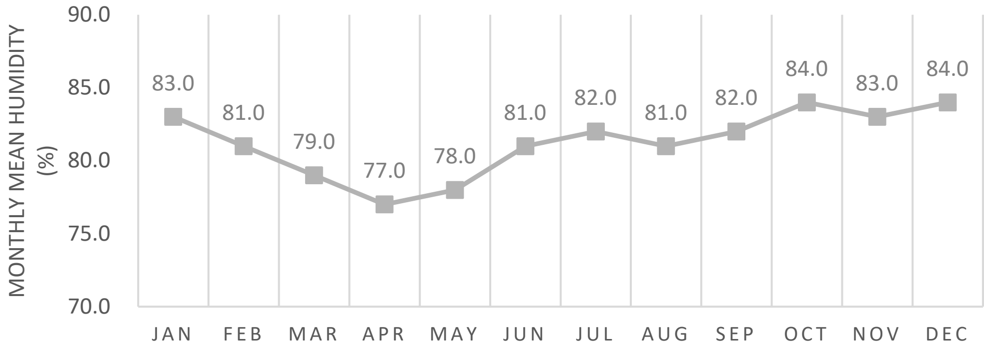


Source: Observed data at Mactan Station, arranged by JICA Survey Team

Figure 4.1.3 Monthly Mean Rainfall during 1982 - 2018

(3) Humidity

The data of Monthly Mean Humidity for 30 years from 1988 to 2017 at the Mactan Station was obtained in this survey. "Monthly Mean Humidity" is defined as monthly average of daily average humidity values during from 1988 to 2017. Figure 4.1.4 shows the value of Monthly Mean Humidity averaged for 30 years. Although the Monthly Mean Humidity was below 80% from March to May due to low rainfall, there is no significant difference between humidity at each month throughout the year. The average value of humidity for 30 years was 81%.



Source: Observed data at Mactan Station, arranged by JICA Survey Team

Figure 4.1.4 Monthly Mean Humidity during 1988 – 2017

(4) Wind

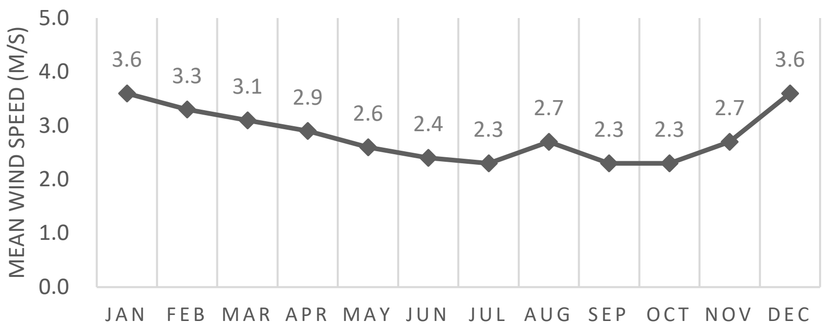
Observed Data

The data of Monthly Mean Wind speed for 30 years from 1981 to 2010 and the data of maximum wind speed and its direction by months for 46 years from 1972 to 2017 at Mactan Station were obtained in this survey. PAGASA records hourly wind data by averaging the data measured for 10 minutes. The observation height is at 10m above ground level. "Monthly Mean Wind speed" is defined as monthly average of daily average wind speed for 30 years.

Wind Speed

Figure 4.1.5 shows the 30-year average value of Monthly Mean Wind speed from 1981 to 2010. The annual average wind speed was 2.8 m/s, and the wind speed exceeding the annual average was recorded from December to April.

In addition, the past maximum wind speed (10 minutes averaged wind speed) from 1972 to 2017 was 55.0 m/s when typhoon MIKE landed on 12th November 1990.

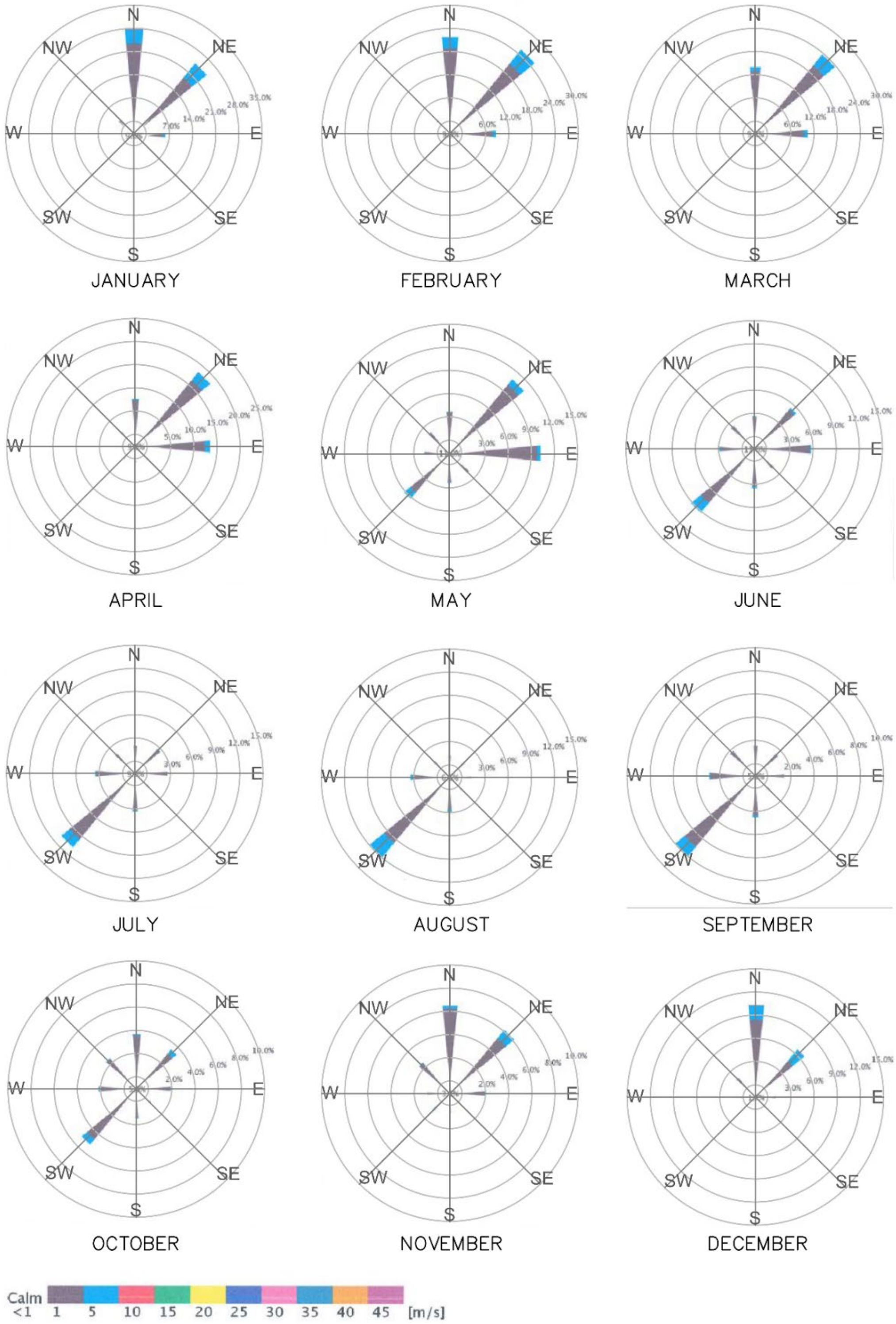


Source: Observed data at Mactan Station, arranged by JICA Survey Team

Figure 4.1.5 Monthly Mean Wind Speed during 1981 – 2010

Wind Direction

Figure 4.1.6 shows wind direction with its frequency (Wind Rose) in each month. The Wind Rose is described based on the data observed hourly every day from 1981 to 2010. From June to October, the wind from southwest was dominant due to the influence of the southwest monsoon. On the other hand, from November to May, the wind from north and northeast was dominant due to the influence of the northeastern monsoon.



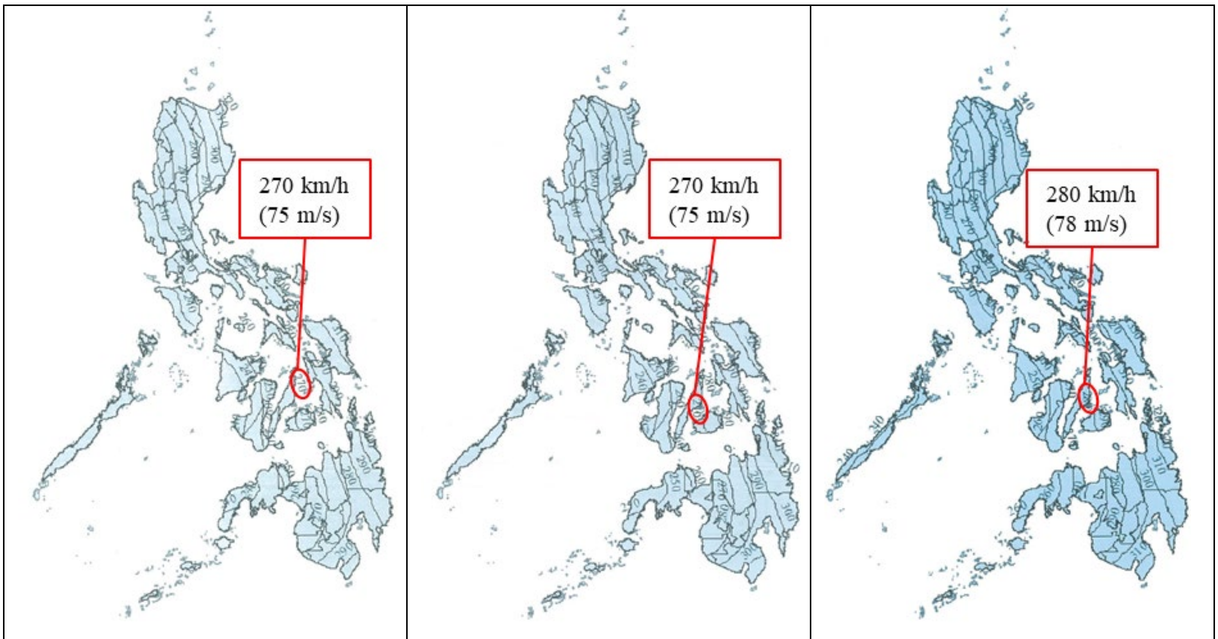
Source: Observed data at Mactan Station, arranged by JICA Survey Team

Figure 4.1.6 Wind Rose during 1981 - 2010

<u>NSCP (National Structural Code of the Philippines)</u>

Figure 4.1.7 shows the 300-year, 700-year, and 1,700-year return period of maximum wind gust speed maps shown in the National Structural Code of the Philippines (NSCP 2015). The values shown in Figure 4.1.7 were determined based on the maximum wind gust speed which represents the maximum of the three-second averaged wind speed observed at a height of 10 m above the ground. Each figure shows wind speed values (km/h) with approximately 15 % probability (return period: 300-year), 7 % probability (return period: 700-year), 3 % probability (return period: 1,700-year) of exceedance in 50 years, respectively.

In the project area, the maximum wind gust speed of return period 300-year, 700-year and 1,700-year are 270 km/h (75 m/s), 270 km/h (75 m/s) and 280 km/h (78 m/s), respectively



Return Period: **300-year** (Approximately 15 % probability of exceedance in 50 years)	Return Period: **700-year** (Approximately 7 % probability of exceedance in 50 years)	Return Period: **1,700-year** (Approximately 3 % probability of exceedance in 50 years)

Unit：km/h
Source: NSCP 2015

Figure 4.1.7 Maximum Wind Gust Speed Maps

(5) Typhoon

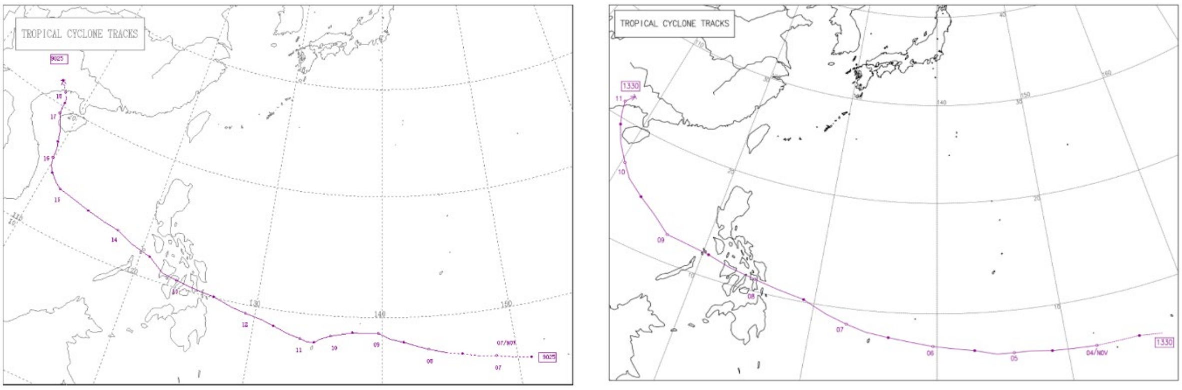
According to the "Disaster Management Reference Handbooks 2015 and 2018 edition" published by the Center for Excellence in Disaster Management & Humanitarian Assistance (CFE-DM), annually, approximately 80 typhoons develop above tropical waters, 20 of them enter the Philippine region, and 6 to 9 of them make landfall on Cebu island. The typhoons which landed on Cebu island from 1983 to 2017 are shown in Figure 4.1.2. A total of 41 typhoons landed in Cebu during the 35 years from 1983 to 2017 (1.2 on average a year), of which 49% hit the island in November and December.

Among them, the maximum wind speed of Typhoon MIKE (RUPING) which hit Cebu island in 1990 was 150 kts (77.2 m/s), and the lowest central pressure was 885 mb. In addition, the maximum wind speed of typhoon HAIYAN (YOLANDA) which landed in November 2013 was 170 kts (87.5 m/s), and the lowest central pressure was 895 mb. The maximum wind speed of HAIYAN was the fastest typhoon recorded from 1983, and its maximum wind speed was 56 m/s at the Mactan Station. Typhoon HAIYAN passed the Medellin district in the northern part of Cebu island, and many houses were destroyed. However, according to the results of interviews with DPWH (Department of Public Works and Highways), Mandaue City and PAGASA Mactan Office, it was reported that there were almost no human or structural damage by storm surge or strong wind caused by typhoon HAIYAN in the project area.

Table 4.1.2 Typhoon Landed on Cebu Island (1983-2017)

Year	Month	Name	Maximum Intensity (kts)	Minimum SLP (mb)
1983	Jun	SARAH	35	-
	Apr	NELSON	105	-
1984	Sep	IKE	125	-
1986	Dec	MARGE	95	-
	Dec	NORRIS	90	-
1988	Jun	VANESSA	45	-
1990	**Nov**	**MIKE (RUPING)**	**150**	**885**
1991	Mar	SHARON	60	-
	Apr	VANESSA	45	-
	Oct	THELMA	45	-
1992	Nov	FORREST	125	-
1993	Nov	KYLE	95	-
	Dec	NELL	70	-
1994	Apr	OWEN	75	-
	Dec	AXEL	115	-
1995	May	-	25	-
	Nov	ZACK	120	-
	Sep	-	30	-
1996	Mar	-	30	-
	Oct	ERNIE	50	-
1997	Nov	LINDA	65	-
2001	Feb	-	25	-
	Nov	LINGLING	115	927
	Dec	KAJIKI	35	-
2002	Mar	-	30	1000
2003	Jul	KONI	65	976
2004	Jun	CHANTHU	75	967
2005	Mar	ROKE	80	963
	Dec	-	45	991
2007	Nov	HAGIBIS	80	963
2008	Apr	NEOGURI	100	948
	Nov	MAYSAK	55	982
2011	Oct	BANYAN	30	1000
2012	Oct	SON-TINH	105	944
	Dec	WUKONG	35	996
2013	Nov	THIRTY	35	996
	Nov	**HAIYAN (YOLANDA)**	**170**	**895**
2014	Nov	SINLAKU	55	982
	Dec	JANGMI	45	989
2016	Nov	TOKAGE	80	963
2017	Jan	ONE	30	1000

Source: Joint Typhoon Warning Center (JTWC)



Typhoon MIKE (November 1990) Typhoon HAIYAN (November 2013)

Source: Japan Meteorological Agency

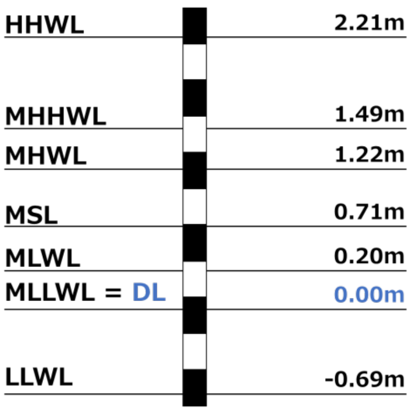
Figure 4.1.8 Tracks of Main Typhoon hitting Cebu Island

4.2 Oceanographical Conditions

(1) Tidal Level

As shown in Figure 4.2.1, the tide conditions in the project site are summarized based on the information obtained from National Mapping and Resource Information Authority (NAMRIA), which manages and measures tide gauges nationwide, and the tide data shown in "Tide and Current Tables Philippines 2019" published by NAMRIA.

As tide levels are arranged from the Mean Lower Low Tide Level (MLLWL) as the Datum Level (DL) in “Tide and Current Tables Philippines 2019”, MLLWL is used as DL in this project as well. The tide level shown in "Tide and Current Tables Philippines 2019" is determined based on the data from 1989 to 2007 observed at Cebu Harbor Station (Latitude: 10° 17’ N, Longitude: 123° 55’ E) closest to the project area in the observatory (shown in Figure 4.2.2). The tidal type at the project site could be understood as semidiurnal with 2 high peaks and 2 low peaks in a day.



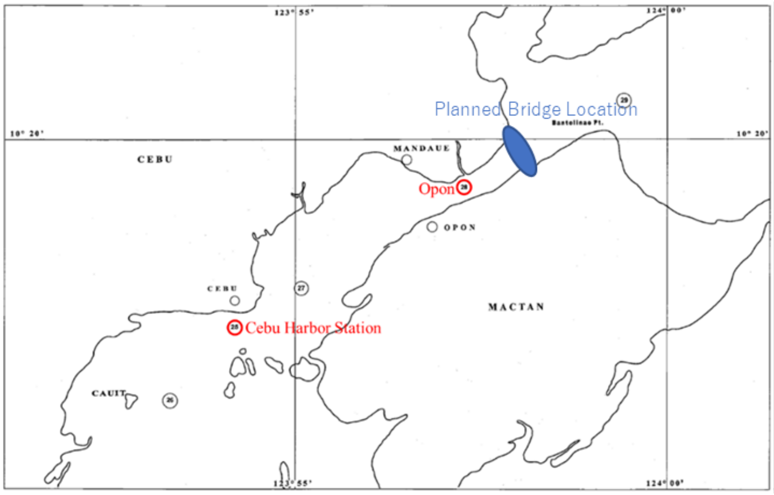
- HHWL: Highest High Water Level
- MHHWL: Mean Higher High Water Level
- MHWL: Mean High Water Level
- MSL: Mean Sea Level
- MLWL: Mean Low Water Level
- MLLWL: Mean Lower Low Water Level
- DL: Datum Level
- LLWL: Lowest Low Water Level

Source: Tide and Current Tables Philippines 2019, arranged by JICA Survey Team

Figure 4.2.1 Tidal Conditions and Historical Maximum/Minimum Tide Records in the Project Area

(2) Tidal Currents

According to "Tide and Current Tables Philippines 2019" published by NAMRIA, tidal current observation has been conducted at five locations in the Philippines (Basilan Strait Station, Iloilo Strait Station, Cebu Harbor Station, San Bernardino Strait Station, Hinatuan Station). “Cebu Harbor Station” (Latitude: 10° 17’ N, Longitude: 123° 55’ E) is closest to the project area in the observatory.



Source: Tide and Current Tables Philippines 2019

Figure 4.2.2 Location of Tidal Current Observation in the Project Area

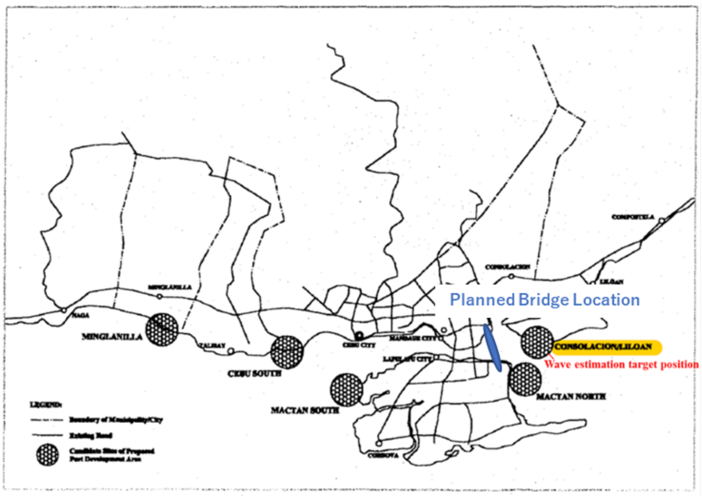
According to the Tide and Current Tables Philippines 2019, the methodology to convert the value of tidal current in the "Cebu Harbor Station" to those of "Opon" which is the closest location to the project area is mentioned.

Since the "Opon" station is located between Mactan island and Cebu island, the tidal current at "Opon" station becomes faster than that of "Cebu Harbor Station" due to the narrowed topography, and velocity of tidal current is to be estimated at 1.8 times rather than "Cebu Harbor Station" in the Tide and Current Tables Philippines 2019. In "Cebu Harbor Station", the maximum value of tidal current is estimated at 0.73 m/s for both flood and ebb tides, and the average velocity of tidal current is estimated at 0.46 m/s.

Therefore, the maximum tidal current in the project area is converted to be 1.31 m/s for both flood and ebb tides, and the average velocity of tidal currents is converted to be 0.82 m/s.

(3) Waves

Wave prediction was conducted near the project for the planning of the new Cebu Port in the "The Study on the Integrated Port Development Plan in the Republic of the Philippines" (JICA, 2002). Figure 4.2.3 shows the location of wave prediction.



Source: The Study on the Cebu Integrated Port Development Plan in the Republic of the Philippines

Figure 4.2.3 Location of the Wave Prediction

The average daily wind speed and direction for 25 years were used in "The Study on the Cebu Integrated Port Development Plan in the Republic of the Philippines". The results of wave prediction are summarized as shown in Table 4.2.1

Table 4.2.1 Significant Wave Height $H_{1/3}$ in 50 Years Probability

H_0 (m)	T (s)	θ	$H_{1/3}$ (m)
5.17	7.7	NE	1.64 – 2.03
4.26	7.2	NNE	1.20 – 1.50

H_0: Max. deep water wave height (m), T: Period (s), θ : Direction, $H_{1/3}$: Significant Wave Height
Source: The Study on the Cebu Integrated Port Development Plan in the Republic of the Philippines

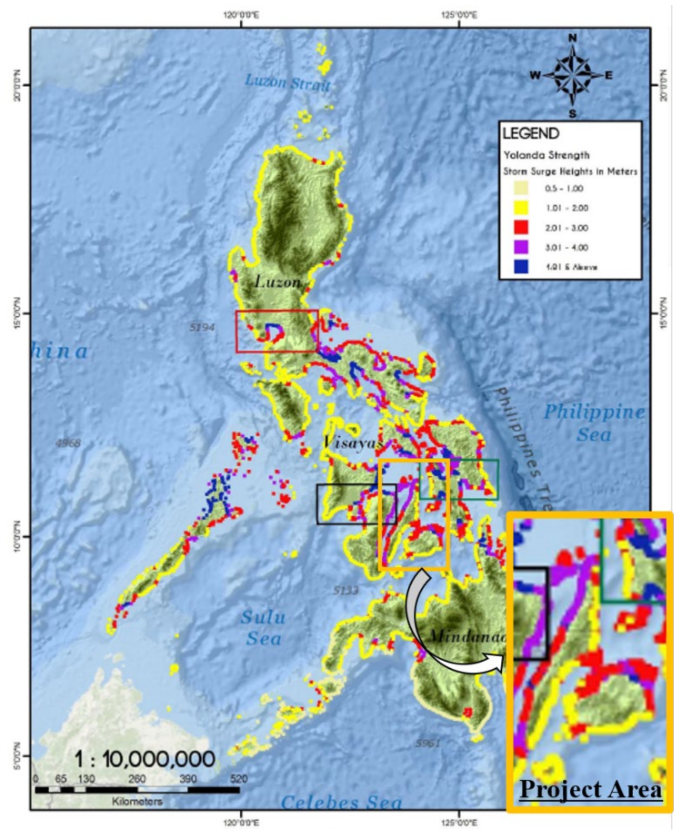
As the project area is located at inland from above mentioned the location of wave prediction, the influence of waves is estimated to be less impact than that of the location of wave prediction. Therefore, the significant wave height $H_{1/3}$ in the project area is assumed to be 2.03 m or less.

(4) Storm Surge

<u>Storm Surge Deviation caused by Typhoon HAIYAN</u>

In "Identification of storm surge areas in the Philippines through the simulation of Typhoon Haiyan-induced storm surge levels over historical storm tracks" (Natural Hazards and Earth System Sciences, 2015), the predicted tide level is analyzed by storm surge simulation considering the Typhoon HAIYAN (see Figure 4.2.4).

According to the result of analysis, it is estimated that the maximum storm surge deviation in the project area is at most 3 m.



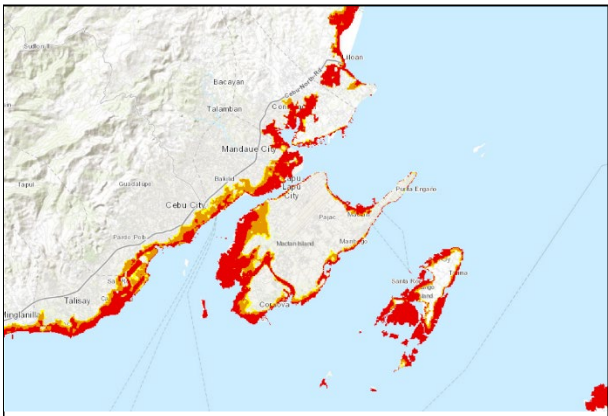
Source: Natural Hazards and Earth System Sciences

Figure 4.2.4 Simulation Result of Predicted Tide Level Caused by Typhoon HAIYAN

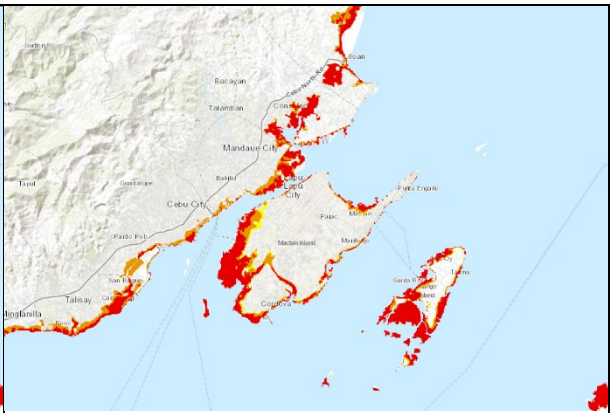
Hazardous Map of Storm Surge

Figure 4.2.5 shows the hazard map of storm surge in the project area provided by Nationwide Operational Assessment of Hazards (NOAH). This hazard map was created by simulating the flooded area due to storm surge using the hydraulic model named FLO-2D developed by the United States Federal Emergency Management Agency (FEMA).

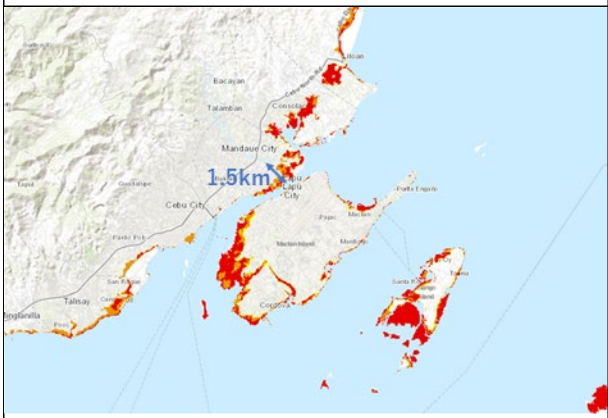
According to the hazard map, the storm surge advisory levels are divided into four levels from 1 to 4, and this figure shows the distribution of storm surge heights when storm surges of up to 2 m, 3 m, 4 m and 5 m hit, respectively. According to Figure 4.2.5, assuming that the storm surge deviation in the project area is 3 m when the typhoon HAIYAN was hit, the hazard map at Advisory Level 2 (3 m height of storm surge) indicates that approximately 1.5 km from the coast line may be flooded more than 1.5m.



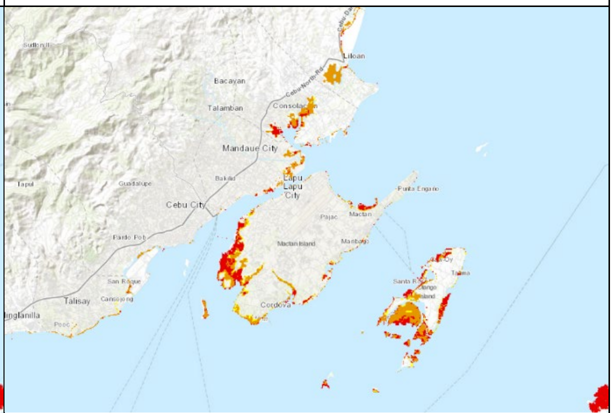
Advisory 4 (5 m Height of Storm Surge)



Advisory 3 (4 m Height of Storm Surge)



Advisory 2 (3 m Height of Storm Surge)



Advisory 1 (2 m Height of Storm Surge)

Lgend:
Red Color：Flooded Height 1.5m, Orange Color：Flood Height 0.5m to 1.5m,
Yellow Color：Flood Height 0.0m to 0.5m

Source: Nationwide Operational Assessment of Hazards (NOAH)

Figure 4.2.5 Hazardous Map of Storm Surge in the Project Area

4.3 Topographic Survey

In order to secure the necessary accuracy of the preliminary design for the Project, topographic survey was conducted along the proposed routes of the 4th Cebu-Mactan Bridge and a part of Mandaue Coastal Road. The survey work was sublet to a local survey company and was performed under the supervision of JICA Survey Team. The site survey was commenced on 22nd February 2019 and is already finished.

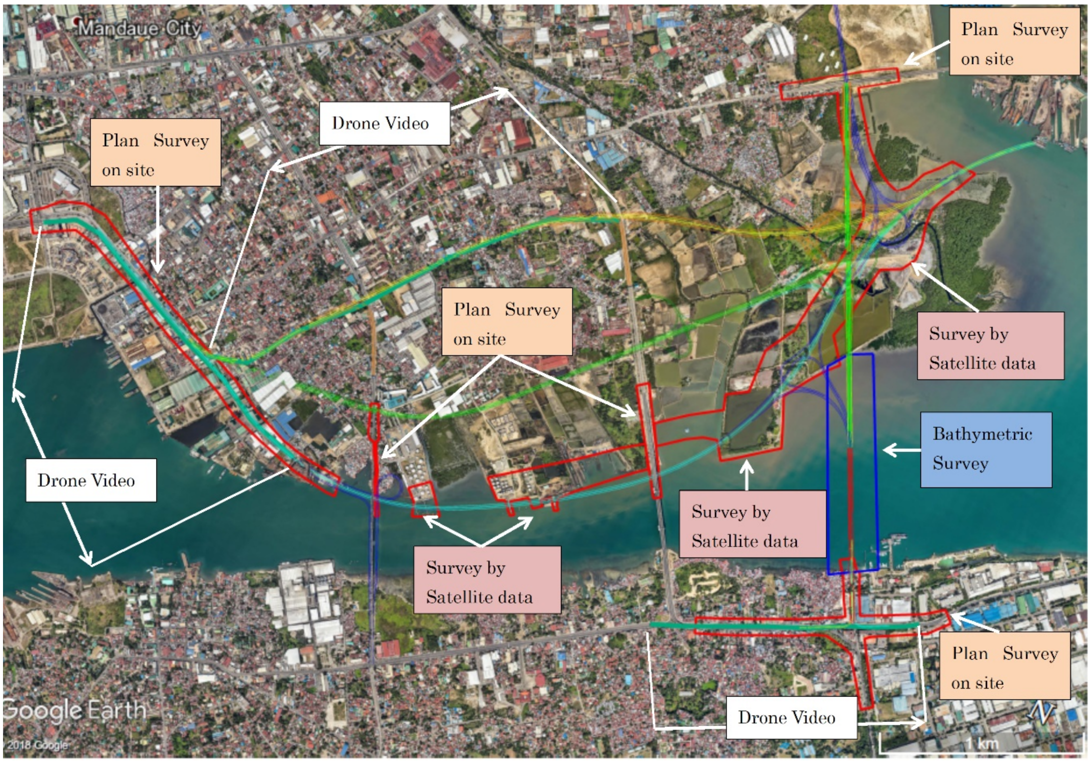
(1) Contents of the Topographic survey

Topographic survey includes Bench Mark settings, land topographic survey, bathymetric survey, video taking by drone and utility survey (underground utilities). Figure 4.3.1 shows the exact locations and areas covered by the above surveys. Table 4.3.1 shows the contents of the survey works. The results of the topographic survey was utilized to realize topographic conditions at the project sites for determining type and scale of the target facilities providing data for the planning and designing.

Table 4.3.1 Contents of Topographic survey

	Unit	Quantity
Topographic (plane) survey on site		
• near Cansaga Bay Bridge	km	0.8
• near Mactan side	km	1.2
• along A. Soriano Ave.	km	1.4
Existing Bride Topo Survey		
• two existing bridges of Cebu–Mactan Bridge	km	1.0
Cross Section Survey	section	10
Bathymetry Survey 600m x 6 lines	has	9
Utility Survey (underground utilities)	utility	3
Drone Video	km	7.5

Source: JICA Survey Team



Source: JICA Survey Team

Figure 4.3.1 Index map of Topographic survey

(2) Accuracy of Topographic survey

Coordinate system was based on UTM Zone 51N, WGS84 spheroid while vertical datum was based from Mean Sea Level (MSL) elevation of the existing NAMRIA Benchmark located or within the project area. Survey output and accuracy are as follows:

- Ground Control Points was in accordance with the DPWH Design Guidelines, Criteria and Standards (DGCS) 2015, Volume 2B: Engineering Surveys.
- Vertical Leveling was at least $\pm$ 8.4mm$\sqrt{L}$ (where L = length of baseline in km)

The topographic maps were drawn as follows;

- Drawing Scale: 1:1,000
- Contour Interval: Major contour at 5.0 meter and Minor contour at 1.0 meter
- Drawing Method: CAD System using DWG format

(3) Result of Topographic Survey

The result of topographic survey is shown in Figure 4.3.2.

Source: JICA Survey Team

Figure 4.3.2 Result of Topographic Survey

<u>Drone Video Capturing</u>

In order to have better understanding of the site condition, drone video was captured at both Mandaue City side and Lapu-Lapu City side.


Mandaue Causeway 3
The Beginning Point of Mandaue Coastal Road


Mactan Circumferential Road 4
Footpass Bridge


Mandaue Causeway 2
8-lane Section


Mactan Circumferential Road 4
Vacant Space of GMC


Mandaue Causeway 1
Mandaue City Hospital


Mactan Circumferential Road 4
Intersection with Airport Access Road


San Miguel Food, Mandaue City Jail


Mactan Circumferential Road 4
Marina Mall, Island Central Mactan

Source: JICA Survey Team

Figure 4.3.3 Frame images from Drone Video Clips

4.4 Geotechnical Investigation

In order to secure the necessary accuracy of the preliminary design for the Project, geotechnical investigation was conducted along the proposed routes of the 4th Cebu-Mactan Bridge and a part of Mandaue Coastal Road. The survey was sublet to a local firm and was performed under the supervision of JICA Survey Team. The site survey was commenced on February 22nd, 2019 and already done all works. The geotechnical investigation includes borehole drilling (includes standard penetration test, undisturbed soil sampling and rock coring) and laboratory soil tests.

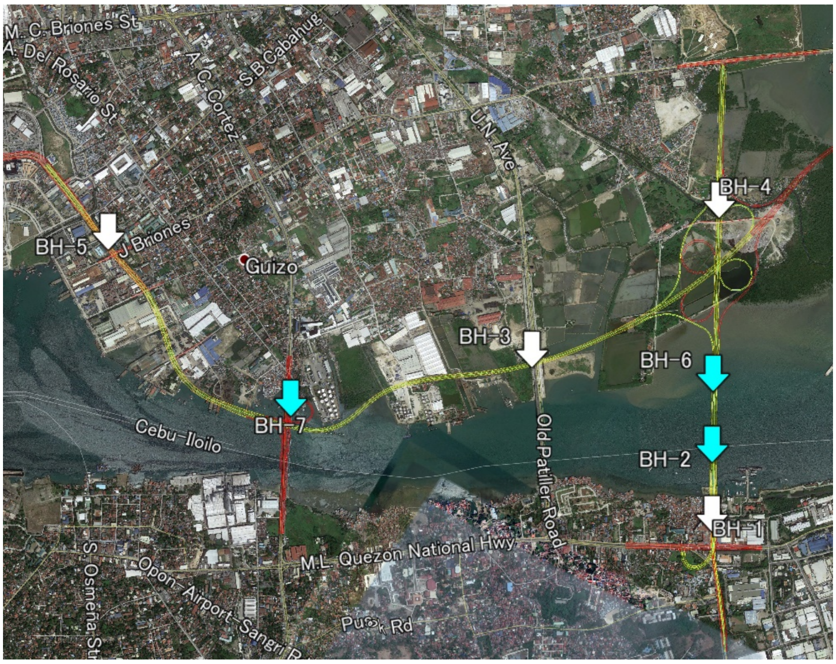
(1) Borehole Drilling

In this investigation, borehole drillings were carried out at selected locations of proposed abutments and piers of the bridges and at some embankments. List/Locations of the drilling and the bulk sample sampling were shown in Table 4.4.1 and Figure 4.4.1.

Table 4.4.1 Locations of Borehole Drilling

	Purpose of survey	Land Owner / Jurisdiction	Condition	
BH 1	Approach Embankment of 4th Mactan Br Lapu Lapu side	PEZA	Land	PEZA Road Side
BH 2	Main Pier of 4th Mactan Br Lapu Lapu side	Coast Guard and Port Authority	Sea	In the Sea for New Mactan BR Lapu-Lapu side
BH 3	Interchange of Mandaue Coastal Road and 4th Mactan Br	Private	Land	Near 2nd Mactan BR Mandaue side
BH 4	Interchange of Mandaue Coastal Road and Access road to Plaridel St	Mandaue Dump Site	Land	Bush in Dump Site
BH 5	Approach Embankment of Mandaue Coastal Road Mandaue side	Mandaue	Land	Space in Hospital
BH 6	Main Pier of 4th Mactan Br Mandaue side	Coast Guard and Port Authority	Sea	In the Sea for New Mactan BR Mandaue side
BH 7	Viadact Bridge of Mandaue Coastal Road	Coast Guard and Port Authority	Sea	In the Sea for Coastal Road

Source: JICA Survey Team



Source: JICA Survey Team

Figure 4.4.1 Index map of Geotechnical Investigation

Standard penetration test (SPT), undisturbed soil sampling (UD Sampling) and rock coring were included in the borehole drillings. The SPTs were conducted at every one (1) meter depth and were continued until confirmation of bearing strata having at least five (5) meter depth of N-value of 50 or more. UD samplings were obtained by using hydraulic piston samplers from the selected depths ranging from very soft to soft soil layers equivalent to the N-value of 4 or less.

Drilling log was shown in Table 4.4.2 as below;

Table 4.4.2 List of Borehole drilling log

No.	Location	Borehole I.D.	Work Duration	Coordinates	Elev. (meter)	Final Depth (meter)
1	Onland	BH-1	May 8 – 11, 2019	N: 1141690.242 E: 606890.659	11.00	25.70
2	Offshore	BH-2	April 8 – 12, 2019	N: 1142009.378 E: 607608.462	-9.06	42.15
3	Onland	BH-3	March 22 – 27, 2019	N: 1141959.878 E: 605592.378	1.82	54.30
4	Onland	BH-4	March 2 – 5, 2019	N: 1143178.362 E: 606062.266	7.72	37.70
5	Onland	BH-5	March 12 – 18, 2019	N: 1141347.831 E: 603264.272	2.68	63.30
6	Offshore	BH-6	March 31 – April 5, 2019	N: 1142346.628 E: 606515.812	-2.77	40.70
7	Offshore	BH-7	April 23 – 27, 2019	N: 1141066.131 E: 604588.207	0.00	46.70
TOTAL						310.55

Source: JICA Survey Team

(2) Outline of site boring result

<u>BH-1 (Onland borehole)</u>

This borehole was drilled to 25.70 m depth. Standard Penetration Test was not conducted in the upper 3.0m depth to avoid hitting underground utilities, as revealed by PEZA. In general, the soil formation consists of creamy white, sand/gravel-sized Limestone fragments. Recorded SPT N-value ranged from zero in the shallow depths and linearly increase towards the bottom and hits practical refusals down to the end of the borehole (N>60). The ground water table was encountered at 9.20 m below the existing ground surface at the time of the investigation.

<u>BH-2 (Offshore borehole)</u>

This borehole was drilled to 42.20 m depth. The soil formation in this area consists of alternating layer of Clay and sand-sized Limestone fragments with varying consistency. Recorded SPT N-value ranged from 0<N<5 in the upper 13.0 meters, followed by the stiffer materials down to 35.0 m with SPT N-value ranged from 10<N<27. Beneath this layer is the competent materials, with refusal SPT N-value (N>50) that extend down to the end of the borehole. The undisturbed sample recovered in this borehole were tested with unconfined compression and consolidation tests.

<u>BH-3 (Onland borehole)</u>

This borehole was terminated at 54.30 m depth. The soil formation in this area consists mainly of Clay materials with varying consistency down to 50.0 m depth reckoned from the existing ground level. The soil consistency in the upper 20.0 m depth is very soft to soft, with a recorded SPT N-value ranged from

0<N<6. 11 stiffer materials that extend down to 50.0 m depth with a recorded SPT N value ranged from 14<N<39. Underneath this layer is the competent materials, described as Sand and Gravel mixture with a refusal SPT N-value, N>60. The undisturbed sample recovered in this borehole were tested with consolidation and triaxial tests.

BH-4 (Onland borehole)

This borehole was situated in the landfill/dumpsite area. Borehole was terminated at 37.70 m depth. The upper 8m depth mainly consists of soil and garbage materials. Underneath this layer, is the alternating sequence of sand/gravel-sized Limestone fragments and Clay materials. Soil consistency in the upper 27.0m depth belongs to very soft to soft, with a recorded SPT N-value ranged from 0<N<6 and occasional high blow of 9<N<21 brought by the presence of fine gravel and limestone fragments. Beneath this layer is the competent materials, that hit practical refusals (N>60). The ground water table was encountered at 6.50m below the existing ground surface at the time of the investigation.

BH-5 (Onland borehole)

This borehole was terminated at 63.30 m depth. The soil stratification in the area consists mainly of Clay materials that extended down to 55.0 m depth reckoned from the existing ground level. Pocket/lenses of sand layer was also encountered between 34.0 to 44.0 meters depth. The uppermost 8.0 m have a consistency of very soft with NF actual Report for the Proposed New Mactan Bridge, Mactan – Mandaue, Cebu. 12 value ranged from 0<N<8. This is then followed by the stiffer materials with linearly increasing SPT blow counts from a low of 8 in the upper stretches to as high as 48 at the bottom. Beneath this layer is the sand/gravel-sized Limestone fragments. SPT N-value hits practical refusals, N>60. Groundwater table was encountered at 6.50 m depth reckoned from the existing ground. The undisturbed sample recovered in this borehole were tested with consolidation and triaxial tests.

BH-6 (Offshore borehole)

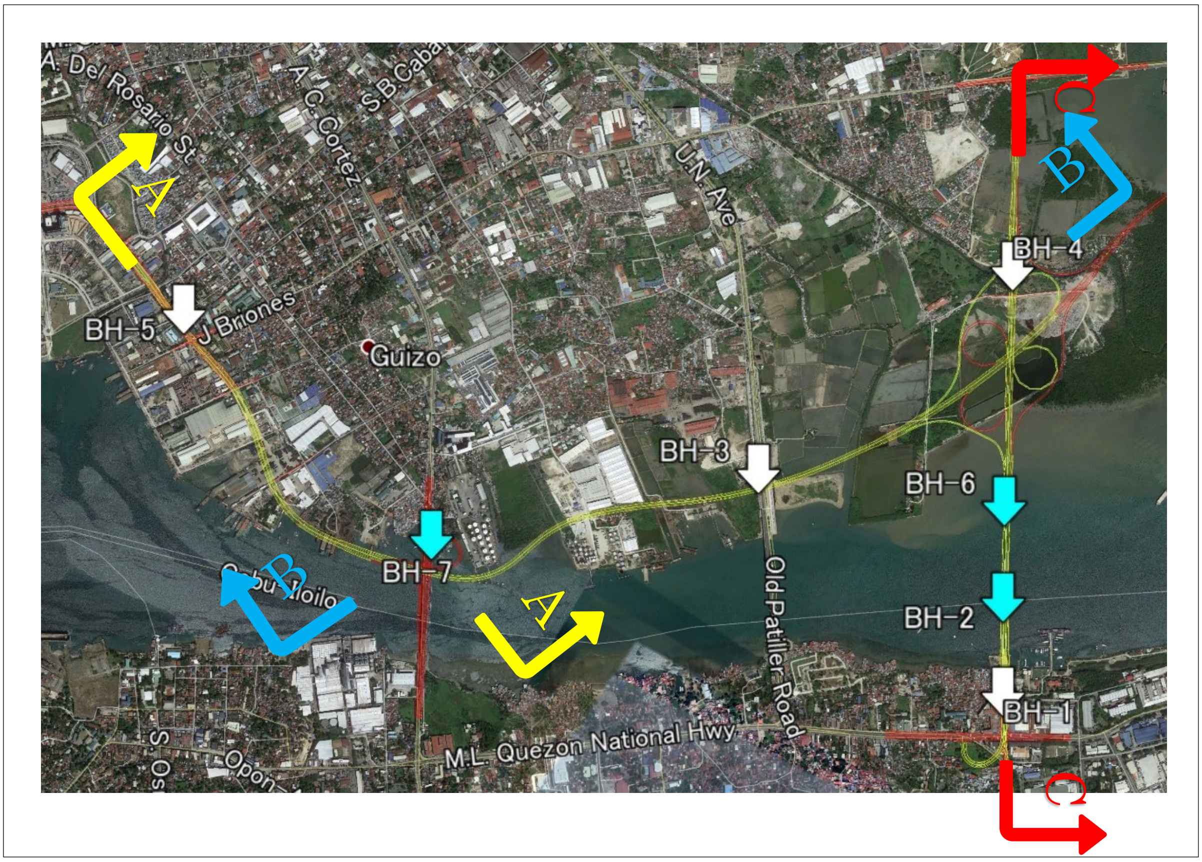
This borehole was drilled to 40.70 m depth. The soil formation in this area consists of upper 30.0 m thick of Clay, with the uppermost 20.0 m recorded an SPT N-value of zero. The zero N-value would mean that the mere sitting of the drop hammer would cause the full penetration of the SPT sampler. Beneath the very soft formation is the stiffer materials encountered from 20 to 30 meters depth with an average SPT N value of 16. Underneath this layer is the competent materials that extends down to the end of the borehole. It is described as mixture of sand-sized Limestone fragments and Clay materials. SPT N-value were recorded to hit practical refusals, N>60. The undisturbed sample recovered in this borehole were tested with consolidation test.

BH-7 (Offshore borehole)

This borehole was terminated at 46.70 m depth. The soil formation in this area consists mainly of Clay materials with pocket/lenses of fine-grained sand and sand-sized limestone fragments. The upper 9.0 m depth has recorded SPT N-value of zero. The zero N-value would mean that the mere sitting of the drop hammer would cause the full penetration of the SPT sampler. This is then followed by the stiffer materials with an SPT N value ranged from 9<N<43 towards 40.0 m depth and hit practical refusals beyond this level, N>60. The undisturbed sample recovered in this borehole were tested with consolidation and triaxial tests.

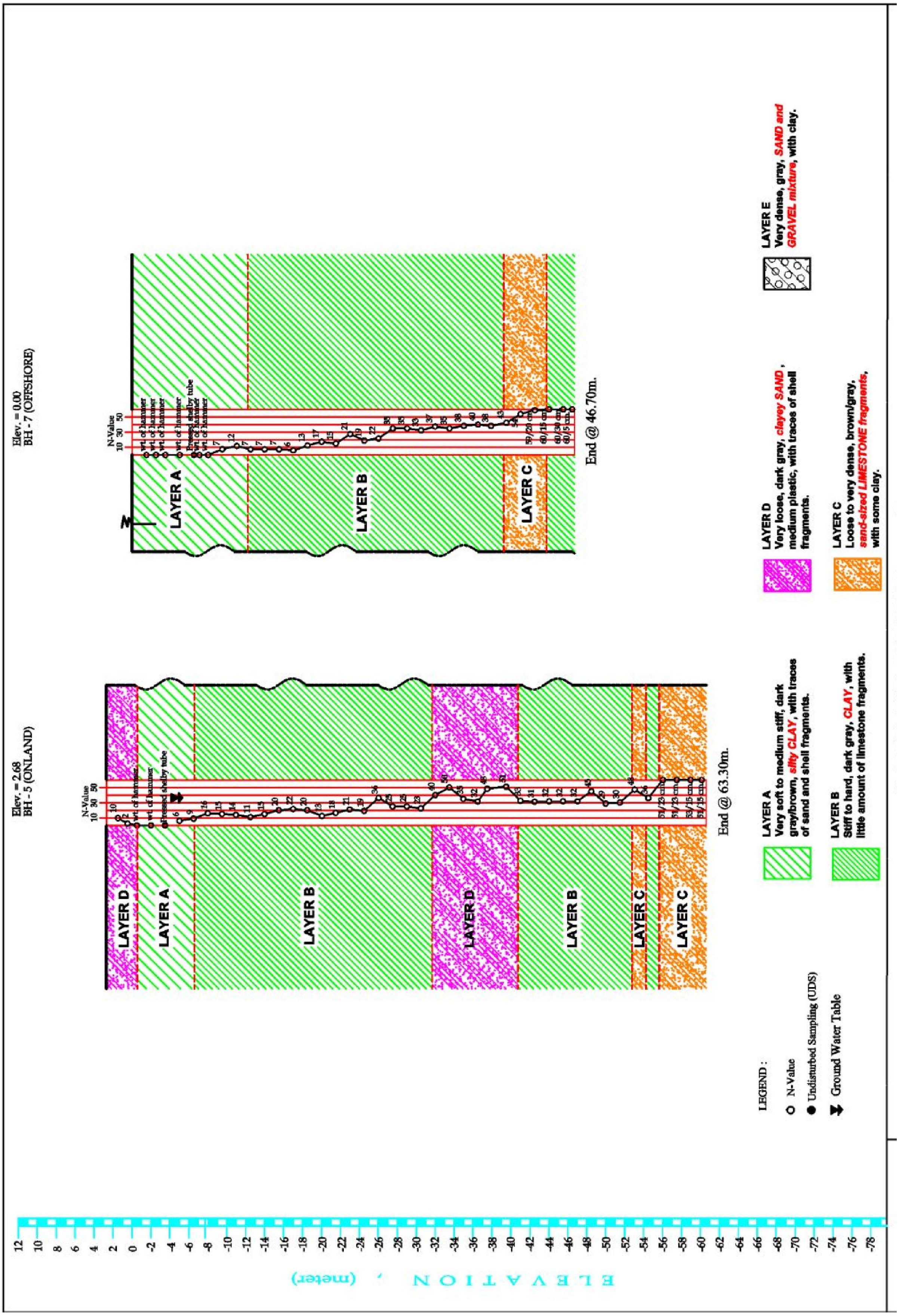
(3) Geological Profile

Geological profile was shown in from Figure 4.4.3 to Figure 4.4.5. This profile was considered by each results of site boring and laboratory test of any samples. Three profiles location (A-A, B-B, C-C) was shown in Figure 4.4.2.



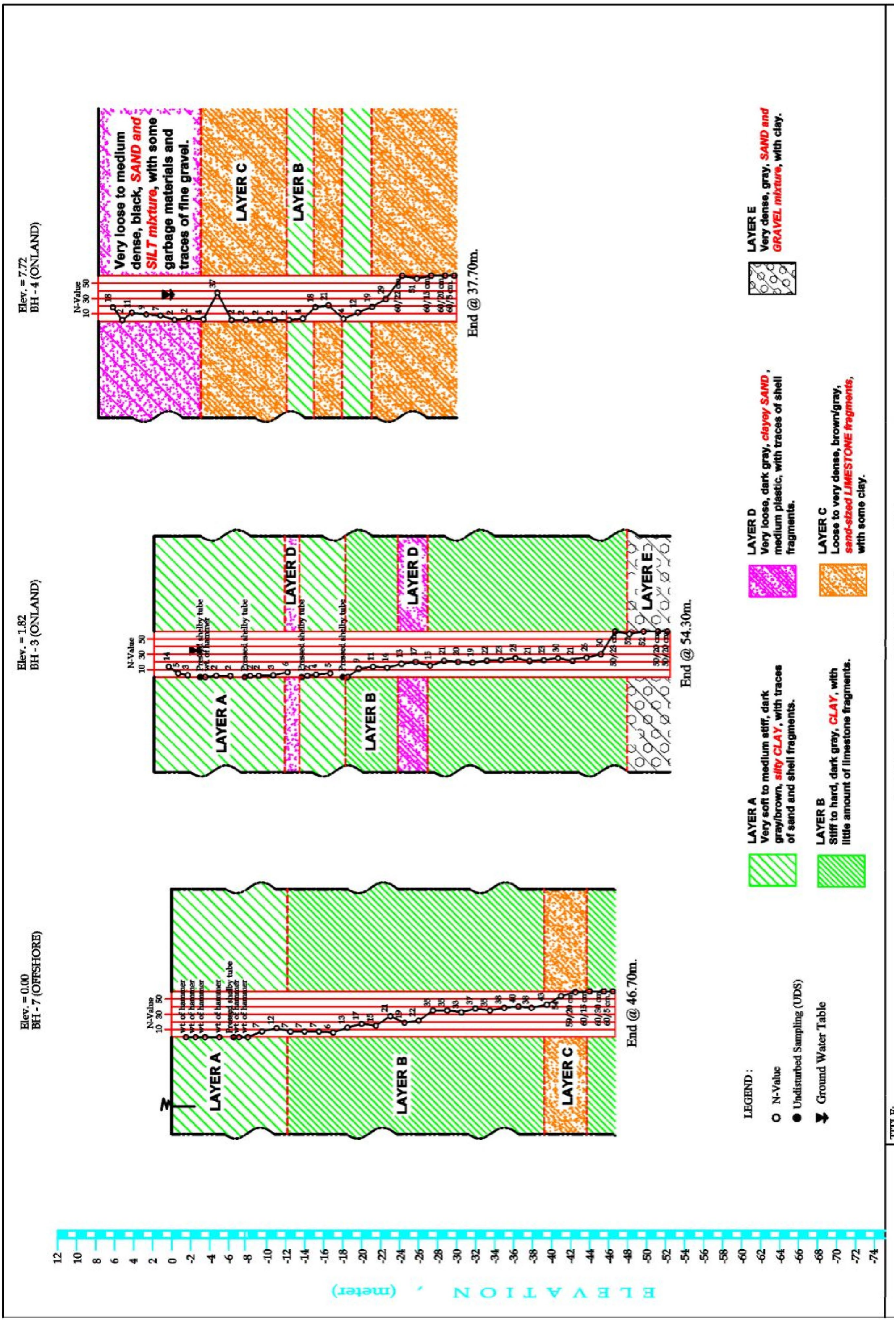
Source: JICA Survey Team

Figure 4.4.2 Location map of Geological Profile



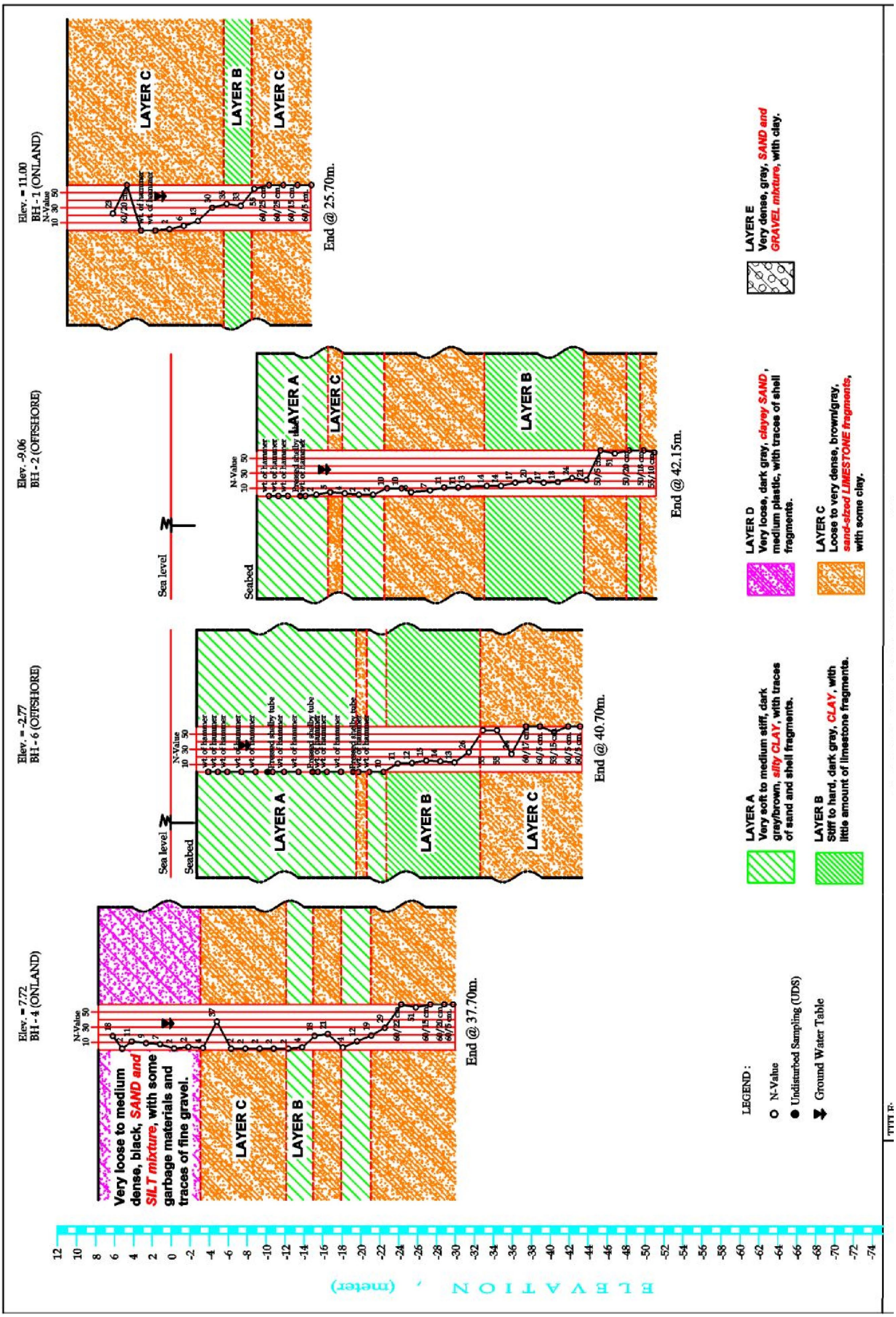
Source: JICA Survey Team

Figure 4.4.3 Geological Profile (A-A)



Source: JICA Survey Team

Figure 4.4.4 Geological Profile (B-B)



Source: JICA Survey Team

Figure 4.4.5 Geological Profile (C-C)

(4) Laboratory test

Quantities of Geotechnical Investigation including the laboratory soil tests were shown in Table 4.4.3.

Laboratory tests is carried out in a laboratory on all the UD Samples, some SPT samples and a bulk sample from the borrow pit. Physical property tests were carried out on all the selected samples. Mechanical property tests were carried out on UD samples.

Table 4.4.3 Quantities of laboratory test

BREAKDOWN OF QUANTITIES											
ITEM NO.	BH NO.	CONTRACT DEP TH (m) OF BOREHOLE	ACTUAL DEP TH (m) OF BOREHOLE	LABORATORY QUANTITIES							
				Soil Class.	Specifi c Gravity	NMC	GSA / Hydromete r	Atterberg Limit	UCT Soil	C o nso . T est	Triaxial Test
ONLAND BOREHOLES											
1	BH-1	40.00	25.70	5	4	5	5	1	0	0	0
2	BH-3	40.00	54.30	6	6	6	6	6	0	2	2
3	BH-4	40.00	37.70	7	7	7	7	3	0	0	0
4	BH-5	40.00	63.30	5	5	5	5	5	0	1	1
Total (4 BHs)		160.00	181.00	23	22	23	23	15	0	3	3
OFFSHORE BOREHOLES											
1	BH-2	40.00	42.15	5	5	5	5	5	1	1	1
2	BH-6	40.00	40.70	5	4	5	5	4	0	1	0
3	BH-7	40.00	46.70	6	6	6	6	6	0	1	1
Total (3 BHs)		120.00	129.55	16	15	16	16	15	1	3	2
Grand Total		**280.00**	**310.55**	**39**	**37**	**39**	**39**	**30**	**1**	**6**	**5**

Source: JICA Survey Team

Summary of all laboratory test results were shown in from Table 4.4.4 to Table 4.4.6.

BH NO.	SPL NO.	DEPTH (m)	SOIL DESCRIPTION	NATURAL MOISTURE CONTENT (%)	SIEVE ANALYSIS % PASSING											ATTERBERG LIMITS			UNCONFINED COMPRESSION TEST (SOIL)	CONSOLIDATION TEST		UNCONSOLIDATED UNDRAINED TRIAXIAL TEST		SPECIFIC GRAVITY (Gs)
					1 1/2"	1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#100	#200	LL	PL	PI	qu (kPa)	Pc (kPa)	Cv	Cohesion	Phi Angle	(g/cc)
	ss-3	7.50-7.95	Creamy white, very loose, gravel-sized LIMESTONE fragments, with some non-plastic silt.	16.70			100	55	41	37	32	27	24	22	21	NP	NP	NP	-	-	-	-	-	-
	ss-5	10.50-10.95	Creamy white, very loose, sand/gravel-sized LIMESTONE fragments and non-plastic SILT mixture.	30.18		100	76	72	68	64	56	49	44	37	32	NP	NP	NP	-	-	-	-	-	2.59
BH-1	ss-7	13.50-13.95	Creamy white, medium dense, sand/gravel-sized LIMESTONE fragments, with some non-plastic silt.	19.13			100	88	79	64	48	36	30	24	21	NP	NP	NP	-	-	-	-	-	2.57
	ss-9	16.50-16.95	Creamy white, hard, silty CLAY, slightly plastic, with limestone fragments	20.83					100	97	89	79	74	67	64	26	17	9	-	-	-	-	-	2.59
	ss-14	24.00-24.30	Creamy white, very dense, gravel- sized LIMESTONE fragments.	17.34		100	86	69	55	37	25	20	17	14	13	NP	NP	NP	-	-	-	-	-	2.57
	uds-1	4.50-4.95	Dark gray, very soft, silty CLAY, medium plastic, with little amount of shell fragments.	69.06								100	98	97	90	40	19	21	4.04	29.43	0.65	9.00	5.00	2.71
	ss-7	9.00-9.45	Dark gray, soft, silty CLAY, medium plastic, with gravel-sized limestone fragments.	51.18		100	87	74	72	68	63	59	56	51	48	38	20	18	-	-	-	-	-	2.66
BH-2	ss-15	21.00-21.45	Creamy white, stiff, sand/gravel-sized coralline LIMESTONE fragments and slightly plastic CLAY mixture	17.25				100	86	69	56	49	46	40	33	29	17	12	-	-	-	-	-	2.68
	ss-18	25.50-25.95	Dark gray, stiff, silty CLAY, medium plastic, with traces sand.	34.57					100	98	97	96	95	94	92	41	21	20	-	-	-	-	-	2.68
	ss-27	39.00-39.35	Creamy white, hard, silty CLAY, slightly plastic, with sand-sized limestone fragments.	18.48			100	93	92	83	74	68	64	58	56	28	19	9	-	-	-	-	-	2.68
	uds-1	4.50-4.95	Brownish gray, very soft, sandy CLAY, medium plastic, with traces of shell fragments.	56.21					100	100	99	99	99	98	93	40	19	21	-	56.90	0.60	-	-	2.72
	uds-2	9.00-9.45	Dark gray, very soft, silty CLAY, medium plastic, with some sand and traces of fine gravel.	41.80					100	94	93	92	91	85	73	39	18	21	-	78.50	0.38	7.00	5.00	2.60
	uds-3	15.00-15.45	Dark gray, very soft, silty CLAY, medium plastic, with little amount of sand and traces of shell fragments.	52.75					100	99	96	93	92	91	88	48	21	27	-	-	-	7.00	5.00	2.63
BH-3	uds-4	19.00-19.45	Yellowish brown, very soft, silty CLAY, medium plastic, with some sand and traces of fine gravel.	34.69			100	96	95	93	89	86	83	75	70	38	18	20	-	-	-	-	-	2.69
	ss-28	40.50-40.95	Gray, very stiff, silty CLAY, medium plastic, with traces of sand.	26.20					100	100	99	99	99	98	93	45	19	26	-	-	-	-	-	2.59
	ss-36	52.50-52.85	Gray, very dense, SAND and GRAVEL mixture, with little amount of medium plastic clay.	20.83			100	76	73	57	43	31	24	17	14	35	18	17	-	-	-	-	-	2.60

Table 4.4.4 Summary Table of Laboratory test results (1/3)

Source: JICA Survey Team

BH NO.	SPL NO.	DEPTH (m)	SOIL DESCRIPTION	NATURAL MOISTURE CONTENT (%)	SIEVE ANALYSIS % PASSING											ATTERBERG LIMITS			UNCONFINED COMPRESSION TEST (SOIL)	CONSOLIDATION TEST		UNCONSOLIDATED UNDRAINED TRIAXIAL TEST		SPECIFIC GRAVITY (Gs)
					1 1/2"	1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#100	#200	LL	PL	PI	qu (kPa)	Pc (kPa)	Cv	Cohesion	Phi Angle	(g/cc)
	ss-7	9.00-9.45	Dark gray, very loose, clayey SAND, medium plastic, with traces of shell fragments	32.80			100	94	85	76	65	59	53	44	40	44	19	25	-	-	-	-	-	2.64
	ss-9	12.00-12.45	Gray, dense, sand-sized LIMESTONE fragments, with little amount of non- plastic silt and traces of shell fragments.	25.20				100	80	76	58	47	33	22	15	NP	NP	NP	-	-	-	-	-	2.55
	ss-11	15.00-15.45	Gray, very loose, gravel-sized LIMESTONE fragments, with clay.	38.79			100	65	59	53	49	46	44	41	39	Insufficient sample			-	-	-	-	-	2.63
BH-4	ss-15	21.00-21.45	Dark gray, soft, CLAY, high plastic, with traces of limestone fragments.	35.83				100	96	95	95	94	94	91	88	52	20	32	-	-	-	-	-	2.60
	ss-17	24.00-24.45	Dark gray, medium dense, sand-sized LIMESTONE fragments.	19.21			100	98	97	92	88	85	78	22	13	NP	NP	NP	-	-	-	-	-	2.68
	ss-20	28.50-28.95	Light brown, medium dense, sand- sized LIMESTONE fragments, with some slightly plastic clay.	15.79			100	97	94	78	62	48	44	41	29	25	17	8	-	-	-	-	-	2.64
	ss-25	36.00-36.35	Brown, very dense, sand-sized LIMESTONE fragments, with some clay.	20.84			100	92	89	79	68	60	53	41	35	NP	NP	NP	-	-	-	-	-	
	ss-2	2.00-2.45	Brown, very soft, sandy CLAY, slightly plastic, with traces of shell fragments.	29.83				100	99	99	98	96	93	81	66	29	19	10	-	-	-	-	-	2.69
	uds-1	6.00-6.45	Dark gray, very soft, silty CLAY, medium plastic, with little amount of sand and fine gravel.	46.52				100	91	89	86	86	85	82	72	38	17	21		49.10	0.45	10.00	5.00	2.65
BH-5	ss-17	25.50-25.95	Dark gray, very stiff, silty CLAY, medium plastic, with traces of sand and shell fragments.	33.89							100	100	100	99	99	44	21	23	-	-	-	-	-	2.57
	ss-32	48.00-48.45	Grayish brown, hard, silty CLAY, medium plastic, with some limestone fragments.	23.67			100	97	95	95	92	90	88	82	69	44	20	24	-	-	-	-	-	2.64
	ss-40	60.00-60.40	Creamy white, gravel-sized LIMESTONE fragments and high plastic CLAY mixture.	18.44	100	80	72	69	68	60	56	52	51	49	47	59	22	37	-	-	-	-	-	2.63

Table 4.4.5 Summary Table of Laboratory test results (2/3)

Source: JICA Survey Team

BH NO.	SPL NO.	DEPTH (m)	SOIL DESCRIPTION	NATURAL MOISTURE CONTENT (%)	SIEVE ANALYSIS % PASSING											ATTERBERG LIMITS			UNCONFINED COMPRESSION TEST (SOIL)	CONSOLIDATION TEST		UNCONSOLIDATED UNDRAINED TRIAXIAL TEST		SPECIFIC GRAVITY (Gs)
					1 1/2"	1"	3/4"	1/2"	3/8"	#4	#10	#20	#40	#100	#200	LL	PL	PI	qu (kPa)	Pc (kPa)	Cv	Cohesion	Phi Angle	(g/cc)
BH-6	uds-1	7.50-7.95	Dark gray, very soft, silty CLAY, medium plastic, with traces of sand.	78.11								100	99	97	96	43	21	22	-	29.43	0.69	-		2.65
	uds-2	12.00-12.45	Dark gray, very soft, silty CLAY, medium plastic, with traces of sand.	69.09							100	100	100	98	93	38	22	16	-	-	-	-	-	2.71
	uds-3	16.50-16.95	Dark gray, very soft, silty CLAY, slightly plastic, with traces of sand.	66.57															-	-	-	-	-	-
	ss-12	16.95-17.40	Dark gray, very loose, sand-sized LIMESTONE fragments and very soft slightly plastic CLAY mixture.	44.17					100	99	97	91	85	67	53	28	20	8	-	-	-	-	-	2.66
	ss-20	28.50-28.95	Yellowish brown, very stiff, silty CLAY, slightly plastic, with some limestone fragments.	18.21					100	99	98	94	90	83	78	29	19	10	-	-	-	-	-	2.67
	ss-28	40.50-40.95	Yellowish brown, hard, coralline LIMESTONE fragments and CLAY mixture.	10.97			100	86	84	80	72	61	55	41	33	Insufficient sample			-	-	-	-	-	-
BH-7	uds-1	6.00-6.45	Dark gray, very soft, silty CLAY, medium plastic, with traces of sand.	68.15								100	100	99	95	45	21	24		39.24	0.57	12.00	5.00	2.70
	ss-9	12.00-12.45	Yellowish brown, medium stiff, CLAY, high plastic, with traces of sand.	35.63									100	100	99	63	26	37	-	-	-	-	-	2.67
	ss-15	22.50-22.95	Brownish gray, very stiff, CLAY, medium plastic, with traces of sand.	32.87								100	100	100	97	51	23	28	-	-	-	-	-	2.68
	ss-21	30.00-30.45	Reddish brown, hard, silty CLAY, medium plastic, with traces of limestone fragments and shell fragments.	29.12					100	100	99	99	98	98	97	43	22	21	-	-	-	-	-	2.70
	ss-25	36.00-36.45	Brownish gray, hard, CLAY, high plastic, with traces of sand.	34.33							100	100	99	99	97	60	22	38	-	-	-	-	-	2.70
	ss-30	43.50-43.80	Creamy white, hard, silty CLAY, slightly plastic, with sand-sized limestone fragments.	21.40					100	98	96	92	87	73	62	27	18	9	-	-	-	-	-	2.67

Table 4.4.6 Summary Table of Laboratory test results (3/3)

Source: JICA Survey Team

5. PRELIMINARY DESIGN

5.1 Highway Design

5.1.1 Design Criteria and Standards

(1) Reference Documents

The design criteria and standards for the Project are defined in reference to the following guidelines:

- DPWH, Design Guidelines, Criteria & Standards, Volume 4 Highway Design, 2015
- DPWH, Road Safety Design Manual, 2012
- DPWH, Road Sign and Pavement Markings Manual, 2012
- AASHTO, A Policy on Geometric Design of Highways and Streets, 7th Edition, 2018
- AASHTO, Guide for Design of Pavement Structures, 4th Edition, 1993
- Transportation Research Board, Highway Capacity Manual, 2010
- Japan Road Association, Road Structure Ordinance, 2015
- Nippon Expressway Company (NEXCO), Design Manuals, Part 4: Geometric Design, 2010

(2) General Design Considerations

Table 5.1.1 summarizes the general design considerations for the Project Roads. The details of each elements are discussed in the following sections.

Table 5.1.1 General Design Considerations

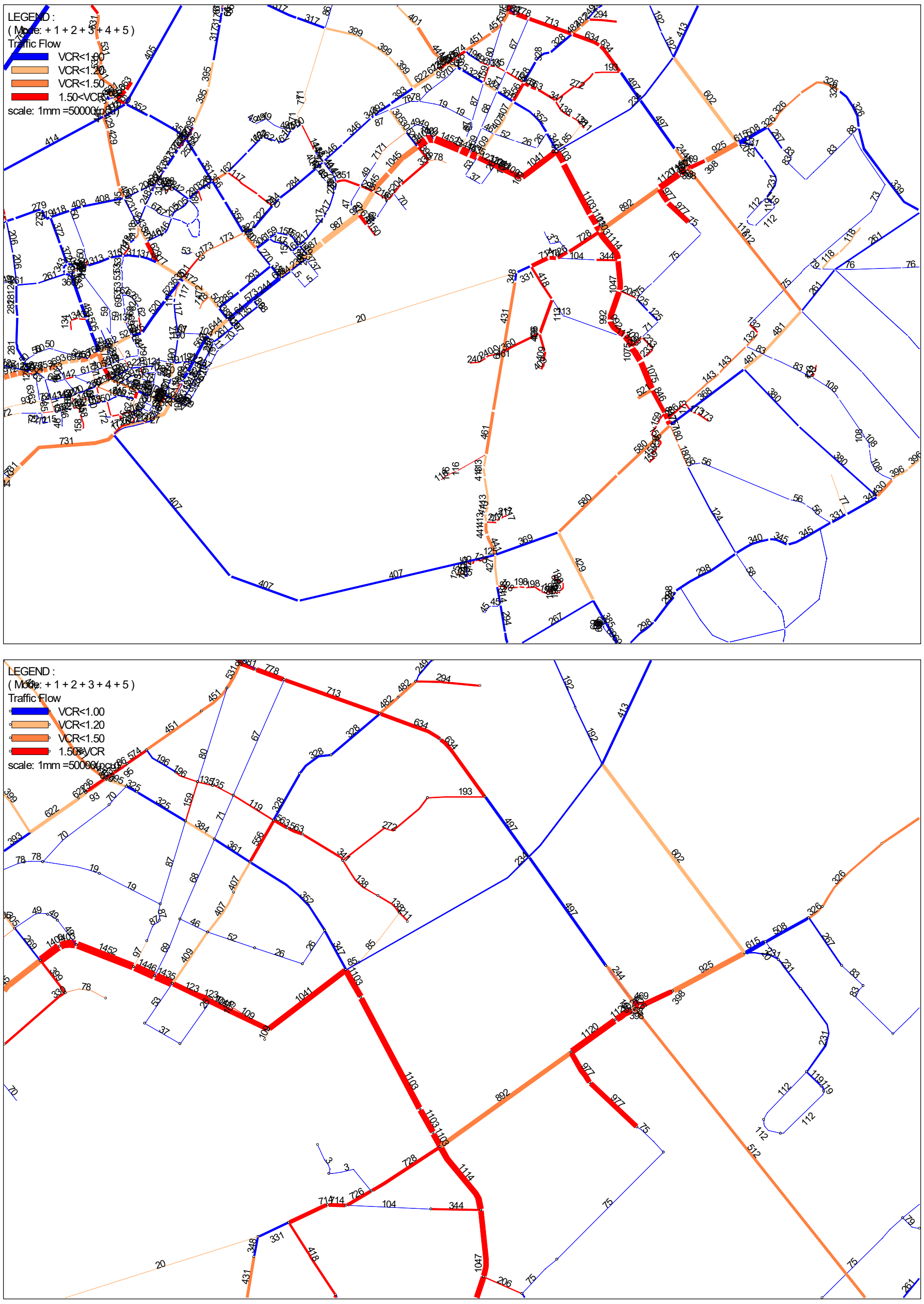
		Unit	4th Cebu-Mactan Bridge	Mandaue Coastal Road	Interchange Ramps	Remarks
Design Traffic Volume (Projection year: 2039)		PCU/day	60,000	24,000 – 104,000	See Figure 5.1.2	Including motorcycle
		vehicle/day	43,000	18,000 – 71,000		Excluding motorcycle
Road Classification	Functionality	-	Intercity Link	Access Controlled Highway in Urban Area	Interchange	
	Japanese Standard	-	3-1	2-1	Type-B	
Design Speed		km/h	60	80	40	Japanese Standard (60 km/h is applied for 4th Cebu-Mactan Bridge due to its short road length.)
Number of Through-Traffic Lanes		Lane	4-lane (2-lane for each direction)	6-lane/4-lane (3-lane/2-lane for each direction)	2-lane/1-lane	
Design Vehicle		-	WB-15	WB-15	WB-15	

Source: Japanese Standard: Explanation and Operation of Road Structure Ordinance, 2015

Design Traffic Volume

The maximum design period commonly used is in the range of 15 to 24 years so both urban and rural highways should normally be designed to accommodate traffic projections for a 20-year period into the future, particularly for new construction. Traffic cannot usually be forecasted accurately beyond this period on a specific facility because of probable changes in the general regional economy, population, and land development along the highway, which cannot be predicted with any degree of assurance. Therefore, the traffic volume in year 2039 (after 20 years from 2019) would be appropriate for the planning and designing of the Project Road.

Based on the traffic demand forecast described in Chapter 4, the design traffic volumes for 4th Cebu-Mactan Bridge and Mandaue Coastal Road were determined as 60,000 PCU/day and 24,000-104,000 PCU/day respectively (see Figure 5.1.1 and Table 5.1.2).



Note: The unit of the traffic volumes shown in the figure is 100 PCU/day (e.g.: 602 on 4th Bridge intends 60,200 PCU/day)
Source: JICA Survey Team

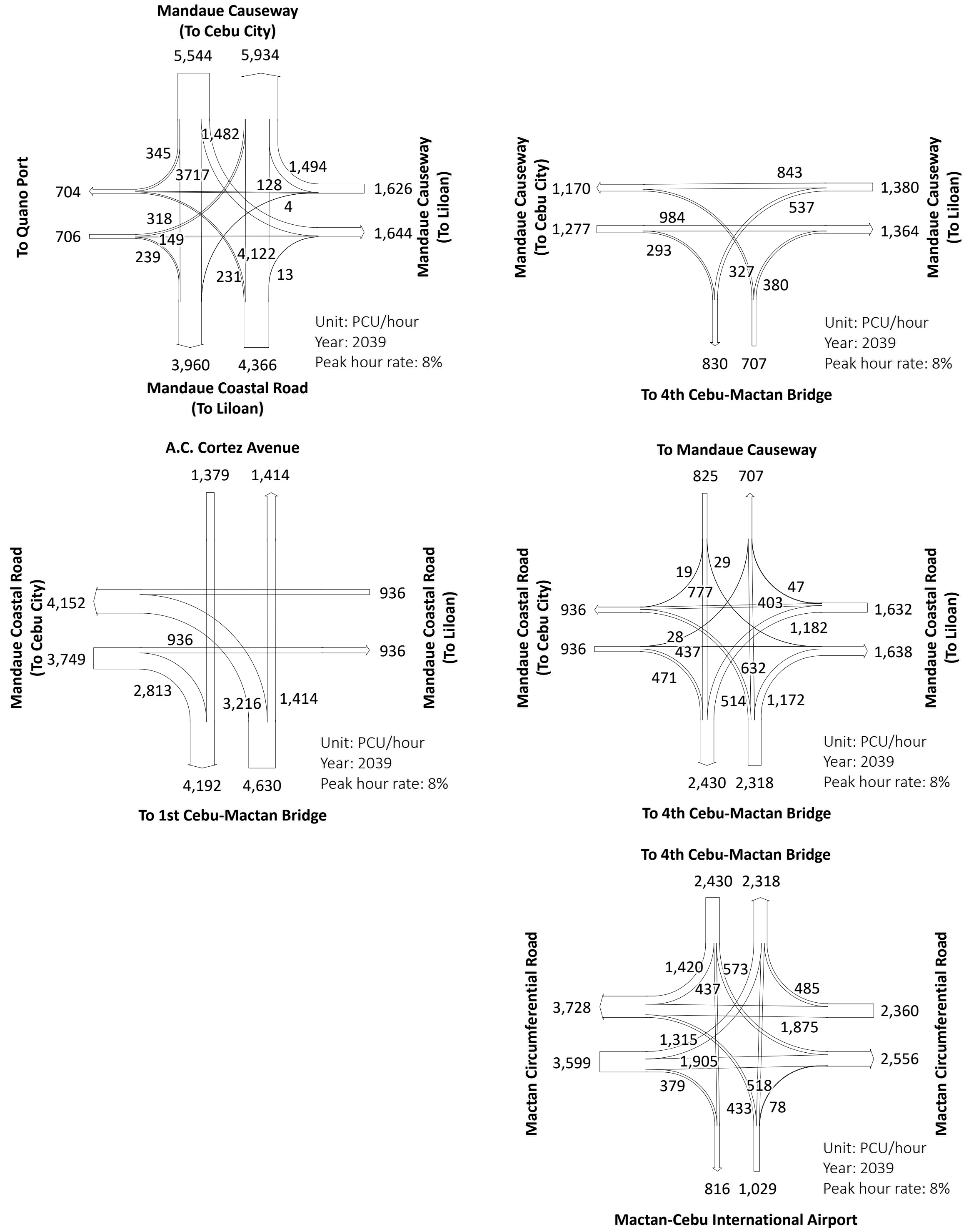
Figure 5.1.1 Projected Future Traffic Volume in 2039

Table 5.1.2 Projected Future Traffic Volume in 2039

		Motorcycle	Car	Jeepney	Tricycle	Truck	Total
PCU factor		0.33	1.00	1.57	0.41	2.29	
4th Bridge	Mactan	14,145	15,426	3,264	590	2,252	35,677
	Mandaue	16,194	16,014	2,860	551	1,532	37,151
	Total (vehicle/day)	**30,339**	**31,440**	**6,124**	**1,141**	**3,784**	**72,828**
	Total (PCU/day)	**10,012**	**31,440**	**9,614**	**468**	**8,665**	**60,199**
Coastal Road	East Bound	28,397	24,232	5,113	710	3,318	61,770
	West Bound	31,600	27,923	5,452	690	3,221	68,886
	Total (vehicle/day)	**59,997**	**52,155**	**10,565**	**1,400**	**6,539**	**130,656**
	Total (PCU/day)	**19,799**	**52,155**	**16,588**	**574**	**14,974**	**104,090**

Source: JICA Survey Team

Figure 5.1.2 shows future traffic flow at the interconnecting points during peak hours. Interchange ramps and at-grade intersections should be designed based on hourly traffic volume so that peak hour traffic should be calculated. According to the traffic survey result conducted by MCUTMP, peak hour rate of traffic at the 1st and 2nd Cebu-Mactan Bridges vary from 6.8% to 9.2% so that peak hour rate of 8% was applied for designing of interchange ramps and at-grade intersections under this Survey.



Source: JICA Survey Team

Figure 5.1.2 Directional Traffic Volume at Interconnecting Points (PCU/hour)

<u>Road Classification</u>

In order to properly design all related roads in this Project, it should be better to classify the functionality of the roads. The following are the expected function of each road:

- 4th Cebu-Mactan Bridge: Intercity link across channel
- Mandaue Coastal Road: Access controlled highway in urban area
- Interchange Ramps: Grade separated interconnection between two or more roadways

Design Speed

In reference to the Japanese standard, design speed of each road segment was determined as follows:

- 4th Cebu-Mactan Bridge: 60 km/h
- Mandaue Coastal Road: 80 km/h
- Interchange Ramps: 40 km/h

Number of Through-Traffic Lanes

In reference to Highway Capacity Manual, the required number of through-traffic lanes was determined for each road segment. Figure 5.1.3 shows examples of the traffic flow condition at each level of service (LOS).

LOS A
Free-flow operations

LOS B
Reasonably free-flow operations

LOS C
Flow with speeds near the free-flow speed of highway

LOS D
The level at whch speeds begin to decline with increasing flows, with density increasing more quickly.

LOS E
Operation at capacity

LOS F
Breakdown or unstable flow

Source: Highway Capacity Manual 2010 (Transportation Research Board)

Figure 5.1.3 Level of Service Examples

The maximum service flow rates for the design speeds of 60 km/h and 80 km/h were calculated using the approximation formula based on the maximum service flow rates at LOS D described in Highway Capacity Manual 2010 (see Table 5.1.3). The approximation formula for LOS D was determined as follows and the calculated maximum service flow rates for the design speeds of 60 km/h and 80 km/h are 1,550 pcu/hour/lane and 1,710 pcu/hour/lane respectively:

$$MSF_D = 12.407 \times FFS + 1001.6$$

Where

MSF_D: Maximum Service Flow Rates at LOS D (pcu/hour/lane)

FFS: Free-Flow Speed (km/h)

Table 5.1.3 Maximum Service Flow Rates (pcu/hour/lane)

FFS		Target LOS				
(mi/h)	(km/h)	A	B	C	D	E
60	96.6	660	1,080	1,550	1,980	2,200
55	88.5	600	990	1,430	1,850	2,100
50	80.5	550	900	1,300	**1,710**	2,000
45	72.4	290	810	1,170	**1,550**	1,900

Source: Highway Capacity Manual 2010 (Transportation Research Board)

Using the calculated maximum service flow rates, the required number of lanes for 4th Cebu-Mactan Bridge and Mandaue Coastal Road were determined as 2 lanes and 3 lanes per direction respectively.

Table 5.1.4 Required Number of Lanes per Direction

	Unit	4th Cebu-Mactan Bridge	Mandaue Coastal Road		Remarks
			Section 1	Section 2	
Traffic Volume per Direction	pcu/day	30,000	52,000	12,000	Half of design traffic volume
K-Factor		8%	8%	8%	Based on the traffic survey result in 2017
Hourly Traffic Volume (A)	pcu/hour	2,400	4,160	960	
Free-Flow Speed	km/h	60	80	80	Design speed
Basic Traffic Volume (B)	pcu/hour/lane	1,550	1,710	1,710	$MSF_D = 12.407 \times FFS + 1001.6$
Required Number of Lanes	lanes	1.55	2.43	0.56	Calculated by A / B
		2	**3**	**2**	Rounded number, minimum 2 lanes

Source: JICA Survey Team

For determination of the required number of lanes for interchange ramps, traffic capacity of 1,200 pcu/hour/lane was considered in reference to the Japanese Standard (NEXCO, Design Manuals, Part 4: Geometric Design, 2010). Table 5.1.5 summarized the required number of lanes each interchange ramp.

Table 5.1.5 Required Number of Lanes for Interchange Ramps

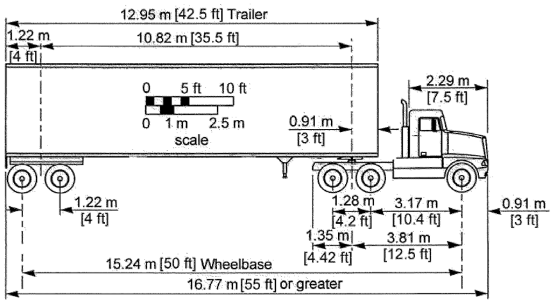
Interchange	Ramp			Traffic Volume (PCU/hour)	Number of Lanes
1st Bridge Interchange	Coastal Road (Cebu)	→	1st Bridge	2,813	2
	1st Bridge	→	Coastal Road (Cebu)	3,216	2
Mandaue Interchange	4th Bridge (Mandaue)	→	Coastal Road (Cebu)	19	1
	4th Bridge (Mandaue)	→	Coastal Road (Liloan)	29	1
	Coastal Road (Liloan)	→	4th Bridge (Mandaue)	47	1
	Coastal Road (Liloan)	→	4th Bridge (Lapu-Lapu)	1,182	2
	4th Bridge (Lapu-Lapu)	→	Coastal Road (Cebu)	514	1
	4th Bridge (Lapu-Lapu)	→	Coastal Road (Liloan)	1,172	2
	Coastal Road (Cebu)	→	4th Bridge (Mandaue)	28	1
	Coastal Road (Cebu)	→	4th Bridge (Lapu-Lapu)	471	1
Lapu-Lapu Interchange	4th Bridge (Mandaue)	→	Mactan Circumferential Road (East)	573	1
	4th Bridge (Mandaue)	→	Mactan Circumferential Road (West)	1,420	2
	4th Bridge (Mandaue)	→	Airport Access Road	437	1
	Mactan Circumferential Road (East)	→	4th Bridge (Mandaue)	485	1
	Mactan Circumferential Road (West)	→	4th Bridge (Mandaue)	1,315	2
	Airport Access Road	→	4th Bridge (Mandaue)	518	1

Source: JICA Survey Team

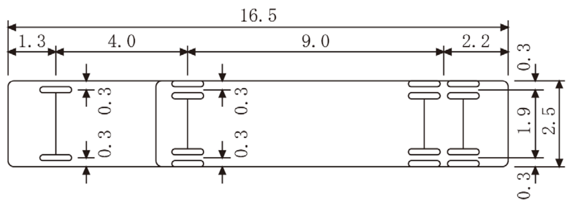
Design Vehicle

Considering that i) majority of the type of vehicle operated in the Philippines are similar in Japan, and ii) the Project roads are located in urban center, WB-15 in AASHTO or semi-trailer in Japanese Standard would be appropriate for designing of the Project Road.

Although the WB-15 design vehicle have been omitted from A Policy on Geometric Design of Highways and Streets since its 6th edition (2011), the WB-15 design vehicle would be still applicable because the 40 feet ISO container would be the most common international container size used in the Philippines.



WB-15 (AASHTO)



Semi-trailer (Japanese Standard)

Source: JICA Survey Team

Figure 5.1.4 Projected Future Traffic Volume in 2039

(3) Cross Section Elements

Table 5.1.6 summarizes the applied values for cross section elements. The details of each elements are discussed in the following sections.

Table 5.1.6 Cross Section Elements

	Unit	Mandaue Coastal Road	4th Cebu-Mactan Bridge	Interchange Ramp		Remarks
				1-lane	2-lane	
Normal Cross Slope		2.0%	2.0%	2.0%	2.0%	
Traveled Way Width	m	3.50	3.50	3.50	3.50	Heavy vehicle traffic was considered.
Median Width (including inner shoulder)	m	2.50	2.50	N/A	N/A	0.5 m bridge railings and 0.5 m center margin were considered.
Inner Shoulder Width	m	0.50	0.50	0.75	0.75	Japanese Standard
Outer Shoulder Width	m	2.50	2.50	1.50	0.75	DPWH Standard and possibility of lane-number increasing in future was considered.

Source: DPWH, Design Guidelines, Criteria & Standards, 2015
AASHTO, A Policy on Geometric Design of Highways and Streets, 7th Edition, 2018
Japanese Standard: Explanation and Operation of Road Structure Ordinance, 2015

Normal Cross Slope

The minimum rate of cross slope applicable to the traveled way is determined by drainage needs. Consistent with the type of highway and amount of rainfall, the usually accepted minimum values for cross slope range from 1.5% to 2.0%. For this Project, a pavement cross slope of 2.0% was applied in accordance with the DPWH standard.

Traveled Way Width

The lane width of a roadway influences the comfort of driving, operational characteristics, and, in some situations, the likelihood of crashes. Considering that the Project Road will cater the traffic between the new container port to be constructed in Consolacion and the existing Cebu Port, lane width of 3.5 m is recommended.

Median and Inner Shoulder Width

A median is the portion of a highway separating opposing directions of the traveled way. Medians are highly desirable on expressways carrying four or more lanes. The median is a portion between the edges of the traveled way for the roadway in the opposing directions of travel, including the width of the median (or inner) shoulder.

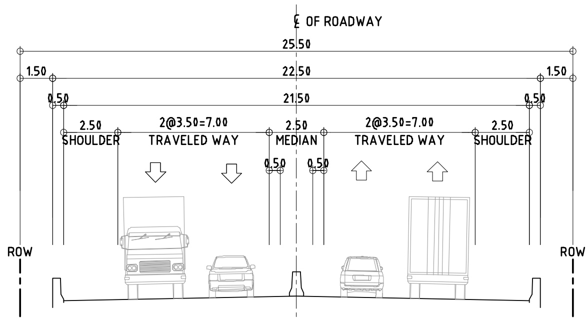
Whereas, AASHTO and Japanese standards suggest the minimum width of median for elevated highway as 3.0 m and 2.25 m respectively, this Project applies 2.50 m width of median consisting of 0.50 m inner shoulder and 0.50 m bridge parapet and 0.50 m center margin between two parapets.

Outer Shoulder Width

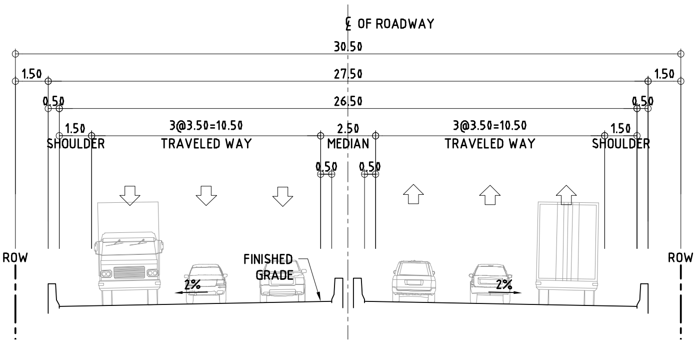
A shoulder is the portion of the roadway contiguous with the traveled way that accommodates stopped vehicles, emergency use, and lateral support for subbase, base, and surface courses. Paved shoulders should be continuous on both the outer and inner sides of all roadway facilities. Whereas that DPWH design standard specifies the minimum requirement of the outer shoulder as 1.50 m, 2.50 m is applied in order to ensure the future expandability from four (4) lanes to six (6) lanes after the design period.

Overall Cross Sectional Configuration

Figure 5.1.5 shows typical cross sections of 4th Cebu-Mactan Bridge and Mandaue Coastal Road. As the result of consultation with DPWH, it was decided that the 4-lane viaduct should have a possibility to expand the number of lanes into 6-lane in future after the design period of 2039.



4-lane Section

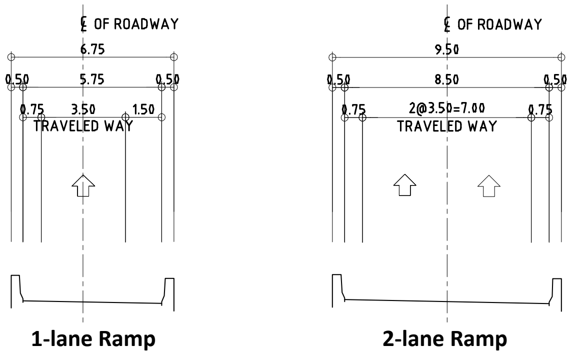


6-lane Section

Source: JICA Survey Team

Figure 5.1.5 Typical Cross Sections of the Project Road

Figure 5.1.6 shows the typical cross sections of interchange ramps. In order to accommodate heavy vehicle traffic, traveled way width was determined as 3.50 m.



Source: JICA Survey Team

Figure 5.1.6 Typical Cross Sections of Interchange Ramps

(4) Geometric Design Standard

Table 5.1.7 summarizes the applied values for geometric design, which was determined in reference to the design standards of DPWH, AASHTO and Japan. Comparison of the different design standards are also summarized in Table 5.1.8 to Table 5.1.11.

Table 5.1.7 Geometric Design Conditions

	Unit	Mandaue Coastal Road	4th Cebu-Mactan Bridge	Interchange Ramp		Remarks
General Design Considerations						
Design Speed	km/h	80	60	50	40	
Minimum Stopping Sight Distance	m	130	85	65	50	DPWH/AASHTO
Horizontal Alignment						
Minimum Radius	m	280	150	90	50	Japanese Standard
Maximum Radius for use of a Transition Curve	m	1,999	999	219	139	R=0.29×V2 (Japanese Standard)
Radius for Normal Crown	m	2,360	1,440	1,050	738	DPWH/AASHTO
Radius for Reversed Crown	m	1,710	1,030	750	525	ditto
Minimum Curve Length	m	240	180	150	120	L=3V (AASHTO)
Minimum Transition Curve Length	m	70	50	40	36	L=V/3600×3 (Japanese Standard)
Maximum Superelevation Rate	-	6%	6%	6%	6%	DPWH
Maximum Superelevation Runoff	-	1/200	1/163	1/150	1/138	DPWH/AASHTO
Vertical Alignment						
Maximum Grade	-	4%	5%	6%	8%	DPWH
Minimum Grade	-	0.3%	0.3%	0.3%	0.3%	DPWH/AASHTO
Minimum Rate of Crest Vertical Curvature (K)	K	30	14	8	4.5	Japanese Standard
Minimum Rate of Sag Vertical Curvature (K)	K	30	18	13	9	DPWH/AASHTO
Minimum Vertical Curve Length	m	60	60	60	60	DPWH
Vertical Clearance	m	5.2	5.2	5.2	5.2	DPWH
Interchange Section						
Minimum Horizontal Radius	m	900	450	N/A	N/A	Japanese Standard
Maximum Grade	-	4.0%	5.0%	N/A	N/A	ditto
Minimum Rate of Crest Vertical Curvature (K)	K	90	45	N/A	N/A	ditto
Minimum Rate of Sag Vertical Curvature (K)	K	60	30	N/A	N/A	ditto

Source: DPWH, Design Guidelines, Criteria & Standards, 2015
AASHTO, A Policy on Geometric Design of Highways and Streets, 2018 7th Edition
Japanese Standard: Explanation and Operation of Road Structure Ordinance, 2015

Table 5.1.8 Comparison of Geometric Design Standards for Design Speed of 80 km/h

	Unit	DPWH	AASHTO	Japan	Applied
General Design Considerations					
Design Speed	km/h	80	80	80	80
Minimum Stopping Sight Distance	m	**130**	**130**	110	130
Horizontal Alignment					
Minimum Radius	m	252	252	**280 (400)**	280
Maximum Radius for use of a Transition Curve	m	379	379	**1,999**	1,999
Radius for Normal Crown	m	**2,360**	**2,360**	3,500	2,360
Radius for Reversed Crown	m	**1,710**	**1,710**	1,240	1,710
Minimum Curve Length	m	N/A	**240 (480)**	140 or 1,000/θ	240
Minimum Transition Curve Length	m	44	44	**70**	70
Maximum Superelevation Rate	-	**6%**	6, 8, 10%	10%	6%
Maximum Superelevation Runoff	-	**1/200**	**1/200**	1/150	1/200
Vertical Alignment					
Maximum Grade	-	6%	7%	**4%**	4%
Minimum Grade	-	**0.3%**	0.3-0.5%	0.3-0.5%	0.3%
Minimum Rate of Crest Vertical Curvature (K)	K	26	26	**30 (45)**	30
Minimum Rate of Sag Vertical Curvature (K)	K	**30**	**30**	20 (30)	30
Minimum Vertical Curve Length	m	**60**	48	50	60
Vertical Clearance	m	**5.2**	4.9	4.8	5.2
Interchange Section					
Minimum Horizontal Radius	m	N/A	N/A	**900**	900
Maximum Grade	-	N/A	N/A	**4.0%**	4.0%
Minimum Rate of Crest Vertical Curvature (K)	K	N/A	N/A	**90**	90
Minimum Rate of Sag Vertical Curvature (K)	K	N/A	N/A	**60**	60

Source: DPWH, Design Guidelines, Criteria & Standards, 2015
AASHTO, A Policy on Geometric Design of Highways and Streets, 2018 7th Edition
Japanese Standard: Explanation and Operation of Road Structure Ordinance, 2015

Table 5.1.9 Comparison of Geometric Design Standards for Design Speed of 60 km/h

	Unit	DPWH	AASHTO	Japan	Applied
General Design Considerations					
Design Speed	km/h	60	60	60	60
Minimum Stopping Sight Distance	m	**85**	**85**	75	85
Horizontal Alignment					
Minimum Radius	m	123	123	**150 (200)**	150
Maximum Radius for use of a Transition Curve	m	213	213	**999**	999
Radius for Normal Crown	m	**1,440**	**1,440**	2,000	1,440
Radius for Reversed Crown	m	**1,030**	**1,030**	800	1,030
Minimum Curve Length	m	N/A	**180 (360)**	110 or 700/θ	180
Minimum Transition Curve Length	m	33	33	**50**	50
Maximum Superelevation Rate	-	**6%**	6, 8, 10%	6, 8, 10%	6%
Superelevation Runoff	-	**1/163**	**1/163**	1/125	1/163
Vertical Alignment					
Maximum Grade	-	6%	7%	5%	5%
Minimum Grade	-	**0.3%**	0.3-0.5%	0.3-0.5%	0.3%
Minimum Rate of Crest Vertical Curvature (K)	K	11	11	**14 (20)**	14
Minimum Rate of Sag Vertical Curvature (K)	K	**18**	**18**	10 (15)	18
Minimum Vertical Curve Length	m	**60**	36	50	60
Vertical Clearance	m	**5.2**	4.9	4.8	5.2
Interchange Section					
Minimum Horizontal Radius	m	N/A	N/A	**450**	450
Maximum Grade	-	N/A	N/A	**5.0%**	5.0%
Minimum Rate of Crest Vertical Curvature (K)	K	N/A	N/A	**45**	45
Minimum Rate of Sag Vertical Curvature (K)	K	N/A	N/A	**30**	30

Source: DPWH, Design Guidelines, Criteria & Standards, 2015
AASHTO, A Policy on Geometric Design of Highways and Streets, 2018 7th Edition
Japanese Standard: Explanation and Operation of Road Structure Ordinance, 2015

Table 5.1.10 Comparison of Geometric Design Standards for Design Speed of 50 km/h

	Unit	DPWH	AASHTO	Japan	Applied
General Design Considerations					
Design Speed	km/h	50	50	50	50
Minimum Stopping Sight Distance	m	**65**	**65**	55	65
Horizontal Alignment					
Minimum Radius	m	79	79	**90**	90
Maximum Radius for use of a Transition Curve	m	148	148	**219**	219
Radius for Normal Crown	m	**1,050**	**1,050**	1,30	1,050
Radius for Reversed Crown	m	**750**	**750**	590	750
Minimum Curve Length	m	N/A	**150 (300)**	80 or 600/θ	150
Minimum Transition Curve Length	m	28	28	**40**	40
Maximum Superelevation Rate	-	**6%**	6, 8, 10%	10%	6%
Superelevation Runoff	-	**1/150**	**1/150**	1/115	1/150
Vertical Alignment					
Maximum Grade	-	**6%**	7%	7%	6%
Minimum Grade	-	**0.3%**	0.3-0.5%	0.3-0.5%	0.3%
Minimum Rate of Crest Vertical Curvature (K)	K	7	7	**8**	8
Minimum Rate of Sag Vertical Curvature (K)	K	**13**	**13**	7	13
Minimum Vertical Curve Length	m	**60**	30	40	60
Vertical Clearance	m	**5.2**	4.9	4.8	5.2

Source: DPWH, Design Guidelines, Criteria & Standards, 2015
AASHTO, A Policy on Geometric Design of Highways and Streets, 2018 7th Edition
Japanese Standard: Explanation and Operation of Road Structure Ordinance, 2015

Table 5.1.11 Comparison of Geometric Design Standards for Design Speed of 40 km/h

	Unit	DPWH	AASHTO	Japan	Applied
General Design Considerations					
Design Speed	km/h	40	40	40	40
Minimum Stopping Sight Distance	m	**50**	**50**	40	50
Horizontal Alignment					
Minimum Radius	m	43	43	**50**	50
Maximum Radius for use of a Transition Curve	m	95	95	**139**	139
Radius for Normal Crown	m	**738**	**738**	800	738
Radius for Reversed Crown	m	**525**	**525**	400	525
Minimum Curve Length	m	N/A	**120 (240)**	70 or 500/θ	120
Minimum Transition Curve Length	m	22	22	**35**	35
Maximum Superelevation Rate	-	**6%**	6, 8, 10%	10%	6%
Superelevation Runoff	-	**1/138**	**1/138**	1/100	1/138
Vertical Alignment					
Maximum Grade	-	6%	7%	**8%**	8%
Minimum Grade	-	**0.3%**	0.3-0.5%	0.3-0.5%	0.3%
Minimum Rate of Crest Vertical Curvature (K)	K	4	4	**4.5**	4.5
Minimum Rate of Sag Vertical Curvature (K)	K	**9**	**9**	4.5	9
Minimum Vertical Curve Length	m	**60**	24	35	60
Vertical Clearance	m	**5.2**	4.9	4.8	5.2

Source: DPWH, Design Guidelines, Criteria & Standards, 2015
AASHTO, A Policy on Geometric Design of Highways and Streets, 2018 7th Edition
Japanese Standard: Explanation and Operation of Road Structure Ordinance, 2015

(5) Ramp Terminals for Grade Separations

The terminal of a ramp is that portion adjacent to the through traveled-way, including speed change, tapers and islands. The free-flow type ramp terminal should be adopted for the interchanges in the Project because of high-volume of traffic demand. Design of ramp terminal should consider the following in order to provide safe and smooth traffic flow:

- Harmonization between main road alignment and interchange ramp alignment
- Visibility of interchange ramp alignment from main road
- Visibility between main road and interchange ramps

Additionally, the following should be considered in particular:

<u>Entrance Ramps</u>

- Inflow angle at merging nose should be small and visibility at merging nose should be provided. In order to provide visibility at merging nose, clear zone should be provided from 100 m and 60 m from merging nose for main road and interchange ramps respectively.
- Vertical alignment of interchange ramp at merging nose should not be upgrade.
- Merging nose is not necessarily visible so that nose offset is not necessary.

<u>Exit Ramps</u>

- Exit ramp terminal should have good visibility. The taper end should be visible from 500 m behind it.
- Deceleration lane should be clearly identified with road marking.
- Deceleration lane should have certain angle from main road in order to let drivers start diverging maneuvers properly. The angle should be about 1/25.
- Diverging nose should be placed with additional lateral offset from traveled-ways of both main road and interchange ramp in order to provide a space for erroneous vehicle to merge into original lane on main road.
- Horizontal and vertical alignments of interchange ramp around diverging nose should have larger radius and forthcoming alignment should be visible from nose point.
- Diverging nose should be clearly identified by drivers and be constructed with curb stone.

In general, there are two types of ramp terminal, namely paralleled type and tapered type. The former is often applied for acceleration lanes (entrance ramps) and the latter is often applied for deceleration lanes (exit ramps).

- <u>Acceleration Lane (Entrance Ramps)</u>: As mentioned earlier, drivers prefer natural driving path but merging traffic needs to find a gap to merge into the lane of main roadway. Paralleled type acceleration lane provides sufficient length to enable vehicles to accelerate and merge into main roadway and it is a very important advantage for the traffic safety. In this regard, paralleled type is recommended for acceleration lane.

- <u>Deceleration Lane (Exit Ramps)</u>: The paralleled type requires S-curve driving maneuvers while tapered type will fit with natural driving path. Based on experiences in Japan, drivers prefer the latter so that tapered type is recommended for deceleration lane.

Based on AASHTO and Japanese standards, minimum acceleration and deceleration lengths are determined as shown in Table 5.1.12.

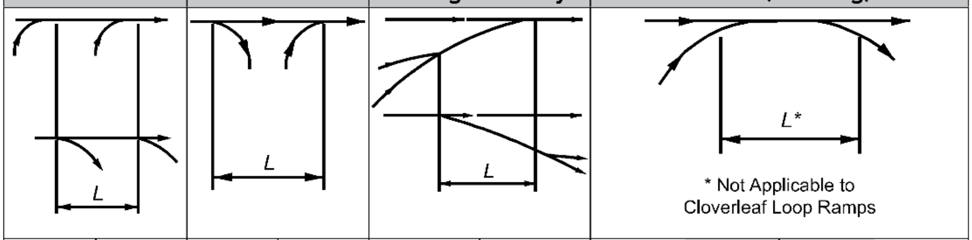
Table 5.1.12 Minimum Length of Acceleration and Deceleration Lanes

Design Parameter			AASHTO		Japan		Applied	
Design Speed (km/h)	Main Roadway		80	60	80	60	80	60
	Interchange Ramp		50	40	-	-	50	40
Entrance Ramp Terminal	Acceleration Length (excluding taper)	1-lane Ramp	115 m	45 m	160 m	120 m	160 m	120 m
		2-lane Ramp	90 – 150 m		220 m	160 m	220 m	160 m
	Taper Length for Acceleration Lane	1-lane Ramp	90 m		50 m	45 m	50 m	45 m
		2-lane Ramp						
Exit Ramp Terminal	Deceleration Length (excluding taper)	1-lane Ramp	90 m	65 m	80 m	70 m	80 m	70 m
		2-lane Ramp	450 m		110 m	90 m	110 m	90 m
	Taper Angle for Deceleration Lane	1-lane Ramp	1/25		1/20	1/15	1/20	1/15
		2-lane Ramp						

Source: AASHTO, A Policy on Geometric Design of Highways and Streets, 2018 7th Edition
Japanese Standard: Explanation and Operation of Road Structure Ordinance, 2015

In case two or more ramp terminals are located in close succession, it is necessary to provide sufficient weaving length and adequate space for signing, a reasonable distance should be provided between successive ramp terminals. Spacing between successive outer ramp terminals is dependent on the classification of the interchanges involved, the function of the ramp pairs (entrance or exit), and weaving potential as shown in Table 5.1.13.

Table 5.1.13 Recommended Minimum Ramp Terminal Spacing



EN-EN or EX-EX		EX-EN		Turning Roadways		EN-EX (Weaving)			
Full Freeway	CDR	Full Freeway	CDR	System Interchange	Service Interchange	System to Service Interchange		Service to Service Interchange	
						Full Freeway	CDR	Full Freeway	CDR
Minimum Lengths Measured between Successive Ramp Terminals									
1000 ft (300 m)	800 ft (240 m)	500 ft (150 m)	400 ft (120 m)	800 ft (240 m)	600 ft (180 m)	2000 ft (600 m)	1600 ft (480 m)	1600 ft (480 m)	1000 ft (300 m)

Notes: EN—Entrance
CDR—Collector distributor road
EX—Exit

Source: AASHTO, A Policy on Geometric Design of Highways and Streets, 2018 7th Edition

(6) At-Grade Intersections

Design Speed

Design speed of local roads for design of at-grade intersections should be lower than the other segments of the roads because higher design speed will require surplus length of shift for increasing/decreasing of lane number at intersection. Considering the traffic pattern at proposed intersections, anticipated travel speed would be 40 km/h. Therefore, design speed of 40 km/h is applied for the local roads in intersections.

Intersection Angle

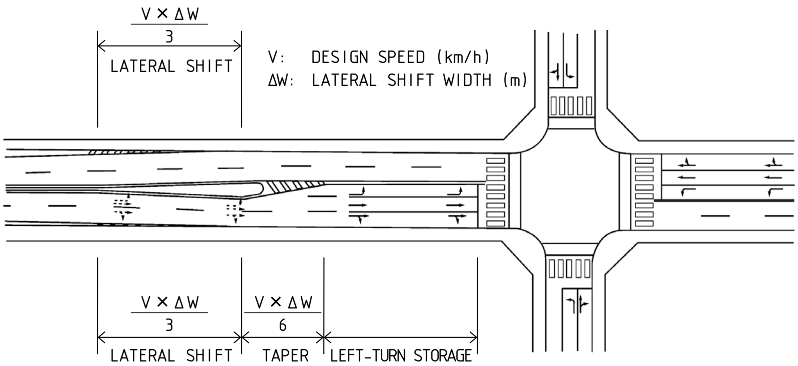
Intersection angle of at-grade intersections should be perpendicular as much as possible. In case it cannot be designed as perpendicular because of the existing site conditions, minimum angle should be 75 degree.

Traveled-way Width

The same traveled-way width of 3.5 m should be used in intersections.

Left- and Right-Turn Lanes

Left- and right-turn lanes should be provided in intersections depending on the number of left or right turning traffic. The length of left- or right-turn lane consists of storage and its taper. The storage in left- or right-turn lane should be a minimum of 30 m and the taper should be calculated based on the formula shown in Figure 5.1.7.



Source: JICA Survey Team

Figure 5.1.7 Required Length for Lateral Shift in Intersection

Turning Roadway

Turning roadway should be properly considered for left- or right-turn lane and the size of intersection is dependent on the size of turning roadways. In order to provide higher traffic safety for pedestrian and better traffic operation in intersections, the size of intersections should be minimized.

For design of the turning roadway, Japanese Standard, namely the Road Structure Ordinance, is helpful to determine the necessary width. The following table shows the relationship between width of turning roadway and outer radius of turning roadway.

Table 5.1.14 Recommended Minimum Ramp Terminal Spacing

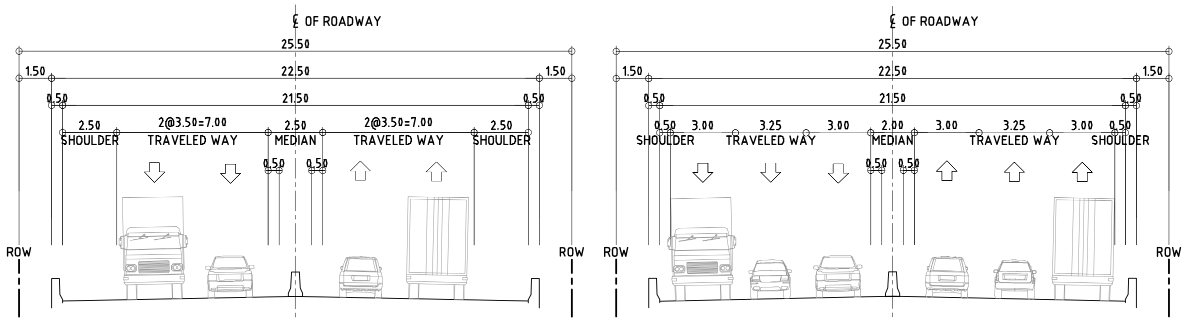
Outer Radius of Turning Roadway (m)	Width of Turning Roadway
13 - 14	8.5
14 - 15	8.0
15 - 16	7.5
16 - 17	7.0
17 - 19	6.5
19 - 21	6.0
21 - 25	5.5
25 - 30	5.0
30 - 40	4.5
40 - 60	4.0
60 -	3.5

Source: Road Structure Ordinance, Japan

5.1.2 Design of 4th Cebu-Mactan Bridge

(1) Typical Cross Sections

As mentioned earlier, the cross section width of the 4th Cebu-Mactan was determined in consideration of the possibility to expand the number of lanes from 4-lane to 6-lane in future (beyond the design period of the Project). Although the width of each cross section elements in future would become narrow, the widths are still within the minimum requirement of design standard.



Within Design Period (until Year 2039) **Future beyond Design Period (after Year 2039)**

Source: JICA Survey Team

Figure 5.1.8 Typical Cross Sections of 4th Cebu-Mactan Bridge

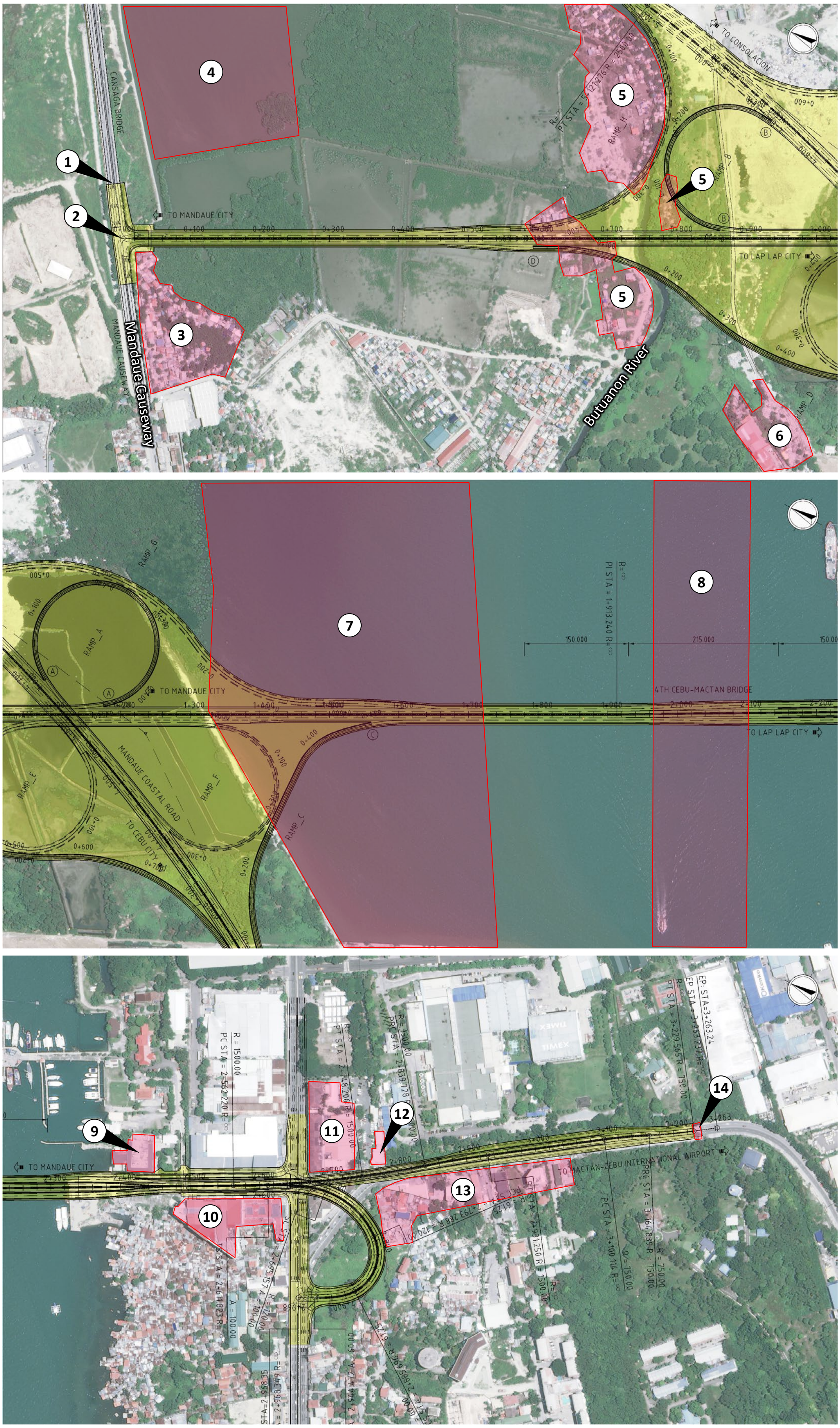
(2) Horizontal Alignment

Based on the selected alignment of the 4th Cebu-Mactan Bridge described in Chapter 2, the details of the alignment was adjusted in consideration of the control points summarized in Table 5.1.15.

Table 5.1.15 Control Points for Horizontal Alignment of 4th Cebu-Mactan Bridge

No.	Control Point	Description
1	Cansaga Bay Bridge	Widening of road for the intersection design should start from the existing abutment of the Cansaga Bay Bridge in order not to reconstruct the bridge.
2	Mandaue Causeway	At-grade intersection with its angle of 83°.
3	Residential houses	Avoid as much as possible.
4	Reclamation Project (Mandaue Global City)	Avoid
5	Informal settlers located near Butuanon River	Avoid as much as possible.
6	Small community at Umapad Dumping Site	Avoid
7	Reclamation Project (Mandaue Global City)	Minimize the effect
8	Navigable waterway	143 m width and 22.86 m above mean water level
9	Cebu Yacht Club	Avoid
10	Shopping Mall (Island Central Mactan)	Avoid
11	Complexed building (Marina Mall)	Avoid
12	Complexed building	Avoid
13	Buildings and parking spaces	Avoid
14	Airport Security Gate	Avoid

Source: JICA Survey Team



Source: JICA Survey Team

Figure 5.1.9 Control Points for Horizontal Alignment of 4th Cebu-Mactan Bridge

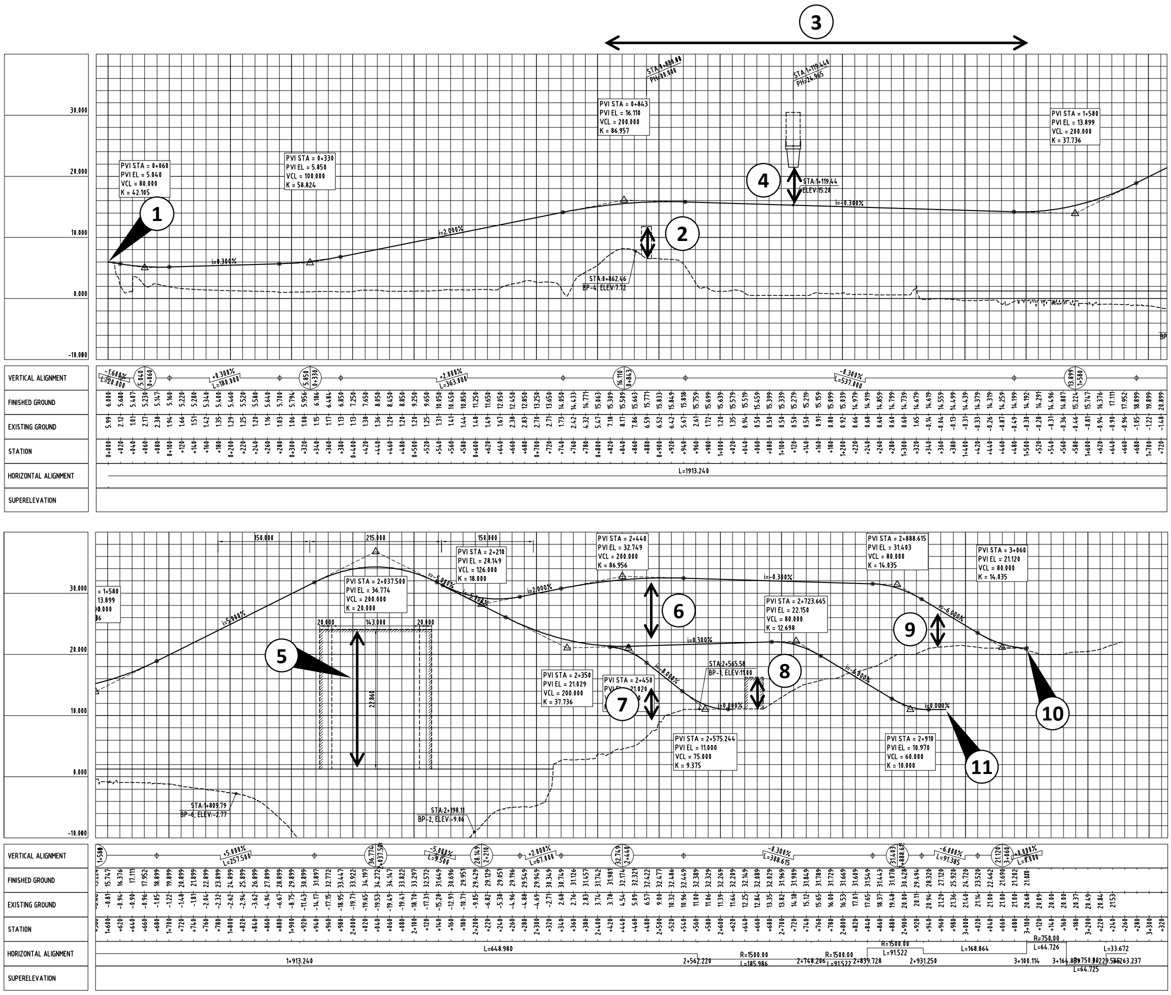
(3) Vertical Alignment

Table 5.1.16 summarizes the control points for vertical alignment of the 4th Cebu-Mactan Bridge.

Table 5.1.16 Control Points for Vertical Alignment of 4th Cebu-Mactan Bridge

No.	Control Point	Description
1	Mandaue Causeway	At-grade intersection
2	Umapad Road	Grade separation (vertical clearance: 5.2 m)
3	Mandaue Interchange	Gentle slope is preferable in interchange section
4	Mandaue Coastal Road	Grade separation
5	Mactan Channel (Navigable Waterway)	Navigational clearance: 22.86 m above mean water level for the width of 183 m (20 m margin + 143 m waterway + 20 m margin).
6	Double deck	9 m
7	Access road to Yacht Club	Grade separation (vertical clearance: 5.2 m)
8	Mactan Circumferential Road	Grade separation (vertical clearance: 5.2 m)
9	Airport Bldg. Access Road	Grade separation (vertical clearance: 5.2 m)
10	Airport Bldg. Access Road	At-grade connection
11	Mactan Circumferential Road	At-grade intersection

Source: JICA Survey Team



Source: JICA Survey Team

Figure 5.1.10 Control Points for Vertical Alignment of 4th Cebu-Mactan Bridge

(4) Site Conditions

Figure 5.1.11 and Figure 5.1.12 show the current condition of the abovementioned design control points for 4th Cebu-Mactan Bridge.

(1) Cansaga Bay Bridge

(2) Mandaue Causeway

(3) Residential Houses

(4) Planned Area for Reclamation Project

(5) Informal settlers located near Butuanon River

(6) Small community at Umapad Dumping Site

(7) Planned Area for Reclamation Project

(8) Mactan Channel

Source: JICA Survey Team, (5) and (7): Mandaue City

Figure 5.1.11 Photos of Design Control Points for 4th Cebu-Mactan Bridge (1)

(9) Cebu Yacht Club

(10) Shopping Mall (Island Central Mactan)

(11) Complexed building (Marina Mall)

(12) Complexed building

(13) Buildings and parking spaces

(14) Airport Security Gate

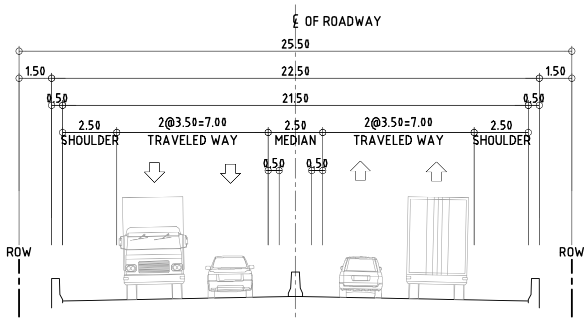
Source: JICA Survey Team

Figure 5.1.12 Photos of Design Control Points for 4th Cebu-Mactan Bridge (2)

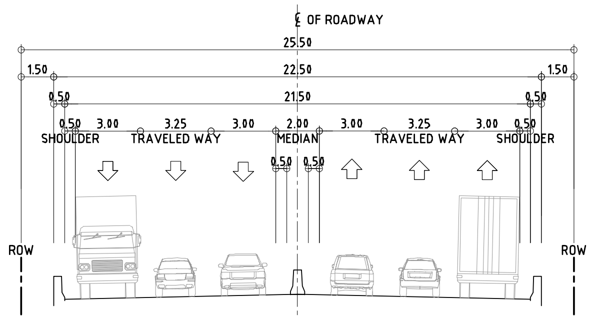
5.1.3 Design of Mandaue Coastal Road

(1) Typical Cross Sections

The cross section width of Mandaue Coastal Road was also considered the possibility to expand the number of lanes from 4-lane to 6-lane in future (beyond the design period of the Project). However, the expansion from 6-lane to 8-lane was not considered because of the width of the existing road to be connected with Mandaue Coastal Road does not have such wide space.

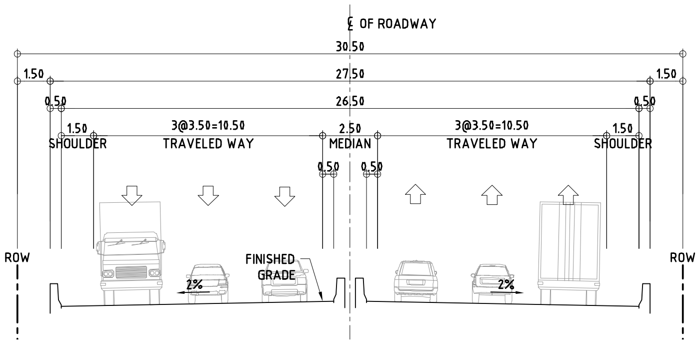


Within Design Period (until Year 2039)



Future beyond Design Period (after Year 2039)

Section from 1st Cebu-Mactan Bridge to 4th Cebu-Mactan Bridge



Section from Beginning Point to 1st Cebu-Mactan Bridge

Source: JICA Survey Team

Figure 5.1.13 Typical Cross Sections of 4th Cebu-Mactan Bridge

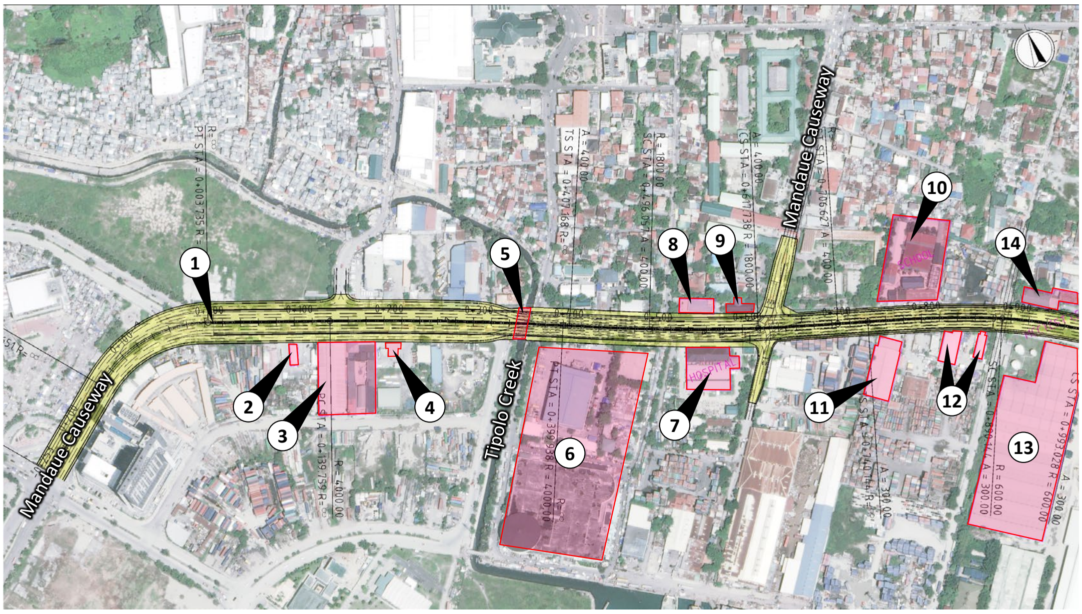
(2) Horizontal Alignment

Based on the selected alignment of Mandaue Coastal Road described in Chapter 2, the details of the alignment was adjusted in consideration of the control points summarized in Table 5.1.17.

Table 5.1.17 Control Points for Horizontal Alignment of Mandaue Coastal Road

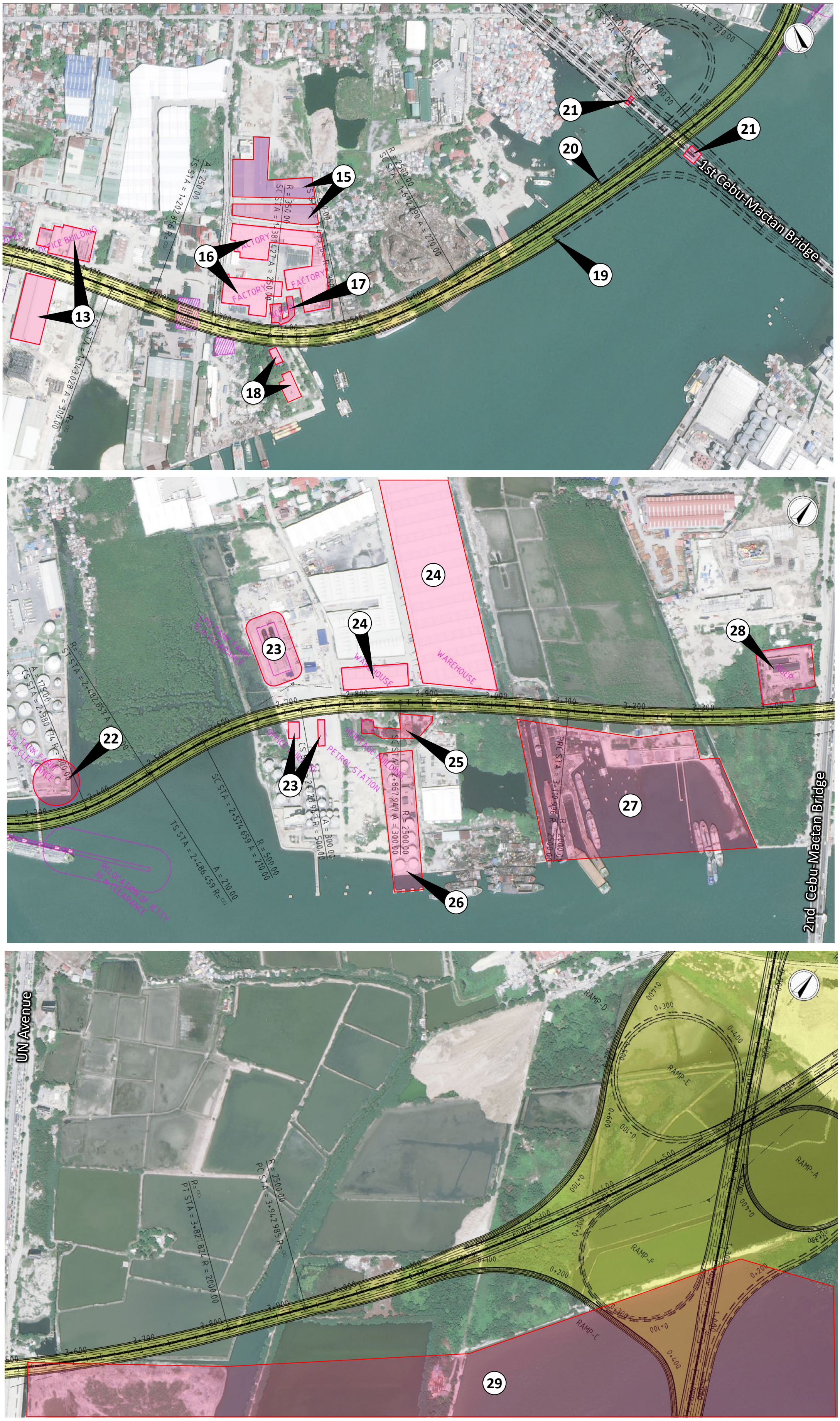
No.	Control Point	Description
1	Mandaue Causeway	The beginning point of Mandaue Coastal Road should start from the tangent section.
2	Petron Petrol Station	Avoid building
3	Factory	Avoid building
4	Mandaue City Hospital	Avoid building
5	Ouano Bridge	Utilize as it is
6	New Mandaue City Government Office (Plan)	Avoid building
7	Mandaue City Hospital	Avoid building
8	Tourism Infrastructure and Enterprise Zone Authority (TIEZA)	Avoid building
9	Office	Avoid building
10	Mandaue City Comprehensive National High School	Avoid
11	Factory	Avoid building
12	Mabuhay Vinyl Corporation	Avoid buildings
13	San Miguel Food	Avoid buildings
14	MCCTEST Center	Avoid building
15	Warehouse	Avoid buildings
16	DUPONT	Avoid building
17	Inchland Academy	Avoid building
18	E. C. Ouano	Avoid buildings
19	Diverging nose (to 1st Cebu-Mactan Bridge)	Secure space for future expansion
20	Merging nose (from 1st Cebu-Mactan Bridge)	Secure space for future expansion
21	Bridge piers of 1st Cebu-Mactan Bridge	Avoid
22	Petron Corporation Mandaue Terminal	Avoid oil tanks (30 m clearance)
23	Arctura Tank Terminal	Avoid buildings, LPG tank
24	Warehouse	Avoid buildings
25	Residential houses including a historical building	Avoid buildings
26	Tank farm	Avoid
27	V.M. Cabahug Shipyard	Avoid as much as possible
28	National Grid Corporation of the Philippines	Avoid
29	Reclamation Project (Mandaue Global City)	Avoid as much as possible

Source: JICA Survey Team



Source: JICA Survey Team

Figure 5.1.14 Control Points for Horizontal Alignment of Mandaue Coastal Road (1)



Source: JICA Survey Team

Figure 5.1.15 Control Points for Horizontal Alignment of Mandaue Coastal Road (2)

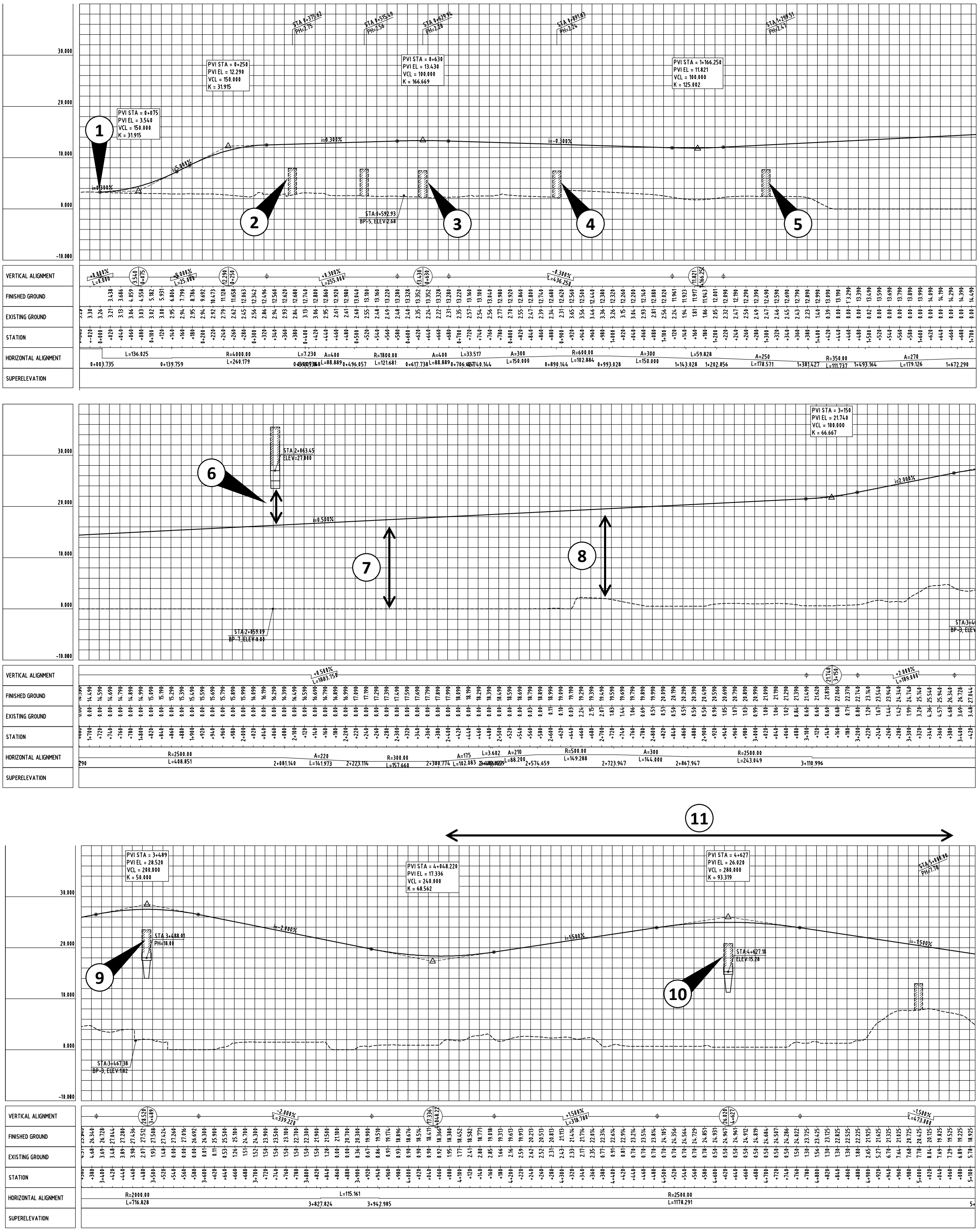
(3) Vertical Alignment

Table 5.1.18 summarizes the control points for vertical alignment of the Mandaue Coastal Road.

Table 5.1.18 Control Points for Vertical Alignment of Mandaue Coastal Road

No.	Control Point	Description
1	Mandaue Causeway	Beginning point (at-grade)
2	F.E. Zuellig Avenue	Grade separation with intersecting road (vertical clearance: 5.2 m)
3	Mandaue Causeway	Grade separation with intersecting road (vertical clearance: 5.2 m)
4	J.M. Ceniza	Grade separation with intersecting road (vertical clearance: 5.2 m)
5	C.M. Cabahug	Grade separation with intersecting road (vertical clearance: 5.2 m)
6	1st Cebu-Mactan Bridge	Grade separation with intersecting road (vertical clearance: 5.2 m)
7	Petron Corporation Mandaue Terminal	Provide 10 m clearance over the pipe line
8	V.M. Cabahug Shipyard	Provide 10 m clearance over the shipyard
9	2nd Cebu-Mactan Bridge	Grade separation with intersecting road (vertical clearance: 5.2 m)
10	4th Cebu-Mactan Bridge	Grade separation with intersecting road (vertical clearance: 5.2 m)
11	Mandaue Interchange	Gentle slope is preferable in interchange section

Source: JICA Survey Team



Source: JICA Survey Team

Figure 5.1.16 Control Points for Vertical Alignment of Mandaue Coastal Road

(4) Site Conditions

Figure 5.1.17 show the current condition of the abovementioned design control points for 4th Cebu-Mactan Bridge.


(1) 8-lane section of Mandaue Causeway


(2) Feeder Road in front of vehicle inspection center


(3) Newly constructed office building in a factory of San Miguel Corporation


(4) Informal settlers behind a factory of San Miguel Corporation


(5) Port facilities at the west side of 1st Cebu-Mactan Bridge


(6) Port facilities at the east side of 1st Cebu-Mactan Bridge


(7) Port facilities at the west side of 1st Cebu-Mactan Bridge


(8) Aquaculture ponds at the east side of 2nd Cebu-Mactan Bridge

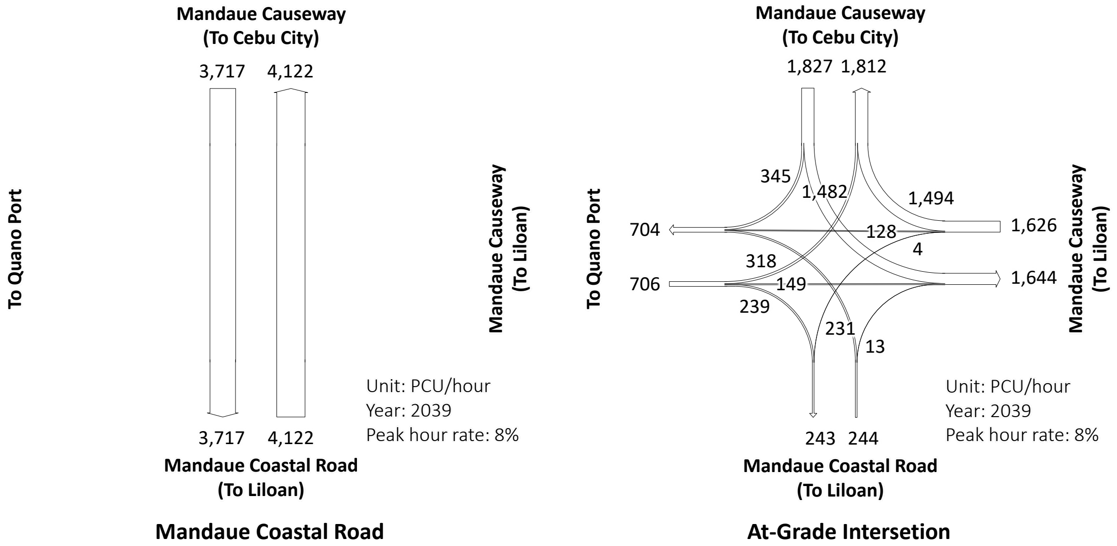
Source: JICA Survey Team

Figure 5.1.17 Photos of Design Control Points for Mandaue Coastal Road

5.1.4 Design of Interchanges and Intersections

(1) Beginning Section of Mandaue Coastal Road

Figure 5.1.18 shows the directional traffic flow at the corner of Mandaue Causeway in front of Mandaue City Hospital. As the traffic demand on this road section is too high, this intersection should be grade separated and the viaduct of the Mandaue Coastal Road should start from earlier before this intersection.

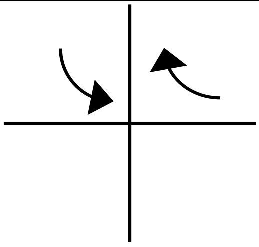
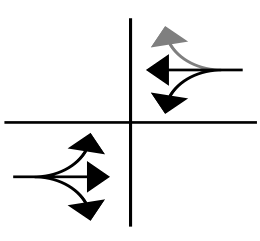
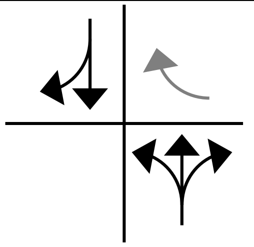


Source: JICA Survey Team

Figure 5.1.18 Traffic Volume at the Intersection in front of Mandaue City Hospital

Table 5.1.20 summarizes the result of traffic analysis of signal controlling of this at-grade intersection. For this analysis, the through traffic shown in the left figure of Figure 5.1.18 was excluded and only the traffic flows shown in the right figure of the same figure were considered because the former directional traffic flow will use the elevated viaduct and it will not interfere with the traffic at the ground level. At the ground level, the majority of the traffic will travel through the L-shaped Mandaue Causeway and few traffic will flow from/to the feeder roads toward the directions to Quano Port or Barangay Looc where SMC Shipping And Lighterage Corporation is located. Therefore, majority of green time should be given to the direction of the L-shaped Mandaue Causeway. The future traffic volume at this intersection can be managed by traffic signal control with the signal phasing shown in Table 5.1.19.

Table 5.1.19 Signal Phasing of the Intersections in front of Mandaue City Hospital

	Signal Phase 1	Signal Phase 2	Signal Phase 3
Signal Phase Diagram			
Green (sec)	50	25	25

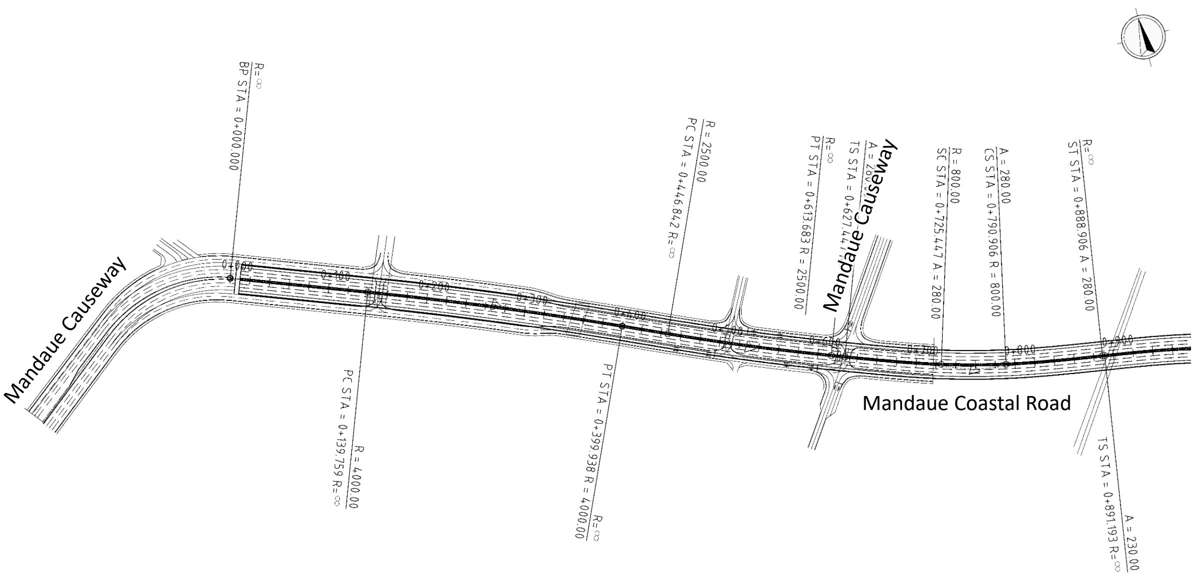
Note: ⟵ Signal controlled flow ⟵ Free flow
Source: JICA Survey Team

Table 5.1.20 Traffic Analysis of Intersection in front of Mandaue City Hospital

		Mandaue Causeway		Mandaue Causeway		Feeder Road		Feeder Road			
		To Cebu City		To Consolacion		To SMC		To Quano Port			
		LT	TH/RT	LT/TH	RT	LT	TH/RT	LT	TH/RT		
Number of Lane		2	1	1	2	1	1	1	1		
Basic Capacity (PCU/hour)		3,600	1,800	1,800	3,600	1,800	2,000	1,800	2,000		
Lane Width (m)		3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5		
Adjustment Factor		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00		
Share of Right-Turn (%)									38%		
Adjustment Factor									0.88		
Share of Left-Turn (%)				3%							
Adjustment Factor				0.99						Saturation Rate of Phase	Saturation Rate of Intersection
Saturation Flow Ratio		3,600	1,800	1,782	3,600	1,800	2,000	1,800	1,760		
Total Traffic Volume (PCU/hour)		1,482	345	132	1,494	231	13	318	388		
Flow Rate		0.412	0.192	0.074	0.415	0.128	0.007	0.177	0.220		
Phase Ratio	Phase 1	0.412			0.415					0.42	0.83
	Phase 2		0.192			0.128	0.007			0.19	
	Phase 3			0.074				0.177	0.220	0.22	
Required Green (sec)	Phase 1	50			50					Cycle Time (sec)	
	Phase 2		25			25	25				
	Phase 3			25				25	20	100	
Share of Green		0.500	0.250	0.250	0.500	0.250	0.250	0.250	0.250		
Traffic Capacity		1,800	450	446	1,800	450	500	450	440		
Volume Capacity Ratio		0.823	0.767	0.296	0.830	0.513	0.026	0.707	0.882		
Judgement		OK	OK	OK	OK	OK	OK	OK	OK		
Traffic Volume per Cycle		42	10	4	42	7	1	9	11		
Storage Length (m)		378	90	48	378	76	13	86	99		

Source: JICA Survey Team

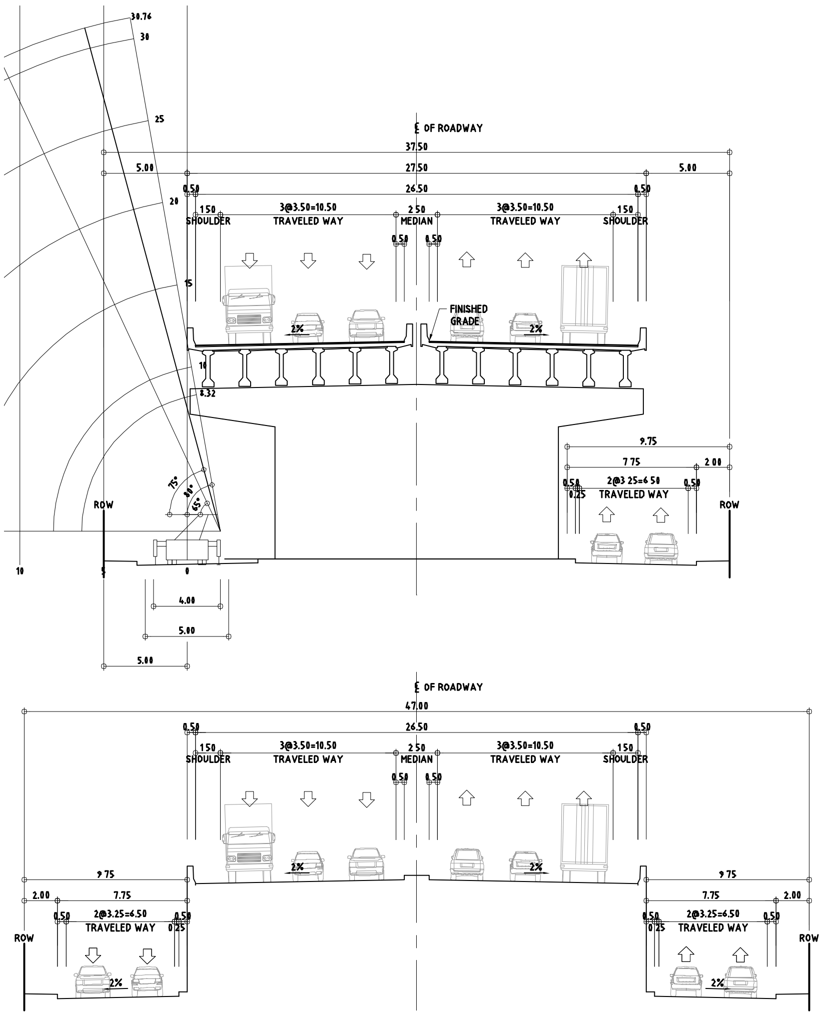
Figure 5.1.19 shows the plan view of the beginning section of Mandaue Coastal Road. Based on the traffic analysis described earlier, the beginning section of Mandaue Coastal Road should have 6-lane. Considering that the number of lanes of the existing road at this section is 8-lane, widening of the road should be implemented in order to accommodate 6-lane Mandaue Coastal Road and 2-lane service roads on both side of the road (in total 10-lane).



Source: JICA Survey Team

Figure 5.1.19 Plan of Beginning Section of Mandaue Coastal Road

Figure 5.1.20 shows typical cross section of the beginning section of Mandaue Coastal Road. Whereas the bridge approach section would require 47.0 m of right of way (ROW) for entire roadway width, the elevated viaduct section would require 37.5 m including 5.0 m margins on both side of road for ensuring a firefighting work space from ground level.



Source: JICA Survey Team

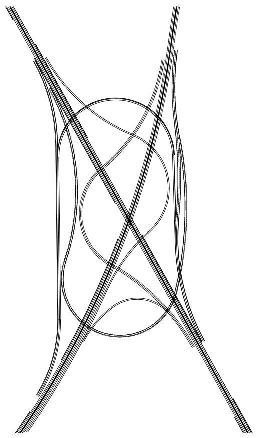
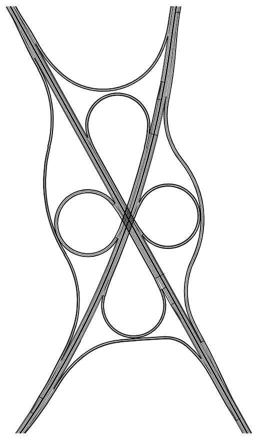
Figure 5.1.20 Typical Cross Section of Beginning Section of Mandaue Coastal Road

(2) Mandaue Interchange

As shown in Table 5.1.5, the required number of lanes for each ramp are determined as 1-lane per direction excluding the ramps for the direction between Mandaue Coastal Road (east side) and 4th Cebu-Mactan Bridge (Lapu-Lapu City side). This was determined based on the traffic capacity of 1,200 pcu/hour/lane in reference to the Japanese Standard.

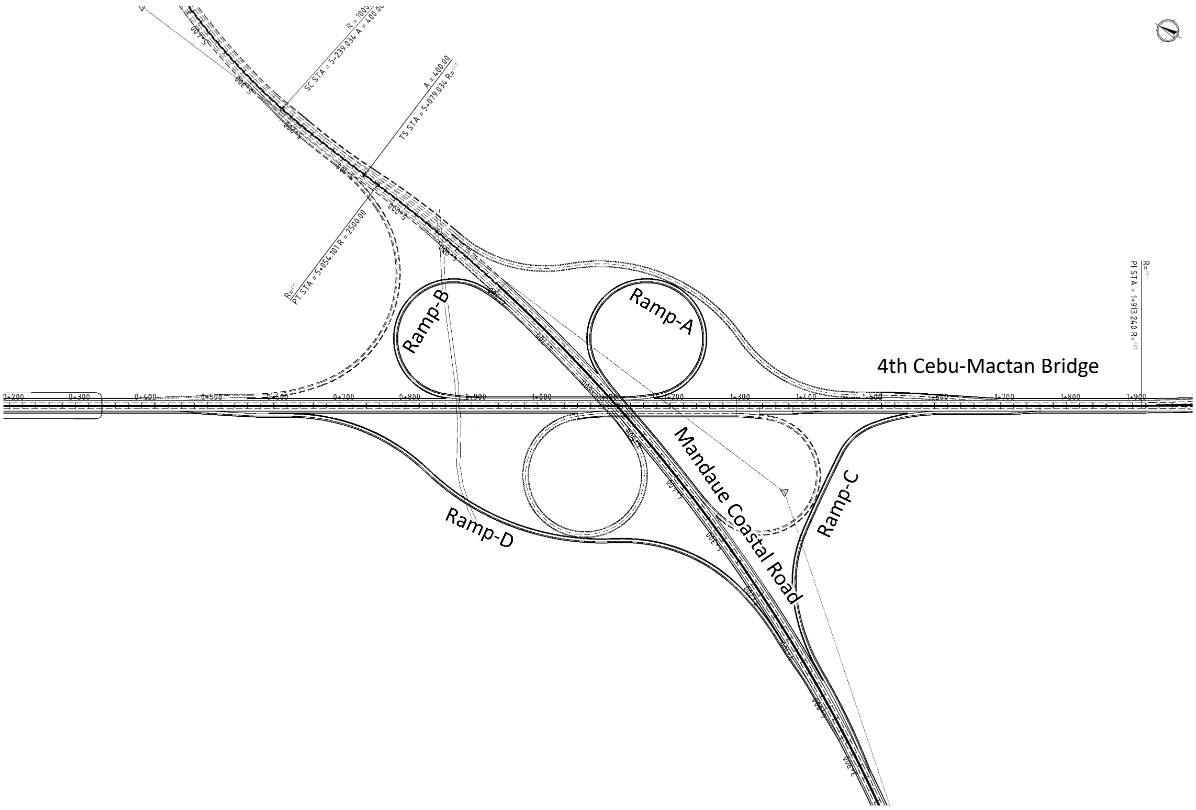
The interchange type for the 4-leg interchange was analyzed with two alternative options. One is Directional Interchange type and another is Cloverleaf Interchange type. Although the Directional Interchange has more advantage in driving performance, construction cost would be higher than Cloverleaf Interchange because it requires longer length of interchange ramps. Considering that this interchange is the interconnection of intercity link across Mactan Channel and an access controlled highway in urban area, high driving performance would not be required (meaning, this interchange will not be an interconnection between two different expressways).

Table 5.1.21 Comparison of Interchange Type

	Directional Interchange	**Cloverleaf Interchange**
		
Driving Performance	Min. radius: 160 m	Min. radius: 90 m
Construction Cost (Rate)	1.8	1.0
Land Acquisition Cost	1.0	1.0
Evaluation		**Recommended**

Source: JICA Survey Team

Figure 5.1.21 shows the plan view of the designed Mandaue Interchange.



Source: JICA Survey Team

Figure 5.1.21 Plan of Mandaue Interchange

Cost Reduction Option

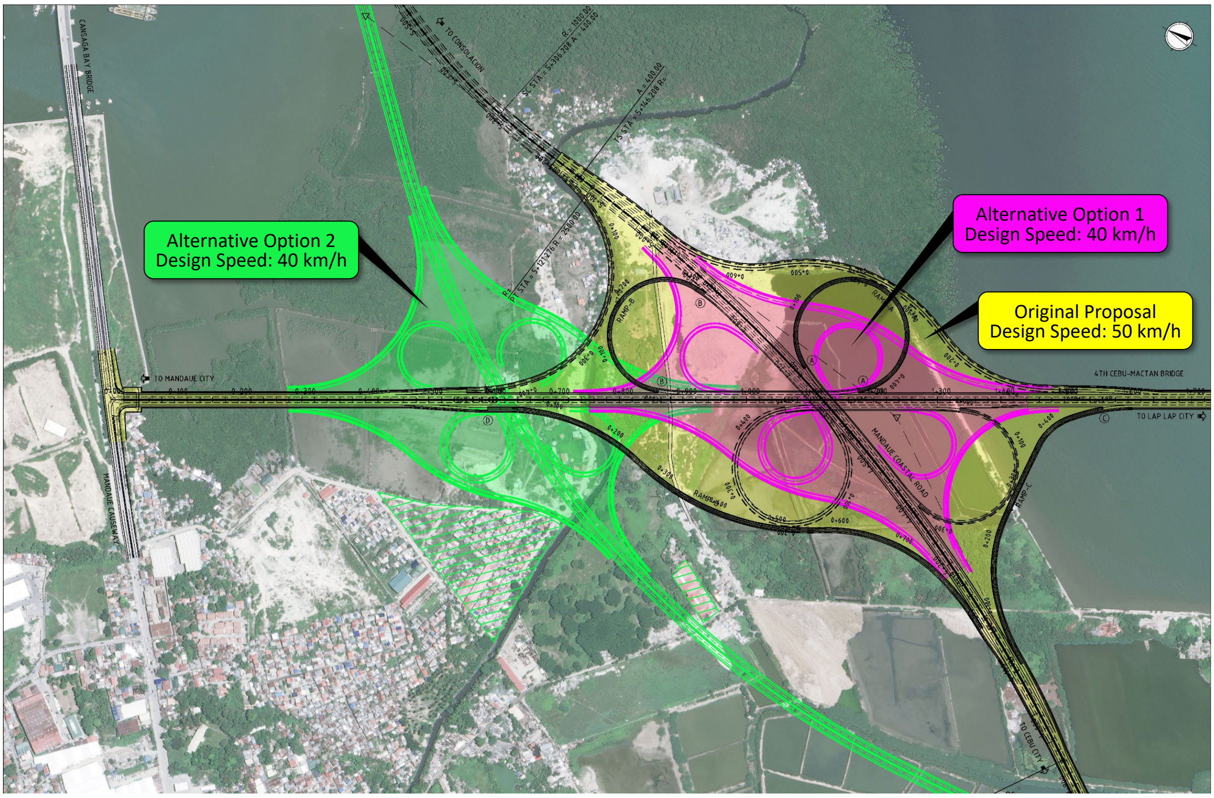
Since the design speed of Mandaue Interchange ramps was determined as 50 km/h for ensuring smooth and safe driving conditions at the interconnection between 4th Cebu-Mactan Bridge and Mandaue Coastal Road, it was found that the land acquisition cost for the interchange is very high even though the area is currently undeveloped.

Whereas the design criteria of minimum horizontal curb radius for the design speed of 50 km/h is 90 m, the radius can be reduced to 50 m if the design speed is reduced to 40 km/h (see Table 5.1.10 and Table 5.1.11). The designed loop ramps of the interchange have already applied the minimum radius of 90 m and the required area of land acquisition for the interchange is approximately 29 ha. If the minimum radius of 50 m is applied with the design speed of 40 km/h, the required area of land acquisition can be reduced to approximately 15 ha (saving of 48%) and it will significantly reflect to the cost reduction.

Therefore, the design speed of the interchange and traffic safety should be carefully reviewed during the Detailed Engineering Design Stage.

Also, there is a possibility that construction of the interchange at the dumping site of Cansaga Bay may need to be delayed due to the environmental issues such as the existence of methane gas. Mandaue City is currently undertaking rehabilitation program at the dumping site but there is a risk of interruption of the program due to lack of budget of the LGU. In such case the position of interchange may need to be shifted to the north as shown in Figure 5.1.22 (Alternative Option 2).

This option would be implementable if the design speed of 40 km/h and increase in project-affected households would be accepted because there are many residential houses, which are mostly informal settlers, along with Butuanon River even though the land acquisition can avoid the existing resettlement site of Mandaue City.



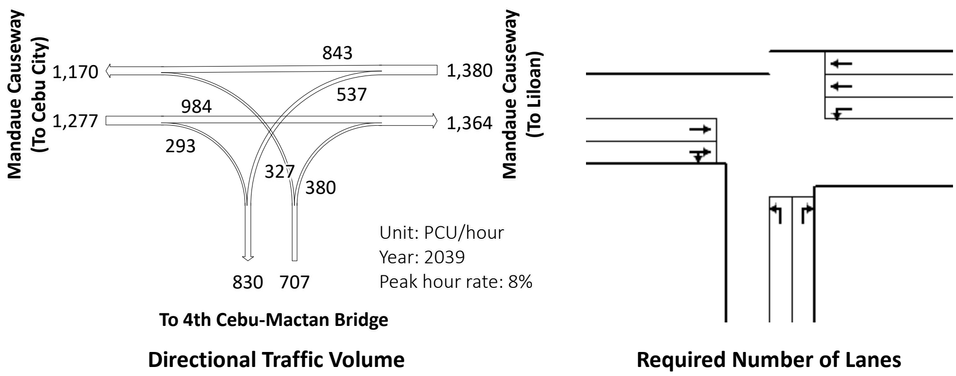
Source: JICA Survey Team

Figure 5.1.22 Cost Reduction Options for Mandaue Interchange

(3) At-Grade Intersection of 4th Cebu-Mactan Bridge and Mandaue Causeway

As mentioned earlier, 4th Cebu-Mactan Bridge will be linked with Mandaue Causeway at the section near Cansaga Bay Bridge. On the future road network in Metro Cebu, many of through traffic will divert to the proposed Metro Cebu Circumferential Road and the traffic using 4th Cebu-Mactan Bridge will also flow from/to the Mandaue Coastal Road, which will be a part of the circumferential road. Therefore, the traffic volume at the intersection of 4th Cebu-Mactan Bridge and Mandaue Causeway will not be so high comparing with the other intersections to be covered under the Project.

Based on the projected directional traffic (see the left figure of Figure 5.1.23), traffic capacity of this intersection was analyzed. Table 5.1.22 summarizes the result of the traffic capacity analysis and the right figure of Figure 5.1.23 shows the required number of lanes at this intersection.



Source: JICA Survey Team

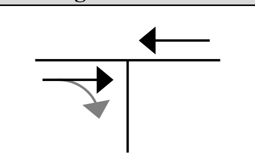
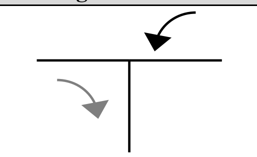
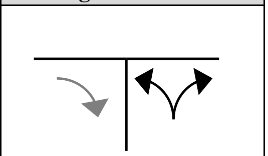
Figure 5.1.23 Directional Traffic Volume and Required Number of Lanes

Table 5.1.22 Traffic Analysis of Intersection of 4th Cebu-Mactan Bridge and Mandaue Causeway

		Mandaue Causeway		4th Cebu-Mactan Bridge		Mandaue Causeway		
		To Consolacion		To Lapu-Lapu		To Cebu City		
		LT	TH	LT	RT	TH/RT		
Number of Lane		1	2	1	1	2		
Basic Capacity (PCU/hour)		1,800	4,000	1,800	1,800	4,000		
Lane Width (m)		3.5	3.5	3.5	3.5	3.5		
Adjustment Factor		1.00	1.00	1.00	1.00	1.00		
Share of Right-Turn (%)						23%		
Adjustment Factor						0.93		
Share of Left-Turn (%)								
Adjustment Factor		0.99					Saturation Rate of Phase	Saturation Rate of Intersection
Saturation Flow Ratio		1,782	4,000	1,800	1,800	3,720		
Total Traffic Volume (PCU/hour)		537	843	327	380	1,277		
Flow Rate		0.298	0.211	0.182	0.211	0.343		
Phase Ratio	Phase 1	0.298				0.343	0.34	0.77
	Phase 2		0.211				0.21	
	Phase 3			0.182	0.211		0.21	
Required Green (sec)	Phase 1	40				40	Cycle Time (sec)	
	Phase 2		30					
	Phase 3			30	30		100	
Share of Green		0.400	0.300	0.300	0.300	0.400		
Traffic Capacity		720	1,200	540	540	1,488		
Volume Capacity Ratio		0.746	0.703	0.606	0.704	0.858		
Judgement		OK	OK	OK	OK	OK		
Traffic Volume per Cycle		15	24	10	11	36		
Storage Length (m)		135	216	90	99	324		

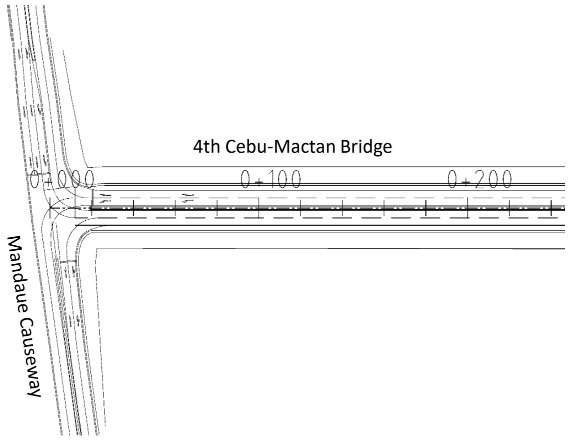
Source: JICA Survey Team

Table 5.1.23 Signal Phasing of the Successive Intersections at Lapu-Lapu Interchange

	Signal Phase 1	Signal Phase 2	Signal Phase 3
Signal Phase Diagram			
Green (sec)	40	30	30

Note: Signal controlled flow Free flow
Source: JICA Survey Team

Figure 5.1.24 shows the plan view of the designed intersection. In order to avoid reconstruction of Cansaga Bay Bridge, widening of Mandaue Causeway will start from the abutment of the bridge.



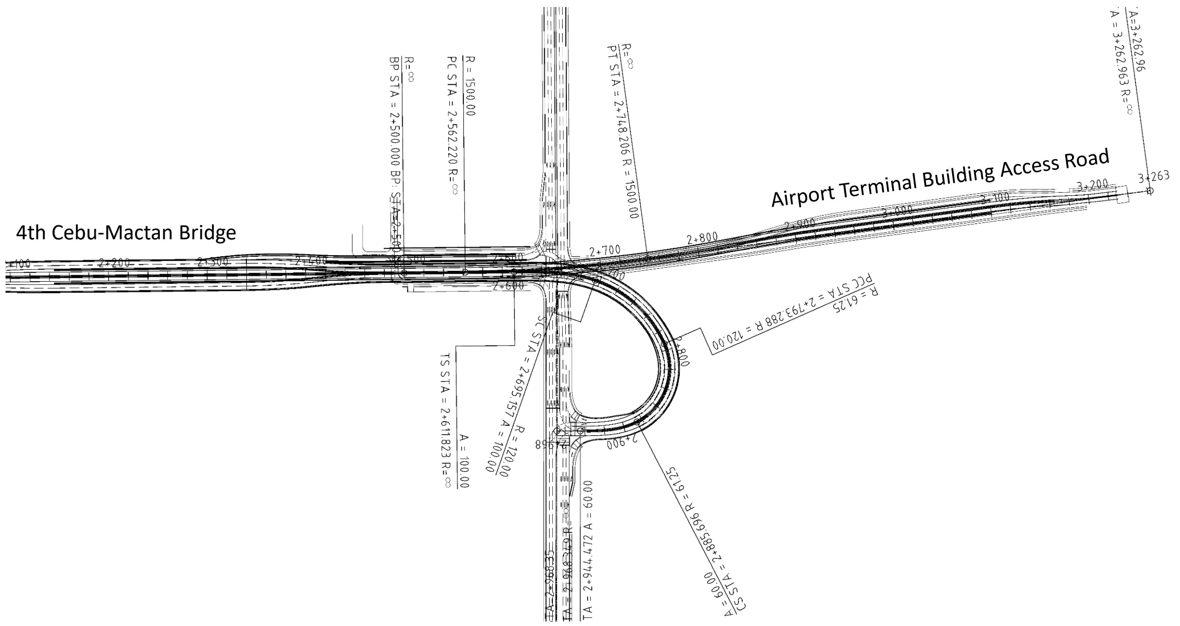
Source: JICA Survey Team

Figure 5.1.24 Plan of At-Grade Intersection of 4th Cebu-Mactan Bridge and Mandaue Causeway

(4) Lapu-Lapu Interchange

As shown in Figure 5.1.2, the directional flow between 4th Cebu-Mactan Bridge and the west side of Lapu-Lapu City has the highest traffic demand among the directional traffic using 4th Cebu-Mactan Bridge. Whereas the construction of the direct link between 4th Cebu-Mactan Bridge and Airport Terminal Building Access Road, which is a Secondary National Road under DPWH, are requested from Lapu-Lapu City, the configuration of interchange ramps shown in Figure 5.1.25 has been considered as the only solution to accommodate ramps for ensuring all of the following requirements:

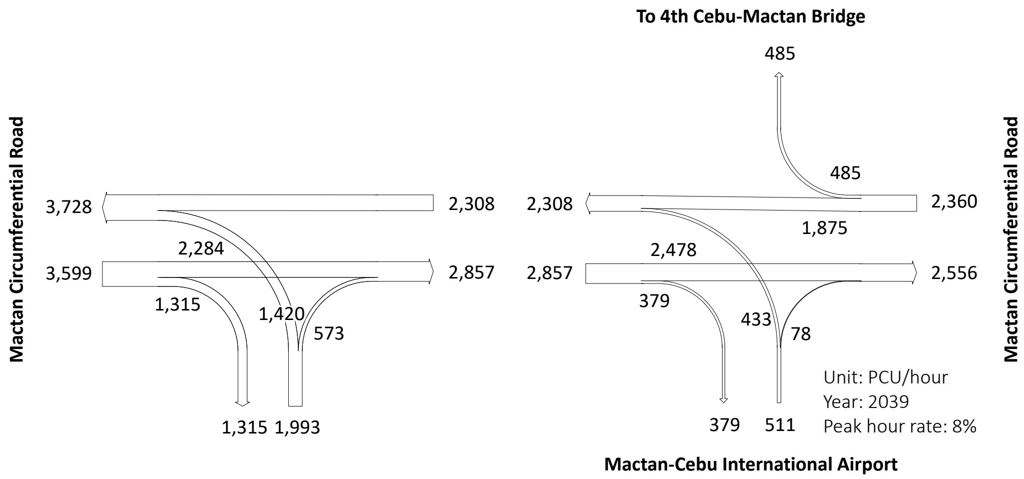
- To provide accessibility to 4th Cebu-Mactan Bridge from three (3) directions, namely Airport Terminal Building Access Road, west and east sides of Mactan Circumferential Road;
- To provide smooth traffic flow at the nodes of intersections in order not to create a new traffic bottleneck;
- To sustain the local accessibility using the existing road towards Mactan Wharf, Cebu Yacht Club and the underground parking of the shopping mall (Island Central Mactan); and
- To mitigate large-scale resettlement of structures.



Source: JICA Survey Team

Figure 5.1.25 Plan of Lapu-Lapu Interchange

Figure 5.1.26 shows the directional traffic volume converting from the projected traffic volume shown in Figure 5.1.2 into the actual traffic flow based on the interchange ramp configuration shown in Figure 5.1.25. Free flow condition can be provided for the traffic flow into 4th Cebu-Mactan Bridge from the three directions (Airport Terminal Building Access Road, west and east sides of Mactan Circumferential Road) but the issue on the traffic signal control at these successive intersections is how left-turning traffic flow can be managed whereas the traffic volume of through traffic along Mactan Circumferential Road is high. Therefore, traffic capacity of these intersections were analyzed in consideration of synchronization of the traffic signal control of the successive intersections.



Source: JICA Survey Team

Figure 5.1.26 Directional Traffic Volume at the Intersections of Lapu-Lapu Interchange

Table 5.1.24 and Table 5.1.25 summarize the result of the traffic analysis for these successive intersections. From these results, it was confirmed that the signalized traffic control would be possible with the reasonable number of lanes shown in Figure 5.1.27 and the signal phasing shown in Table 5.1.26 .

Table 5.1.24 Traffic Analysis of Intersection at Lapu-Lapu Interchange (1)

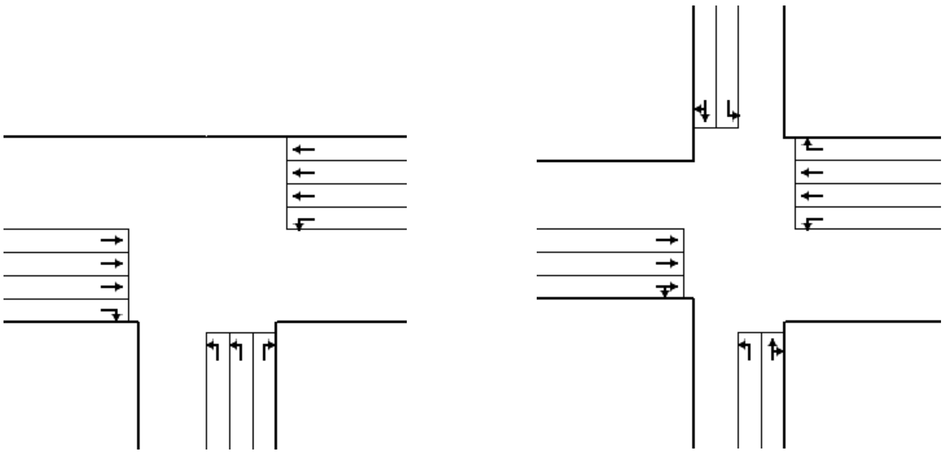
		Mactan Circumferential		Lapu-Lapu Interchange		Mactan Circumferential			
		To East		To 4th Bridge		To West			
		LT	TH	LT	RT	TH	RT		
Number of Lane		1	3	2	1	3	1		
Basic Capacity (PCU/hour)		1,800	6,000	3,600	1,800	6,000	1,800		
Lane Width (m)		3.5	3.5	3.5	3.5	3.5	3.5		
Adjustment Factor		1.00	1.00	1.00	1.00	1.00	1.00		
Share of Right-Turn (%)									
Adjustment Factor									
Share of Left-Turn (%)									
Adjustment Factor								Saturation Rate of Phase	Saturation Rate of Intersection
Saturation Flow Ratio		1,800	6,000	3,600	1,800	6,000	1,800		
Total Traffic Volume (PCU/hour)		0	2,308	1,420	573	2,284	1,315		
Flow Rate		0.000	0.385	0.394	0.318	0.381	0.731		
Phase Ratio	Phase 1					0.381	Free Right Turn	0.38	0.77
	Phase 2							0.00	
	Phase 3			0.394	0.318			0.39	
Required Green (sec)	Phase 1					40	40	Cycle Time (sec)	
	Phase 2	10					10		
	Phase 3			40	40		40	90	
Share of Green		0.111	0.444	0.444	0.444	0.444	1.000		
Traffic Capacity		200	2,667	1,600	800	2,667	1,800		
Volume Capacity Ratio		0.000	0.866	0.890	0.716	0.857	0.731		
Judgement		OK	OK	OK	OK	OK	OK		
Traffic Volume per Cycle		0	58	36	15	58	33		
Storage Length (m)		0	522	324	135	522	297		

Source: JICA Survey Team

Table 5.1.25 Traffic Analysis of Intersection at Lapu-Lapu Interchange (2)

		Mactan Circumferential			Lapu-Lapu Interchange		Mactan Circumferential		
		To East			To 4th Bridge		To West		
		LT	TH	RT	LT	RT	TH/RT		
Number of Lane		1	2	1	1	1	3		
Basic Capacity (PCU/hour)		1,800	4,000	1,800	1,800	1,800	6,000		
Lane Width (m)		3.5	3.5	3.5	3.5	3.5	3.5		
Adjustment Factor		1.00	1.00	1.00	1.00	1.00	1.00		
Share of Right-Turn (%)							13%		
Adjustment Factor							0.96		
Share of Left-Turn (%)									
Adjustment Factor								Saturation Rate of Phase	Saturation Rate of Intersection
Saturation Flow Ratio		1,800	4,000	1,800	1,800	1,800	5,760		
Total Traffic Volume (PCU/hour)		0	1,875	485	433	78	2,857		
Flow Rate		0	0.469	0.269	0.241	0.043	0.496		
Phase Ratio	Phase 1		0.469	Free			0.496	0.48	0.72
	Phase 2			Right				0.00	
	Phase 3			Turn	0.241	0.043		0.24	
Required Green (sec)	Phase 1		50	50			50	Cycle Time (sec)	
	Phase 2	10		10					
	Phase 3			30	30	30		90	
Share of Green		0.111	0.556	1.000	0.333	0.333	0.556		
Traffic Capacity		200	2,222	1,800	600	600	3,200		
Volume Capacity Ratio		0.000	0.844	0.269	0.722	0.130	0.893		
Judgement		OK	OK	OK	OK	OK	OK		
Traffic Volume per Cycle		0	47	13	11	2	72		
Storage Length (m)		0	423	117	99	26	648		

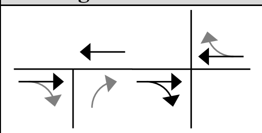
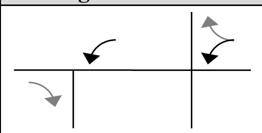
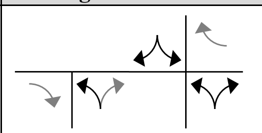
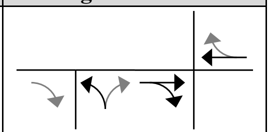
Source: JICA Survey Team



Source: JICA Survey Team

Figure 5.1.27 Required Number of Lanes of the Successive Intersections at Lapu-Lapu Interchange

Table 5.1.26 Signal Phasing of the Successive Intersections at Lapu-Lapu Interchange

	Signal Phase 1	Signal Phase 2	Signal Phase 3	Signal Phase 4
Signal Phase Diagram				
Green (sec)	40	10	30	10

Note: Signal controlled flow Free flow

Source: JICA Survey Team

Distance between two Consecutive Intersections

The distance between two consecutive intersections should be long as much as possible, but it sometimes needs to be short due to the site conditions. The required minimum distance of it is basically governed by the four (4) factors, such as weaving length, storage length at signal control, left-turning lane length and drivers' attention limit.

- Weaving length: In Japan, if the distance between two consecutive intersections is longer than the following equation, calculation of weaving length is not required. At this specific location of Lapu-Lapu Interchange, this length can be calculated as 240 m where only 120 m can be secured under the design.

  $D = V \times N \times 2$

  Where;

  D: Distance between two constructive intersections (m)

  V: Design speed (km/h)

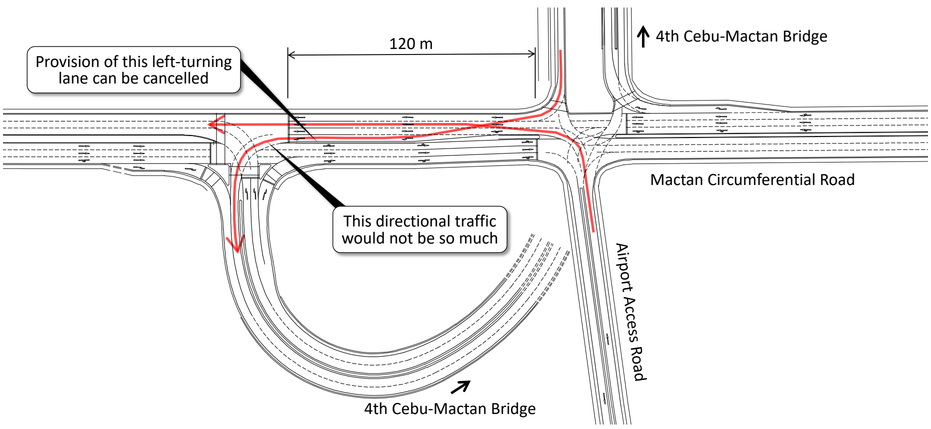
  N: Number of lanes per direction

  However, it is expected that there will be no weaving traffic at the section (see Figure 5.1.26), the above discussion can be negligible.

- Storage length at signal control is the accumulated length of queue of vehicles in a cycle of signal phasing. If the traffic signal control will be independent for the consecutive two intersections, this length needs to be considered. But usually, signal control of such short distance intersections can be synchronized and this length can also be negligible.

- Left-turning lane length is also the accumulated length of queue of vehicles for waiting the timing of left-turning in a cycle of signal phasing. As shown in Figure 5.1.26, such traffic is not appeared in the traffic demand but it would be expected from the yacht club or shopping mall to the 4th Cebu-Mactan Bridge. The traffic volume of such direction would not be so much and the impact would be negligible. However, in order to ensure the smoothness (no interruption) of traffic, left-turning lane into the loop ramp of Lapu-Lapu Interchange may be eliminated.

- Drivers' attention limit: In case if the distance of two intersection is too short, drivers' attention may loose for a moment during entering into the second intersection or drivers may not be able to judge the traffic situation. However there is no statistical study on such situation and thus, it is difficult to determine the minimum length from the drivers' attention limit.



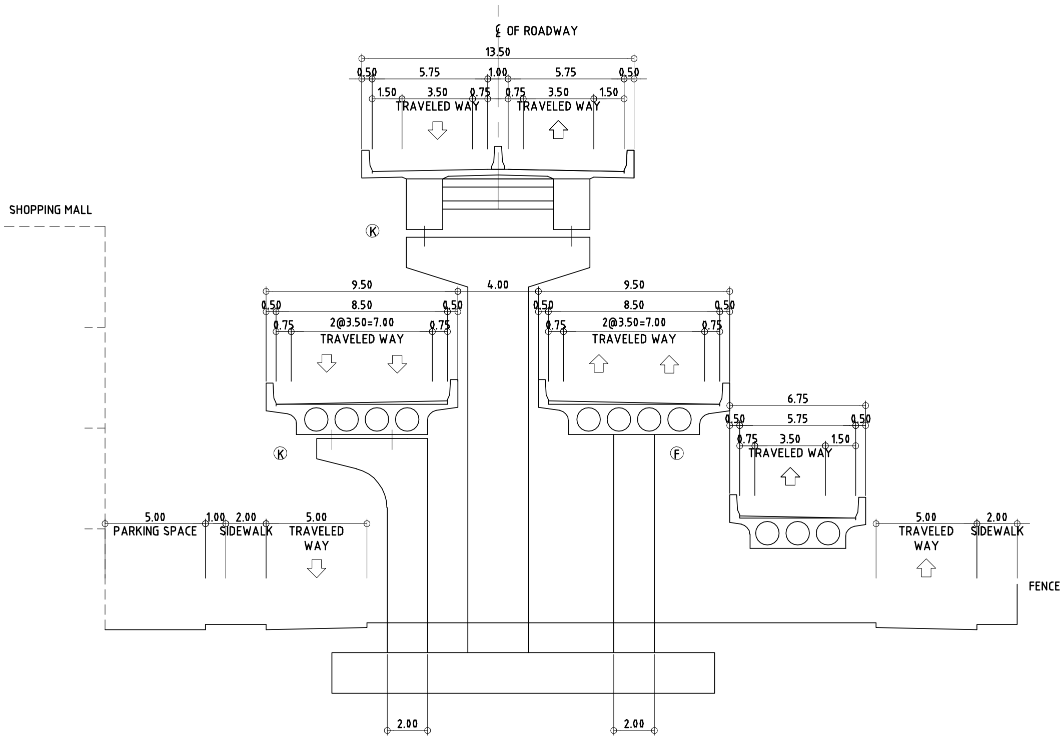
Source: JICA Survey Team

Figure 5.1.28 Typical Cross Section of Lapu-Lapu Interchange

Considering the above an as a result of discussion with DPWH Bureau of Quality and Safety, it was decided that the distance of two consecutive intersection (between two stop lines) at 120 m would be too short to accommodate weaving maneuver within the short section even though such traffic volume would not be so much and thus, provision of left-turning lane for entering into the loop ramp of Lapu-Lapu Interchange should be canceled in order to ensure the traffic safety and smoothness of traffic.

Multi-layered Configuration

Figure 5.1.29 shows typical cross section of Lapu-Lapu Interchange at the section between the shopping mall (Island Central Mactan) and a factory in Mactan Export Processing Zone 1. For construction of the interchange, resettlement of the factory is necessary.



Source: JICA Survey Team

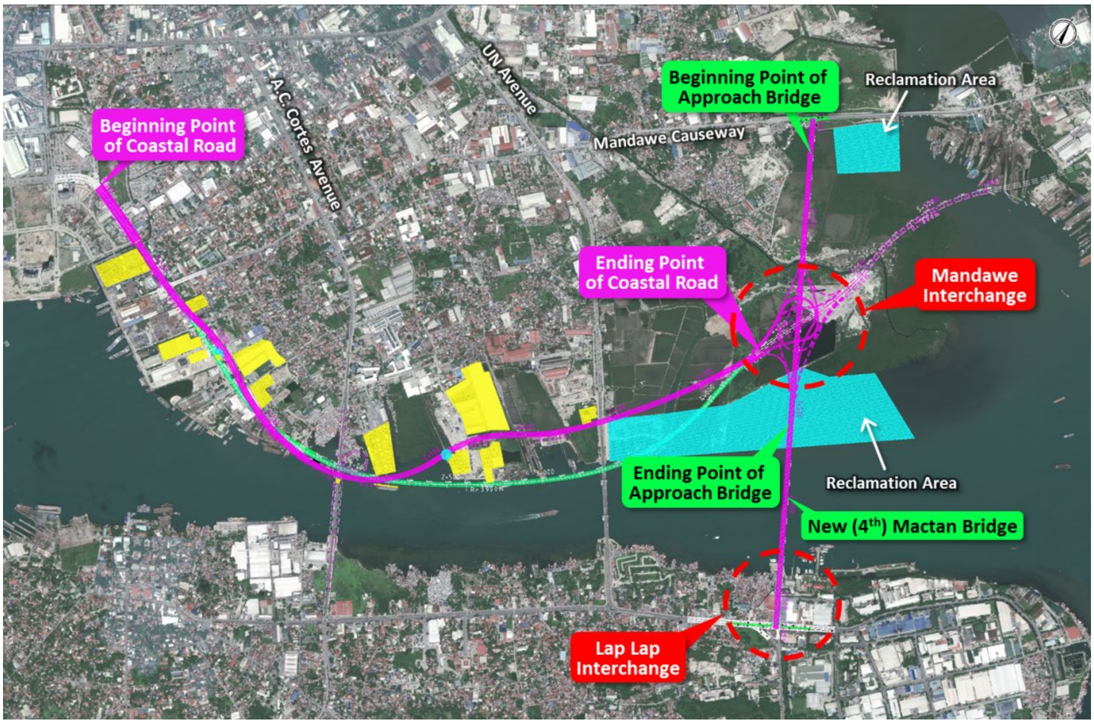
Figure 5.1.29 Typical Cross Section of Lapu-Lapu Interchange

5.2 Bridge Design

5.2.1 Scope of Bridge Section

This project consists of following sections. Location and summary of each section are shown in Figure 5.2.1 and Table 5.2.1.

- 4th Cebu-Mactan Bridge Section
- Approach Road Section
- Mandaue Coastal Road Section
- Mandaue Interchange Section
- Lapu-Lapu Interchange Section



Source: JICA Survey Team

Figure 5.2.1 General Layout of each Section

Table 5.2.1 Summary of Bridge Structure at each section

Route name	Bridge Length	Span numbers	Structure type	Major structure center span length: Lc
4th Cebu-Mactan Bridge (0 to end of 4th Cebu-Mactan Bridge)	2,300m	60 span	PC-I girder PC Hollow Slab Steel Box Girder	4th Cebu-Mactan Bridge Lc=215m Approach bridge, Lc=80m
Mandaue Coastal Road	4,751m	122 span	PC-I girder PC Hollow Slab Steel Box Girder	75span PC-I girder 4 overpass over facilities, Lc=80-100m 2 overpass over roads, Lc=60m
Mandaue Interchange	2,160m	73 span	PC Hollow Slab	
Lapu Lapu Interchange (from end of 4th Cebu-Mactan Bridge)	1,137m	33 span	PC Hollow Slab Steel Box Girder	2 layer bridge, Lc=48m 2 overpass over road, Lc=65, 60m
Total	10,348m	288 span		

5.2.2 Design Condition

(1) Applicable Standard

The following design standards are applied for bridge design.

- Design Guidelines, Criteria & Standards, Volume 5 Bridge Design 2015
- DPWH Guide Specifications, LRFD Bridge Seismic Design Specifications, 1st Edition, 2013
- AASHTO LRFD Bridge Design Specifications
- Specifications for Highway Bridges issued by Japanese Road Association

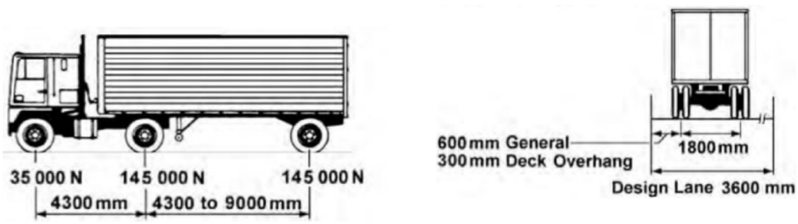
(2) Live Load

Applied live load is based on AASHTO LRFD. However, this road is planned to connect between new container terminal to be located in Consolacion and Cebu International Port, thus, it is expected "International Maritime Container Cars (total weight: 44 ton)" will pass this road. Therefore, the following live loads are considered for bridge design.

Design for Main Girder and Substructure

HL-93 (combination of the Design Truck: HS20-44 or Design Tandem, and Design Lane Load) is applied. Details of each loads are shown as below;

- Design Truck: HS20-44: The loading combination for spacing of wheels and axles of design vehicle specified in AASHTO LRFD is the layout given in Figure 5.2.2.



Source: AASHTO LRFD

Figure 5.2.2 Design Truck (HS20-44)

- Design Tandem: The Design Tandem is a pair of 110 kN axles load spacing 1.20m in longitudinal direction. Transversely, spacing of wheels is taken as 1.80m width.
- Design Lane Load: The design lane load is a uniform linear load of 9.3 kN/m in longitudinal direction. Transversely, the design lane load shall be assumed to be uniformly distributed over a 3.0m width.

Design for Deck Slab

In order to resist load for "International Maritime Container", HS25 truck load is considered for design of deck slab. HS25 with a gross vehicle weight of 40.8 ton, which is 25% greater than those of HS20, shall be considered for design of deck slab.

(3) Wind load

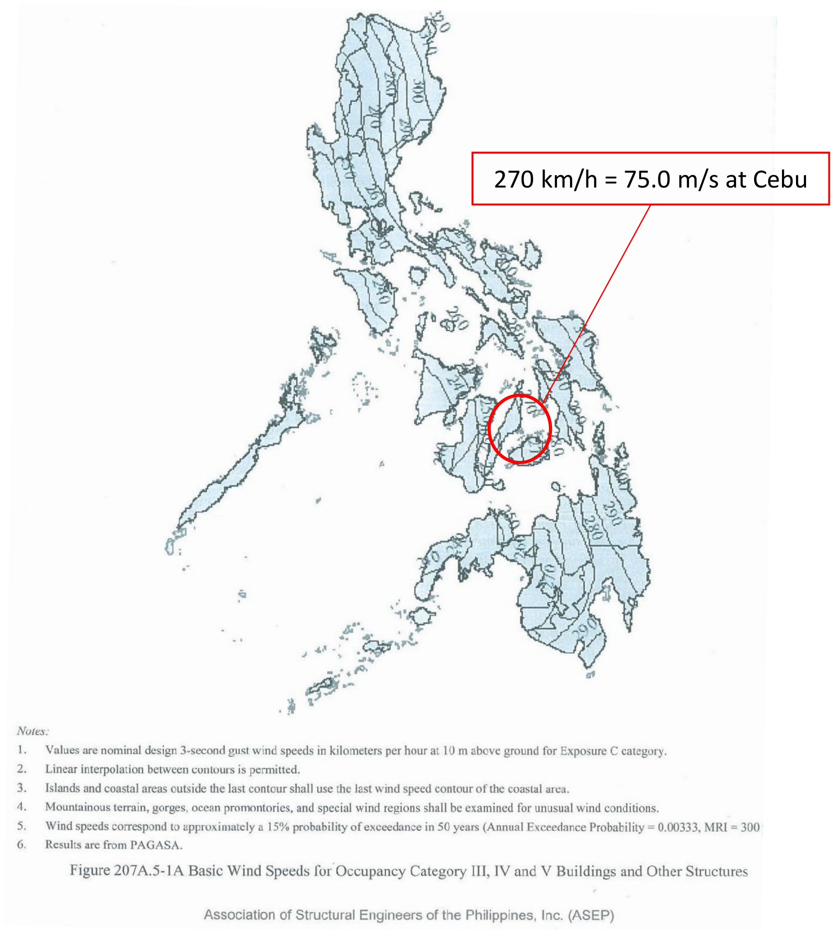
Basic Design Speed

Since the main bridge has a long span length, wind load is an important factor in the determination of girder shape and for the structural design. In the strait, continuous strong winds blow at high speed perpendicular to the bridge and create conditions which tend to generate vibration in the bridge, and evaluation of wind is therefore important.

The maximum wind speed from 1972 to 2017 obtained from observed data is 55m/s at Cebu PAGASA station. The obtained data is for 10-minute average wind speed at 10m height with unknown roughness. This wind speed is rather high considering the design wind speed in DGCS. The design wind speed in DGCS is the uniform wind speed in the whole of the Philippines, and variations between local areas are not taken into consideration. It is necessary to set the basic wind speed based on observational data at the site.

As a reference to determine the basic wind speed, the maximum wind speed in the Philippines is indicated in Philippines 2015, 7th Edition, Volume I Building, Towers, and other Vertical Structures by the Association of Structural Engineers of the Philippines, Inc. (ASEP). The maximum wind speed shown in Figure 5.2.1 has a 15% probability of exceedance in 50 years and a return period of 300 years. This wind speed is higher than the 100-year return period wind speed which is used for bridge design and is therefore applicable as the basic wind speed.

In Figure 5.2.1, the basic wind speed with Surface Roughness C is 75 m/s (3-second gust wind speed). When this wind speed is converted into Surface Roughness D, the wind speed 10m above ground becomes 75x1.18=88.5 m/s. As mentioned above, the design wind speed shall be V10=88.5 m/s (3-second gust, h=10 m). When more accurate data is obtained during the detailed design phase, the wind speed will be reviewed.



Source: National Structural Code of the Philippines 2015, 7th Edition

Figure 5.2.3 Basic Wind Speed for Buildings in Exposure C Category

Design Wind Load

The following equation is used for the design wind load for the main bridge design.

$$p = 0.5\rho(V_d)^2 C_d G$$

Where:

p	= Wind pressure
ρ	= Mass density of air = 0.125 [kg s^2/m^4]
C_d	= Drag coefficient
G	= Gust factor
V_d	= Design wind speed [m/s]

Gust Factor and Drag Coefficient

The gust factor G is defined as the ratio of the peak gust to the mean wind speed, and the gust factor for each structure uses the default values of Japanese standards. The drag coefficient shall be estimated by the Girder width/height ratio and verified by wind tunnel tests at the detailed design stage.

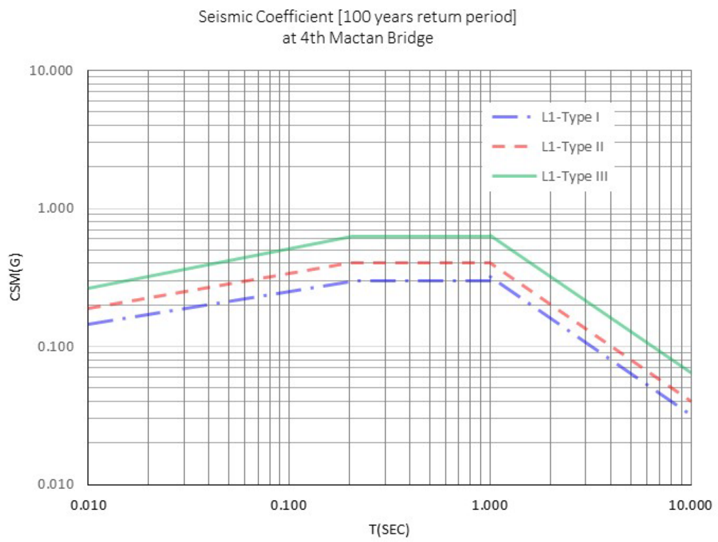
(4) Earthquake Load

DPWH Guide Specifications LRFD Bridge Seismic Design Specifications ("BSDS"), 2013 is applied for the seismic design of structures. The Bridge Operational Classification is classified as OC-I (Critical Bridges).

The soil type at 4th Cebu-Mactan Bridge is categorized as Type-II *(currently being surveyed)*. In accordance with BSDS, the acceleration coefficients in Cebu are shown in the following tables and the design response spectrum for each soil type are shown in the corresponding figures.

Table 5.2.2 Acceleration Coefficient Level 1 Earthquake

Soil	Fpga	PGA	As	Fa	Ss	SDS	Fv	S1	SD1	Ts=SDl/SD
Type I	1.2	0.12	0.144	1.2	0.25	0.30	1.6	0.2	0.32	1.07
Type II	1.56	0.12	0.1872	1.6	0.25	0.40	2.0	0.2	0.40	1.00
Type III	2.21	0.12	0.2652	2.5	0.25	0.63	3.2	0.2	0.64	1.02

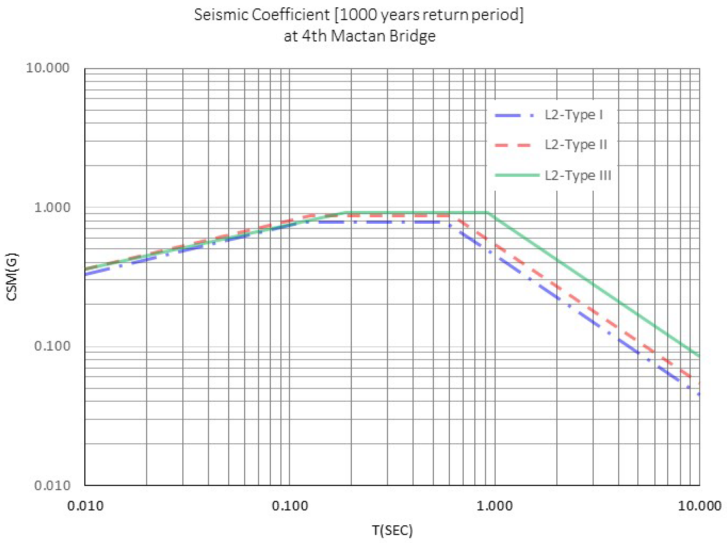


Source: JICA Survey Team

Figure 5.2.4 Acceleration Coefficient Level 1 Earthquake

Table 5.2.3 Acceleration Coefficient Level 2 Earthquake

Soil	Fpga	PGA	As	Fa	Ss	SDS	Fv	S1	SD1	Ts=SDI/SD
Type I	1.1	0.3	0.33	1.12	0.7	0.78	1.5	0.3	0.45	0.57
Type II	1.2	0.3	0.36	1.24	0.7	0.87	1.8	0.3	0.54	0.62
Type III	1.2	0.3	0.36	1.30	0.7	0.91	2.8	0.3	0.84	0.92



Source: JICA Survey Team

Figure 5.2.5 Acceleration Coefficient Level 2 Earthquake

(5) Temperature Load

<u>Temperature Range</u>

In consideration of the weather at the bridge location, ±15 degrees which is the value of notice of DPWH is considered as the uniform temperature range in the design. The basic temperature (at the time of erection) is assumed to be 28.0 degrees*.

*Average temperature from the Cebu PAGASA Complex Station, Mactan Int'l Airport. 1988-2017.

<u>Temperature gradient</u>

As for the temperature gradient, a 15-degree difference of the steel deck is considered for the girder design referring to the default value in Japanese standards.

(6) Navigation Clearance

Navigation Clearance is determined based on consultation result with the Coastal Guard and Department Order of DPWH No. 166, Series of 2016.

<u>Navigational Horizontal Clearance</u>

Required clearance between bridge pier columns is determined as follows after several discussion/consultation with the Coastal Guard.

- Navigational Horizontal Clearance: 143 m
- Safety Margin: 20 m to be added on both sides of Navigational Horizontal Clearance
- Bridge structure shall secure space for both Navigational Horizontal Clearance and Safety Margin in any substructure type as shown in Figure 5.2.6 and Figure 5.2.7.
- Securement of the Safety Margin shall not be required during construction stage.

Navigational Vertical Clearance

Navigation Vertical Clearance shall be determined based on Department Order of DPWH No. 166, Series of 2016 and consultation with the Coastal Guard as follows;

Vertical Clearance = HWL+HV+K

Where;

HWL: Highest Water Level recorded within the area of responsibility=+2.21m

HV: Height of Vessel=21.86m

K: constant 1 meter allowance=1.00m

Regarding to Tidal Level at the location of New (4th) Mactan Bridge, this is estimated in accordance with the tidal data shown in "Tide and Current Table 2019 Philippine" issued by NAMRIA and Benchmark No. "BM-X". Relationship of each tidal level is as follows;

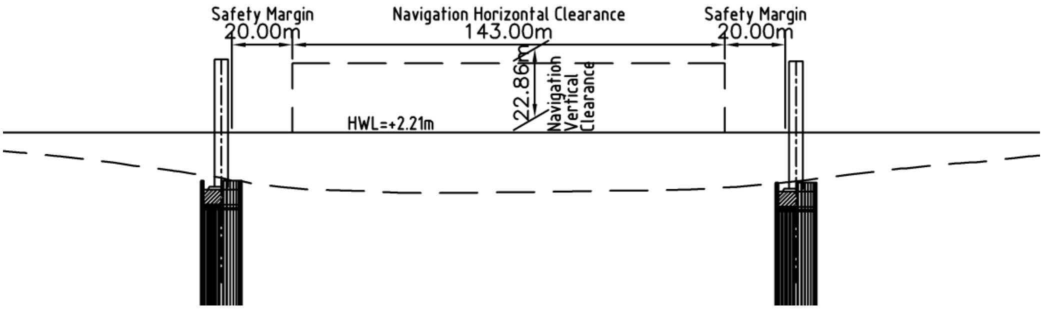
EL of "BM-X": +2.802m

MLLW: 0.000m

HWL: +2.210m

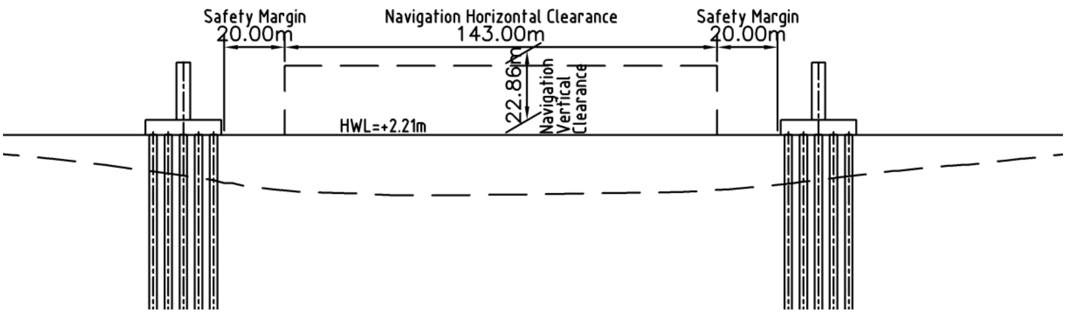
Sketch of Navigation Clearance for both Horizontal and Vertical

Based on above consideration, Navigation Clearance for both Horizontal and Vertical is shown in Figure 5.2.6and Figure 5.2.7.



Source: JICA Survey Team

Figure 5.2.6 Sketch of Navigation Clearance (in case, foundation locates under seabed)

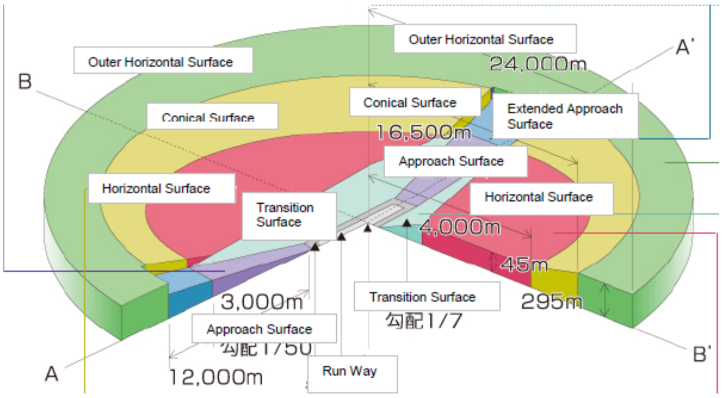


Source: JICA Survey Team

Figure 5.2.7 Sketch of Navigation Clearance (in case, pile cap locates above sea level)

(7) Aviation Limit

Since 4th Mactan Bridge Locate near Mactan-Cebu International Airport, aviation limit needs to be considered. Based on interview with (Mactan-Cebu International Airport Authority or Civil Aviation Authority of the Philippines))Airport Authority, aviation condition of Mactan-Cebu International Airport applies International Civil Aviation Organization (ICAO) Specification, then, aviation limit is considered as shown in Figure 5.2.8.



Source: Haneda Airport

Figure 5.2.8 Sketch of Aviation limit

Since 4th Cebu-Mactan Bridge will be located within 4km of Mactan-Cebu International Airport, 45 m height from elevation of runway shall be considered. Based on interview result from Mactan-Cebu International Airport Authority, elevation of runway is +6.00 m, therefore, elevation of the aviation limit becomes +51.00 m.

(8) Ship Collision Force

In accordance with Design Guidelines, Criteria & Standards, Volume 5 Bridge Design 2015, ship collision force is specified as follows;

$P_s = 1.2 x 10^5 x V \sqrt{DWT}$

Where;

P_s: equivalent static vessel impact force [N]

DWT: deadweight tonnage of vessel [Mg]

V: vessel impact velocity [m/s]

Design Collision Velocity

Design Impact Velocity is also calculated in accordance with Design Guidelines, Criteria & Standards, Volume 5 Bridge Design 2015 as follows and ;

V: design vessel impact velocity

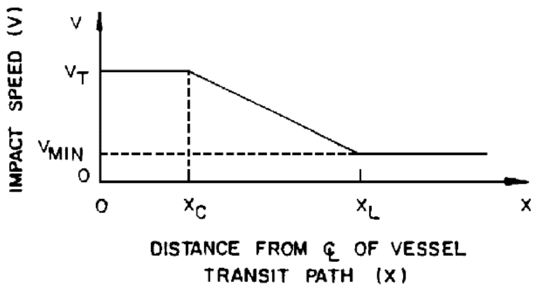
V_T: typical vessel transit velocity in the channel under normal environmental conditions, but not taken to be less than V_{MIN} [m/s] = 8 [Knots] = 4.12 [m/s] (interview result from Coast Guard)

V_{MIN}: minimum design impact velocity taken as not less than the yearly mean current velocity for the bridge location [m/s] = 0.82 [m/s] (refer to **Chapter 4**)

X: distance to face of pier from centerline of channel [mm]

X_C: distance to edge of channel [mm]

X_L: distance equal to 3 times the length overall of the design vessel [mm]



Source: Design Guidelines, Criteria & Standards, Volume 5 Bridge Design 2015

Figure 5.2.9 Design Collision Velocity Distribution

Size of Design Vessel

According to Philippine Coastal Guard, the maximum height of vessel passing through Mactan Channel is 21.86 m. This size of vessel is categorized as Cargo Ship (DWT: 1,000) in reference to the "Investigation of Height of Vessel by Statistical Solution" (Report of Investigation Result No. 31 by National Institute for Land and Infrastructure Management).

Also, size of Cargo Ship (DWT: 1,000) is specified as follows according to the "Investigation of Size of Vessel by Statistical Solution" (Report of Investigation Result No. 28 by National Institute for Land and Infrastructure Management)

- Length of Vessel: 63.0 [m]
- Width of Vessel: 11.0 [m]

(9) Overburden Depth of Pile Cap

As described in previous chapter, the project scope consists of following sections.

- Section in sea area: 4th Cebu-Mactan Bridge Section and some part of Mandaue Coastal Road Section
- Section in industrial and commercial areas: first half of Coastal Road Section and Lap-Lap Interchange Section
- Section in unused land area: Approach Road Section, second half of Coastal Road Section and Mandaue Interchange Section
- Land reclamation area: some part of 4th Cebu-Mactan Bridge Section and Approach Road Section

Regarding the section in industrial and commercial areas, it is recommended to secure at least 1.5 m depth of overburden soil above pile cap in order to secure space for drainage facilities and utilities above pile cap.

Regarding the section in unused land area, currently, there is no development plan in this area. However, there is some possibility to develop as factory, commercial or residential area in future. Thus, it is also recommended to secure enough space for future development.

Therefore, all pile caps to be constructed at land area (factory and commercial area and unused land area) should secure 1.5 m overburden depth from existing ground level.

Regarding the section in the proposed land reclamation area, currently, this area is in the sea, therefore, pile cap places at 1 m below seabed level.

Summary of overburden depth of pile cap is summarized in Table 5.2.4.

Table 5.2.4 Summary of Overburden Depth of Pile Cap

Section	Overburden Depth
Factory and Commercial Area	1.5 m overburden depth below existing ground level
Unused Area	1.5 m overburden depth below existing ground level
Land Reclamation Area	1.0 m overburden depth below seabed level

Source: JICA Survey Team

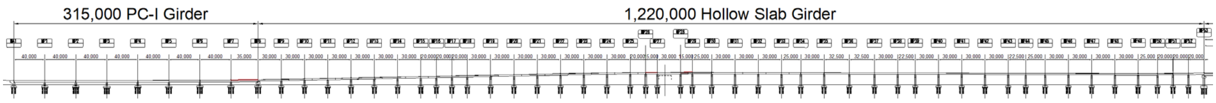
5.2.3 Design of 4th Cebu-Mactan Bridge

(1) Bridge Arrangement

The viaduct section of 4th Cebu-Mactan Bridge was designed as the combination of 30 m-span hollow slab girder for future development area, 40 m-span PC-I girders for mangrove area and 80 m-span steel box girders on water as shown in Table 5.2.5. The main bridge across Mactan Channel will be a 215 m-span steel box girder bridge.

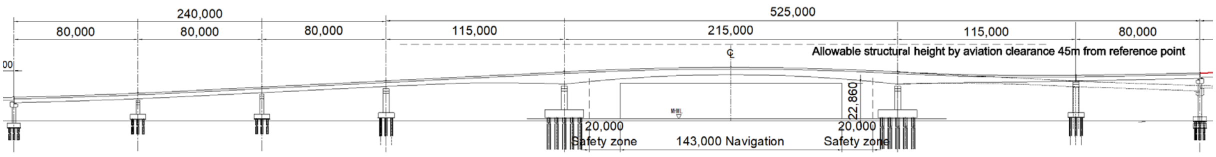
Table 5.2.5 List of Bridges of 4th Cebu-Mactan Bridge

Name of bridge	Chainage	Total length	Structure type	Span arrangement
North approach bridge Land section	0+40~1+575.0	1,535m	PC-I girder PC Hollow Slab	7@40+35=8span 7@30+3@20+7@30 +20+15+30+15+25+3@30+25+30+2@32.5 +30+22.5+4@30+22.5+25+4@30+25 +3@20=45span
North approach bridge Water section	1+575.0~1+815.0	240m	Steel box girder with composite slab	3@80m
4th Cebu-Mactan Bridge Main Bridge	1+815.0~2+340	525m	Steel box girder with orthotropic steel deck	115+215+115+80m
Total		2,300m	60 spans	



Source: JICA survey team

Figure 5.2.10 Side View of 4th Cebu-Mactan Bridge (Land section)



Source: JICA survey team

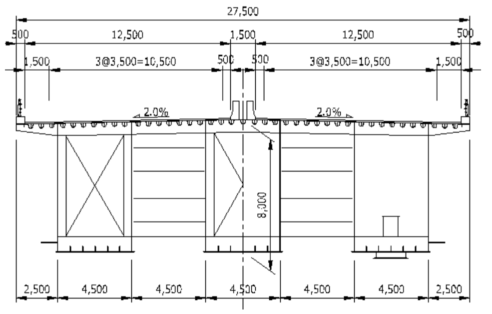
Figure 5.2.11 Side View of Main Bridge of 4th Cebu-Mactan Bridge (Water section)

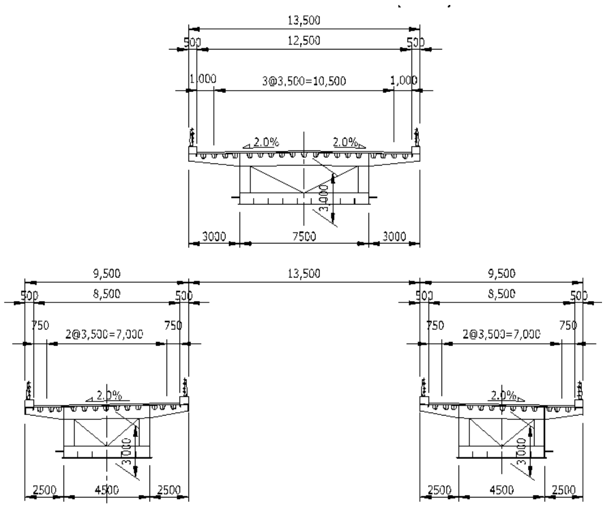
In order to examine the optimum span layout for the viaduct, the following are considered in the design of the bridge.

- In consideration of the navigational safety of small vessels and utilization of the waterfront of the proposed reclamation project (Mandaue Global City), the span length of the approach bridge within the proposed reclamation area is determined as 80 m.
- For determination of the span length of the side span of the main bridge, the deflection of the center span was taken into consideration to prevent it to be excessively large.

(2) Design of Main Bridge

As a result of the comparison of the superstructure type of 4th Cebu-Mactan Bridge described in Section (4), the steel box girder type is selected as a suitable structure for the main bridge, and the narrow steel box girder type with composite slab is selected for the approach bridge.

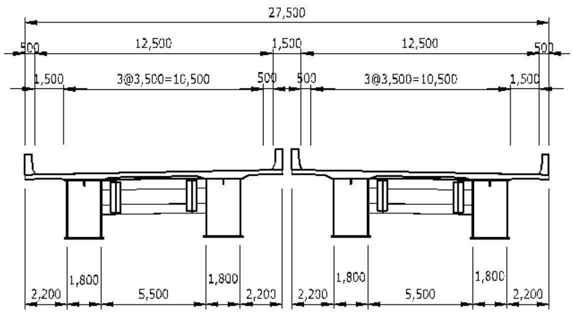




(1) Center span (at MP57)

(2) Side span at Lapu-Lapu side (at MP59)

Main Bridge



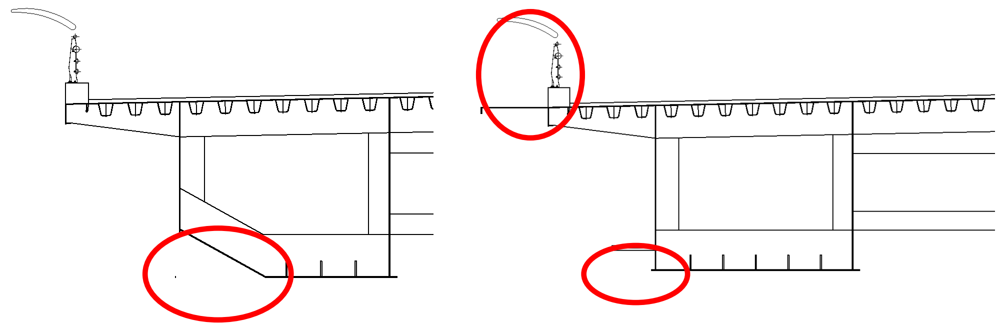
Approach Bridge

Source: JICA survey team

Figure 5.2.12 Road Width and Cross Section of 4th Cebu-Mactan Bridge

The following points are considered in the design of the bridge.

- The center span will be constructed using the large block erection method to minimize the closure period of the navigation channel.
- Construction of a bridge having a change in width in 215 m of center span and a branch in side span is the first experience in the world. For branch structure, 3-Box girder is proposed. Reinforcement structure at the branch section and wind stability should be checked carefully in detailed design stage.
- The continuity between the main bridge and the approach bridge is considered for aesthetic reasons.
- The bridge site receives direct typhoon strikes and the design wind speed is very high at 88.5 m/s (gust wind). Therefore, wind stability is a key factor when determining the girder section. Different alternatives can be considered for the girder section as measures for wind stability. The detailed shape and measures will be studied in the detailed design stage.



Source: JICA survey team

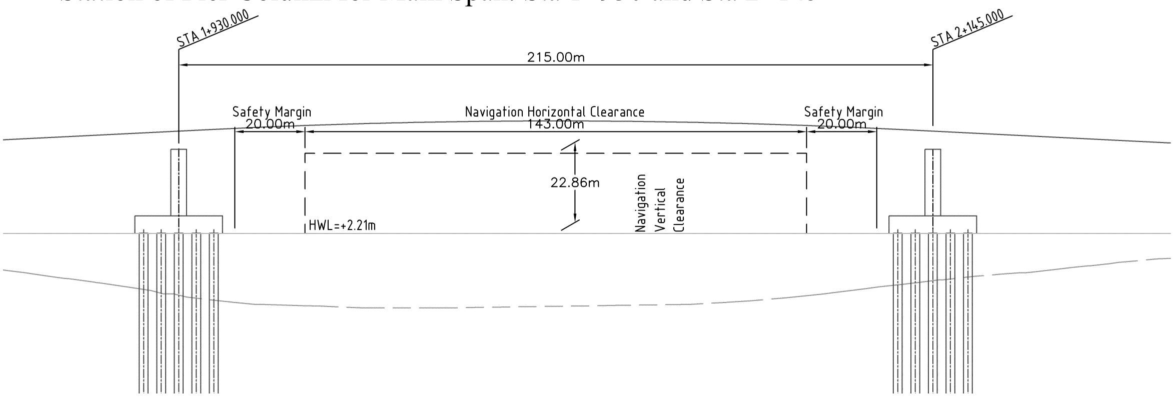
Figure 5.2.13 Alternative Measures for Wind Stability

(3) Pier Column Location for Main Span

Pier column location for main span was decided in consideration of navigable waterway location, which was decided based on bathymetric survey result.

In addition to this, necessary navigation clearance in horizontal direction (143 m), safety margin (20 m) and clearance for construction work (15 m) was considered. As a result of this, pier column location for main span was decided and the relationship between navigable waterway and pier column location for main span is shown in Figure 5.2.14.

➢ Station of Pier Column for Main Span: Sta 1+930 and Sta 2+145



Source: JICA Survey Team

Figure 5.2.14 Cross Section for Navigable Waterway and Pier Column for Main Span

(4) Superstructure Type

Preliminary Selection of Bridge Type

Table 5.2.6 shows the bridge types applicable for the 185-215 m required span length. When choosing the best bridge alternative, safety and economy have to be considered along with the soil conditions at the bridge site, constructability, technical innovation in the Philippines and maintenance.

Out of the seven bridge types in Table 5.2.6, arch bridges and cable-stayed bridges were not be considered because their height do not satisfy the aviation limit, and suspension bridges was not included in the evaluation because of economic considerations and their applicability for soft soil. A detailed evaluation was therefore made to the following three bridge types:

- Case 1: Extradosed Bridge
- Case 2: Steel Box Girder Bridge
- Case 3: Truss Bridge

Table 5.2.6 Preliminary Comparison of Bridge Type for 4th Cebu-Mactan Bridge

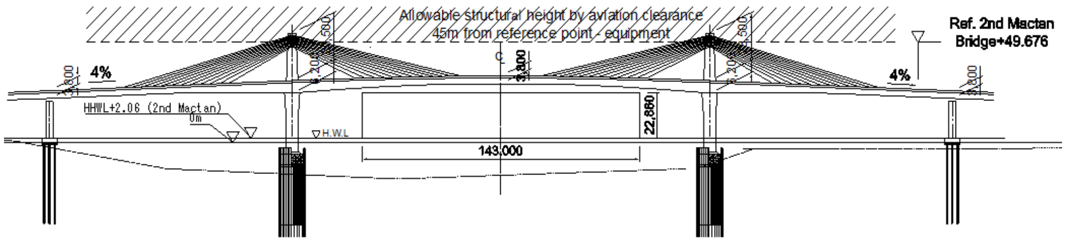
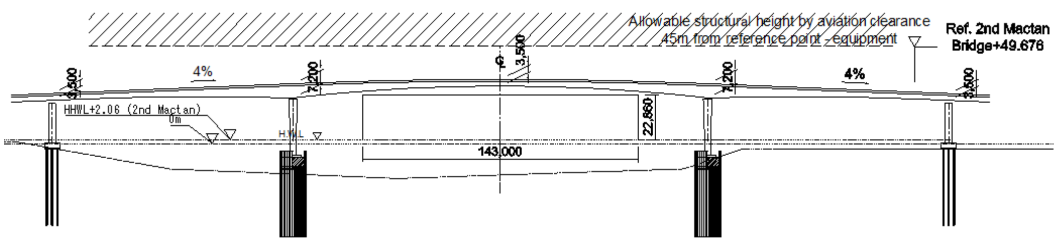
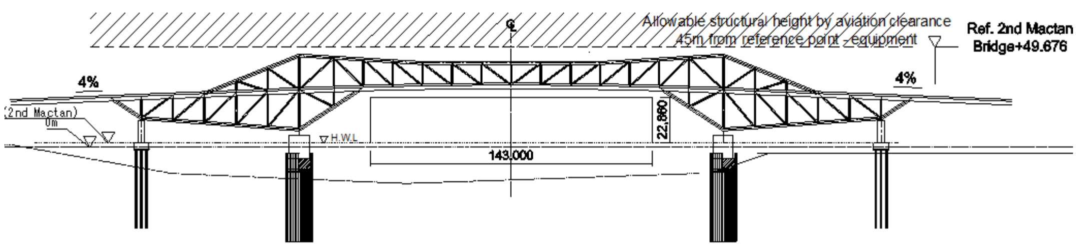
1st Evaluation of bridge type for 4th Mactan Bridge for Main Span Length = 185~215m

Bridge type	Extradosed Bridge	Steel-Box girder	Arch	Steel Truss	Cable-stayed bridge	Suspension bridge
Generally applied span length (Maximum)	100-180m (312m Maximum) 	30-200m (300m Maximum) 	50-250m (552m Maximum) 	60-200m (549m Maximum) 	130-500m (1104m Maximum) 	150-2000m (1991m Maximum) 
Characteristics /Construction	Applicable for longer span length than conventional PC Box Girder. Cantilever construction method can shorten the occupation time of waterway. 2nd Mactan Bridge	One-time erection of large block can be applied and occupation time of waterway can be shortened.	One-time erection can be applied and occupation time of waterway can be shortened.	The large number of steel members has the disadvantage with maintenance requirement. Since it is possible to erect by traveler crane, occupation time of waterway can be shortened. 1st Mactan Bridge	Applicable for longer span length. Since it is constructed by cantilever and lift-up erection methods. 3rd Mactan Bridge	Applicable for very long span length.
Safety for Aviation	Possible	Good	× N/A	Good	× N/A	Possible
Safety for Navigation	Good	Good	Possible	Possible	Good	Good
Soft soil	Possible	Good	Good	Good	Good	**Poor**
Cost	Good	Good	Good	Good	Moderate	**poor**
Technical Innovation	New scale in Philippine	SHBS Wind resistance design New scale in Philippine	SHBS New scale in Philippine	SHBS		New scale in Philippine
Evaluation	**Applicable** **→ 2nd Evaluation**	**Applicable** **→ 2nd Evaluation**	**Not Applicable** Cannot secure Aviation Condition	**Applicable** **→ 2nd Evaluation**	**Not Applicable** Cannot secure Aviation Condition	**Not Applicable** Because of High Construction Cost

Selection of Bridge Type

The selection of bridge type involves a comparison of bridges with the same center span length and there are no advantages or disadvantages regarding natural and social environmental impact. Bridge types are compared by structural characteristics: (1) construction cost, (2) aesthetics, (3) necessity of advanced technology, (4) aviation limit & navigational clearance, (5) constructability, (6) construction period, and (7) maintenance. Table 5.2.7 shows the detailed evaluation of bridge type.

Table 5.2.7 Comparison of Bridge Type for 4th Cebu-Mactan Bridge (1/2)

	Side view
Case 1. Extradosed bridge	
Case 2. Steel box girder bridge	
Case 3. Truss bridge	

Source: JICA Survey Team

Table 5.2.8 Comparison of Bridge Type for 4th Cebu-Mactan Bridge (2/2)

	Evaluation		
Case 1. Extradosed bridge	Overview	・Employs concrete towers and PC girders. Same type as 2nd Mactan Bridge. ・Span length is limited to less than 185m considering aviation clearance.	
	Construction cost	0.90	◎ 20 Pt.
	Landscape	・The bridge towers can be designed so that the bridge stands out as a landmark. ・Not as appealing as other bridge types since there is a extra-dosed bridge and new cable-stayed bridge over the Mactan strait.	○ 10 Pt.
	Design innovation	・Not very innovative since there are already similar bridges of the same type over the strait and elsewhere in Philippine. ・Would be the longest extra-dosed bridge in Philippine.	△ 5 Pt.
	Aviation clearance / Navigation safety	・Pylon height is high and it is difficult to design the bridge securing aviation clearance if span length is more than 185m. Height of tower/Center span of past experience = 1/9.17	△ 5 Pt.
	Constructability	・Cantilever erection method is suitable for construction of superstructure.	○ 10 Pt.
	Construction period	・Approximately 48 months.	○ 10 Pt.
	Maintenance	・Cable anchorages require periodic re-painting. ・Inspection of high locations is required.	◎ 20 Pt.
	Overall evaluation	・Difficult to apply span length more than 185m ・Longer construction period	80 Point
Case 2. Steel box girder bridge	Overview	・To reduce the cost of foundation, steel box with steel deck bridge is selected. ・In order to shorten the construction period, large block erection can be applied.	
	Construction cost	1.00	○ 10 Pt.
	Landscape	・The slender curved structure makes the bridge stand out as a landmark. ・Has symbolic value as the elegant shape is very different from other bridges over the Mactan strait. ・Welding structure using high performance steel provide beautiful surface.	◎ 20 Pt.
	Design innovation	・Would be the longest-span steel box girder bridge in Philippine. ・High performance steel (SBHS), wind resistance design and hybrid pier would be applied.	◎ 20 Pt.
	Aviation clearance / Navigation safety	・Structure height is low and it is possible to secure aviation clearance. ・No projected structure under girder and it is safety to navigation clearance.	◎ 20 Pt.
	Constructability	・Large block erection method is suitable for construction of superstructure. ・The navigational channel only has to be closed once since large block erection with jacks can be used.	◎ 20 Pt.
	Construction period	・Approximately 36 months. ・Main girder are pre-fabricated so the substructure can be constructed simultaneously with superstructure fabrication. ・Large block erection makes the on-site construction period shorter than for the other alternatives.	◎ 20 Pt.
	Maintenance	・Since this is constructed above sea, Heavy Duty Painting should be applied. ・Periodic inspection and re-painting is requied.	◎ 20 Pt.
	Overall evaluation	・Shortest Construction Period ・Possible to apply latest technology	130 Point
Case 3. Truss bridge	Overview	・To reduce the cost of foundation, steel truss with steel deck bridge is selected. Same type as 1st Mactan Bridge. ・In order to reduce the construction period, large block erection can be applied.	
	Construction cost	1.24	△ 5 Pt.
	Landscape	・The truss pattern can be designed so that the bridge stands out as a landmark. ・Not as appealing as other bridge types since there is a similar truss bridge over the Mactan strait.	○ 10 Pt.
	Design innovation	・Not very innovative since there are already similar bridges of the same type over the strait and elsewhere in Philippine. ・High performance steel (SBHS) would be applied.	○ 10 Pt.
	Aviation clearance / Navigation safety	・Structure height is low and it is possible to secure aviation clearance. ・There are truss member under deck and it has possibility of ship collision as 1st Mactan Bridge.	△ 5 Pt.
	Constructability	・Cantilever erection method or large block erection method can be applied for construction of superstructure. ・Large block erection method can be applied in order to shorten construction period.	◎ 20 Pt.
	Construction period	・Approximately 40 months. (In case of Cantilever erection, but can be shorten to 36 months if large block erection method is applied.)	◎ 20 Pt.
	Maintenance	・Since this is constructed above sea, Heavy Duty Painting should be applied. ・This bridge type is composed many members, periodic inspection and re-painting is requied and take longer time.	△ 5 Pt.
	Overall evaluation	・Most expensive alternative	75 Point

Evaluation ◎: Good, ○: Fair, △: Poor

Source: JICA Survey Team

As a result of the comparison, a steel box girder bridge with orthotropic steel deck was recommended for the bridge type for 4th Cebu-Mactan Bridge.

(5) Foundation Type

As described in previous chapter, the selected superstructure type of 4th Cebu-Mactan Bridge is steel box girder type with steel deck slab and its main span length is 215 m.

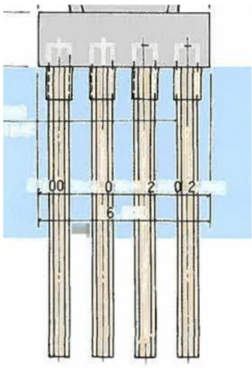
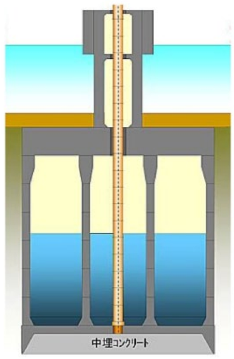
Since this bridge locates at sea, applicable foundation types are as follows;

- Cast-in-Situ Concrete Pile (Pile Vent Type)
- Steel Pipe Sheet Pile Foundation
- Cason Foundation

However, based on geotechnical investigation result, it was found that there is limestone layer as bearing layer at Lapu-Lapu side. Since it is difficult to install steel pipe to rock layer, Steel Pipe Sheet Pile Foundation cannot be applied as foundation type of 4th Cebu-Mactan Bridge.

Therefore, comparative study was made for Cast-in-Situ Concrete Pile (Pile Vent Type) and Cason Foundation as shown in Table 5.2.9.

Table 5.2.9 Comparison Table on Foundation Type of New (4th) Mactan Bridge

	Cast-in-Situ Concrete Pile (Pile Bent Type)	Cason Foundation
Sketch		
Characteristic	- Same foundation type as 2nd Mactan Bridge - No difficulty for construction since pile cap locate above water level - Superiority against load level in proposed New (4th) Mactan Bridge	- Rare foundation type in the Philippines - Necessity to apply large scale facilities to construct this foundation type, especially, construction at 10m below water level
Evaluation	Superior	Inferior

Source: JICA Survey Team

In the Philippines, Cast-in-situ concrete pile (Pile Bent type) is commonly applied for foundation type. A caisson foundation is a suitable foundation type for relatively large loads, but large construction facilities would be necessary to construct foundations of 10 m or more in depth in sea.

In these regards, Cast-in-situ concrete pile (Pile Bent type) was adopted for the foundations of the main bridge of 4th Cebu-Mactan Bridge.

5.2.4 Design of Approach Bridge

(1) Study of superstructure type of Approach Bridge

Approach Bridge in Sea

It is expected that many small vessels will pass under the 4th Cebu-Mactan Bridge and vessels will anchor at sea in order to visit shipyards near the bridge. For the safety of the bridge and vessels, it is desirable not to install many piers in Mactan Channel. The side spans in the channel outside of navigable waterway should be 80 m in order to ensure the safety of small vessels. 80 m was chosen by following reasons:

- According to AASHTO Vessel Collision Design of Highway Bridges, historical ship collision data shows that roughly twice of accidents have occurred at approach piers comparing with the main piers of navigation spans. Safety for vessels should also be considered for the approach bridge.
- According to AASHTO, "Bridges with main span less than two or three times the design vessel length, length overall (LOA), are particularly vulnerable to vessel collision" Considering that LOAs of small vessels nearby the bridge site are 30 m (Cruiser anchored at yacht harbor) or 30-40 m (200 DWT ferry boat and 200 DWT barge) 80 m span for approach bridge is recommended.
- The bridge should not affect to the waterfront of the future development plan in Mandaue City as much as possible.

Since the bridge location can be seen from the coast and a future urban development area, the aesthetics of the bridge would also be important. The bridge should apply the same steel box girder type as the main bridge of 4th Cebu-Mactan Bridge, and the girder shape and color should also be the same so as to ensure continuity between the main bridge and the approach bridge.

Approach Bridges on Land

Most of the approach bridges on land is located in the interchange area, and the PC-I girder or PC hollow slab were applied from the viewpoints of economic efficiency and easiness of maintenance (refer to Section 5.2.5 (3) 4).

(2) Study of substructure type of Approach Bridge

The section of Approach Bridge is classified into 2 sections, namely the section at sea and the section at the proposed land reclamation area and undeveloped area.

At Sea

The superstructure type of the approach bridge at sea section was determined as steel box girder. Applied load to substructure and foundation is relatively larger, therefore, cast-in-situ concrete pile type would be applicable. Regarding the elevation of pile cap, pile bent type (bottom elevation of pile cap is at MHWL: +1.22m) is applied because of the following reasons:

- Commonly used in the Philippines
- Applied to existing Cebu South Coastal Road
- Possible to eliminate of cofferdam structure since it is not necessary to construct pile cap below seabed, and this causes more economical option.

At the Proposed Land Reclamation Area and Undeveloped Area

The superstructure type of the approach bridge at land reclamation area and unused area was determined as PC hollow slab mainly in consideration of the aesthetic advantage. Applied load to substructure and foundation is moderate. Cast-in-situ concrete pile type or steel pipe type would be applicable in consideration of applied superstructure type of the approach bridge and geotechnical investigation result (depth of bearing layer is more than 50 m).

According to the geotechnical investigation result, it is confirmed that there is a weak clay layer (N value: 0~3 about until 18 m depth). Although there is no concrete plan for development of the proposed land reclamation project, it is expected there will be landfilling work after completion of the project bridge. Under this condition, negative friction will be applied to pile foundation of the project bridge. Therefore, in order to reduce negative impact by negative friction due to land development work near future, steel pile is applied for this section, because skin friction of steel pile is smaller than cast-in-situ concrete pile, steel pile will not be affected compared with cast-in-situ concrete pile. In addition, it is possible that effect of negative friction can be removed by applying bituminous layer to surface of steel pile.

5.2.5 Design of Mandaue Coastal Road

(1) Study of superstructure type of Coastal Road

Characteristics of General Section

Since the general section of the coastal road is very long and located in a coastal area, this should be considered in the selection of the bridge type. Furthermore, if the piers are low and the coastal road is exposed to sea water in a severely corrosive environment.

Periodical maintenance against corrosion has to be considered for steel materials, and maintenance work such as repainting on a long section of more than 5 km involves significant work. Concrete bridges are appropriate on the general section in order to mitigate maintenance work, except where lightweight steel material is required for long spans and bridges with high piers located at a sufficient distance from the sea water.

Consideration of Construction

Precast girders are appropriate considering salt adhesion in the coastal area as well as workability and quality control of the long section of more than 5 km.

In case of cast-in-situ construction, protective measures against salt adhesion during concrete casting are required.

Span Length

Since there are no special conditions for span length on the general section, the most economical span length is calculated using the empirical formula of Japan Highway Public Corp.

Average column height = 15m (assumption)
Average foundation depth = 45m (assumption)
Span length = (1.0~1.5) x (15 + 45 / 3) = 30m~45m = 37.5m (average) = 40m (rounded)
*Source: Japan Highway Public Corp.

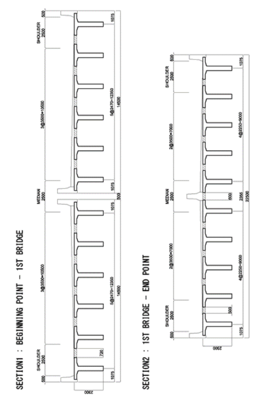
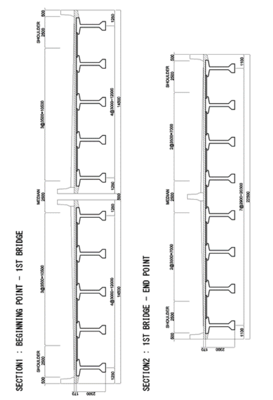
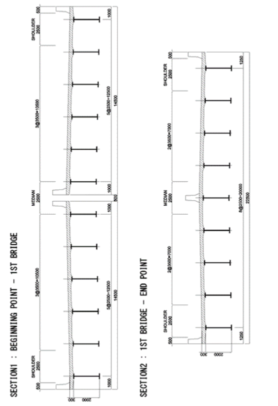
Selection of girder type

The following three bridge types most applicable to 40m spans are compared.

- PC T-girder
- PC I-girder with PC-board
- Steel I-girder

Table 5.2.10 shows the comparison table for the general section of the Coastal Road Bridge. Based on this comparison, the PC-I girder type was proposed as the optimum superstructure type for the Coastal Road. It is also the most popular girder type for the viaduct in the Philippines.

Table 5.2.10 Comparison of Bridge Type for General Section of Coastal Road Bridge

	PC T-Girder		PC I-Girder with PC- board		Steel I-Girder	
Section						
Structure	Concrete is durable against corrosion in coastal areas. Good durability due to PC slab.	◎ 20	Concrete is durable against corrosion in coastal areas. RC slab on precast PC plate cast-in-situ.	○ 10	Suitable for soft soil with light self-weight. Heavy duty painting should be applied for anti-corrosion. RC slab cast in-situ.	○ 10
Constructio n	Not affected by ground conditions since using erection girder. Prestressing works in situ of transverse tendon for slab.	○ 10	Not affected by ground conditions since using erection girder. Other formwork and scaffolding for slab works in-situ is not necessary since using PC-board.	◎ 20	Not affected by ground conditions by crane erection and launching erection method. For RC slab, formwork and scaffolding is necessary in-situ.	○ 10
Maintenanc e	Periodic inspection and general maintenance.	◎ 20	Periodic inspection and general maintenance.	◎ 20	Periodic re-painting is necessary. Large-scale maintenance for long section of more than 5km.	△ 5
Technical Innovation	Much experience in the Philippines.	○ 10	Much experience in the Philippines.	○ 10	Same type with Cansaga bay bridge	○ 10
Cost	(1.05)	○ 10	(1.00)	◎ 20	(1.44)	△ 5
Overall evaluation	○(70 / 90)		◎(80 / 90)		△ (40 / 90)	

Source: JICA survey team

(2) Study of superstructure type over facilities

It is necessary to cross over some facilities such as an oil plant by using long span bridges on the coastal road. The required span length is 60-100 m which is about twice the span length of the general section and an appropriate bridge type shall be studied. The PC box girder and steel box girder types are compared.

Study of material

As with the general section, there are corrosion problems in the case of steel box girders, but the required maintenance scale is not large. Furthermore, the corrosion problems are mitigated since the elevation of the crossover areas is higher than that of the general section. The PC box girder is constructed cast-in-situ and protective measures against salt adhesion during concrete casting are required.

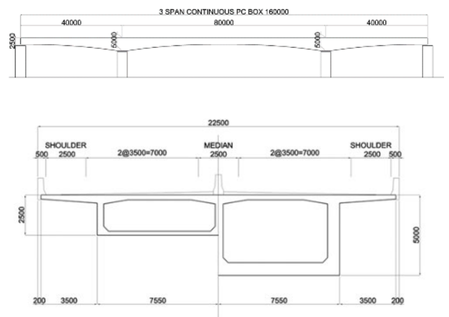
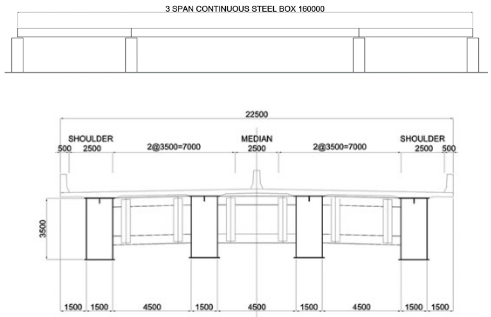
Consideration of Construction

Since the purpose of the long span sections is to cross over some facilities/obstacles, it is reasonable to consider that the ground space under the bridge cannot be used. Therefore, the cantilever method is planned to be used for the PC box girders and the launching method for the steel box girders.

Selection of Girder Type

A comparison of the two bridge types is shown in Table 5.2.11.

Table 5.2.11 Comparison of Bridge Type for Long Span Section of Coastal Bridge around 80m

	PC BOX Girder		STEEL BOX girder with composite slab	
Side view & Section				
Structure	Much experience for the span length. The alignment may be higher since the girder height is high at the piers.	○ 10	Suitable for long spans and soft soil with light self-weight. Girder height is constant in a span.	◎ 20
Construction	Not affected by ground conditions since using cantilever method. Construction period is relatively long. Many in-situ stressing works. All structures are cast in-situ and protective measures are necessary against salt adhesion during concrete casting.	○ 10	Not affected by ground conditions since using launching method. Construction period is short. Formwork and scaffolding for in-situ slab works is not necessary because of the composite slab.	◎ 20
Maintenance	Periodic inspection and general maintenance.	◎ 20	Periodic re-painting is required.	○ 10
Technical Innovation	Much experience in the Philippines.	○ 10	Steel girder with composite slab would be the first in the Philippines.	◎ 20
Cost	(0.93)	◎ 20	(1.00)	○ 10
Overall evaluation	○ (70 / 100)		◎ (80 / 100)	

Source: JICA survey team

(3) Study of superstructure type in Mandaue IC Area

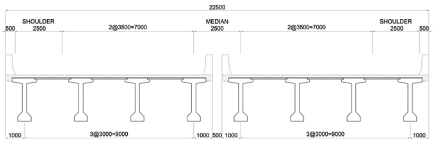
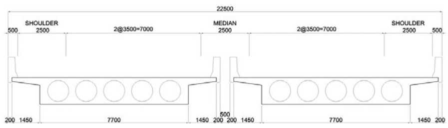
For the Mandaue IC Area, cast in-situ PC hollow slab shall be used for following reasons.

- IC area has many changes of width due to connection to ramp way. Hollow slab girder is most appropriate bridge type in width change.
- In the IC area, it is desirable to have a structure with flat girder soffit in consideration of the landscape.

For the above reasons, the hollow slab is the most applied structure type for Interchanges as usual. The optimum span length of the hollow slab is 20m~30m, and 30m span length is applied.

In consideration of the special conditions of interchange area, the comparison with the PC I-girder which is selected to general section of coastal road is shown in Table 5.2.12.

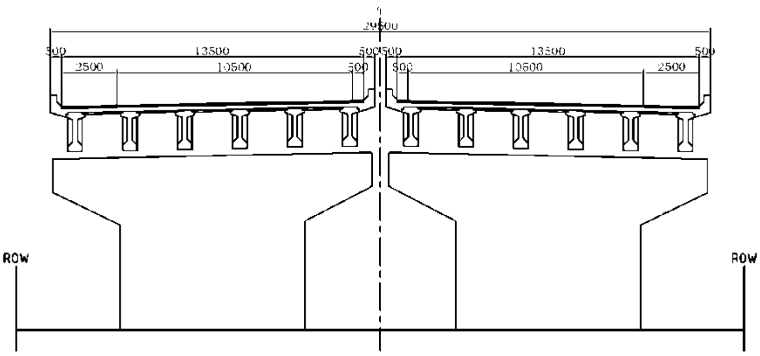
Table 5.2.12 Comparison of Bridge Type for Interchange Area

	PC I-Girder with PC- board		**PC Hollow Slab**	
Section				
Structure / Landscape	It is not suitable to width changing bridge in IC and complex girder arrangement is required. It is inferior to hollow slab girder in the view of landscape.	△ 5	Appropriate structural type to adapt to width changing bridge in IC area. Good for landscape with flat girder soffit and low girder height.	◎ 20
Construction / Widening	RC slab is casted in-situ and protective measures are necessary against salt adhesion during concrete casting. Not affected by ground conditions since using erection girder. Depending on the ramp connecting location and width change, various girder length and PC board sizes are required. There is no advantages of precast girder in IC area.	△ 5	Structure is casted in-situ and protective measures are necessary against salt adhesion during concrete casting. Hollow slab girder is constructed with full scaffolding on ground. IC area has no restriction in ground condition and has no problem. Attention is needed to rise of a void form during casting concrete.	○ 10
Maintenance	Periodic inspection and general maintenance.	◎ 20	Periodic inspection and general maintenance.	◎ 20
Technical Innovation	Much experience in the Philippines.	○ 10	Much experience in the Philippines.	○ 10
Cost	(0.91)	◎ 20	(1.00)	○ 10
Overall evaluation	○ (60 / 100)		◎ (70 / 100)	

Source: JICA survey team

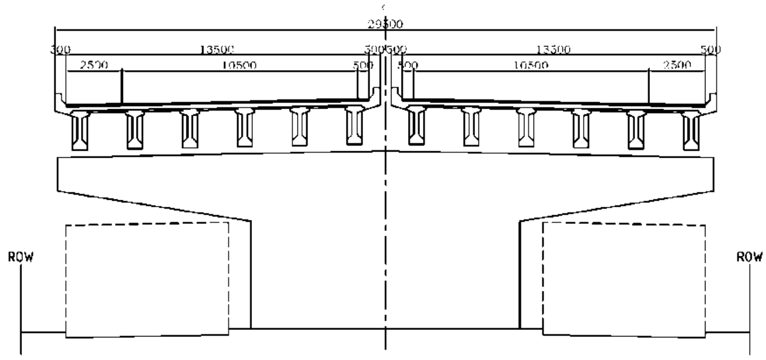
(4) Study of substructure type of Coastal Road

2 number of pier column with pier head structure are applied most of this section as shown in Figure 5.2.15. However, Coastal Road passes above existing ground at section near Beginning Point. Therefore, 1 number of pier column with pier head is applied at this section in order to secure space for existing road under Coastal Road as shown in Figure 5.2.16. PC structure will be applied to pier head of 1 pier column, since cantilever length is long.



Source: JICA Survey Team

Figure 5.2.15 Cross Section for 2 Pier Columns at Coastal Road



Source: JICA Survey Team

Figure 5.2.16 Cross Section for 1 Pier Columns at Coastal Road at section near BP

Regarding the foundation type, applied load to the substructure and the foundation is moderate since superstructure type of Coastal Road is PC-I girder. Therefore, Cast-in-Situ Concrete Pile type or Steel Pipe type are applicable in consideration of above mentioned reason and geological investigation result (depth of bearing layer is more than 50m.).

First half of Coastal Road passes inside residential and factory area where have been developed already. Therefore, since there is no risk about negative friction due to consolidation, Cast-in-Situ Concrete Pile type is applied.

Regarding the second half of Coastal Road (after crossing of 2nd Cebu-Mactan Bridge), this section passes at unused area and reclamation area. Therefore, as same as “Approach Bridge Section”, steel pipe type is applied for this section.

(5) Design of coastal road bridge

Bridge Arrangement

The bridge route consists of PC-I girders, hollow slab girder and steel box girders based on the study results. A list of bridges on the Coastal Road is shown in Table 5.2.13.

Table 5.2.13 List of Bridges on Coastal Road

Name of bridge	Chainage	Total length	Structure type	Span Number
Coastal road bridge	0+132.7~0+942.7	810m	PC-I girder	13@40+35+2@30+4@40+35 =21span
Coastal road bridge (San Miguel Food overpass)	0+942.7~1+112.7	170m	Steel box girder with composite slab	45+80+45
Coastal road bridge	1+112.7~2+177.7	1,065m	PC-I girder	35+4@40+30+21@40 =27span
Coastal road bridge (Oil jetty overpass)	2+177.7~2+397.7	220m	Steel box girder with composite slab	60+100+60
Coastal road bridge	2+397.7~2+622.7	225m	PC-I girder	3@40+3@35 =6span
Coastal road bridge (Arctura Tank terminal overpass)	2+622.7~2+837.7	215m	Steel box girder with composite slab	60+95+60
Coastal road bridge	2+837.7~2+977.7	140m	PC-I girder	2@30+2@40 =4span
Coastal road bridge (Shipyard overpass)	2+977.7~3+157.7	180m	Steel box girder with composite slab	50+80+50
Coastal road bridge	3+157.7~3+417.7	260m	PC-I girder	2@30+5@40 =7span
Coastal road bridge (2nd Cebu-Mactan Bridge overpass)	3+417.7~3+557.7	140m	Steel box girder with composite slab	40+60+40
Coastal road bridge	3+557.7~4+522.7	965m	PC-I girder PC hollow slab	30+9@40 =10span 22.5+3@30+22.5+25+30+25+27.5+5@30+27.5+5@25 =21span
Coastal road bridge (4th Cebu-Mactan Bridge overpass)	4+522.7~4+723.7	201m	Steel box girder with composite slab	31+35+60+35+40 (North) 40+40+60+35+26 (South)
Coastal road bridge	4+723.7~4+883.7	160m	PC hollow slab PC-I girder	20+4@30+20 =6span
Total	-	4,751m	-	122 spans

(6) Concept and issues of bridge planning

<u>Facilities along the coastal road between 1st Cebu-Mactan Bridge and 2nd Cebu-Mactan Bridge</u>

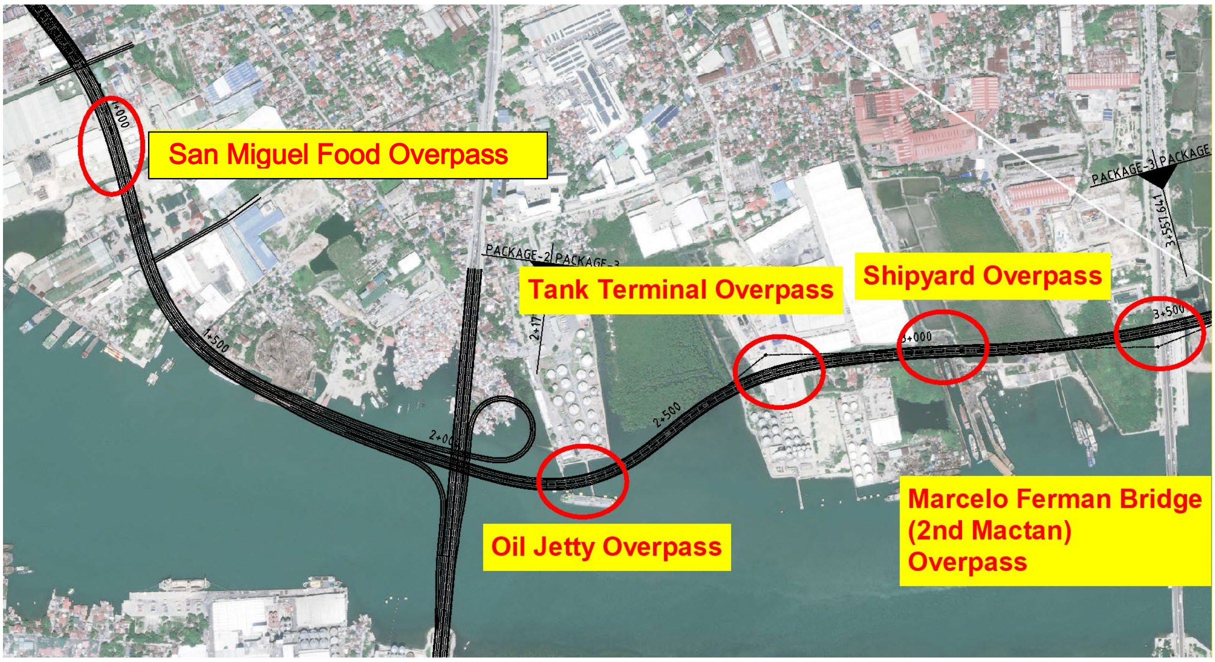
Between the beginning point and 2nd Cebu-Mactan Bridge, the road will cross over some facilities and long span bridges are required. Each bridge is planned based on the following concepts. Discussions with the owners of these facilities are needed for these bridges.

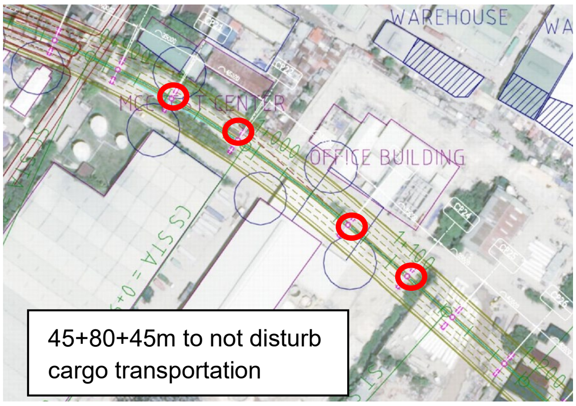
- San Miguel Food factory: The bridge alignment passes on San Miguel Food factory. In order to enable cargo transportation of the factory, location of piers avoids the road in factory and cargo loading area. 45+80+45m span bridge is planned in accordance with this condition.
- Oil jetty of Petron Corporation: The bridge alignment passes on the sea away from the oil tanks, and the bridge crosses over an oil pipe line which transfers oil from ships to the tanks. A 20m security distance between the oil pipe and the piers is required in order to ensure the safety of

the bridge. A 100m span bridge is planned in accordance with this condition.

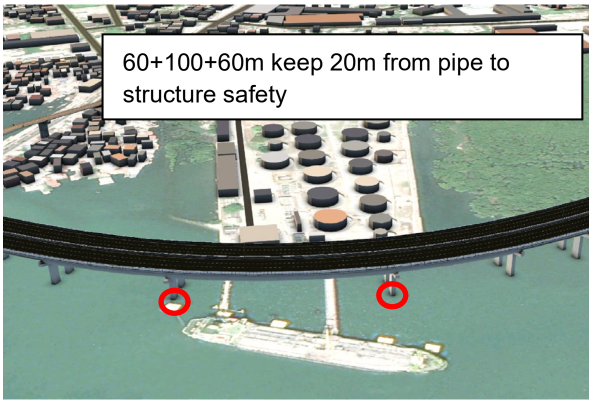
- Arctura Corporation Tank Terminal: The bridge alignment passes on the city side of the tanks. In order to enable vehicles which carry flammable liquid to pass under the bridge and prevent collisions with the piers, location of piers secure to keep enough space which can vehicles pass. A 95m span bridge is planned in accordance with this condition.

- V.M. Cabahug Shipyard: The bridge alignment passes over the dock. For this reason, an 80m span bridge is planned in accordance with this condition.

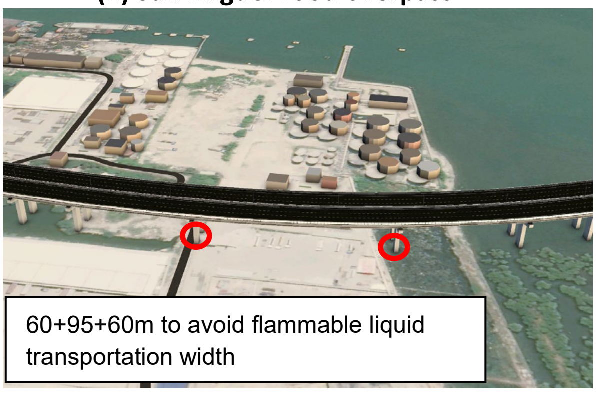




(1) San Miguel Food overpass



(2) Oil jetty overpass



(3) Tank terminal overpass

(4) Shipyard overpass

Source: JICA survey team

Figure 5.2.17 Facilities along Coastal Road and Bridge Spans

2nd Cebu-Mactan Bridge Overpass

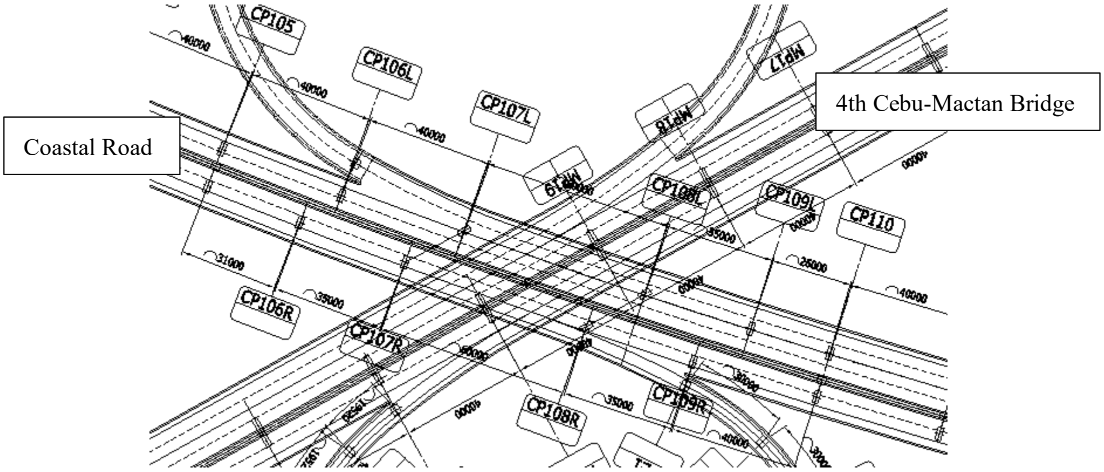
The overpass of 2nd Cebu-Mactan Bridge shall be designed with the following considerations.

- ➢ The traffic closure period during construction shall be short.
- ➢ Reduction of future maintenance work.
- ➢ Since it is always seen by passing traffic, the aesthetics of the structure shall be excellent.

Based on these conditions, the steel box girder bridge with composite girder is proposed.

4th Cebu-Mactan Bridge Overpass

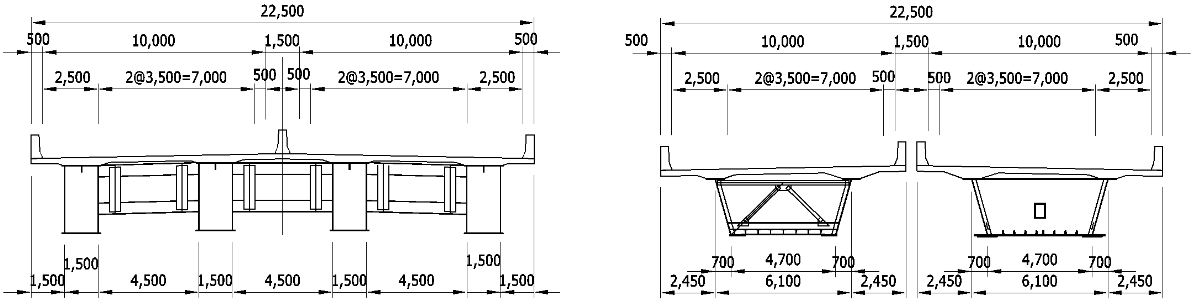
A steel box girder bridge is suitable for the overpass of 4th Cebu-Mactan Bridge for the same reason as 2nd Cebu-Mactan Bridge. Since the overpass crosses 4th Cebu-Mactan Bridge at a skewed angle, the pier positions in each direction are different. Moreover, since the widening and separation of the road for the Interchange Ramp continues, the bridge is divided in each direction. A bridge proposal is shown in Figure 5.2.18.



Source: JICA survey team

Figure 5.2.18 Span Arrangement of 4th Cebu-Mactan Bridge Overpass

A variation of the steel box girder is shown in Figure 5.2.19. A suitable type shall be selected according to the span length and construction conditions.



Source: JICA survey team

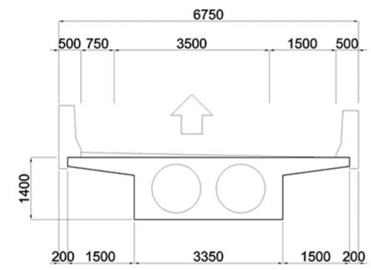
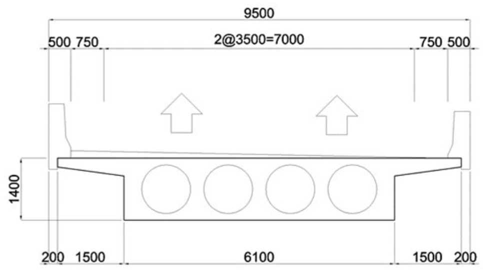
Figure 5.2.19 Cross Section of Long Span Bridge of Coastal Road

5.2.6 Design of Interchange Ramp Bridges of Mandaue IC

(1) Study of Superstructure Type of Interchange Ramp Bridges

For the interchange ramp bridge, cast in-situ PC hollow slab type is proposed since experience of their construction is extensive and they have high applicability to curved sections. There is no restrictions in Madaue IC area regarding ground conditions. PC hollow slab can be constructed by ground support system which is most economical construction method.

Table 5.2.14 Bridge Type of Interchange Ramp Bridges

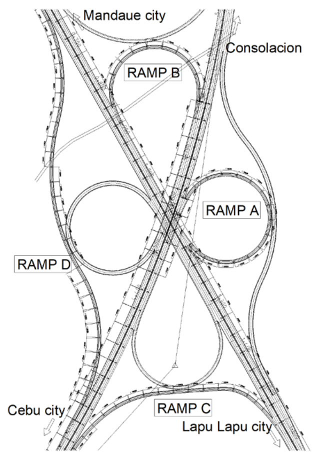
1 Lane Ramp	2 Lane Ramp
	

Source: JICA survey team

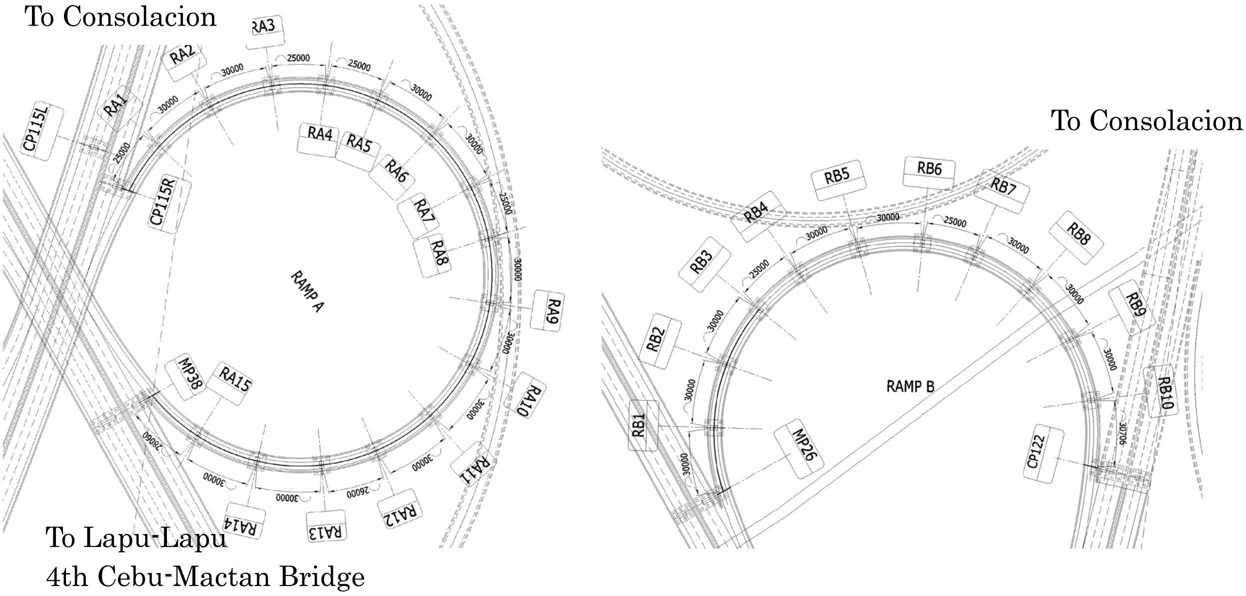
(2) Design of Interchange Ramp Bridges

A list of bridges on Interchange Ramp is shown in Table 5.2.15.

Table 5.2.15 List of Bridges on Interchange Ramp of Mandaue IC

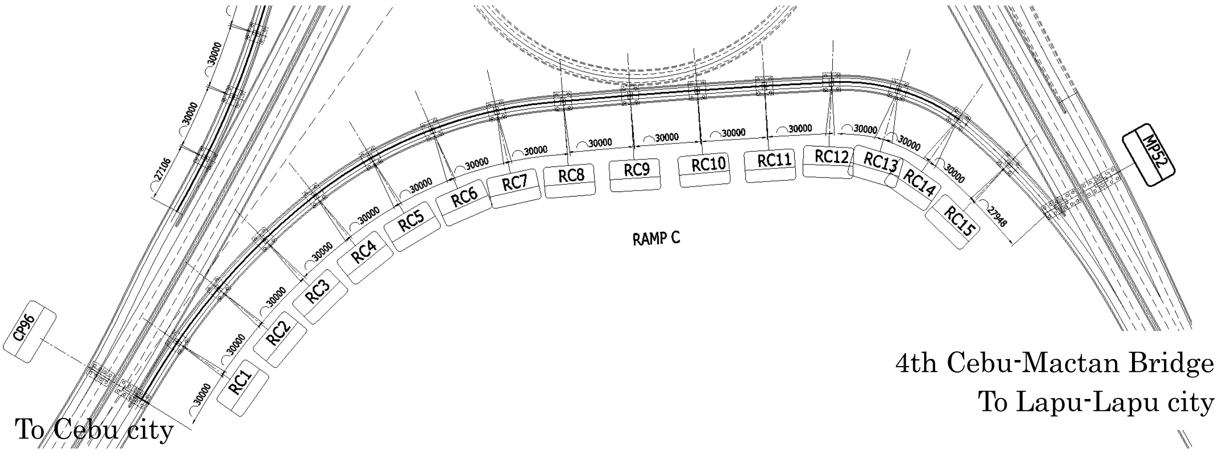
Name of Interchange Ramp	Direction	Rampway length	Structure type	Span arrangement	Map
Ramp A	From Cebu city to Mandaue	455.5m	Hollow slab girder	25+2@30+2@25+2 @30+25+4@30+26 +2@30+28.06 =16span	
Ramp B	From Lapu-Lapu city to Cebu city	327.3	Hollow slab girder	3@30+25+2@30+2 5+3@30+30.76 =11span	
Ramp C	From Cebu city to Lapu-Lapu city	483.4m	Hollow slab girder	15@30+27.948 =16span	
Ramp D	From Mandaue city to Cebu city	891.2m	Hollow slab girder	6@30+2@25+5@30 +25+10@30+27+4 @30+27.106 =30span	
Other ramp way		(2nd stage construction)			
Total		2160.1m	73 spans		

Source: JICA survey team



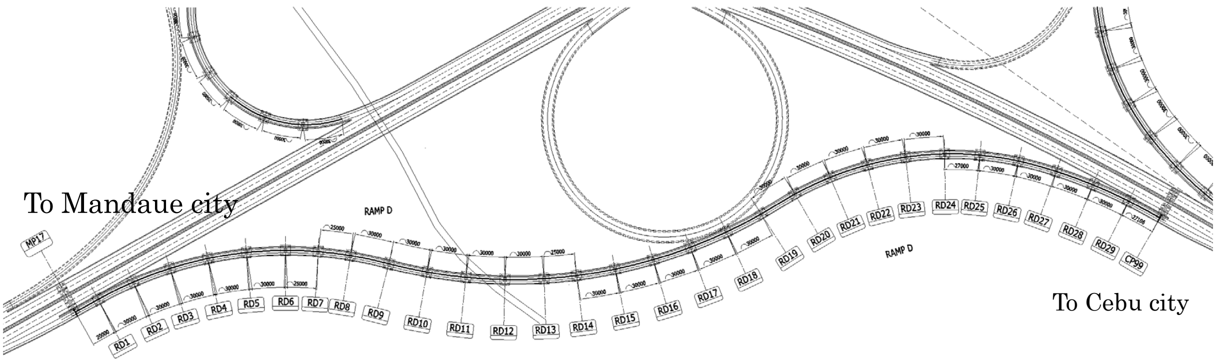
Source: JICA survey team

Figure 5.2.20 Bridge Span Arrangement of Ramp A and Ramp B



Source: JICA survey team

Figure 5.2.21 Bridge Span Arrangement of Ramp C



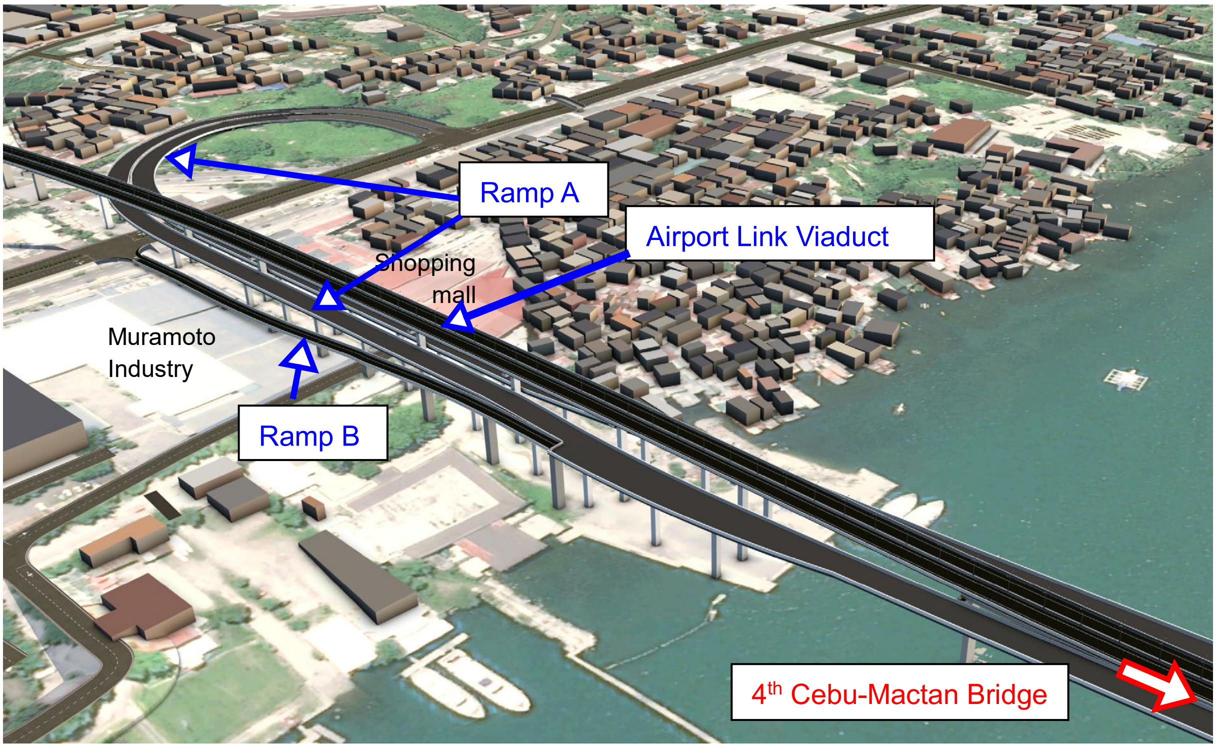
Source: JICA survey team

Figure 5.2.22 Bridge Span Arrangement of Ramp D

5.2.7 Design of Interchange Ramp Bridges of Lapu-Lapu IC

(1) Bridge Arrangement

Lapu-Lapu IC consists of three routes. Bridge layout is shown in Figure 5.2.23. Bridge length of each bridge are shown in Table 5.2.16.



Source: JICA survey team

Figure 5.2.23 Bridge layout of Lapu-Lapu IC

Table 5.2.16 List of Bridges on Interchange Ramp of Lapu-Lapu IC

Name of bridge	Chainage	Total length	Structure type	Span arrangement
Airport link viaduct	2+340~2+580	240m	Steel box girder with composite slab	5@48
Airport link viaduct (Overpass)	2+580~2+735	155m	Steel box girder with composite slab	50+60+45
Airport link viaduct	2+735~2+970	205m	Hollow slab girder	25+6@30
Ramp A Bridge	2+340~2+580	210m	Hollow slab girder	24+30+26+30+34+4@24 (North) 24+24+32+30+34+4@24 (South)
Ramp A Bridge (Overpass)	2+580~2+735	155m	Steel box girder with composite slab	50+65+40
Ramp A Bridge	2+735~2+795	60m	Hollow slab girder	2@30
Ramp B Bridge	2+420~2+532	112m	Hollow slab girder	30+34+2@24
Total		1137m	33span	

Source: JICA survey team

(2) Study of Superstructure Type of Interchange Ramp Bridges

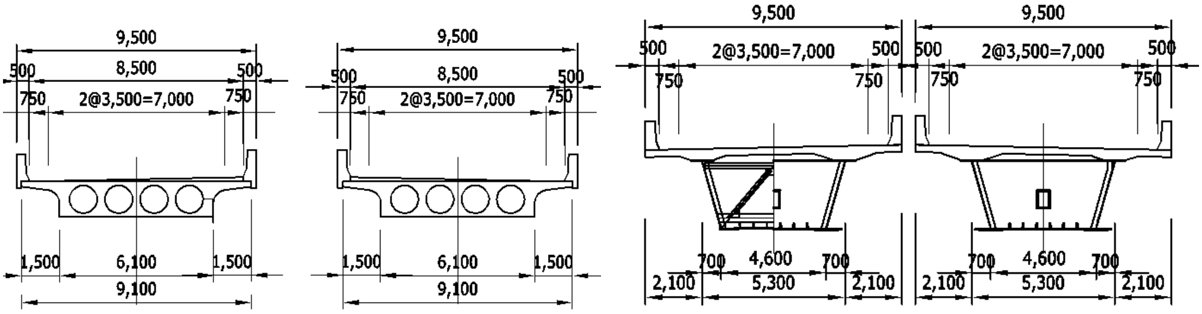
<u>Ramp A and Ramp B Bridge</u>

For the general part of the Interchange Ramp, PC hollow slab girder type which is same type as Mandaue IC and has more esthetic and economical are proposed. For the bridge over Mactan Circumferential Road, an open section steel box girder bridge with composite slab is proposed.

Open section steel box girder bridges are rationalized structures which reduce the number of components by using high durability slabs such as PC and composite slabs with a wide span. Because they have a box section, application on curved bridges such as Interchange Ramps is possible. In Japan, open section steel box girders are increasingly used for Interchange Ramp bridges in urban areas.

Since formwork and scaffolding can be omitted for composite slabs, the amount of site work decreases drastically and the safety of existing roads is much higher. There is no risk of falling concrete pieces and maintenance management can be reduced because the area exposed to the outside is small.

For these reasons, open section steel box girders are suitable for bridges constructed over existing roads.



Source: JICA survey team

Ramp A General section **Ramp A Bridge over Mactan Circumferential Road**

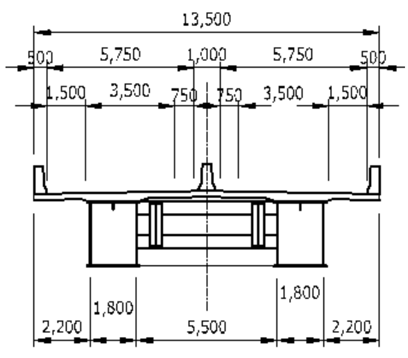
Figure 5.2.24 Cross Section of Interchange Ramp Bridge and overpass of Existing Road

<u>Airport Link Viaduct</u>

Airport link viaduct is divided into 2 sections, first one is section from the end of 4th Cebu-Mactan Bridge to Mactan Circumferential Road and second one is section after Mactan Circumferential Road to the end of Airport Link.

Regarding the section rom the end of 4th Cebu-Mactan Bridge to Mactan Circumferential Road, Lapu-Lapu IC is planned as 2 layer bridges which consists of Ramp A bridge in lower layer and Airport link viaduct in upper layer. Airport link viaduct has hollow slab bridge in lower and cannot install scaffolding for construction for this section. And long and complex construction method is not preferable at the narrow area close to buildings. Steel box girder can construct without scaffolding and construction period at site can be shorten. Moreover, the influence of seismic force is large due to high pier of upper bridge, a lightweight structure is appropriate.

For these reasons, steel box girder is suitable for bridges upper layer of Airport link viaduct. About slab type of steel box girder, high durability slabs such as PC and composite slabs shall be applied. Since formwork and scaffolding can be omitted for composite slabs, the amount of site work decreases drastically and the safety of existing roads is much higher.



Source: JICA survey team

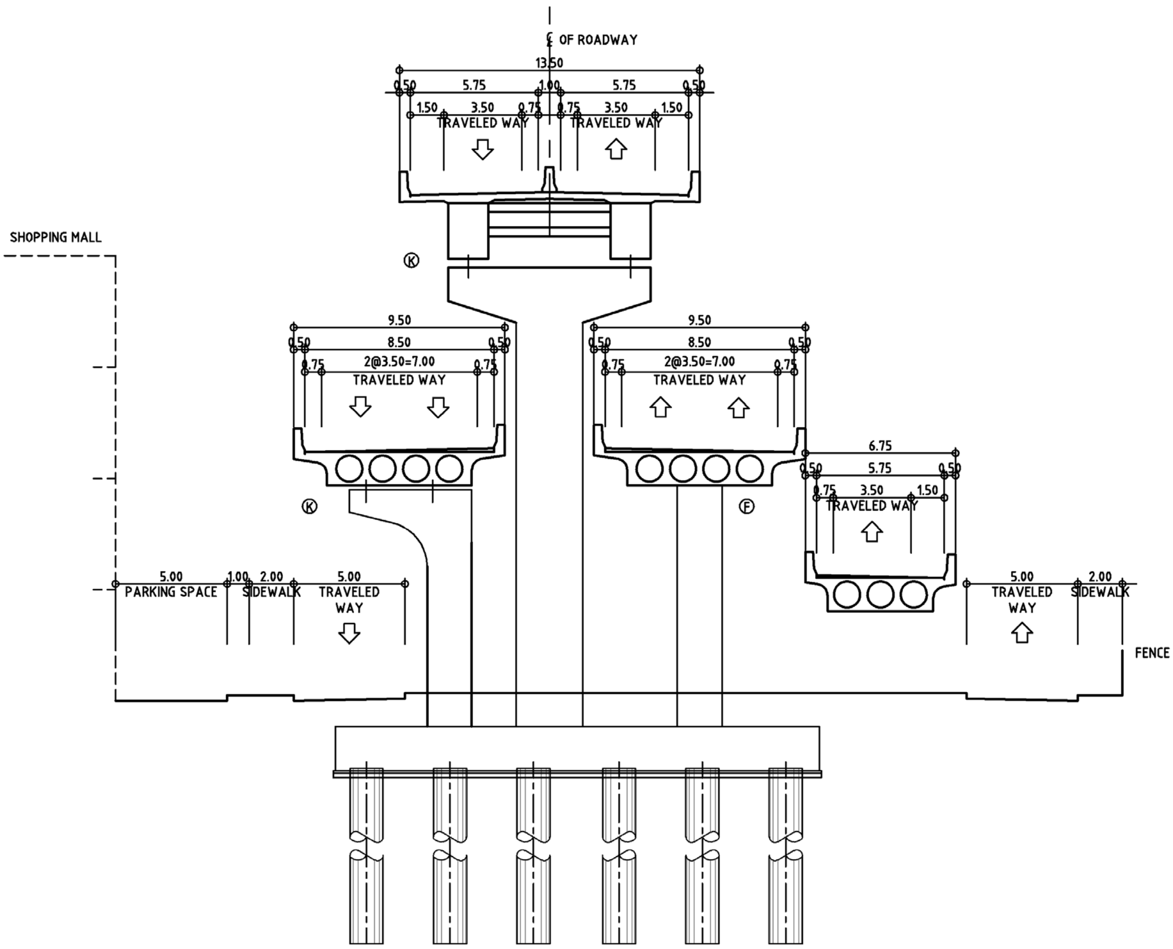
Figure 5.2.25 Cross Section of Airport Link Viaduct at upper layer section and overpass of existing road

Regarding the section after Mactan Circumferential Road, PC hollow slab is proposed since there is no restriction to put scaffolding system under the bridge.

(3) Study of substructure type of Lapu-Lapu IC

Lapu-Lapu IC section is planned as 2 layer bridge and superstructure types are proposed as steel box girder as upper layer bridge and PC hollow slab as lower layer bridge. Since elevation of upper layer is about 20 m height from ground elevation and width of column is restricted in order to keep narrowest section as much as possible for reduction of land acquisition, therefore, steel pier column is applied for upper layer bridge. On the other hand, elevation of lower layer bridge is about 10 m height from ground elevation and there is not sever restriction for placement of pier column, therefore, conventional RC pier column is applied for lower layer bridge.

However, since area of Lapu-Lapu IC section is limited and there is not enough space to have separate foundation for both upper layer bridge and lower layer bridge, therefore, foundation is shared by both upper layer bridge and lower layer bridge as shown in Figure 5.2.26.



Source: JICA Survey Team

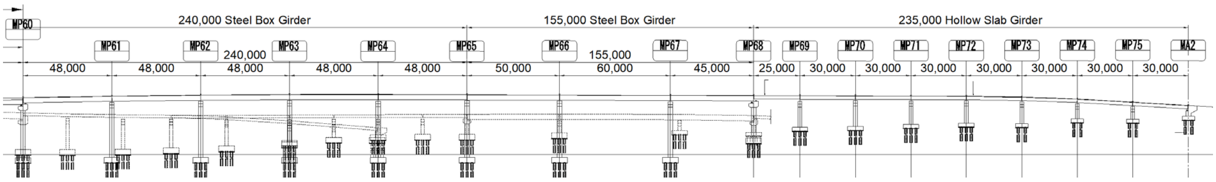
Figure 5.2.26 Cross Section for Lapu-Lapu IC Section

Regarding the foundation type, applied load to the substructure and the foundation is moderate since superstructure type of Lapu-Lapu IC is combination of both steel box girder and PC hollow slab.

Therefore, Cast-in-Situ Concrete Pile type or Steel Pipe type are applicable in consideration of above mentioned reason and geological investigation result (depth of bearing layer is about 30m.).

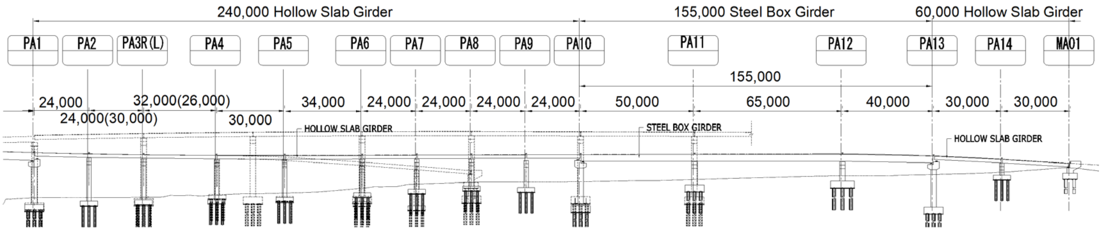
(4) Design of Interchange Ramp Bridges

The bridge route consists of 30 m span hollow slab girder for general section and 48-60 m span steel box girders at upper layer bridge and overpass of existing road based on the study. Bridge arrangement of Airport Link Viaduct, Ramp A bridge and Ramp B bridge are shown in Figure 5.2.27, Figure 5.2.28 and Figure 5.2.29.



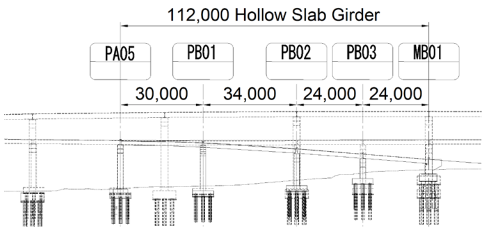
Source: JICA survey team

Figure 5.2.27 Bridge plan of Airport Link Viaduct



Source: JICA survey team

Figure 5.2.28 Bridge plan of Ramp A Bridge of Lapu-Lapu IC



Source: JICA survey team

Figure 5.2.29 Bridge plan of Ramp B Bridge of Lapu-Lapu IC

5.2.8 Technical Issues and Solutions

The project is expected to be financed with an ODA loan under JICA's Special Terms for Economic Partnership (STEP). Under the STEP scheme, Japanese technologies will be substantially utilized for the project. Applicable Japanese technologies are described in this section.

(1) Design and construction of long span steel box girders

4th Cebu-Mactan Bridge will be the longest steel box girder bridge in South-East Asia. In Asian countries, only Japan has similar type of bridges (3 bridges out of the world's longest 10 bridges). Design and construction technologies of Japan would be fully utilized.

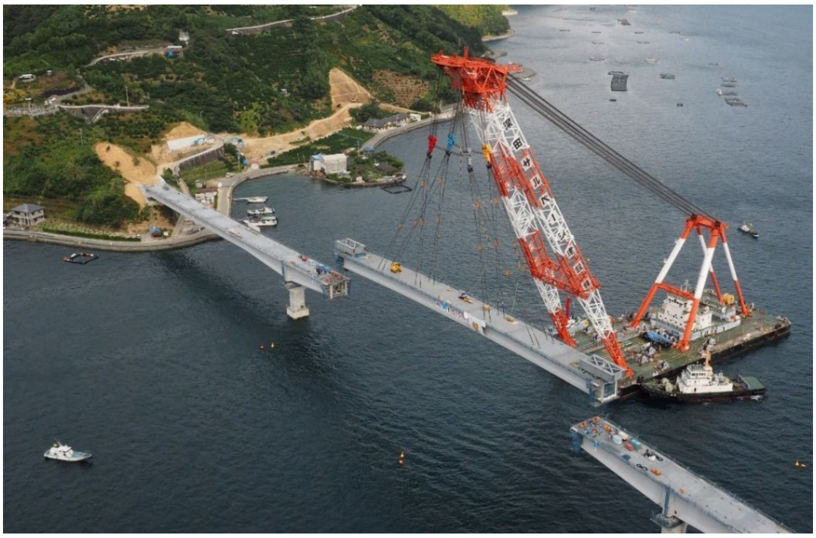


Figure 5.2.30 Example of large block erection of steel box girder bridge (Kushima Bridge)

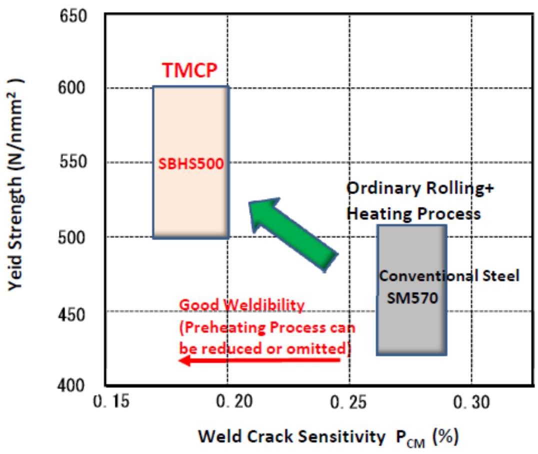
(2) Steel for Bridge High Performance Structures (SHBS)

SBHS is the steel materials developed particularly for bridges in Japan, which has advantage in high strength and can avoids pre-heating at a welding work compared with the existing steel materials. The material was applied for the Tokyo Gate Bridge and was standardized as steel materials for bridges in Japanese design standard in January, 2018.

The advantages of adoption of SBHS to 4th Cebu-Mactan Bridge are,

- In case of existing steel materials, strength of steel material needs to reduce for a thick plate, but SBHS can secure same strength for a thick plate. This cause reduction of steel weight and construction cost.
- Pre-heating is unnecessary at welding work, work in manufacture can be reduced. This cause reduction of fabrication cost.
- Since welding of a thick plate becomes easy, a welding joint is applicable instead of bolt joint. The beautiful appearance which does not have a bolt can be provided.

For 4th Cebu-Mactan Bridge, application of SBHS is expected from 20 to 30% of total steel materials, and the effect will be high.

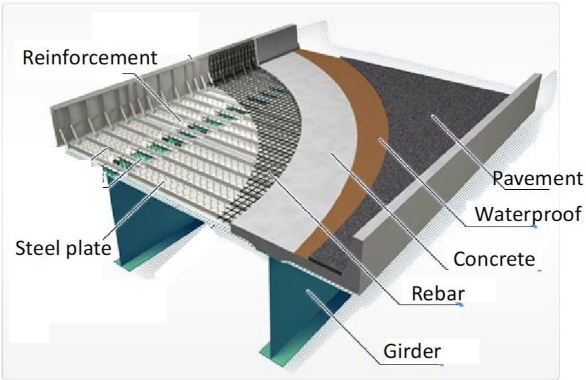


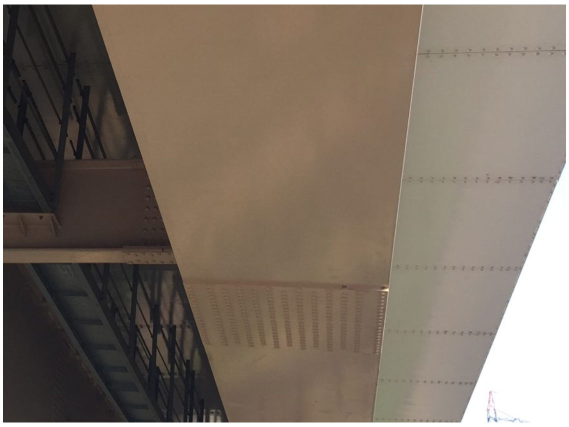
Source: The Japan Iron and Steel Federation

Figure 5.2.31 Weld crack sensitivity of SBHS and sample of application (Tokyo Gate Bridge)

(3) Composite slabs

Since formwork and scaffolding can be omitted for composite slabs, the amount of site work will be decreased drastically and the safety of existing roads is higher.





Source: JICA survey team

Figure 5.2.32 Example of composite slab with steel box girder bridge

(4) Wind resistance design and wind tunnel testing

Wind resistance design is essential issue in the design of long span steel box girder bridge.

In Japan which receives frequently attack of a typhoon, there are many study and experience of wind tunnel tests, installation of a wind resistance component, and installation of Tuned Mass Damper (TMD) for a steel box girder bridge. Technical transfer of wind resistance design of Japan is expected.

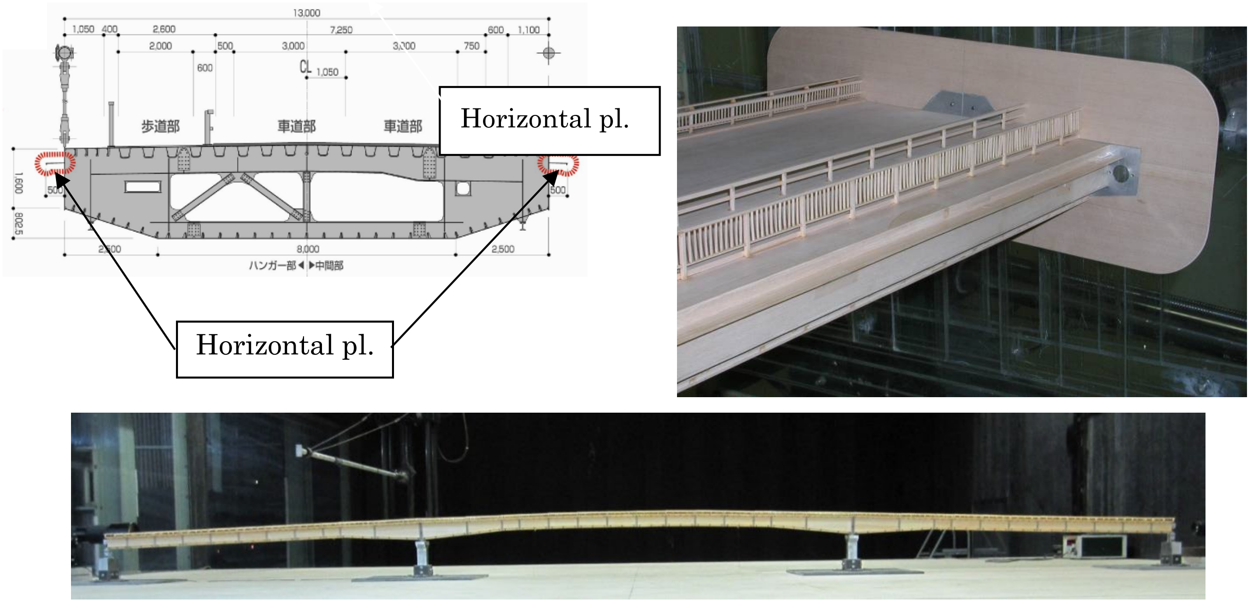


Figure 5.2.33 Example of wind resistance components and wind tunnel test

(5) Anti-collision protection

Since 4th Cebu-Mactan Bridge and Coastal Road Bridge locate above/close the sea, the environmental condition is very severe for steel structure.

In order to avoid corrosion problem, heavy duty coating which makes high durability over a long bridge life is proposed to be applied. As heavy duty coating, fluorocarbon resin coating, and thermal spray material made from aluminum magnesium alloy are considered. Fluorocarbon resin coating is proposed a basic painting method in the view of aesthetics and construction ability.

Although initial expense of thermal spray alloy is high, total cost including of maintenance cost (i.e. LCC) is excellent. For special condition bridge which is difficult in future inspection, thermal spray material made from aluminum magnesium alloy which can make maintenance-free for 100 years will be studied.

Figure 5.2.34 Thermal spray alloy Arc Plasma Spraying method

6. CONSTRUCTION PLANNING AND PRELIMINARY COST ESTIMATES

6.1 Construction Planning

Construction planning was carried out based on the preliminary design. This chapter describes the guideline of project packaging and construction plan.

6.1.1 Construction Package of the Project

The majority of the construction works under the Project would be at sea and scale of the project is large and therefore, Special Terms for Economic Partnership (STEP) Loan will be applied.

The Project road was tentatively divided into four (4) segments as following:

- Segment-1 : 4th Cebu-Mactan Bridge, STA 0+000 – STA 3+263, L=3,263 km
- Segment-2 : Mandaue Coastal Road, STA 0+000 – STA 2+177.647, L=2,178 km
- Segment-3 : Mandaue Coastal Road, STA 2+177.647 – STA 3+557.647, L=1,380 km
- Segment-4 : Mandaue Coastal Road, STA 3+557.647 – STA 4+883.647, L=1,326 km

The segmentation of the contract packages will be decided during the Detailed Design Stage based on the combination of the above segments and the following items:

(1) Conditions at the Construction Site

The Location of construction site is at sea and coastal area. There are limited space for construction works due to the narrow width of the construction yard and one-way construction procedure would be required because of the limited accessibility to the construction site. A smaller number of packages will be more advantageous.

(2) Construction Cost

Construction cost per package will be decided based on the expected capability of contractors. If invitation and participation will be extended to small capability contractor, the proposed cost per package should be smaller and become many packages. If STEP Scheme will be applied, it would be depend on the capability of Japanese contractors.

(3) Geopolitical Conditions

In case the existing political boundaries will restrict or affect construction activities, the boundary of contract packages should be determined based on such conditions.

(4) Uniformity of Structural Types

Packaging can be also determined by the types of structures and in case if there are interchange, it is also considered near the interchange will be one of the boundary.

(5) Scale of Merits (Size of Precast Segment and Size of Steel Structure Segment)

The number of contract packages is also expected to be minimized by same sizes of precast segments that will be applied for longer sections, and also size of steel structure segment will be made one package which has also the advantage of reducing construction cost.

(6) Type of Financing Scheme (Regular Yen Loan or STEP Loan)

If there is a requirement for a specific Japanese technology or a certain percentage of Japanese product(s) in the project, it is most likely that STEP loan will be utilized due to the advantage of the lower interest rate and longer repayment period.

In case STEP loan will be applied, the number of packages will have to be smaller in consideration of the capacity of Japanese contractors.

6.1.2 Anticipated Number of Interested Contractor

In order to examine the optimum segmentation of contract packages for the Project, the following combinations are considered:

- Option 1: Single contract package
- Option 2: 2 contract packages
- Option 3: 4 contract packages

Table 6.1.1 summarizes the result of comparison. Case-3 (4 contract packages) is considered as the most effective condition for this project.

Table 6.1.1 Comparison of Proposed Schemes of Contract Packages

Description		Option 1 (1 Package)		Option 2 (2 Packages)		Option 3 (4 Packages)	
Section Length		CP1: 8.147 km		CP1: 3.263 km CP2: 4.884 km		CP1: 3.263 km CP2: 2.178 km CP3: 1.380 km CP4: 1.326 km	
Construction Cost (Civil Work)		CONFIDENTIAL					
Geographical and Geopolitical Conditions		CP1: Mandaue, Lapu Lapu		CP1: Mandaue, LapuLapu CP2: Mandaue		CP1: Mandaue, Lapu Lapu CP2: Mandaue CP3: Mandaue CP4: Mandaue	
Evaluation							
Uniformity of Structural Types	30	There will be 4 bridge types in one (1) contract but each bridge type has certain length having a merit of scale.	30	There will be 4 bridge types in one (1) contract but each bridge type has certain length having a merit of scale.	30	The number of bridge type varies on every contract packages. Even though the length of each bridge is shorter than Options 1 and 2, each contract package still has a merit of scale.	20
Number of Interested Contractors	50	Size of one contract package is too big and joint venture of large contractor group would only be eligible.	5	Size of one contract package is big and large contractor would only be eligible.	25	Many contractors would be eligible for the bidding and competitiveness of bidders would be expected.	50
Conditions at the Construction Site	20	The size of construction site is big but no coordination with other contractor would be necessary.	20	Coordination with other contractor would be necessary at the boundary of contract package. But accessibility for each contract package would be good.	10	Coordination with other contractor would be necessary at the boundary of contract package. Access point to the site will be limited.	5
Overall Evaluation	100		55		65	**Recommended**	**75**

Source: JICA Survey Team

Table 6.1.2 through Table 6.1.4 show the bridge length per structural type of the above cases for examining the scale of merits.

Table 6.1.2 Bridge Length per Structural Type (Case-1)

	Contract Package 1 (m)
PC-I Girder	3,365 (41%)
PC Hollow Slab	2,330 (29%)
Steel Box Girder w/ Composite Slab	1,916 (24%)
Steel Box Girder w/ Orthotropic Steel Deck	525 (6%)
Total	3,385 (100%)

Source: JICA Survey Team

Table 6.1.3 Bridge Length per Structural Type (Case-2)

	Contract Package 1 (m)	Contract Package 2 (m)
PC-I Girder	315 (9%)	3,050 (64%)
PC Hollow Slab	1,755 (52%)	575 (12%)
Steel Box Girder w/ Composite Slab	790 (23%)	1,126 (24%)
Steel Box Girder w/ Orthotropic Steel Deck	525 (16%)	0 (0%)
Total	3,385 (100%)	4,751 (100%)

Source: JICA Survey Team

Table 6.1.4 Bridge Length per Structural Type (Case-3)

	Contract Package 1 (m)	Contract Package 2 (m)	Contract Package 3 (m)	Contract Package 4 (m)
PC-I Girder	315 (9%)	1,875 (92%)	625 (45%)	550 (41%)
PC Hollow Slab	1,755 (52%)	0 (0%)	0 (0%)	575 (43%)
Steel Box Girder w/ Composite Slab	790 (23%)	170 (8%)	755 (55%)	201 (15%)
Steel Box Girder w/ Orthotropic Steel Deck	525 (16%)	0 (0%)	0 (0%)	0 (0%)
Total	3,385 (100%)	2,045 (100%)	1,380 (100%)	1,326 (100%)

Source: JICA Survey Team

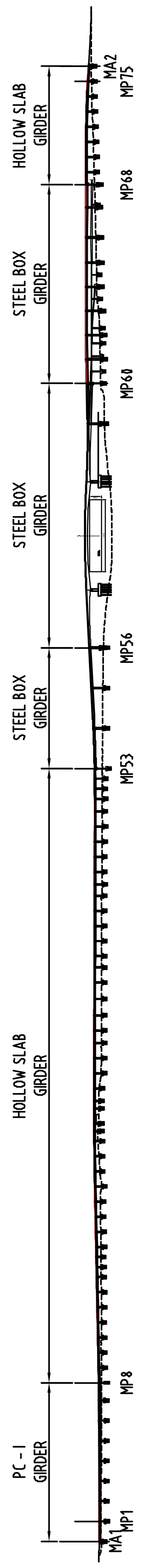
6.1.3 Construction Plan of the Project

(1) Construction Plan

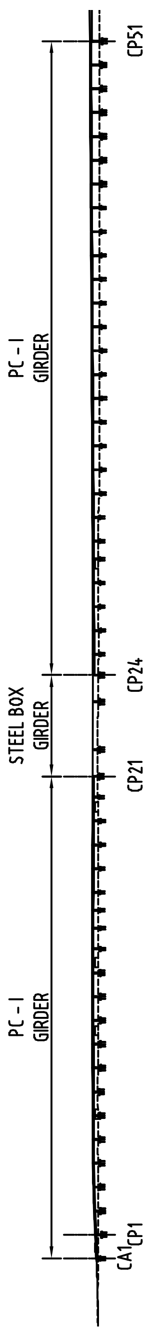
Based on the result of the Preliminary Design, construction plan is prepared in consideration of the seasonal characteristics whereas the Project site is located at sea and coastal area where is susceptible to typhoons.

(2) Construction Schedule

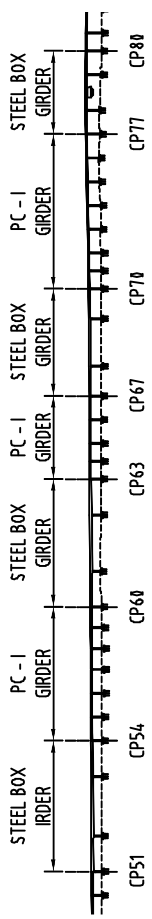
The construction schedule did not take into consideration of ROW acquisition-related activities such as demolition and movement of houses and structures, which means that the construction schedule assumes that ROW acquisition for the Project has been completed and that each section has been cleaned up before commencement of the construction works. Based on the above condition, total construction period for each Package was estimated as shown in Figure 6.1.2 through Figure 6.1.5.



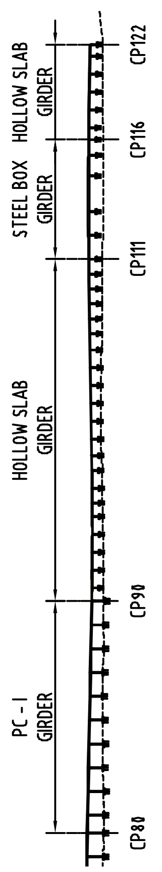
Package 1 (4th Cebu-Mactan Bridge)



Package 2 (Mandaue Coastal Road: STA 0+000 – STA 2+177.647)



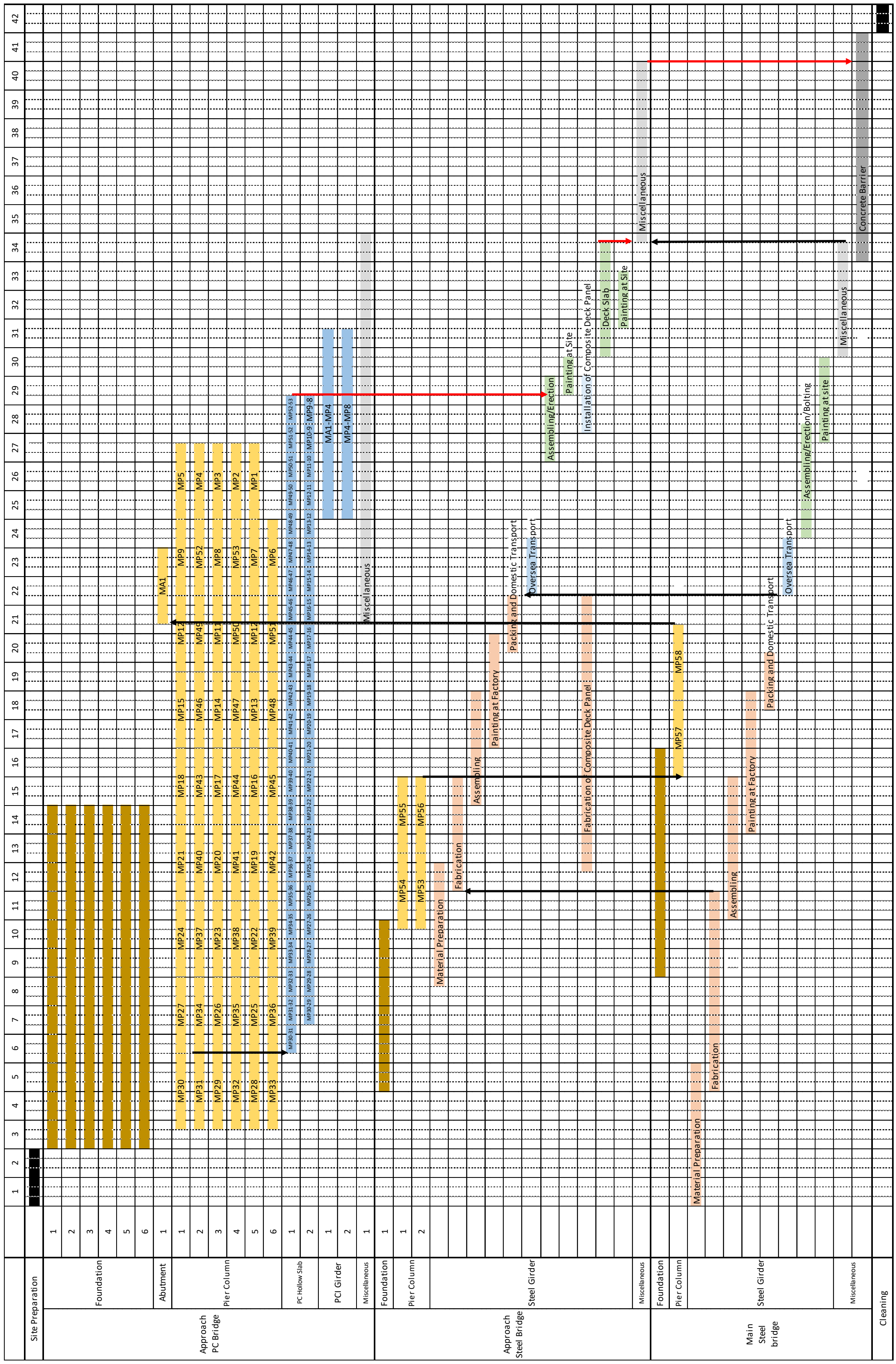
Package 2 (Mandaue Coastal Road: STA 2+177.647 – STA 3+557.647)



Package 2 (Mandaue Coastal Road: STA 3+557.647 – STA 4+883.647)

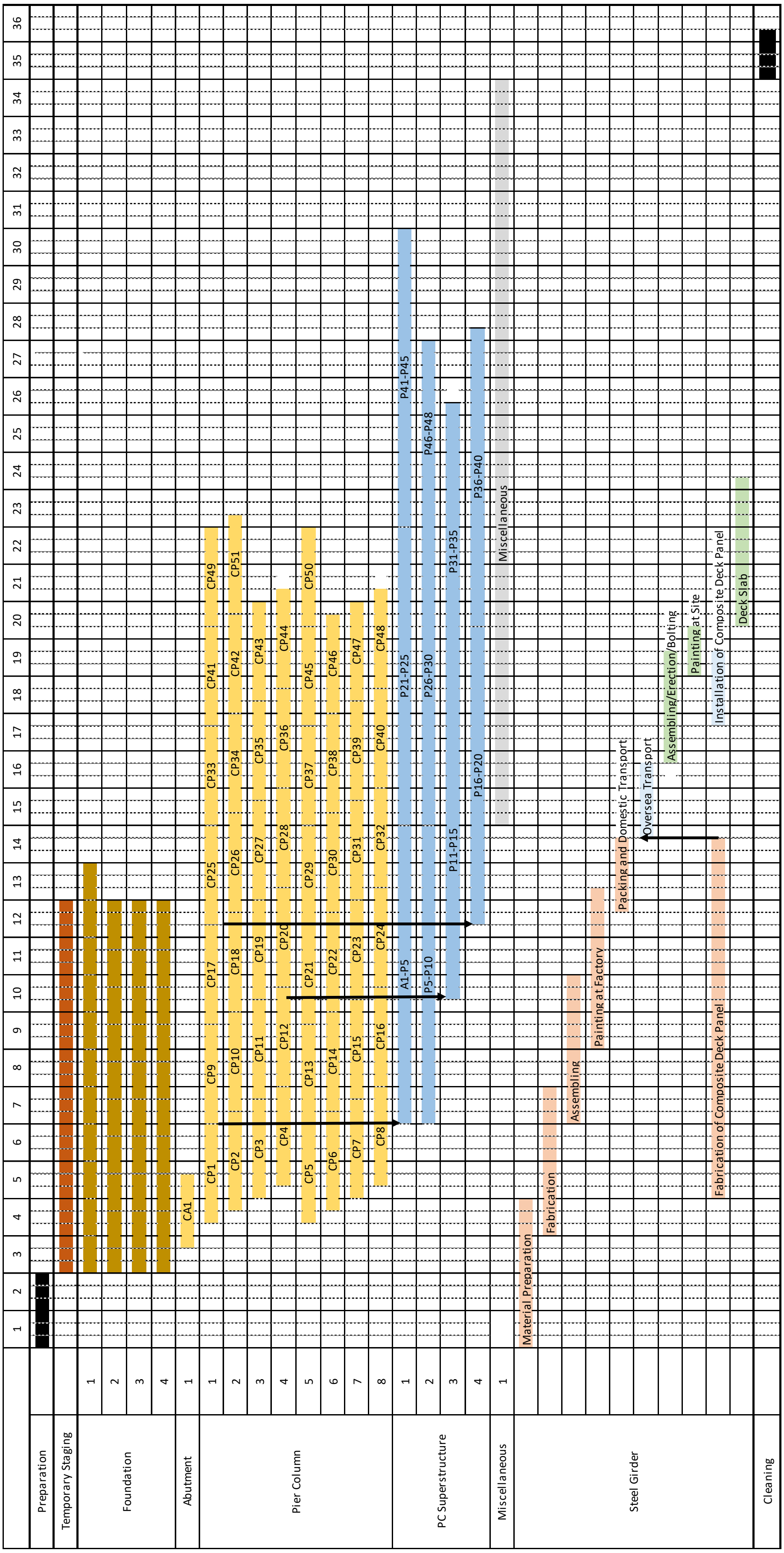
Figure 6.1.1 Profile Views

Source: JICA Survey Team



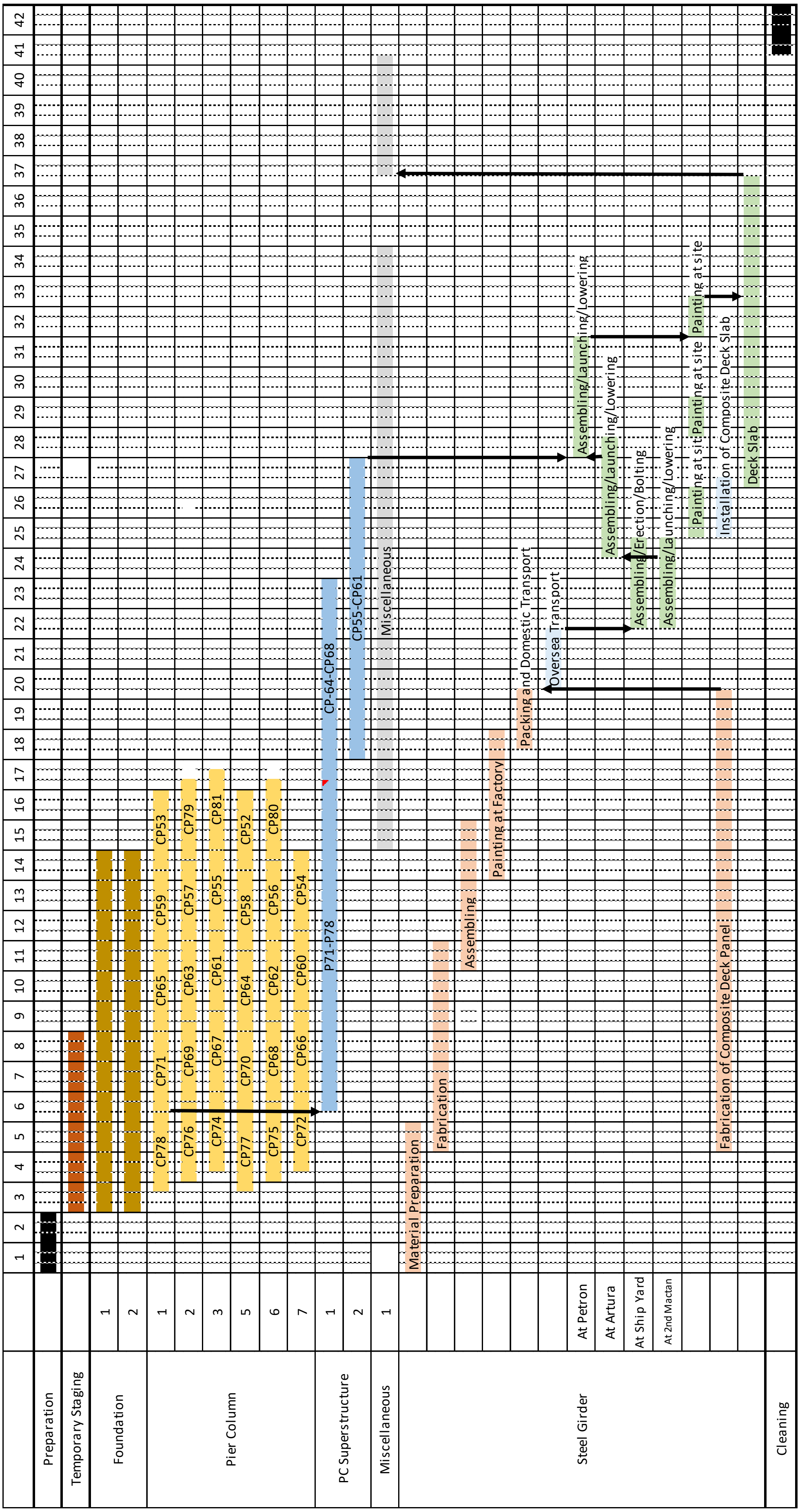
Source: JICA Survey Team

Figure 6.1.2 Construction Schedule for Package 1



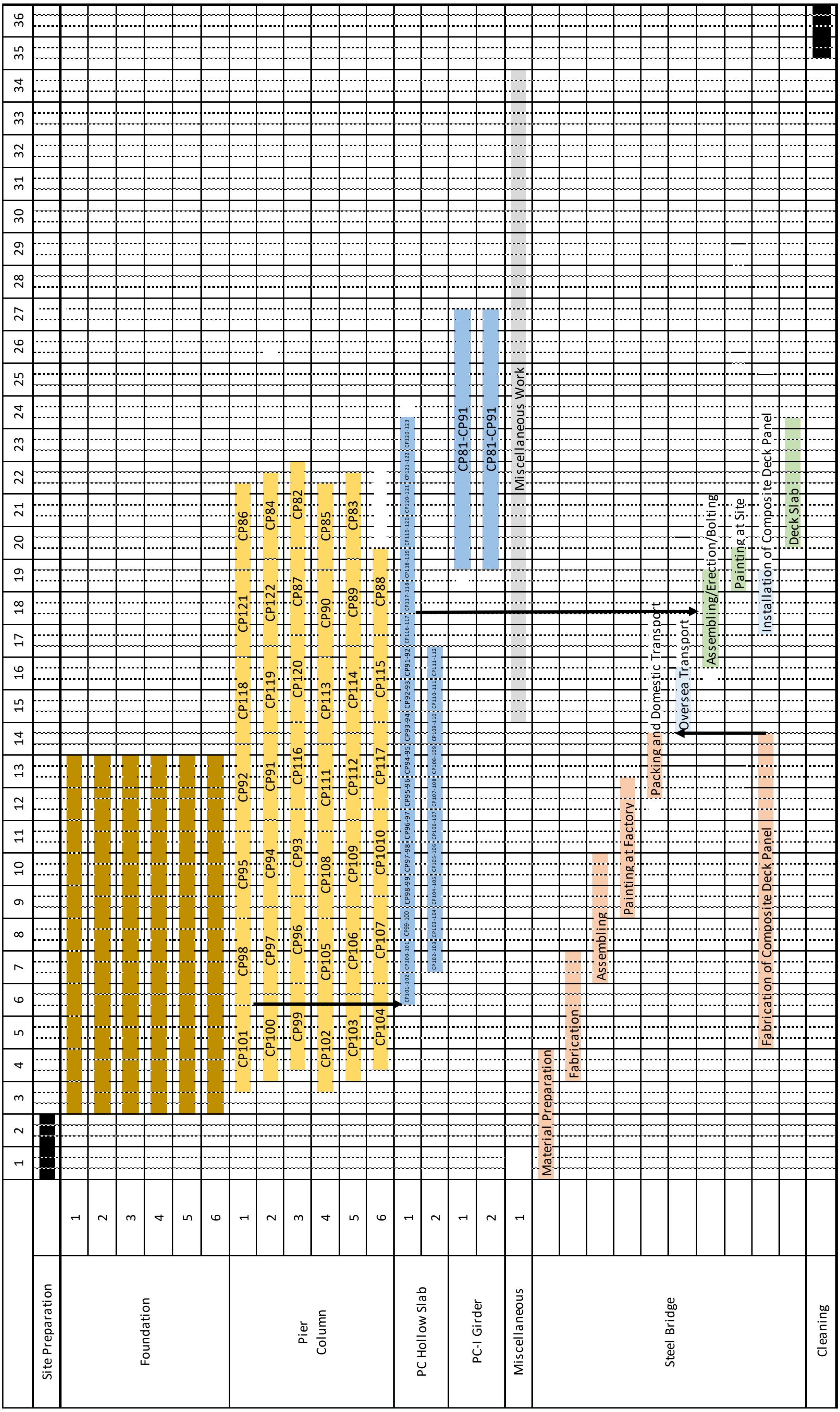
Source: JICA Survey Team

Figure 6.1.3 Construction Schedule for Package 2



Source: JICA Survey Team

Figure 6.1.4 Construction Schedule for Package 3



Source: JICA Survey Team

Figure 6.1.5 Construction Schedule for Package 4

(3) Special Construction Method for Election of Main Bridge (Japanese Technology)

Steel box girders will be assembled on the super barge near new bridge construction area. After assembling, girders will be conveyed to the bridge construction site. Set up for position and lift up of steel box girder is used special winch system for large-scale one-time casting of steel box girder bring from Japan. Size of super barge is assumed to be as follows:

- Length: 110 m
- Width: 32 m
- Loading Capacity: 14,500 ton

(4) Procurement of Material and Equipment

The major materials and equipment would be procured in the Philippines but steel members, steel pipe sheet piles, steel pipes etc., may need to be imported from Japan. List for import from Japan is shown in Table 6.1.5.

Table 6.1.5 Procurement of Materials and Equipment

Item	Unit	Quantity	Remarks
Cement	ton	11,588	From Japanese subsidiary company in the Cebu Philippines
Reinforcing Steel Bar Grade SD 390	ton	5,207	From Japan
Structure Steel for Box Girder	ton	18,499	Material is from Japan, Fabrication is other country
Structure SBHS Steel for Box Girder	ton	10,298	Material and Fabrication is from Japan
Structure Steel for Pire	ton	798	Material is from Japan, Fabrication is other country
Galvanized Steel Deck Plate for Composite Slab t=6mm	sq.m	46,469	From Japan
Aluminum, Magnesium alloy and Fluorocarbon Polymers Paint	kg	49,542	From Japan
Steel Pipes Piles with Drilled System, (1200mm Ø)	l.m	104,280	From Japan
Temporary Steel Pipes Piles Cofferdam, (900mm Ø) SPSP	ton	3,330	From Japan
Noise Barrier (H=2.0 m)	l.m	4,000	From Japan
MSE Wall (SUPER TERRE ARMEE)	sq.m	7,000	From Japan

Source: JICA Survey Team

Procurement for other material is procured in the Philippines or other country.

(5) Traffic Management and safety during Construction

Since the experimental scheme of truck ban was started on March 9, 2009, large vehicles were banned, from 6 a.m. to 8:30 a.m. and 4 p.m. to 8:30 p.m., from Lopez Jaena Street, M.C. Briones Street, J. Rizal Street along the national highway; U.N. Avenue leading to the Marcelo Fernan Bridge; A.C. Cortes Avenue, J. Briones Street, and Plaridel Street leading to the 1st Cebu-Mactan Bridge; and, Ouano Avenue and A. Soriano Street at the Mandaue Reclamation Area. This Truck Ban will affect to the delivery of materials and equipment to the construction site.

Metro Cebu was established Mactan Cebu Bridge Management Board (MCBMB) and this board member is including 15 agency such as Cebu Government, Cebu City, Mandaue City, Lapu Lapu City, Municipality of Cordova, Police regional 7 office, DPWH Region VII office, Land Transportation office 7, Coast Guard, PNP Regional Maritime office 7, NEDA region 7, Naval Forces central, Department of Tourism 7, Philippine Information Agency 7 and Chairman is Cebu Provincial Governor.

Traffic Management during construction works of the project would need coordination with MCBMB for management of traffic control of the roads along the site during construction works. Each LGU has Traffic control section and this project needs support from them such as exemption of Track Ban.

The Contractor should arrange traffic enforcer at each entrance of construction site, camp yard and the intersections near the construction site.

(6) Safety and Health at Construction Site

Safety and health for construction worker at inside of construction site shall follow DO13 Guideline of Safety and Health for Labor at Construction Site issued by Department of Labor and Employment (DOLE). Contactor should appoint Chief of Safety and Health Control and this parson shall instruct workers before starting works every day. For every month this parson shall conduct safety patrol during construction and give feedback about improvement of work condition.

(7) Research of Potential Material Source

Potential material sources for the Project was given from DPWH Region VII Office and the location, accessibility, available quantity and quality of materials were reviewed. Quarry site, natural exposure site or Manufacturing supplier of material source is selected from the nearest location from project site. Material Source map is shown in Figure 6.1.6.

<u>Fine and Crushed Aggregate Material Source</u>

Material source sites for fine and crushed aggregate material were selected at six (6) river site and one (1) supplier near project site. Each location, hauling distance, possible volume are shown in Table 6.1.6.

Quality of the above material sources would be good for construction materials and these materials can be utilized as crushed aggregate for base course, sub-base course of pavement and fine aggregate and crushed aggregate for concrete.

Table 6.1.6 Fine Aggregate and Crushed Aggregate Material Sources

Name of Quarry Site or Supplier	Location	Hauling Distance (km)	Estimated Quantity (m^3)	Remarks
Yuson Construction and supply	6 km from Talamban Road Cebu City Sebu	15	20,000	Fine and Crushed Aggregates
Camanchiller River	Km 49+400 Carmen Toledo City Cebu	50	15,000	Fine and Crushed Aggregates
Combado River	Km.65+151 Cantu-od Balamban, Cebu	36	50,000	Fine and Crushed Aggregates Boulders, Cobbles
Bago River	Km. 87+377 Asturias, Cebu	90	50,000	Fine and Crushed Aggregates Boulders, Cobbles
Arpili River	Km.55+301 Balamban Cebu	70	10,000	Fine and Crushed Aggregates
Cambus OC Quarry	KO 83+060 Buenavista Bohol	65	90,000	Fine and Crushed Aggregates Boulders, Cobbles
Inabanga River	KO 87+252 Inabanga Bohol	70	191,500	Fine and Crushed Aggregates Boulders, Cobbles
Dulang Quarry	KO 105+700 TNR Tanghaligue Talibon Bohol	72	260,000	Fine and Crushed Aggregates Boulders, Cobbles
Sinandigan Quarry	KO 137+80 TER Sinandigan Ubay Bohol	75	260,000	Fine and Crushed Aggregates Boulders, Cobbles

Source: DPWH Region VII Office

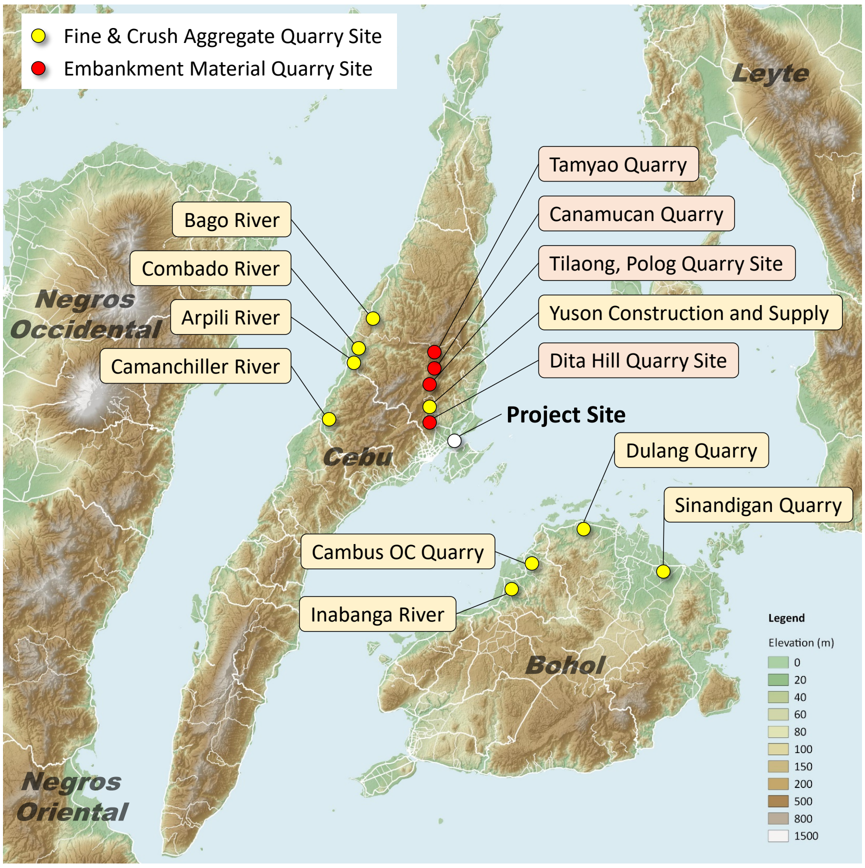
Embankment Material Source

There are four (4) possible borrow sources for embankment fill materials selected from the nearest project site. The Four (4) material sources site for embankment, its locations, hauling distance and possible volume are shown in Table 6.1.7.

Table 6.1.7 Embankment Material Sources

Name of Material Sources	Location	Hauling Distance (km)	Estimated Quantity (m3)	Remarks
Dita Hill Quarry site	8.7 km from Talamban Road Cebu City	15	20,000	Embankment (Limestone)
Canamucan Quarry site	KM 25+990 Compostela	20	52,000	Embankment (Limestone)
Tilaong, Polog Quarry site	Tilaong, and Polog Consolacion,	15	60,000	Embankment (Limestone)
Tamyao Quarry	Tamyao, Cambayog Compostela,	20	55,000	Embankment (Limestone)

Source: DPWH Region VII Office



Source: JICA Survey Team

Figure 6.1.6 Material Source Map

(8) Application of Advanced Japanese Technology

Depending on the necessity, Japanese advanced technology for bridge construction, which would be eligible for STEP Loan, may need to be considered.

(9) Construction site and access Roads

The construction site of the Project is located at sea shore of Mactan Channel and construction area is almost at the sea. One of the accessible point to the construction site is from the sea using barge and temporary staging would be prepared from the land. Selecting access road is important. A temporally available land or the existing road will be used as the main construction site. It is the place for stockpiling materials as steel, formworks and scaffoldings for construction of piers. If access from the sea would be necessary to pass under the existing Cansaga Bay Bridge, the center span of this bridge having 35 m width and 4 m depth of water level would be passable for large barge.

For access to the construction site at beginning point on land it is intended to use the existing roads near the proposed route and other roads in the area of local road. The transportation of vehicles would be affected by local traffic to some extent, so it is required to carry out proper traffic management in order to minimize adverse impacts to the public transportation.

(10) Construction Camp yards

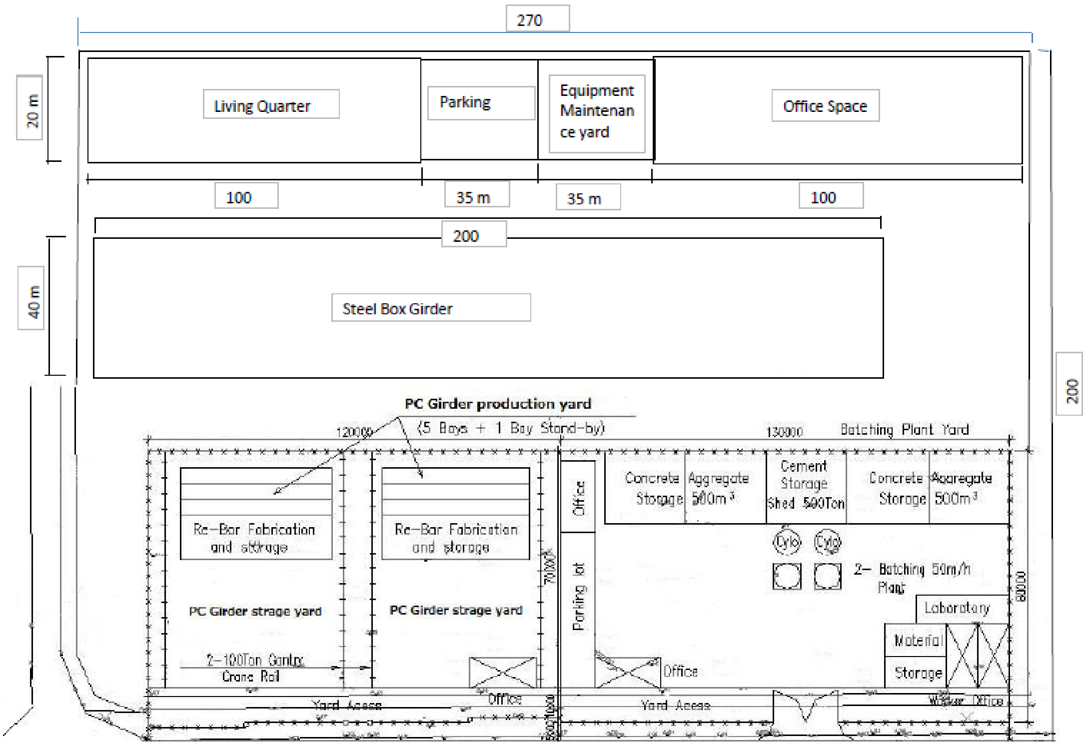
The major construction activities for the 4th Cebu-Mactan Bridge project are producing numbers of PC girders and Steel Box Girders for each package, these manufactured PC girders and assembled steel box girder will be transported from construction yard to the project construction site timely in accordance with the implementation schedule using mostly by barge. The candidate of the construction camp yard is proposed at the reclamation area beside the existing Cansaga Bay Bridge. Since the construction camp yard is temporary use but production activities are large volume to prepare concrete materials by the concrete batching plant and assembling of steel box girders. The contractor will select proper location for the construction site and its scale during tender procedure. Typical recommendable construction camp yard layout plan for this Project is shown in the Figure 6.1.7. The location of recommendable construction camp yard is shown in Figure 6.1.8. Consideration of Environmental Issue for setting of Camp Yard is following:

- Concrete batching plant is setting within the project construction yards. Concrete batching plant is the main production equipment within the yard and it require the area of approximately 2 ha together with other equipment and facilities. So that environmental impacts arising from the plant are unavoidable. These environmental issues relating to the concrete batching plant needs to be considered. Major considering item is location of the construction yard and water quality, air quality, noise and solid waste where they will be generated.
- Construction yards have a requirement of the location in an area where they will not pose a hazard to the environment or the amenity of the local community but they require safety and functional access to the project construction sites.
- Concrete batching plant will produce highly alkaline wastewater, dust emission and noise and they are the key potential impacts associated with the plant operation. These problems need to be considered when planning an operations and management through the construction periods at the sites. As for the basic requirement for the plants, it should be planned a contaminated storm water and process wastewater can be retained within the construction yards. The area of construction yard should not be hazardous area.
- One of the major environmental issues is that generative dust problem, and this problems can be minimized by allocating the concrete batching plant out of prevailing winds when it brow high and direction towards nearby community. The prevailing wind direction must be considered during the operation period at the site selection proposal by the contractor, to ensure that bunkers and conveyors are facilitated in the leeward direction to minimize the effects of the wind. The provision of an artificial wind barrier as fences to help control the emission of dust from the plant must be considered at beginning stage.
- To protect amenity, buffers must be provided between batching plants and a surrounding sensitive land use areas. Mitigation buffers are provided to minimize any potential impacts due to accidental or fugitive air emissions.

- Access and exit routes for heavy transport vehicles must be considered measures to minimize impacts on the environment and amenity of the surrounding areas.
- There are potential pollutants occurred in batching plant, generated wastewater includes cement, sand, aggregates and petroleum products in the operation process. These substances can adversely affect the environment by increasing soil and water pH, and increasing the turbidity of water course in the vicinity. Increased water turbidity results some impacts when entering an aquatic environment. This may affect a rate of photosynthesis by plants and reduce the visibility of aquatic organisms. Turbidity can also clog fish gills, smother bottom feeding flora and fauna and generally decrease the amenity of surrounding area. However the area of the project site surroundings is urbanized area and the existing water courses is environmentally not so good level of condition.
- During the plant operation dust from cement, sand and aggregates becomes a pollutant. Generated fine dust particles are easy to enter neighboring communities so that dust must be controlled so there are no significant emissions from the plant. Potential sources of dust pollution include delivery of raw materials in trucks and trailers, storage of raw materials in stockpiles and transfer of raw materials by front end loader, conveyors, hoppers and agitators etc.
- Leakage or spillage of raw materials from silos, inspection covers and duct work. The best way to avoid offsite dust problems is to prevent the release of the dust through good operation and management with proper techniques and system.
- Noise emission issues: Generated noise becomes a form of pollution and a potential source of conflict between the operators of a concrete batching plant and the local community. Noise emitted from a concrete batching plant must be managed as carefully through operation management procedures. Management should give high priority to liaising with the local community so that it can be aware of and resolve noise issues.
- Major noise sources at batching plants are considering as truck and front end loader engine noise, hydraulic pumps, aggregate delivery to bunkers and hoppers, conveyor belts, air valves, air brakes of truck, filters, alarms, amplified speakers in the yard, compressors, swinging, scraping and loading devices etc.
- Solid Waste issues: The main solid waste generated by batching plants is waste concrete. Waste minimization is preferred approach to dealing with this issue. Careful matching of orders with production could minimize the need to return unused concrete to the batching plant.
- Guideline and regulation on the waste concrete to a fully enclosed pit where it can be dried and collected. It should then be reused, or taken to a recycling facility or locally authorized disposal site. Producers should satisfy themselves the reuse of such wastes avoids adverse environmental impacts.
- Concrete agitator mixers and chutes must not be rinsed out to the storm water system or roadways. It may be possible to add water and agitate the mixer during the return trip to the plant.
- Through a proper management and operation of the construction yards all concrete should be accounted for, to ensure proper disposal of the waste product.
- Within the yards generated used cans, glass bottles, paper, other office waste and packaging materials such as plastic and cardboard should be considered in the waste minimization program. Recycling of these materials is part of best practice.

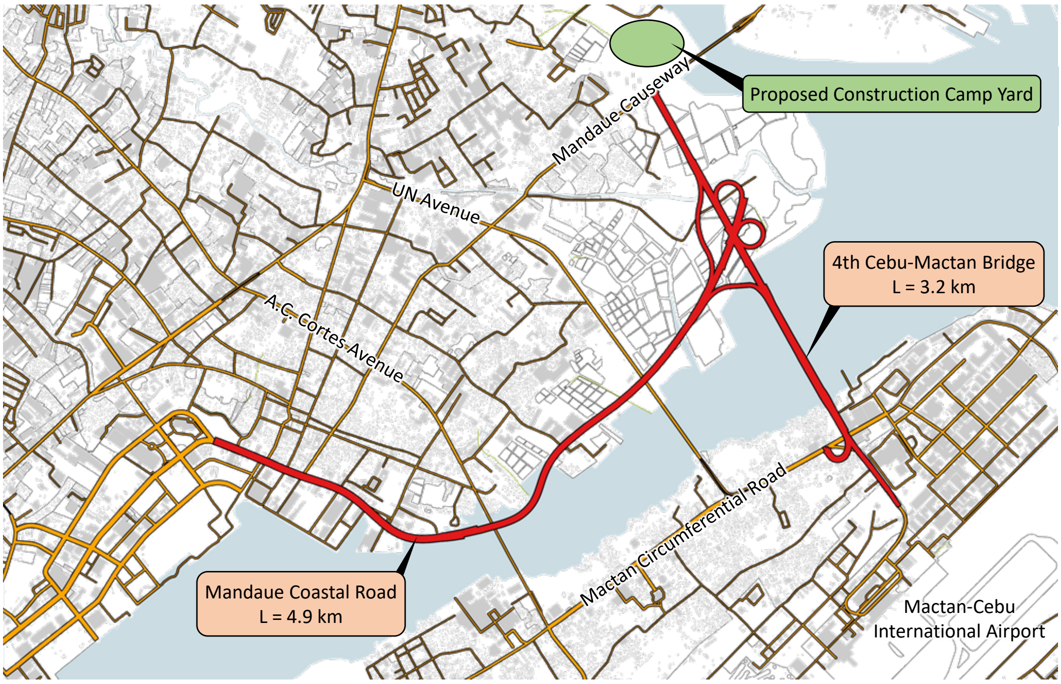
(11) Construction Disposal Area

Debris or unsuitable material will be disposed at Interchange area in Mandaue reclamation area.



Source: JICA Survey Team

Figure 6.1.7 Typical Recommendable Construction Camp Yard Layout Plan



Source: JICA Survey Team

Figure 6.1.8 Location of Recommendable Construction Camp Yard

6.2 Preliminary Cost Estimates

The Civil Works cost was estimated based on several factors, as follows:

- Unit prices used were based from similar GOP and BOT projects implemented or tendered by DPWH from 2010-2019 and unit prices for major items were estimated based on 2019 prices.
- Procedures and composition for the derivation of base construction cost were patterned from similar projects.

(1) Procedure for the Construction Cost Estimation

The procedure for cost estimation uses the unit price for the "base cost" approach, which is generally adapted for similar projects and estimation of some major items. From the previous similar projects, preliminary quantity takeoffs for construction item for the earth works, Main Bridge, Viaducts, Interchange, drainage and other works were estimated. The cost estimate is based on the estimated quantity takeoffs from the preliminary design and the current market prices.

(2) Procedure for the Base Construction Cost Estimation

The following procedures to derive the base construction cost are used:

- Assumptions necessary for the estimate shall be established based on the results of the preliminary studies, market research, site investigation, and unit prices of recent similar projects;
- Three (3) direct cost elements are identified:
  - Labor Costs
  - Material Costs (foreign/imported materials and local materials)
  - Equipment Costs (Association of Carriers and Equipment Lessors, ACEL)
- The project was broken down into its component activities and a list of corresponding work items including field activities are prepared in accordance with internationally accepted specifications and preliminary designs proposed for the Project Road.
- Based on the constraints or requirements as well as the results obtained from the site investigation, standard construction sequences and methods for each work item are studied and formulated. The construction technology, sequences and method to be employed including the approximate number of labor and equipment requirements, and other subsidiary items are therein considered.

(3) Condition of Unit Price

The construction cost estimate is composed of the direct cost and indirect cost. The computations are in accordance with the DPWH Standard Specifications and department orders relative to unit price computation and analysis.

<u>Cost of Material</u>

Materials are classified into two groups: commercial materials, available in the international and/or local markets (referred to as purchased materials) and material produced by the contractor (referred to as processed materials). The price of purchased materials are based on the quotations of various suppliers or agencies such as the Price Stabilization Council, the local markets, international and/or local prices of selected materials; the National Steel Corporation, and other private sector sources. The cost of transportation to the site is added to these costs. The cost of processed materials are estimated based on the analysis of outputs of necessary equipment, labor, royalties, and other items in accordance with recommended construction procedures.

Cost of Equipment

The cost of equipment is based on "The Association of Construction Equipment Lessors, Inc. (ACEL)" rental rates which include operator's wages, fringe benefits, fuel, oil, lubricants and equipment maintenance.

Cost of Labor

Labor costs used in the analysis are the wages authorized by the Department of Labor and Employment. All fringe benefits such as vacation and sick leaves, Workmen's Compensation Act, GSIS and SSS contributions, allowances, bonus, etc. are also taken into account.

(4) Indirect Costs

According to the Department Order No. 29, Series of 2011 of DPWH, the indirect cost considers the following conditions:

- Mobilization and demobilization (1 % of Direct cost)
- Value Added Tax (VAT) (5% of total Direct and Indirect Costs)
- Marked Up (16% of Estimated Direct Cost)
  - Overhead Expenses: 7% of Estimated Direct Cost
  - Contingencies: 0.5% of Estimated Direct Cost
  - Miscellaneous Expenses: 0.5% of Estimated Direct Cost
  - Profit: 8% of Estimated Direct Cost

(5) Civil Works Cost Estimate

Civil Works Cost for Cebu-Mactan Bridge and Coastal Road Construction Project was estimated based on the above premises and result is shown in Table 6.2.1.

Table 6.2.1 Preliminary Civil Work Cost Estimates for Cebu New Mactan Bridge Construction Project (All Package)

Unit: PHP

Item No.	Description	Unit	Quantity	Unit Cost	Amount	Foreign Currency (FC)	Local Currency (LC)	Taxes
Part A	**Facilities For The Engineers**							
A.1.1(a)	Provide 220 Sq.m Field Office, Laboratory Building and Living Quarters for the Engineer on Rental Basis	month				CONFIDENTIAL		
A.1.1(b)	Operate and Maintain Temporary Field Office, Laboratory Building and Living Quarters for the Engineer	month						
A.1.1(c)	Provision of Furnitures, Fixtures, Office Equipment and Appliances for the Combined Field Office, Laboratory & Living Quarters for the Engineer	l.s.						
A.1.1(d)	Furnishing of Laboratory Testing Equipment , Apparatus and Publications	l.s.						
A.1.1(e)	Operate and Maintain Combined Field Office, Laboratory and Living Quarters for the Engineer	month						
A.1.1(f)	Provide Satellite Field Office for the Engineer on Rental Basis	month						
A.1.2(a)	Furnish Three (3) units, Sedan Type, 1600cc Displacement, Gasoline with factory installed air conditioner and car accessories, Brand new	l.s.						
A.1.2(b)	Operate and Maintain Sedan Type, Service Vehicle for the Engineer , brand new (3 units)	month						
A.1.2(c)	Furnish Three (3) units, 4x2 Pick-up Type, 2500cc Displacement, Diesel with factory installed air conditioner and car accessories, Brand new	l.s.						
A.1.2(d)	Operate and Maintain 4x2 Pick-up type,, Service Vehicle for the Engineer , brand new (3 units)	month						
A.1.3(a)	Furnish Survey Equipment and Apparatus for the Engineer, under - Brand New	l.s.						
A.1.3(b)	Provision of Survey Personnel for the Assistance to the Engineer	month						
A.1.4	Progress Photographs	month						
A.1.5(a)	Provision of Communication Facility for the Engineer, Mobile Cellular Phone or Equivalent	l.s.						
A.1.5(b)	Provision of Cellcards for Cellular Phones for the Engineer	month						
	Sub Total of A							
Part B	**General Requirement**							
B.1	Mobilization and Demobilization (1% of civil work cost)	L.S.						

Item No.	Description	Unit	Quantity	Unit Cost	Amount	Foreign Currency (FC)	Local Currency (LC)	Taxes
	Provision of Service Vehicle	L.S.				CONFIDENTIAL		
	Operate and Maintain Service Vehicle	month						
	Site Preparation & Land Rent Expense	L.S.						
B.4	Construction Safety and Health Program	L.S.						
B.5	Standard Project Information Sign	each						
B.7	Traffic Control and Management During Construction	L.S.						
B.17	Removal and Relocation of Utilities	P.S.						
B.25	Environmental Management and Monitoring	month						
B.26	Installation of Overseas Development Assistance (ODA) Recognition Plate	L.S.						
B.28	Dayworks	P.S.						
	Administrative Cost for Foreign Engineer	L.S.						
	Sub Total of B							
Part C	**Earthwork**							
100(1)	Clearing and Grubbing	Ha.						
100(3)	Individual Removal of Trees (Small)150mm to 900mm Dia.	each						
101(3)	Removal of Existing Concrete Pavement	sq.m						
102(1)	Unsuitable Excavation	cu.m						
103(1) a	Structure Excavation	cu.m						
103(1) b	Structure Excavation Below Water Level	cu.m						
104(5)a	Structural Backfill	cu.m						
104(5)b	Granular Backfill	cu.m						
105(1)	Subgrade Preparation	sq.m						
	Sub Total of C							
Part D	**Subbase And Base Courses**							
200	Aggregate Subbase Course	cu.m						
	Sub Total of D							
Part E	**Surface Courses**							
302(2)	Bituminous Tack Coat, Emulsified Asphalt, SS-1	sq.m.						
310(1)	Anti-Rutting Bituminous Concrete Binder Course, Hot Laid (t=4 cm)	sq.m.						

Item No.	Description	Unit	Quantity	Unit Cost	Amount	Foreign Currency (FC)	Local Currency (LC)	Taxes
310(2)	Anti-Rutting Bituminous Wearing Concrete Course, Hot Laid (t=4 cm)	sq.m.			CONFIDENTIAL			
310(3)	Polymer Asphalt Concrete III-WF Type (t=4 cm)	sq.m.						
311(1)c	Portland Cement Concrete Reinforced with Wire Mesh Pavement, 320mm thk.	sq.m.						
	Sub Total of E							
Part F	**Bridge Construction**							
400 (17)b	Concrete Piles cast in Drilled Holes, (1500mm Ø) with Permanent Casing	lm						
400 (17)c	Concrete Piles cast in Drilled Holes, (2500mm Ø) with Permanent Casing	lm						
400 (17)g	Steel Pipes Piles with Drilled System, (1200mm Ø)	lm						
400(22)a	Low Strain Pile Integrity Test (PIT), dia. =1200-3000mm	each						
400(22)b-2	High Strain Dynamic Testing (P.D.A.), dia = 1500mm	each						
404(4)	Reinforcing Steel Bars, Grade SD 390	kg						
405(1)a-1	Structural Concrete Class "AA2" (30 Mpa) for Column, Copings, Wingwalls, Backwalls and Shear Keys	cu.m						
405(1)a-2	Structural Concrete Class "AA2" (30 Mpa) for Deck Slabs	cu.m						
405(1)a-3	Structural Concrete Class "AA2" (30Mpa) for Parapet, Medians, End Cross Beam	cu.m						
405(1)a-4	Structural Concrete Class "AA2" (28 Mpa) for Pile Cap	cu.m						
405(1)a-6	Structural Concrete Class "AA2" (30 Mpa) for Abutment, Retaining U-Wall	cu.m						
406(1)a	PSCG GIRDER AASHTO TYPE V (30.000 M SPAN - PIER TO PIER)	cu.m						
406(1)b	PSCG GIRDER AASHTO TYPE V (35.000 M SPAN - PIER TO PIER)	cu.m						
406(1)c	PSCG GIRDER AASHTO TYPE VI (40.000 M SPAN - PIER TO PIER)	each						
406(3)	Prestressed Concrete Class "PP1" (38 Mpa) for PC Voided Slabs, Φ1,200 Form	cu.m						
406(3)a	Prestressing Steel	kg						
407(1)	Lean Concrete	cu.m						
407(2)	Expansion Joint (Type A)	lm						
407(4)a	Expansion Joint (KMA 80 Type Aluminum Cast)	lm						

Item No.	Description	Unit	Quantity	Unit Cost	Amount	Foreign Currency (FC)	Local Currency (LC)	Taxes
407(4)c	Expansion Joint (KMA 160 Type Aluminum Cast)	lm				CONFIDENTIAL		
408(1)a	Structural Steel for Box Girder Type 1(Furnished, Fabricated, Painted, Delivered and Elected by Track Clane)	kg						
408(1)b	Structural Steel for Box Girder Type 2 (Furnished, Fabricated, Painted, Delivered and Elected from Sea)	kg						
408(1)c	Structural Steel for SBHS Box Girder (Furnished, Fabricated, Painted, Delivered and Elected from Sea)	kg						
408(2)	Structural Steel for Pier with Anchor System (Furnished, Fabricated, Painted, Delivered and Elected)	kg						
412(1)b	Elastomeric Bearing Pad (400 x 500 x 60 Duro 60)	each						
412(1)b	Bearing for Steel Bridge	each						
412(1)b	Bearing for Main Bridge	each						
SPL 421	Waterproofing on Bridge deck Slab	sq.m						
SPL 422	Galvanized Steel Deck Plate for Composite Slab t=6mm	sq.m						
SPL 423	Noise Barrier (H=2.0 m)	lm						
	Bird-car Collision Prevention Pole	nos						
517(1)a	Drain Pipes (200mmØ, PVC)	lm						
517(2)	Cast Iron Deck Drain Type-1	each						
400 (12)	Temporary Sheet Piles 24m x 13m (furnished, driven/extracted)	each						
SPL 424	Temporary Staging for Approach to Pire site (12 months use)	sq.m						
517(4)	Temporary Steel Pipes Piles Cofferdam, (900mm Ø) Type 1 (23.76 x 12.96)	each						
	Sub Total of F							
Part G	**Drainage**							
500(1)f	Reinforced Concrete Pipe Culvert (910mm diameter), Class IV	l.m						
501(2)a	U-Ditch Canal (300mm x 600mm)	l.m.						
502(4)	Catch Basin	each						
515	Mechanical Stabilized Earth Wall excluding Back Fill (TERRE ARMEE)	sq.m						
	Sub Total of G							
Part H	**Miscellaneous Items**							
600(2)	Concrete Curb and Gutter Type A	lm						

Item No.	Description	Unit	Quantity	Unit Cost	Amount	Foreign Currency (FC)	Local Currency (LC)	Taxes
601	Sidewalk	sq.m				CONFIDENTIAL		
602 (1)	Right of Way Monuments	each						
603 (3)	Metal Guardrail (Singl Metal Beam with concrete post)	l.m.						
605(1)a	Warning Signs on Bridge 450mm x 500mm	each						
605(1)b	Warning Signs 400mm x 500mm Single Post	each						
605(2)a-1	Regulatory Sign Φ600mm Single Post	each						
605(2)a-2	Regulatory Sign Φ600mm Single Post on Bridge	each						
605(3)c	Informatory Signs 1500mm x 3900mm Cantilever Type	each						
605(3)n	Informatory Signs 1650mm x 2700mm, 1650mm x 2300mm, 1650mm x 3800mm, 1650mm x 3500mm Gantry Type	each						
607(1)	Reflective Road Stud (100 x 100 x 22 mm)	each						
611 (1)	Tree Planting	each						
	Wetland Park Development	ls						
612(1)a	Reflectorized Thermoplastic Pavement Markings (White)	sq.m						
	Sub Total of H							
Part J	**Electrical Works**							
SPL 801a	Double Arm Post, H = 9m., on Ground with Street Light (LED), 130-154 Watts, 90-305 Volts	each						
SPL 806	Warning Light, Complete with Conduits	each						
	Sub Total of J							
	Grand Total Amount							

Source: JICA Survey Team

(6) Estimated Cost per Bridge Type

Based on the above estimated construction cost, the unit cost for construction of each bridge type is summarized in Table 6.2.2.

Table 6.2.2 Estimated Unit Cost per Bridge Type

	Steel Box Girder w/ Orthotropic Steel Deck	Steel Box Girder w/ Composite Slab	PC-I Girder	PC Hollow Slab	Total
Construction Cost for Superstructure (PHP million)			CONFIDENTIAL		
Area (sq. m)					
Unit Cost for Superstructure (PHP)					
Unit Cost for Substructure and Foundation (PHP)					
Unit Cost for Bridge Construction (PHP)					

Source: JICA Survey Team

(7) Land Acquisition Cost Estimate

The estimated cost for implementation of resettlement is estimated to be approximately PHP 14,259 million which covers the costs for compensating affected structures/improvements and land/property, that for developing the resettlement site, the cost for implementing the livelihood restoration program, resettlement and assistance for vulnerable groups, and the cost for monitoring.

Table 6.2.3 Total Cost for Implementation of the RAP

No.	Items	Amount (PhP)	Remarks
1	Compensation Cost for Land	10,471,708,050	
2	Compensation Cost for HH Structures	9,088,660	
3	Compensation Cost for Other Structures	1,776,270,960	
4	Compensation Cost for Trees	99,510	
5	Compensation Cost for Assets	49,350,690	
6	Cost for Development of Resettlement Site	66,162,800	
7	Cost for Implementing LRP	-	
8	Cost for Resettlement and Assistance to Vulnerable Groups	1,820,000	
9	Cost for Monitoring	25,000,000	
Sub-total		**12,399,500,670**	
10	Administrative Cost and Contingency	1,859,925,101	15%
TOTAL		**14,259,425,771**	

Source: JICA Survey Team

(8) Consultancy Cost

Duration of the Consultancy Services for the Cebu-Mactan Bridge and Coastal Road Construction Project is as below:

- Detailed Engineering Design: 15 months
- Pre-Construction: 16 months
- Construction Supervision: 42 months
- Feasibility Study: 11 months

Consulting Services include i) detailed design, ii) tender assistance, iii) construction supervision, iv) facilitation of implementation of Environmental Management Plan (EMP), Environmental Monitoring

Plan (EMoP) and Resettlement Action Plan (RAP), v) feasibility study on replacement of Sergio Osmeña Bridge (1st Cebu-Mactan Bridge) and vi) technology transfer.

The Consulting Services is expected to be commenced from January 2021 and be completed by September 2029. The total duration of consulting services will be 105 months including 12 months of defects notification period.

Sixty-one (61) International Experts and forty-eight (48) Local Experts will be engaged, for a total of 1,049 man-months for International Experts and 2,652 man-months for Local experts and required man-month for supporting staffs.

	Start	End	Months	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Procurement of Consultant	2020/01/01	2020/12/31	12										
Consulting Services	2021/01/01	2029/09/30	105										
Detailed Design	2021/01/01	2022/03/31	15										
Procurement of Contractor	2022/01/01	2023/04/30	16										
Civil Works (Package 1)	2023/05/01	2026/10/31	42										
Civil Works (Package 2)	2025/01/01	2027/12/31	36										
Civil Works (Package 3)	2025/01/01	2028/06/30	42										
Civil Works (Package 4)	2025/01/01	2027/12/31	36										
Defects Notification Period (Package 1)	2026/11/01	2027/10/31	12										
Defects Notification Period (Package 2)	2028/01/01	2028/12/31	12										
Defects Notification Period (Package 3)	2028/07/01	2029/06/30	12										
Defects Notification Period (Package 4)	2028/01/01	2028/12/31	12										

Source: JICA Survey Team

Figure 6.2.1 Expected Implementation Schedule of the Project

(9) Summary of Project Cost

The Project Cost for the Construction of 4th Cebu-Mactan Bridge and Mandaue Coastal Road is summarized in Table 6.2.4.

Table 6.2.4 Summary of Project Cost

	Foreign Currency Portion (million JPY)			Local Currency Portion (million PHP)			Amount (million JPY)		
	Total Cost	JICA Portion	Others	Total Cost	JICA Portion	Others	Total Cost	JICA Portion	Others
Package-1 (4th Cebu-Mactan Bridge)	CONFIDENTIAL								
Package-2 (Mandaue Coastal Road)									
Package-3 (Mandaue Coastal Road)									
Package-4 (Mandaue Coastal Road)									
Civil Works Sub Total									
Consulting Services									
Land Acquisition									

Source: JICA Survey Team

(10) Procurement for Japanese Contents for the Project

Equipment and materials expected to be imported from Japan is used mainly Min Steel Box Girder bridge with steel deck slab and Viaduct for this project. Each major equipment and Material from Japan is as shown in Table 6.2.5. Percentage of Japanese Contents is more than 30% of JICA requirement.

Table 6.2.5 Japanese Content for Main Steel Box Girder Bridge and Viaduct

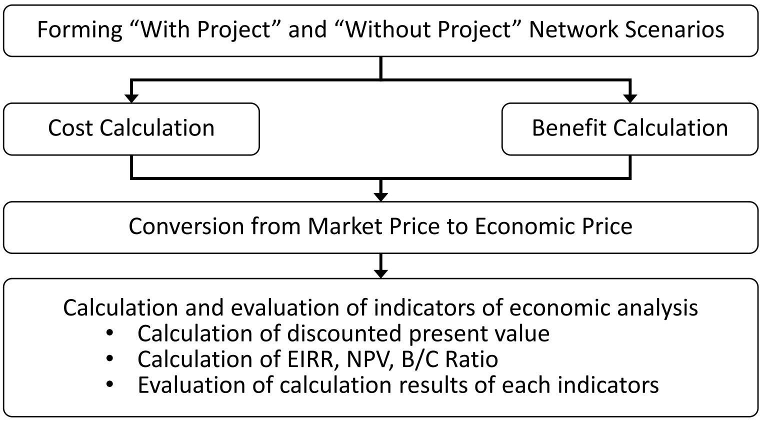
Item	Amount (Pesos)	Percentage
Cement	CONFIDENTIAL	
Reinforcing Steel Bars, Grade SD		
Steel Pipes Piles		
Structural Steel		
Structural Steel (SBHS)		
Steel Deck Plate for Composite Slab		
Noise Barrier		
Special Paint for Steel Box Girder		
Temporary Steel Pipes Piles Cofferdam		
Seismic Type of MSE Wall (Super TERRE ARMEE)		
Special Election System for Steel Gilder		
Japanese Labor		
Japanese Administration Expenses		
Total of Japanese Contents		
Loan Amount		

Source: JICA Survey Team

7. ECONOMIC ANALYSIS

7.1 Methodology

The JICA Survey Team conducted an incremental discounted cash-flow analysis to evaluate the economic viability of the proposed project after completion of the preliminary design and cost estimates. The economic internal rate of return (EIRR) and economic net present value (ENPV) were calculated to determine the viability of the proposed project. The analysis focused on the "With Project" and "Without Project" network scenarios to measure the incremental impact of the project. Project life is assumed to be 50 years from 2021 and 2070 including the period for detailed design and construction. Analysis was conducted based on the flowchart shown in Figure 7.1.1.



Source: JICA Survey Team

Figure 7.1.1 Process of Economic Analysis

A sensitivity analysis was also carried out to assess the responsiveness of the viability indicators to changes in critical variables such as economic costs and economic benefits.

7.2 Calculation of Project Cost and Benefit

(1) Economic Costs of the Project

The economic costs were determined by deducting all taxes included in the financial cost and by applying the shadow wage rate to the unskilled labor component of investment cost. Economic cost was estimated to be equivalent to 85% of financial cost in reference to the ICC Project Evaluation Procedures and Guidelines prepared by NEDA, which applies 1.2 of shadow exchange rate, and other Japanese ODA Loan projects implemented in the Philippines. The conversion factor applied to the operation and maintenance (O&M) costs was also be 85%. Details and basis for calculation of project cost and O&M cost were calculated based on the preliminary design and cost estimates.

(2) Economic Benefits of the Project

The main economic benefits of the project are the savings owing to the reduction in vehicle operating cost (VOC) and travel time cost (TTC). The implementation of the proposed project is expected to reduce traffic volume, which in turn will result in shorter travel times and faster vehicle operating velocity. The shorter travel time translates into lower travelling time costs, while the faster vehicle velocity implies lower operating costs. The values of these economic benefits will be based on the willingness to pay for time cost and VOC per trip. Reduction in CO_2 emission was included for additional benefits of mentioned above benefits. Negative benefits of traffic congestion during construction period were not considered in this Survey.

Calculating the core benefits of the project, the unit VOCs and TTCs were then estimated. The unit VOCs were based on the average operating costs of a representative set of vehicles. The cost items that were considered in the computation were (i) fuel, (ii) lubricant, (iii) tire, (iv) repair, (v) depreciation, (vi) capital opportunity, (vii) overhead, and (viii) crew. The results of the computation were consolidated and expressed as a function of travel speed as shown in the table below.

Table 7.2.1 Vehicle Operating Cost (VOC)

Speed (km/hour)	VOC (PHP per 1,000 kilometer)				
	Motor Cycle	Passenger Car	Public Vehicle	Tricycle	Truck
5	10,353	27,333	44,244	20,706	178,178
10	6,038	16,746	25,742	12,076	99,240
20	3,803	11,145	16,308	7,606	59,533
30	3,038	9,188	13,361	6,076	43,107
40	2,625	8,182	11,663	5,250	35,274
50	2,437	7,658	11,658	4,874	31,702
60	2,421	7,744	12,580	4,842	29,762
70	2,473	8,024	13,973	4,946	29,308
80	2,581	8,454	15,527	5,162	30,423
90	2,756	9,083	16,854	5,512	32,533

Source: The Project for Capacity Development on Transportation Planning and Database Management, (MUCEP, 2015)

The estimates of unit TTCs were based on the mode of transportation across household income groups. The monthly TTC per mode of transportation is the weighted average of household income with percentage of vehicle ownership as weights. However, these values represent the value of time while working and not the travel time cost. The average value of travel time per mode of transportation is the product of value of time per hour and the share of business trip and "to work" trip.

Table 7.2.2 Time Value of Passengers

Mode Type	Time Value (PHP per hour)
Motorcycle	53.6
Passenger Car	104.7
Public Vehicle	54.7
Tricycle	47.9
Truck	64.7

Source: The Project for Capacity Development on Transportation Planning and Database Management, (MUCEP, 2015)

The estimates of unit cost of CO_2 were based on the following table issued by "Policy Research Institute for land infrastructure, Transport and Tourism". Estimated CO_2 cost in Japan is used for the calculation of benefits in this analysis.

Table 7.2.3 CO_2 Cost Used for Evaluation of Transportation Project

USD per t_{CO2}	Approach Adopted	2010	2020	2030	2040	2050
France	Abatement Cost	39	123	295	Grows at 4.5% p.a.	
UK (non-traded)	Abatement Cost	40-122	47-142	55-164	106-319	158-473
Norway	Abatement Cost	Before 2015: 24		2015-2030: interpolated		After 2030: 91
The Netherlands	Abatement Cost	12.6 to 194.90				
Germany	Damage Cost	2010: 54-161		2030: 94-288		2050: 174-523
U.S.	Damage Cost	12-97	13-140	18-174	23-209	28-241
New Zealand	Damage Cost	34.4				
Japan	Damage Cost	25.7				
Sweden	Fuel tax on CO2	For investment <10 years: 128			For investments>10 years:172	

Sources/Notes:

1. Carbon values are sourced from a preliminary OECD survey of monetary carbon value in selected member countries.
2. All carbon values were first inflated to 2013 prices in domestic currency using GDP deflator and then converted to USD using PPP conversion factors. GDP deflators and PPP data are sourced from OECD Statistics.
3. A conversion factor of 3.67 is used to convert tCO2 (for Japan).

(3) Calculation of the Project Benefit

Pre-conditions

For the calculation of the benefit, the future traffic demand forecast was conducted on two network scenarios of “With Project” and “Without Project” in each of 2030 and 2050. “With Project” network is same as the master plan network proposed by MCUTMP. “Without Project” network exempted the link of proposed project from the master plan network. The projects to be included in the master plan network is described in the **Chapter 3**.

Daily Project Benefit in 2030 and 2050

Based on the result of demand forecast, VOC, TTC and CO_2 emission were estimated for each case in 2030 and 2050. The daily project benefit was calculated as shown in the table below and converted as yearly benefit. For the economic analysis, the benefit of each year during project life was calculated by interpolating and extrapolating of the figures in 2030 and 2050.

Table 7.2.4 Daily Project Benefit Estimated by Traffic Demand Forecast

Year	Case	VOC (Mil. PHP/day)	TTC (Mil. PHP/day)	CO2 (ton/day)
2030	With Project (A)	524.63	479.95	8,616
	Without Project (B)	530.83	486.19	8,691
	Benefit (B-A)	6.20	6.24	75
2050	With Project (A)	682.02	594.78	10,553
	Without Project (B)	695.77	609.89	10,718
	Benefit (B-A)	13.75	15.11	165

Source: JICA Survey Team

7.3 Results of Cost-Benefit Analysis

The conditions of calculation of the economic analysis for the proposed project are as follows:

- Price and cost: Constant price in 2019
- Computation period: 50 years (45 years starting from operation)
- VAT are not considered.
- Social discount rate is 10%.

The proposed project yielded an EIRR of 10.9%, so it is larger than 10% of social discount rate set by the National Economic and Development Authority (NEDA). Thus, this proposed project brings about positive economic effects for national economy of the Philippines.

- EIRR: 10.9%
- B/C: 1.13 (at discounted rate of 10%)
- NPV: PHP 5,708.54 million (at discounted rate of 10%)

Table 7.3.1 Cost-Benefit Analysis of the Project

(PHP million)

	Cost			Benefit				Net Cash Flow
	Investment Cost	O/M Costs	Total Cost	VOC	TTC	CO_2	Total Benefit	
2020	CONFIDENTIAL							
2021								
2022								
2023								
2024								
2025								
2026								
2027								
2028								
2029								
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2031								
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Source: JICA Survey Team

7.4 Sensitivity Analysis

A sensitivity analysis was carried out to verify the sensitivity of EIRR in accordance with the change of cost and benefit as shown in the table below. All cases show that it is economically viable in terms of national economy, except the case with 10% cost increase and 10% benefit decrease.

Table 7.4.1 Sensitivity Analysis of the Project

			Project Cost		
			10% Decrease	**Base Case**	**10% Increase**
Benefit	10% Increase	EIRR (%)	12.6%	11.7%	10.9%
		B/C	1.38	1.24	1.13
		NPV (Mil. PHP)	15,101.47	10,690.43	6,279.40
	Base Case	EIRR (%)	11.8%	10.9%	10.2%
		B/C	1.25	1.13	1.03
		NPV (Mil. PHP)	10,119.58	5,708.54	1,297.51
	10% Decrease	EIRR (%)	10.9%	10.1%	9.4%
		B/C	1.13	1.02	0.92
		NPV (Mil. PHP)	5,137.69	726.65	-3,684.38

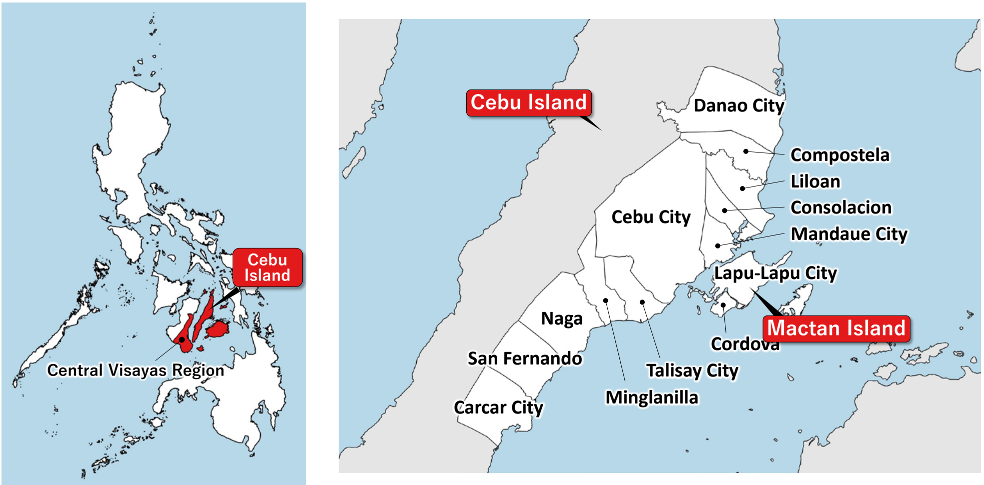
Source: JICA Survey Team

8. ENVIRONMENTAL IMPACT ASSESSMENT

8.1 Project Components that affect the Environmental Condition

8.1.1 Project Components

The Project Area, Metro Cebu, belongs to the Central Visayas Region, on one of the Visayan Islands located in central Philippines and consists of 13 local governments including Cebu City. Metro Cebu is the second largest metropolitan area after Metro Manila with a population of 2.85 million in 2015.



Central Visayas **Metro Cebu**

Source: JICA Survey Team

Figure 8.1.1 Project Location Map

The project components include the construction and eventual operations of the 4th Cebu-Mactan Bridge, Mandaue Coastal Road, Interchanges and Intersections in Mandaue and Lapu-lapu area.

Table 8.1.1 Summary of Project Description

Total Length	8.2 km
4th Cebu-Mactan Bridge	3.3 km
Mandaue Coastal Road	4.9 km
No. of lanes of 4th Cebu-Mactan Bridge	4
No. of lanes of Mandaue Coastal Road	4-6
Roadway width	20.0-47.0 m
Median Island	1.5 m
Interchanges	2
Viaduct length	8.2 km
Implementation Period	9 years
Detailed Engineering Design	15 months
Land Acquisition	Start 2021
Civil works construction	36-42 months
Target Start of operation for 4th Cebu-Mactan Bridge	2026
Target Start of operation for Mandaue Coastal Road	2028

Source: JICA Survey Team

8.1.2 Description of the project phase

1) Pre-Construction Phase

These involved the following activities, namely:

- Detailed Engineering Design, including the review of the feasibility study result and implementation of supplemental studies
- Road-Right-of-Way acquisition
- Securing of permits and clearances from relevant national government agencies and the LGUs (City/Municipal and barangay governments of Mandaue City and Lapu-lapu City) as prerequisite for project construction and operation to commence. (See Table 1.4.5)
- Preparation of procurement for the construction
- Relocation of utilities (e.g. electric poles, water lines, communication lines, etc.) along right of ways
- Removal, relocation and replanting trees
- Others

2) Construction Phase

Based on the result of the Preliminary Design, the construction plan is prepared in consideration of seasonal characteristics whereas the Project site is located at sea and coastal area where is susceptible to typhoons.

Construction plan is described in Chapter 6, including construction schedule, procurement of material and equipment, research of potential material source, construction site and access roads, construction camp yards and construction disposal area.

(1) Possibility of Employment Number

Possibility of Employment number is shown in Table 8.1.2.

Table 8.1.2 Number of Employment

	Contractor	Consultant	Total
Professional	40	58	98
Skilled Labor	9,226		9,226
Unskilled Labor	7,074		7,074
Technical and Support Staff	40	24	64
Total	16,380	82	16,462

Source: JICA Survey Team

(2) Necessity Number of Equipment for Cebu Mactan 4th Bridge Construction Project

Major Construction Equipment is shown in Table 8.1.3.

Table 8.1.3 Net working hours Rate for Cebu Mactan 4th Bridge Construction Project Equipment during Construction

Equipment	Capacity	Necessity Number of Equipment	Unit		Total Quantity
Equipment					
Dump Track	11 ton	52	Total run Km./Unit	run km	3,127,832.85
Wheel Loder	1.53 m3	5	Total working hr/unit	hr	6,569.80
Motor Grader 14G	3m/200HP	1	Total working hr/unit	hr	274.19
Vibratory Roller	11 ton, 125 Hp	3	Total working hr/unit	hr	736.93
Tired Roller	12.6 ton	3	Total working hr/unit	hr	736.93
Crawler Tractor (w/ Bulldozer)	Caterpllar D7G PS		Total working hr/unit	hr	-
Hydraulic Excavator	1.0 m3	12	Total working hr/unit	hr	29,351.82
Backhoe	0.6 m3	6	Total working hr/unit	hr	14,115.86
Vibratory Plate Compactor	7 Hp	20	Total working hr/unit	hr	48,864.18
Track Crane	160 ton, 300Hp	2	Total working hr/unit	hr	630.00
Crawler Crane	60T/275Hp	11	Total working hr/unit	hr	109,895.00
Drill Rig for Pile	CWV Model TRM35/31	11	Total working hr/unit	hr	109,895.00
Concrete transit Mixer	5 m3	29	Total run Km./Unit	run km	514,736.60
Concrete Pump	60 yd3	7	Total working hr/unit	hr	17,157.89
Concrete Plant	40m3/hr	4	Total working hr/unit	hr	12,868.42
Track Mounted Crane	21-25t, 200Hp	5	Total run Km./Unit	run km	58,625.83
Concrete Vibrator	Gasoline type	57	Total working hr/unit	hr	411,789.28
Semi Trailer	20 ton	6	Total run Km./Unit	run km	1,260.00
Asphalt Paver	4.7 m, 112 Hp	3	Total working hr/unit	hr	783.97
Asphalt Distributor	5 ton	4	Total working hr/unit	hr	1,412.45
Asphalt Plant	60 t/hr	3	Total working hr/unit	hr	741.54
Lane Marker	8 ton Track	1	Total run Km./Unit	run km	8,106.00
Deck Barge Non Propelled	1000 t	5	Total working hr/unit	hr	720.00
Tugboat	30.96m	5	Total working hr/unit	hr	720.00
Super deck Barge	Shinyo 14,500t	4	Total working hr/unit	hr	2,160.00
Non Propelled Barge with Crane	650t with 60t Crane	5	Total working hr/unit	hr	720.00
Crane Hydraulic Tel Boom,	121-140 tons	8	Total working hr/unit	hr	-
High Bed Trailer	65 t	4	Total run Km./Unit	run km	-

Source: JICA Survey Team

(3) Environmental Issue for setting of Camp Yard and Consideration of Environmental Issue for setting of Camp Yard, Concrete Batching Plant

Environmental Issue for setting of camp yard and consideration of environmental issue for setting of camp yard, concrete batching plant in particular, is following;

- Construction yards have a requirement of the location in an area where they will not pose a hazard to the environment or the amenity of the local community but they require safety and functional access to the project construction sites.
- Concrete batching plant is setting within the project construction yards. Concrete batching plant is the main production equipment within the yard and it requires the area of approximately 2 ha together with other equipment and facilities. So that environmental impacts arising from the plant are unavoidable. These environmental issues relating to the concrete batching plant needs to be considered. Major considering item is location of the construction yard and water quality, air quality, noise and solid waste where they will be generated.
- Concrete batching plant will produce highly alkaline wastewater, dust emission and noise and they are the key potential impacts associated with the plant operation. These problems need to

be considered when planning an operations and management through the construction periods at the sites. As for the basic requirement for the plants, it should be planned a contaminated storm water and process wastewater can be retained within the construction yards. The area of construction yard should not be hazardous area.

Air quality issues in Camp Yard:

- One of the major environmental issues is that generative dust problem, and this problems can be minimized by allocating the concrete batching plant out of prevailing winds when it brow high and direction towards nearby community. The prevailing wind direction must be considered during the operation period at the site selection proposal by the contractor, to ensure that bunkers and conveyors are facilitated in the leeward direction to minimize the effects of the wind. The provision of an artificial wind barrier as fences to help control the emission of dust from the plant must be considered at beginning stage.
- During the plant operation dust from cement, sand and aggregates becomes a pollutant. Generated fine dust particles are easy to enter neighboring communities so that dust must be controlled so there are no significant emissions from the plant. Potential sources of dust pollution include delivery of raw materials in trucks and trailers, storage of raw materials in stockpiles and transfer of raw materials by front end loader, conveyors, hoppers and agitators etc.
- To protect amenity, buffers must be provided between batching plants and a surrounding sensitive land use areas. Mitigation buffers are provided to minimize any potential impacts due to accidental or fugitive air emissions.
- Access and exit routes for heavy transport vehicles must be considered measures to minimize impacts on the environment and amenity of the surrounding areas.

Water quality issues in Camp Yard:

- There are potential pollutants occurred in batching plant, generated wastewater includes cement, sand, aggregates and petroleum products in the operation process. These substances can adversely affect the environment by increasing soil and water pH, and increasing the turbidity of water course in the vicinity. Increased water turbidity results some impacts when entering an aquatic environment. This may affect a rate of photosynthesis by plants and reduce the visibility of aquatic organisms. Turbidity can also clog fish gills, smother bottom feeding flora and fauna and generally decrease the amenity of surrounding area. To avoid spillage and contamination of surface and ground waters, temporary drainage plan with sump pits/sedimentation pond to trap sediments and wastes will be prepared and proper handling of oil and lubricants also be implemented.

Noise emission issues in Camp Yard:

- Generated noise becomes a form of pollution and a potential source of conflict between the operators of a concrete batching plant and the local community. Noise emitted from a concrete batching plant must be managed as carefully through operation management procedures. Management should give high priority to liaising with the local community so that it can be aware of and resolve noise issues.
- Major noise sources at batching plants are considering as truck and front end loader engine noise, hydraulic pumps, aggregate delivery to bunkers and hoppers, conveyor belts, air valves, air brakes of truck, filters, alarms, amplified speakers in the yard, compressors, swinging, scraping and loading devices etc.

Solid Waste issues in Camp Yard:

- The main solid waste generated by batching plants is waste concrete. Waste minimization is preferred approach to dealing with this issue. Careful matching of orders with production could minimize the need to return unused concrete to the batching plant.
- Guideline and regulation on the waste concrete to a fully enclosed pit where it can be dried and collected. It should then be reused, or taken to a recycling facility or locally authorized disposal site. Producers should satisfy themselves the reuse of such wastes avoids adverse environmental impacts.
- Concrete agitator mixers and chutes must not be rinsed out to the storm water system or roadways. It may be possible to add water and agitate the mixer during the return trip to the plant.
- Through a proper management and operation of the construction yards all concrete should be accounted for, to ensure proper disposal of the waste product.
- Within the yards generated used cans, glass bottles, paper, other office waste and packaging materials such as plastic and cardboard should be considered in the waste minimization program. Recycling of these materials is part of best practice.

(4) Demobilization

Demobilization is the final stage in the construction phase, which includes the following:

- Demolition of temporary facilities (e.g. scaffoldings, formworks, temporary power supply lines, etc.);
- Decommissioning/moving-out of construction equipment and machineries,
- Disposal of construction solid waste (e.g. debris, etc.),
- De-hiring, laying-off of local construction workers

The project proponents shall require to submit detailed waste management program (WMP) prior to construction. Proof of implementation shall be submitted together with Compliance Monitoring Report (CMR). The project proponents shall also require to detailed demobilization plan for the construction yards.

<u>Demolition of temporary facilities, construction equipment and machineries</u>

Through the activities on demolition of temporary facilities, construction equipment and machineries, further contamination of the waterways and dust re-suspension may occur due to abandoned wastes. In addition, possible spread of communicable diseases shall occur due to abandoned wastes.

The following actions will also be implemented by the contractors;

- All temporary sanitation facilities, especially the portable toilets are properly dismantled and no domestic wastes are abandoned; and
- Conduct a site inspection at the work sites to ensure that construction spoils/debris, solid, and domestic wastes are properly disposed to approved disposal sites and not abandoned in the construction areas

<u>Disposal of construction solid waste</u>

Pre-construction activities that will result in solid waste generation include the demolition of existing road structures. During construction phase, a total of around 18,500 m3 of construction debris will be for disposal. The excess soil from earthwork activities such as excavation, backfilling and embankment will be used for redevelopment of a wetland park within the interchange area.

Table 8.1.4 Summary of Excavation work and Removal

Item	Unit	Quantity
Excavation	qu.m	352,249.09
Back fill	qu.m	277,088.16
Removal of Existing Concrete Pavement	qu.m	18,507.77

Source: JICA Survey Team

The following actions will also be implemented by the contractors;

- Reuse excavated excess soil to backfill depressed areas within or nearby the area
- Recycle construction debris through sorting and stockpiling
- Take appropriate measures, such as covering hauling trucks with tarpaulin or canvass, in transporting excess/excavated earth materials to disposal site
- Take proper and diligent management of solid waste, such as covering temporary stockpiles of excavated materials and hauling regularly to DENR-approved disposal sites

Construction Disposal Area

According to Republic Act (RA) 6969-Toxic and Hazardous Substances and Republic Act (RA) 9003-Ecological and Solid Waste Management Act, the project proponents shall require to submit detailed waste management program (WMP) for proper handling, collection and disposal of solid, hazardous and liquid waste to EMB Regional/ Central office and LGUs such as Department of Public service (DPS) prior to construction.

Construction debris or unsuitable material to be reused will be disposed within the interchange area, if the WMP will be accepted. The WMP will include the plan that this area will be redeveloped as a Wetland Park after the construction works.

Other option for excess waste materials, contractors will secure hauling permits and dispose excess earth materials to approved-suitable disposal sites (e.g. projects already issued with ECCs).

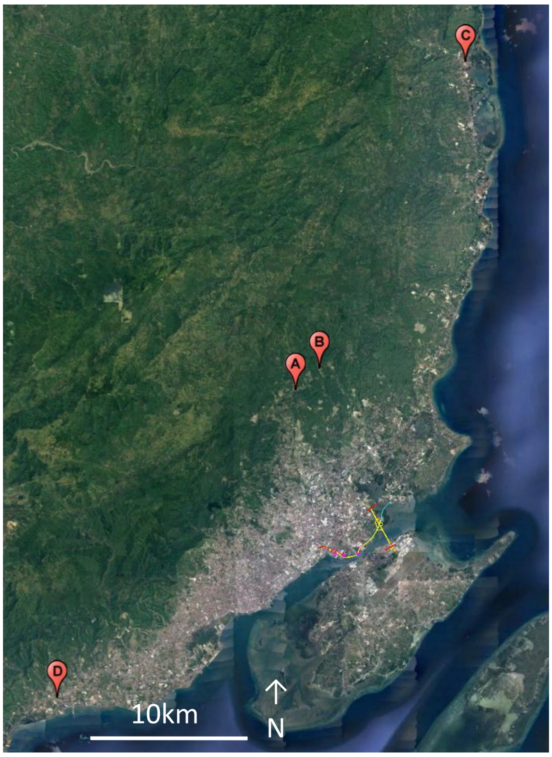
The candidate sites are shown below and in Figure 8.1.2.

a. *Binaliw Sanitary landfill (SLF) in Barangay Binaliw Cebu City:* The open sanitary landfill site for now that has been accepting residuals from Cebu City and Mandaue since May 2019 is the Binaliw Sanitary landfill (SLF) in Barangay Binaliw Cebu City located approximately 10km from the project site, operated by a private company.

b. *The SLF in Consolacion, Cebu operated by the Asian Energy System Corp.:* It is temporarily closed as it is undergoing rehabilitation to comply with the DENR-EMB Cease and Desist Order conditions issued in May 2019. It will be re-opened after the conditions are sufficiently met.

c. *New Sanitary Landfill Facility:* The Cebu Provincial Government has a Sanitary Landfill Facility project in the Municipality of Carmen to which an ECC is already issued, and will soon be constructed in the said locality. This will accept residuals from the LGUs within the province including Mandaue City.

d. *New Sanitary Landfill Facility:* A private company is currently constructing a SLF in the Municipality of Minglanilla. An ECC was already issued to this said SLF by the EMB.



Source: JICA Survey Team and Map is Google Map

Figure 8.1.2 Location of Candidate Disposal Sites

Demobilization of Social Service Utilities

Possible long-term interruption of basic social service utilities such as power and water supplies will occur. Contractors/Sub-Contractors must ensure that all affected service utilities are immediately and properly restored to their normal operation; and conduct a joint site inspection involving the ESHO of the Contractors, leaders of affected barangays, and representatives of concerned utility companies to ensure immediate restoration of affected service utilities.

3) Operation Phase

The operation phase basically includes the 4th Cebu-Mactan Bridge-Mandaue Coastal Road presence, infrastructure maintenance, vegetation maintenance, and traffic management.

(1) Infrastructure Maintenance

General highway maintenance activities retain roadways at a reasonable level of service, comfort, and safety. The rate of degradation of the pavement surface will be determined by the volume of traffic, proportion of heavy trucks, certain vehicle characteristics (*e.g.,* radial tires), and the structure and quality of pavement. The repair of the asphalt surface may involve excavation or removal of the existing pavement and subgrade, patching and leveling, grading and gravelling, surface treatment, and asphalt concrete overlays. Disruption to the public from these repairs would be temporary and infrequent in nature.

Periodic maintenance of roadway drainage systems may be required. This may involve the replacement or repair of culverts and re-establishment of the drainage ditches. Other highway maintenance activities include shoulder grading, localized pavement repair, and line repainting. Disruption to the public from these repairs will be temporary and infrequent in nature.

(2) Vegetation Management

Growth of vegetation within the 4th Cebu-Mactan Bridge-Mandaue Coastal Road may interfere with the lines of sight required for safe use of the highway. Clearing/mowing along the 4th Cebu-Mactan Bridge-Mandaue Coastal Road is part regular maintenance to maintain sight lines and may involve both manual and mechanized cutting.

Vegetation Management will also include maintenance of planted trees (along sidewalks), pocket parks, mangrove plantations and tree plantations outside of the project area (per ECC condition compliance).

(3) Accidents, Malfunctions, and Unplanned Events

All necessary precautions will be taken to prevent the occurrence of Accidents, Malfunctions, and Unplanned Events that may occur throughout all phases of the Project and to minimize any environmental effects should they occur. Accidental events with the greatest potential for environmental effects include:

- Hazardous material spills
- Failure of erosion and sediment control measures
- Fire
- Vehicular collisions
- Disturbance of archaeological or heritage resources

4) **Decommissioning/Abandonment Phase**

The 4th Cebu-Mactan Bridge-Mandaue Coastal Road is being plan and intended for long-term operations. Should there be a plan to alter or demolished the structures and new developments will be introduced thereon, an abandonment plan shall be prepared and submitted to the EMB.

8.2 Baseline Condition on Environmental and Social consideration

8.2.1 Administrative Boundary and Land Size

Mandaue City is one of the three urbanized cities located in Cebu Island with a land size of approximately 3,284 ha. It consists of 28 barangays including the City South Special Economic Administrative Zone (CSSEAZ). Out of the 28, six need to be involved more deeply. The land size of Lapu-Lapu City, on the other hand, is approximately 6,424 ha among which approximately 1,300 ha falls within the Mactan-Cebu International Airport. Lapu-Lapu City consists of 30 barangays out of which two need to be more closely engaged. The barangays that fall under Mandaue City and Lapu-Lapu City are shown in Table 8.2.1.

Table 8.2.1 Barangays in Mandaue City and Lapu-Lapu City

City	Name of Barangays
Mandaue City	Alang-Alang, Bakilid, Banilad, Basak, Cabancalan, Cambaro, Canduman, Casili, Casuntingan, Centro, Cubacub, Guizo, Ibabao-Estancia, Jagobiao, Labogon, Looc, Maguikay, Mantuyong, Opao, Pagsabungan, Paknaan, Subangdaku, Tabok, Tawason, Tingub, Tipolo, Umapad, CSSEAZ
Lapu-Lapu City	Agus, Babag, Bankal, Baring, Basak, Buaya, Calawisan, Canjulao, Caw-oy, Caohagan, Caubian, Gun-ob, Ibo, Looc, Mactan, Maribago, Marigondon, Pajac, Pajo, Pangan-an, Poblacion, Punta Engaño, Pusok, Sabang, Santa Rosa, Suba-basbas, Talima, Tingo, Tungasan, San Vicente

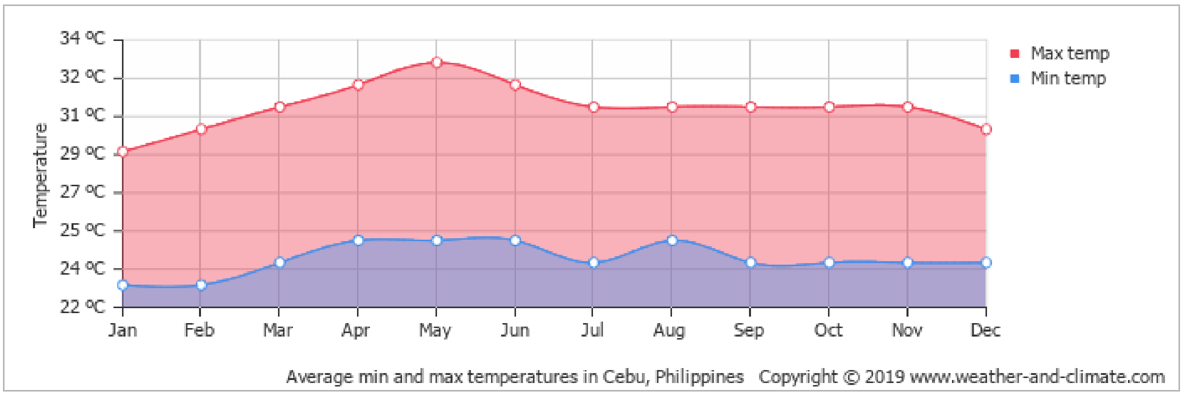
Source: Lapu-Lapu City (2014)

8.2.2 Climate

1) Climate Classification

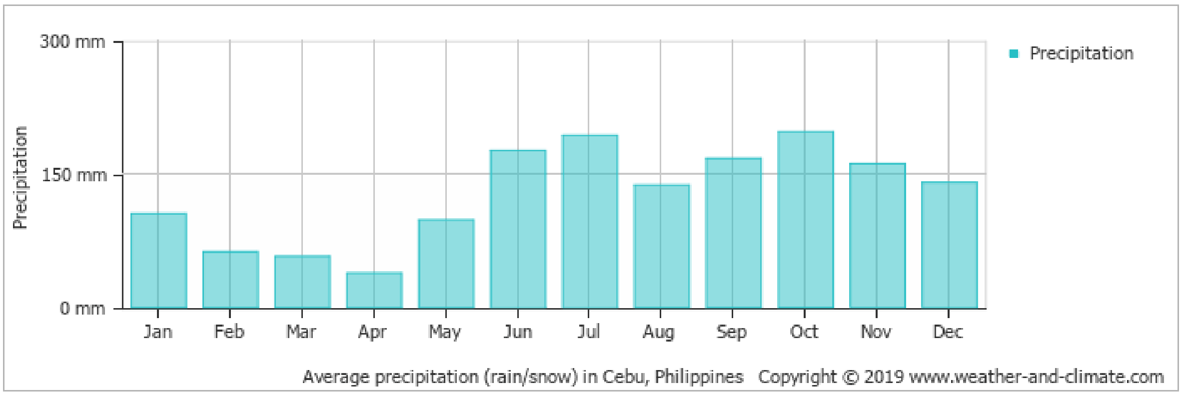
The climate in Metro Cebu (which includes the Mandaue) belongs to the Type IV of the Modified Coronas Classification of Philippine Climates. It is relatively dry from November to April and wet during the rest of the year. Average annual rainfall in the PAGASA Airport Station is about 1,500 mm.

Mandaue City and Lapu-Lapu City belong to Am (i.e. tropical monsoon climate) under Koeppen's Climate Classification Map. Temperature in Cebu Island reaches its lowest point in January with a minimum and maximum temperature of approximately 23 decrees and 29 degrees Celsius, and its highest point in May where the minimum and maximum temperatures are approximately 25 decrees and 33 degrees Celsius. In general, however, it can be said that it is warm throughout the year. The area has a rainy and dry season and the average precipitation level in a month during the rainy season (i.e. June to December) is just above 150 mm while that in the dry season (i.e. January to May) is approximately 50 to 100 mm. The average monthly maximum and minimum temperature and precipitation level in Cebu Island are shown in Figure 8.2.1 and Figure 8.2.2, respectively.



Source: World Weather & Climate Information (available at: https://weather-and-climate.com/average-monthly-Rainfall-Temperature-Sunshine,mandaue-city-ph,Philippines)

Figure 8.2.1 Maximum and Minimum Average Monthly Temperature in Cebu Island



Source: World Weather & Climate Information (available at: https://weather-and-climate.com/average-monthly-Rainfall-Temperature-Sunshine,mandaue-city-ph,Philippines)

Figure 8.2.2 Monthly Precipitation Level in Cebu Island

2) Ambient Temperature

The climate of Cebu Mactan area is categorized as tropical rainforest climate, being high temperature and high humidity throughout the year. There is no significant difference between seasons in the Cebu Mactan area all the year round, and the fluctuation of temperature is small.

The temperature is observed at the Cebu PAGASA (Philippine Atmospheric, Geophysical and Astronomical Services Administration) Complex station (hereinafter, Mactan Station) located near the Mactan-Cebu International Airport. The location of Mactan Station is shown in Table 8.2.2.

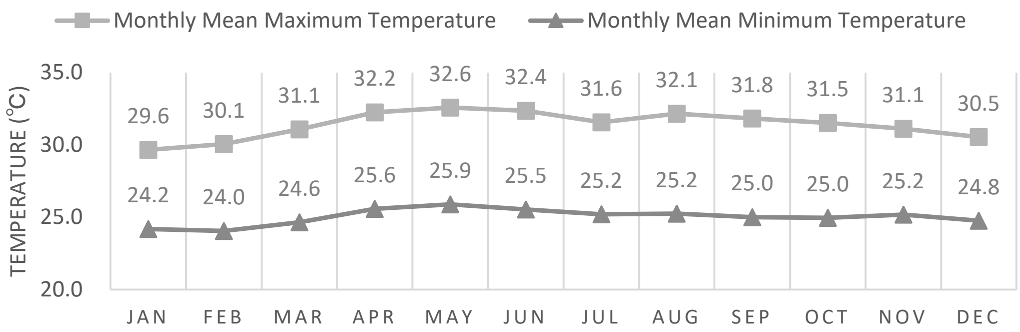
Table 8.2.2 Position of Mactan Station

Name of the observatory	Latitude (North)	Longitude (East)	Elevation (m)
Mactan Station	10.32°	123.98°	23

Source: JICA Survey Team

The data of Monthly Mean Maximum and Minimum Temperatures during the period from 1982 to 2018 in Mactan Station was obtained in this survey. However, only the observation data from 2006 to 2018 was used here, since some data before 2006 has been missing. Figure 8.2.3 shows the Monthly Mean Maximum and Minimum Temperature datum at Mactan Station. "Monthly Mean Maximum and Minimum Temperatures" are defined as monthly average of daily maximum and minimum values during from 2006 to 2018. The highest Monthly Mean Temperature at the station was 32.6℃ in May, and the lowest was 24.0℃ in February. Since the fluctuation of temperature is small throughout the year, the difference between the Monthly Maximum and Minimum Temperatures in the same month is also small at 5℃ to 7℃.

According to the records at the Mactan Station, the past maximum temperature was 37.0℃ observed on 31st May 2010 and the lowest temperature was 19.2℃ on 16th January 1992. The difference between the minimum and the maximum temperatures is 17.8℃.

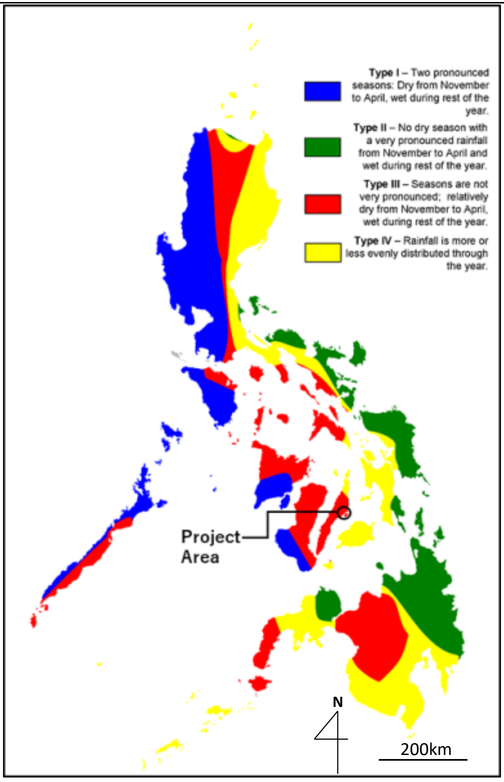


Source: Observed data at Mactan Station, arranged by JICA Survey Team

Figure 8.2.3 Monthly Mean Maximum and Minimum Temperatures during 2006 - 2018

3) Rainfall

Figure 8.2.4 shows the climate classification map throughout the Philippines. The project area belongs to the category of Type III; "*Seasons are not very pronounced; relatively dry from November to April, wet during rest of the year*".

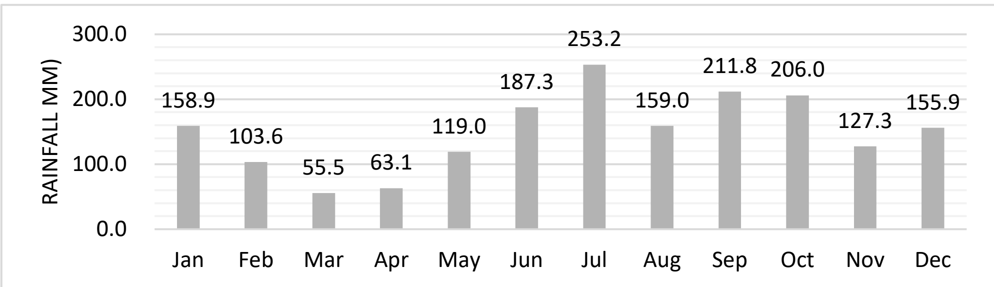


Source: PAGASA

Figure 8.2.4 Climate Classification Map throughout the Philippines

Figure 8.2.5 shows the Monthly Mean Rainfalls observed at Mactan Station during the period from 1982 to 2018. "Monthly Mean Rainfall" is defined as monthly average of the daily rainfall data for 37 years (1982 to 2018). The dry season from November to April has low rainfall, and its averaged Monthly Mean Rainfall was 91.7 mm/month. On the other hand, averaged Monthly Mean Rainfall from May to October was 168.3 mm/month. Annual mean rainfall at the Mactan Station from 1982 to 2018 was 1,636.3 mm/year.

According to the records at the Mactan Station, the past highest daily rainfall was 276.1 mm/day on 12th November 1990 when Typhoon MIKE landed on Cebu Island.

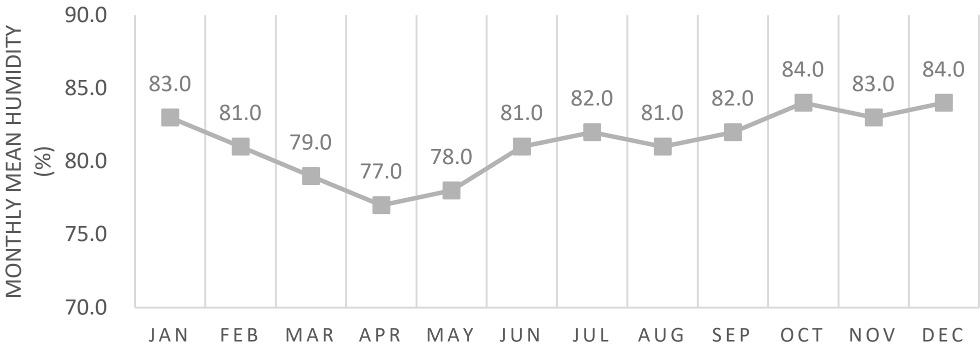


Source: Observed data at Mactan Station, arranged by JICA Survey Team

Figure 8.2.5 Monthly Mean Rainfall during 1982 - 2018

4) Humidity

The data of Monthly Mean Humidity for 30 years from 1988 to 2017 at the Mactan Station was obtained in this survey. "Monthly Mean Humidity" is defined as monthly average of daily average humidity values during from 1988 to 2017. Figure 8.2.6 shows the value of Monthly Mean Humidity averaged for 30 years. Although the Monthly Mean Humidity was below 80% from March to May due to low rainfall, there is no significant difference between humidity at each month throughout the year. The average value of humidity for 30 years was 81%.



Source: Observed data at Mactan Station, arranged by JICA Survey Team

Figure 8.2.6 Monthly Mean Humidity during 1988 – 2017

5) **Wind**

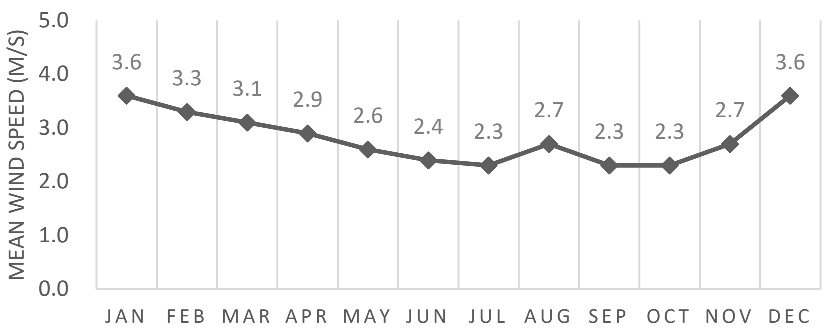
Observed Data

The data of Monthly Mean Wind speed for 30 years from 1981 to 2010 and the data of maximum wind speed and its direction by months for 46 years from 1972 to 2017 at Mactan Station were obtained in this survey. PAGASA records hourly wind data by averaging the data measured for 10 minutes. The observation height is at 10m above ground level. “Monthly Mean Wind speed” is defined as monthly average of daily average wind speed for 30 years.

Wind Speed

Figure 8.2.7 shows the 30-year average value of Monthly Mean Wind speed from 1981 to 2010. The annual average wind speed was 2.8 m/s, and the wind speed exceeding the annual average was recorded from December to April.

In addition, the past maximum wind speed (10 minutes averaged wind speed) from 1972 to 2017 was 55.0 m/s when typhoon MIKE landed on 12th November 1990.

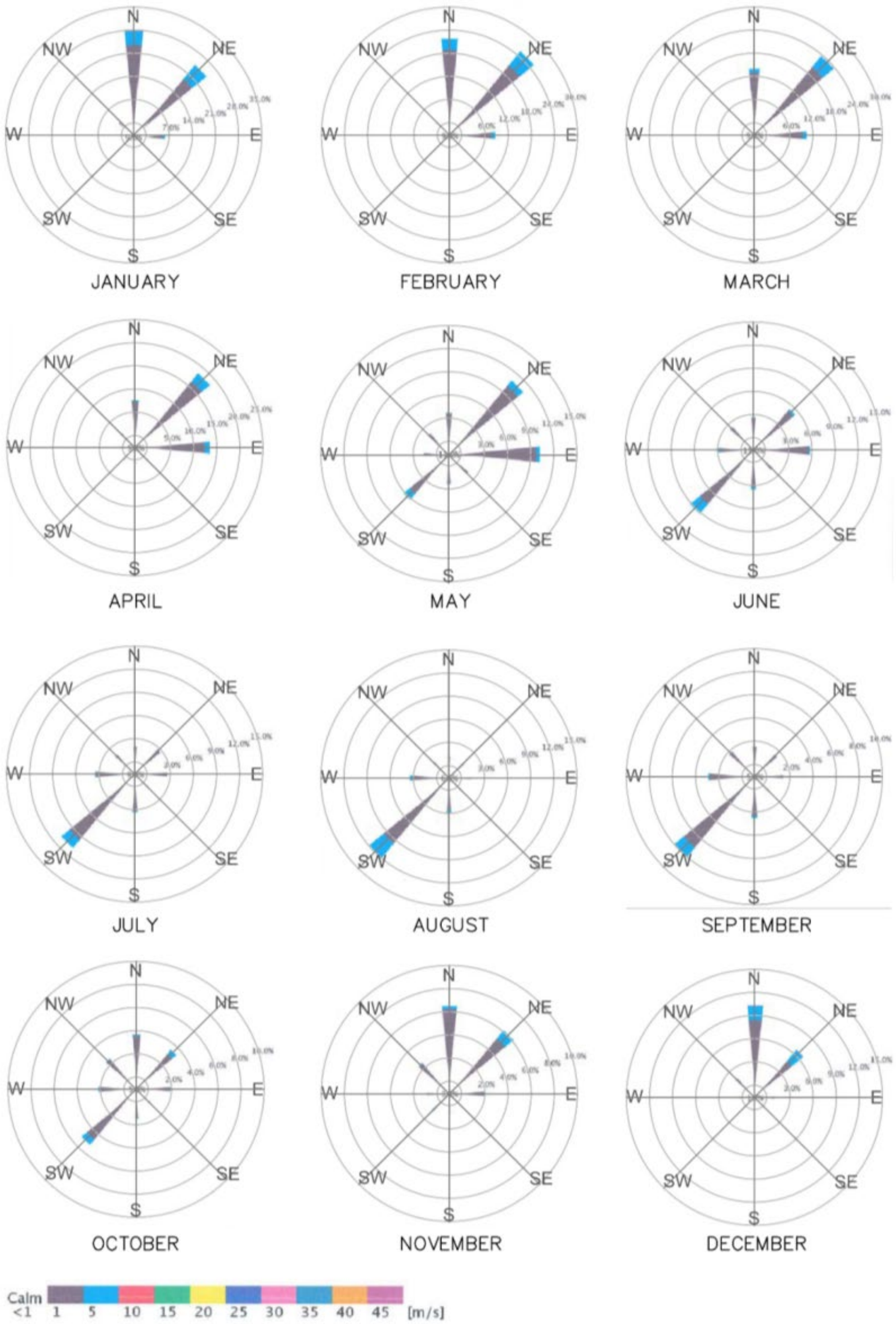


Source: Observed data at Mactan Station, arranged by JICA Survey Team

Figure 8.2.7 Monthly Mean Wind Speed during 1981 – 2010

Wind Direction

Figure 8.2.8shows wind direction with its frequency (Wind Rose) in each month. The Wind Rose is described based on the data observed hourly every day from 1981 to 2010. From June to October, the wind from southwest was dominant due to the influence of the southwest monsoon. On the other hand, from November to May, the wind from north and northeast was dominant due to the influence of the northeastern monsoon.



Source: Observed data at Mactan Station, arranged by JICA Survey Team

Figure 8.2.8 Wind Rose during 1981 – 2010

NSCP (National Structural Code of the Philippines)

Figure 8.2.9shows the 300-year, 700-year, and 1,700-year return period of maximum wind gust speed maps shown in the National Structural Code of the Philippines (NSCP 2015). The values shown in Figure 8.2.9were determined based on the maximum wind gust speed which represents the maximum of the three-second averaged wind speed observed at a height of 10 m above the ground. Each figure shows wind speed values (km/h) with approximately 15 % probability (return period: 300-year), 7 % probability (return period: 700-year), 3 % probability (return period: 1,700-year) of exceedance in 50 years, respectively.

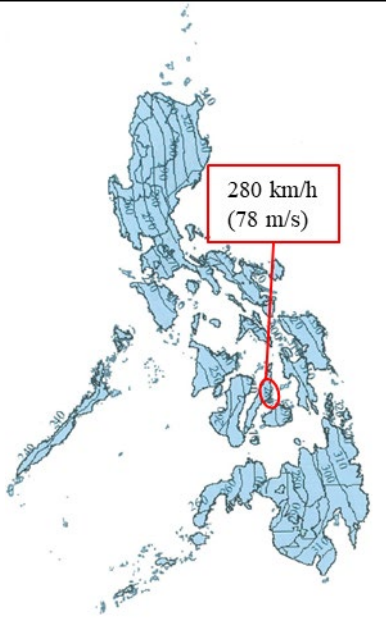
In the project area, the maximum wind gust speed of return period 300-year, 700-year and 1,700-year are 270 km/h (75 m/s), 270 km/h (75 m/s) and 280 km/h (78 m/s), respectively

Return Period： **300-year**

（Approximately 15 % probability of exceedance in 50 years）

Return Period： **700-year**

（Approximately 7 % probability of exceedance in 50 years）



Return Period： **1,700-year**

（Approximately 3 % probability of exceedance in 50 years）

Unit：km/h
Source: NSCP 2015

Figure 8.2.9 Maximum Wind Gust Speed Maps

6) Typhoon

According to the "Disaster Management Reference Handbooks 2015 and 2018 edition" published by the Center for Excellence in Disaster Management & Humanitarian Assistance (CFE-DM), annually, approximately 80 typhoons develop above tropical waters, 20 of them enter the Philippine region, and 6 to 9 of them make landfall on Cebu island. The typhoons which landed on Cebu island from 1983 to 2017 are shown in Figure 8.2.4 A total of 41 typhoons landed in Cebu during the 35 years from 1983 to 2017 (1.2 on average a year), of which 49% hit the island in November and December.

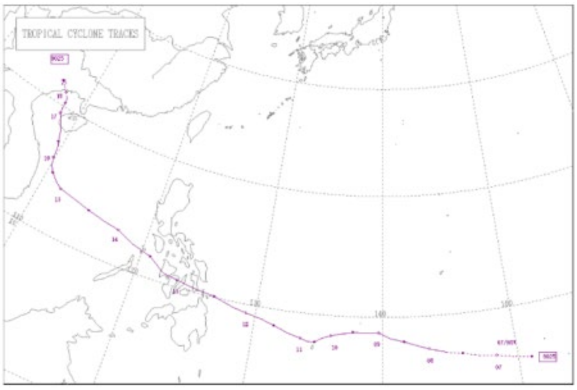
Among them, the maximum wind speed of Typhoon MIKE (RUPING) which hit Cebu island in 1990 was 150 kts (77.2 m/s), and the lowest central pressure was 885 mb. In addition, the maximum wind speed of typhoon HAIYAN (YOLANDA) which landed in November 2013 was 170 kts (87.5 m/s), and the lowest central pressure was 895 mb. The maximum wind speed of HAIYAN was the fastest typhoon recorded from 1983, and its maximum wind speed was 56 m/s at the Mactan Station. Typhoon HAIYAN passed the Medellin district in the northern part of Cebu island, and many houses were destroyed.

However, according to the results of interviews with DPWH (Department of Public Works and Highways), Mandaue City and PAGASA Mactan Office, it was reported that there were almost no human or structural damage by storm surge or strong wind caused by typhoon HAIYAN in the project area.

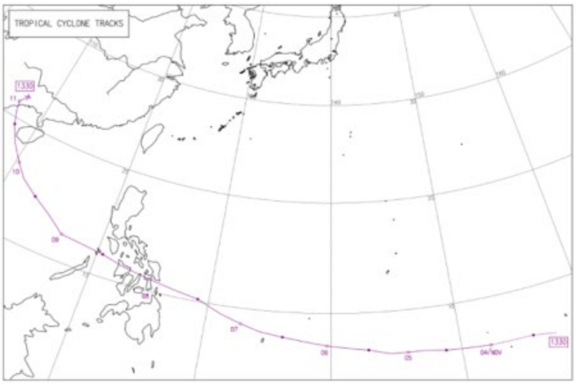
Table 8.2.3 Typhoon Landed on Cebu Island (1983-2017)

Year	Month	Name	Maximum Intensity (kts)	Minimum SLP (mb)
1983	Jun	SARAH	35	-
	Apr	NELSON	105	-
1984	Sep	IKE	125	-
1986	Dec	MARGE	95	-
	Dec	NORRIS	90	-
1988	Jun	VANESSA	45	-
1990	**Nov**	**MIKE (RUPING)**	**150**	**885**
1991	Mar	SHARON	60	-
	Apr	VANESSA	45	-
	Oct	THELMA	45	-
1992	Nov	FORREST	125	-
1993	Nov	KYLE	95	-
	Dec	NELL	70	-
1994	Apr	OWEN	75	-
	Dec	AXEL	115	-
1995	May	-	25	-
	Nov	ZACK	120	-
	Sep	-	30	-
1996	Mar	-	30	-
	Oct	ERNIE	50	-
1997	Nov	LINDA	65	-
2001	Feb	-	25	-
	Nov	LINGLING	115	927
	Dec	KAJIKI	35	-
2002	Mar	-	30	1000
2003	Jul	KONI	65	976
2004	Jun	CHANTHU	75	967
2005	Mar	ROKE	80	963
	Dec	-	45	991
2007	Nov	HAGIBIS	80	963
2008	Apr	NEOGURI	100	948
	Nov	MAYSAK	55	982
2011	Oct	BANYAN	30	1000
2012	Oct	SON-TINH	105	944
	Dec	WUKONG	35	996
2013	Nov	THIRTY	35	996
	Nov	**HAIYAN (YOLANDA)**	**170**	**895**
2014	Nov	SINLAKU	55	982
	Dec	JANGMI	45	989
2016	Nov	TOKAGE	80	963
2017	Jan	ONE	30	1000

Source: Joint Typhoon Warning Center (JTWC)



Typhoon MIKE (November 1990)



Typhoon HAIYAN (November 2013)

Source: Japan Meteorological Agency

Figure 8.2.10 Tracks of Main Typhoon Hitting Cebu Island

8.2.3 Air Quality

According to an inventory survey carried out in 2015 by the Environmental Management Bureau (EMB) of DENR, the source of air pollution in Central Visayas (Region VII), which includes the project site, is mainly the transportation sector. The share of such mobile sources accounts for approximately 77% of the total emissions level. This is much higher than the share of stationary sources (i.e. 10%). Nevertheless, the level of air pollution in the project area is considered generally favorable and values for PM10 and TSP have been both below the standards set under the Republic Act No. 8749.

According to Sinogaya et al. (2019), the medium value measured for NO_2 over a six month period between December and June[1], and that measured for SO_2 over a nine month period between December and September in both Mandaue and Lapu-Lapu City are shown below. All values are below the environmental standards of the Philippines.

Table 8.2.4 Level of NO2 and SO2 in Mandaue and Lapu-Lapu City

Sampling Point/Guideline Value in the Philippines	NO_2	SO_2
Mandaue City	15 ppb	30 ppb
Lapu-Lapu City	20 ppb	20 ppb
Guideline Value in the Philippines	80 ppb	70 ppb

Source: Sinogaya *et al.* 2019

Since no secondary data could be obtained on ambient air quality that can serve as a baseline data for the project, air quality was measured under this study.

8.2.4 Water Quality

The entire Metro Cebu area has no centralized Water Treatment Facility (WTF) or Sewage Treatment Plant (STP) and most of the establishments including households conveniently use the waterways as outfalls for untreated wastewater, thus, the poor environmental quality of the waters of Mandaue and Lapu-lapu.

Largo (2002) noted, that '*nutrient levels of samples taken from the three stations within the channel, indicate high values for nitrogen (ammonia, nitrite and nitrate) and phosphorus (as phosphate). Possible*

[1] The paper does not specify the year in which the data was collected.

sources of these nutrients could be from sewage effluents from domestic households and from agricultural fertilizers that wash out into the sea through river channels and from direct land run-off during rainy periods.

8.2.5 Protected Areas

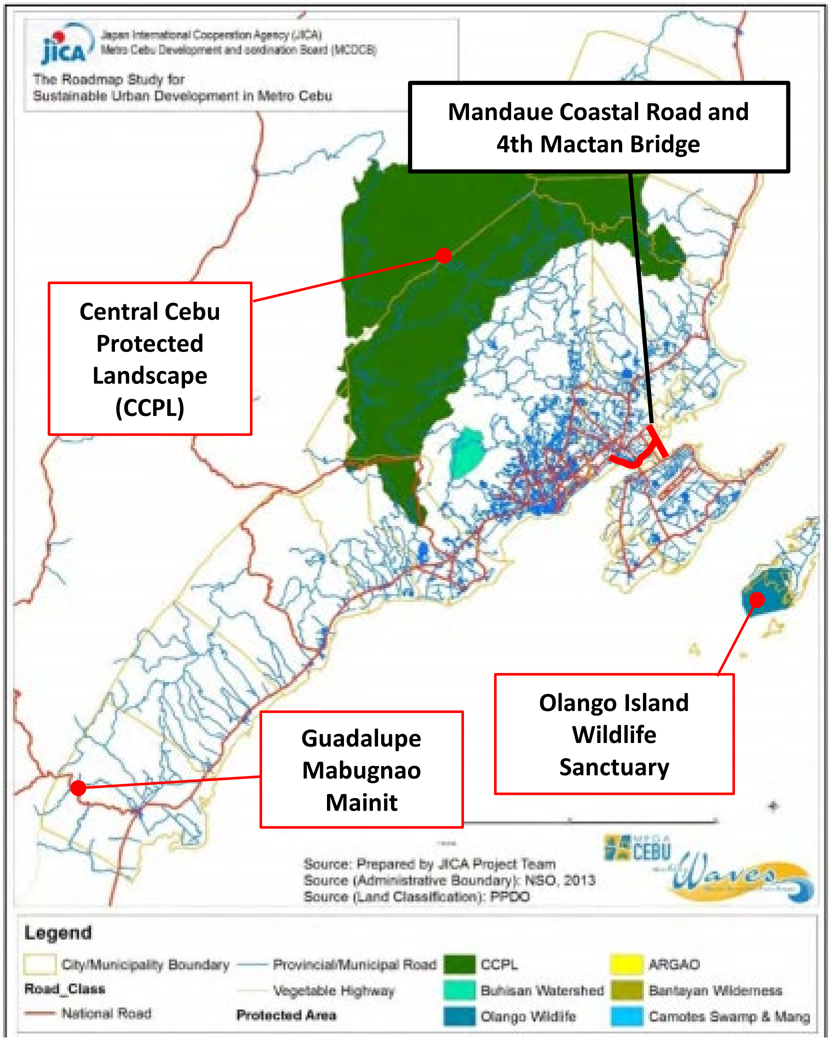
1) Protected Areas

Among the protected areas designated under the Republic Act No. 7586 (National Integrated Protected Areas System/NIPAS Act of 1992), Olango Island Wildlife Sanctuary located in Olango Island Wildlife Sanctuary, Central Cebu Protected Landscape (CCPL) located in the center of Cebu City, and Guadalupe Mabugnao Mainit situated in Carcar City of Cebu Island are the closest from but not within the project site. Since these protected areas are located distant from the project site (i.e. approximately 10km, 20km and 40km, respectively), no adverse impact of the project is expected. Description of the protected areas and their locations are shown in Table 8.2.5.

Table 8.2.5 Protected Areas located near but not within the Project Site

Name of Protected Areas	Olango Island Wildlife Sanctuary	Central Cebu Protected Landscape (CCPL)	Guadalupe Mabugnao Mainit
Reason/Purpose of Designation	important habitat for water birds including endangered Chinese Egret (Egretta eulophotes)	watershed and its complementary biological diversities as well as the aesthetic, historical, cultural and economic significance to the continued existence, survival, sustenance, growth and development of present and future inhabitants of the Island of Cebu	existence of important watershed forest reserve in the central Mantalongon
Land Size	920 ha	29,062 ha	57.5 ha
Major Protected Species	Chinese Egret (Egretta eulophotes) and Asian Dowitcher (Limnodromus semipalmatus)	NA	NA
Management Organization	DENR	DENR	DENR
Time of Designation	1992	2007	1986
Distance from Project Site (as crow flies)	approx. 10km	approx. 20km	approx. 40km
Remarks	Registered tidal flat under the Ramsar Convention (Nov 1994)		

Source: JICA Survey Team



Source: The Roadmap Study for Sustainable Urban Development in Metro Cebu Final Report

Figure 8.2.11 Protected Areas located near the Project Site

2) Wildlife Sanctuary -Tidal flat in Cansaga Bay

Tidal flat is located at the outer edge of the mangrove forest that grows along Cansaga Bay with its area being approximately 50 hectare (see Figure 8.2.12). These tidal flats have been found to be providing a habitat for herons, snipes and terns and to be offering to more than 300 birds a feeding ground as explained above. Hence, the possibility cannot be denied that endangered species also use these areas and these tidal flats should be considered important for birds. However, the state of tidal flats' environment has been found to be degrading due to development and the associated garbage and driftwood.

Source: JICA Survey Team

Figure 8.2.12 Tidal Flat in Cansaga Bay

8.2.6 Population

According to a census survey, the population in 2015 was 362,654 in Mandaue City (out of which 182,715 was male and 179,939 female) and 408,112 in Lapu-Lapu City (out of which 202,089 was male and 206,023 female). The rate of annual population growth between 2000 and 2010, and 2010 and 2015 were 2.46% and 1.73% in Mandaue City, and 4.91% and 2.94% in Lapu-Lapu City, respectively.

This is high compared to the population growth rate in Cebu City (1.88% and 1.21%, respectively). Table 8.2.6 shows the population in Mandaue City and Lapu-Lapu City in 2010 and 2015 by sex. Table 8.2.7 shows the annual population growth rate in the two cities and in the surrounding cities.

Table 8.2.6 Population in Mandaue City and Lapu-Lapu City (by sex)

Time of Census	Total Population	Male	Female	Number of Men in 100 of Women
Mandaue City				
2010	331,213	164,452	166,761	98
2015	362,654	182,715	179,939	101
Lapu-Lapu City				
2010	350,467	172,839	177,628	97
2015	408,112	202,089	206,023	98

Source: Freedom of Information (available at:

https://www.foi.gov.ph/requests/aglzfmVmb2ktcGhyIAsSB0NvbnRlbnQiE1BPUENPTS05OTI2NTEyNDQ5ODEM)

Table 8.2.7 Annual Population Growth Rate in Mandaue City, Lapu-Lapu City and surrounding Cities

Province, City	Annual Population Growth Rate	
	2000-2010	2010-2015
Bohol	0.97	0.87
Cebu (excluding Cebu City, Lapu-Lapu City and Mandaue City)	1.94	2.22
Cebu City	1.88	1.21
Mandaue City	2.46	1.73
Lapu-Lapu City	4.91	2.94

Source: Freedom of Information (available at:

https://www.foi.gov.ph/requests/aglzfmVmb2ktcGhyIAsSB0NvbnRlbnQiE1BPUENPTS05OTI2NTEyNDQ5ODEM

Of the project affected Barangays in Mandaue City, it is Barangay Looc, having the highly densely populated with 189.32 pop/hectare. Brgy. Looc has also the highest number of Project Affected Families (PAF). Brgy. Pusok in Lapu-lapu is also the highly densely populated of the affected barangays in Lapu-lapu City.

Table 8.2.8 Population Density

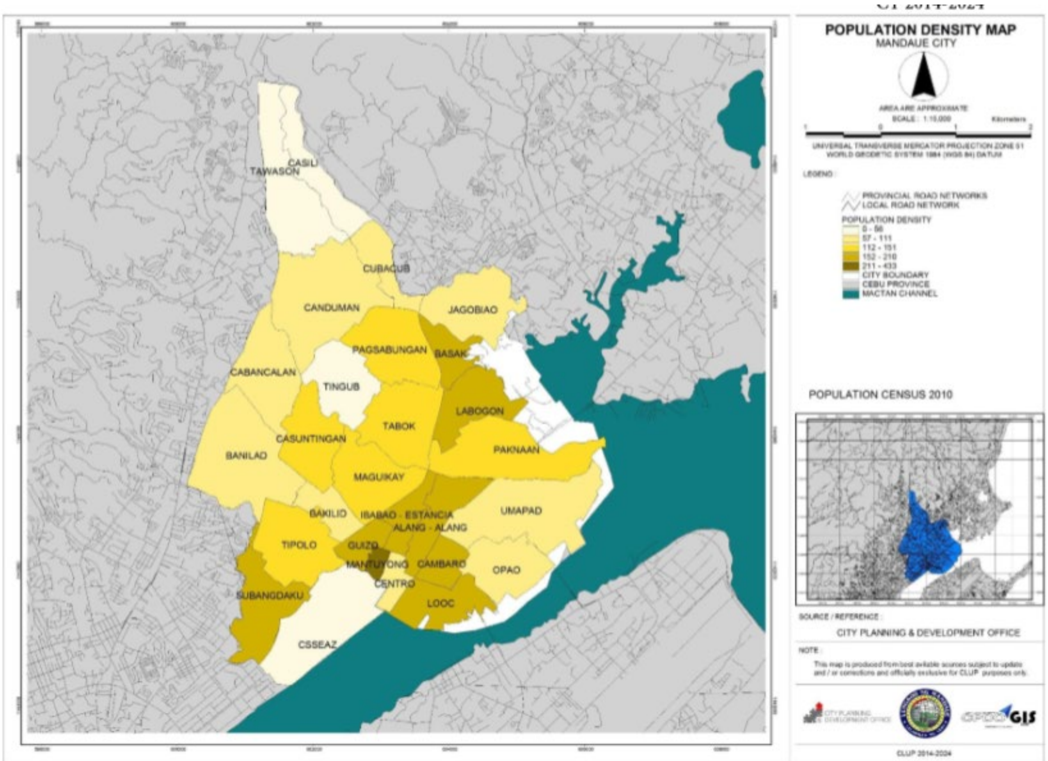
Barangay	Total Population 2015	Area (has)	Population Density	Barangay	Total Population 2015	Area (has)	Population Density
MANDAUE CITY	**77,427**			**LAPU-LAPU CITY**	**36,936**		
Centro	3,383	29.29	115.52	**Ibo**	8,126	148.10	
Looc	17,143	90.55	189.32	Pusok	28,810	153.34	
Opao	11,457	103.68	110.51				
Umapad	18,501	209.74	88.21				
Paknaan	26,943	169.75	158.73				

Source: Mandaue City CLUP, Lapu-lapu City CLUP

Table 8.2.9 Population Number and Household Size

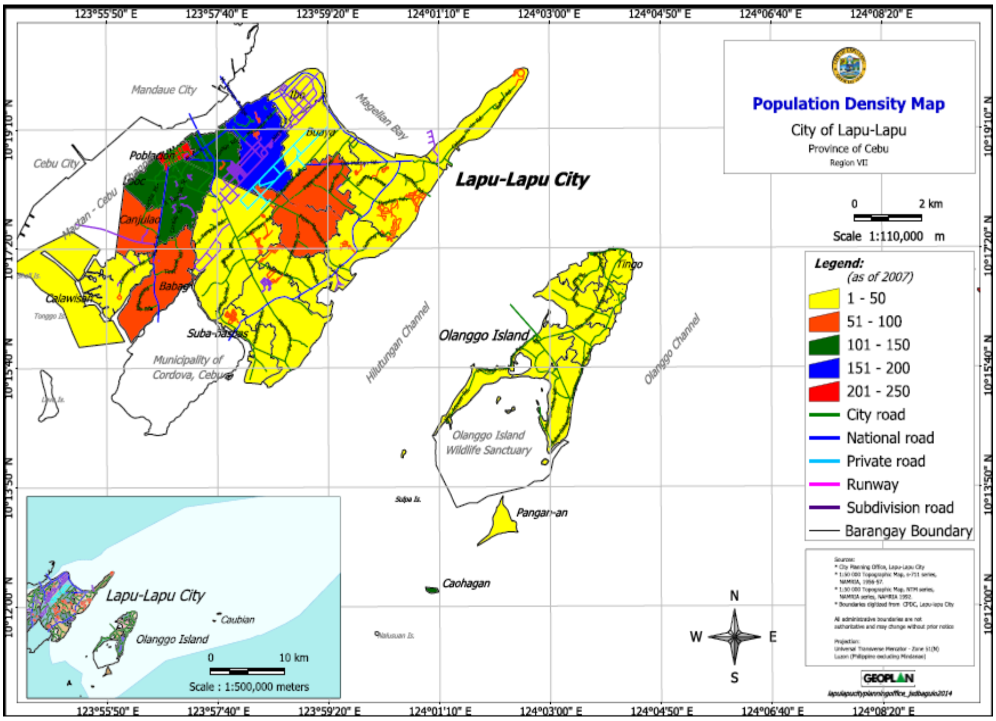
Barangay	Population in 2010	No. of HHs	Ave. HH Size	Barangay	Population in 2010	No. of HHs	Ave. HH Size
MANDAUE CITY	**331,320**	78394	4.23	**LAPU-LAPU CITY**	**350,467**	80,913	4.33
Centro	3,236	725	4.46	Ibo	7,055		
Looc	14,438	3,184	4.53	Pusok	26,568		
Opao	9,907	2,152	4.60				
Umapad	17,454	3,923	4.45				
Paknaan	22,957	5,186	4.43				

Source: Mandaue City CLUP, Lapu-Lapu City CLUP, 2010 Census of Population and Housing



Source: Mandaue City CLUP 2014-2024

Figure 8.2.13 Population Density Map of Mandaue City



Source: Mandaue City CLUP

Figure 8.2.14 Population Density Map of Lapu-Lapu City

8.2.7 Industry

Mandaue City

Commercial activities such as manufacturing and trading play a major role in Mandaue City's economy. As of 2013, there were a total of 13,372 commercial establishments and 1,317 industrial establishments located in the city's 27 barangays. The annual revenue from these commercial and industrial establishments were approximately Php 92 billion and Php 49 billion in 2014. Further, there are five shopping malls and the largest brewery in the country (i.e. San Miguel Corporation) as well as several middle and high-end residences, townhouses and condominiums (Mandaue City Comprehensive Land Use Plan 2014).

There are 16 major agricultural crops produced in Mandaue City. As of 2013, 407 metric tons of these major crops were produced for local sales and consumption. Among the 16 crops, four are staple crops (i.e. corn and fruit-bearing trees such as banana, mango and jackfruit). 150 metric tons were produced. The existing livestock activities in 2012 were piggery, cattle and goat-raising while the poultry products were broilers and eggs. Most of these livestock-raising are backyard activities except for the poultry farms. There are still some small areas for fishing grounds and aquaculture farming in Mandaue City. Fishing/Aquaculture products counted for approximately 807 tons in 2013. The number of local fishermen was approximately 167 out of which only 47 of them were registered. The catch is either sold at different satellite markets within the city, the public market and neighborhood or consumed locally (Mandaue City Comprehensive Land Use Plan 2014).

Lapu-Lapu City

Lapu-Lapu City makes a significant contribution to the overall development of Cebu Province and to Region VII as a whole. The Mactan-Cebu International Airport serves as the gateway in the region from the rest of the world by offering a transshipment point by air of cargoes and people flying to and from neighboring provinces in the Visayas and Mindanao. The historic significance of the city and its attractive coastline with world-class resort hotels make the area a prime destination to foreign and domestic tourist. Naturally, the service sector, dominated by hotel and restaurants, wholesale and retail, real estate renting, transportation and storage, play an important role in the City's employment and production.

Except for fishery, the development potential of agriculture for Lapu-Lapu City is limited due to land constraints. With only 6,424 hectares of land area, the geology of the Mactan Island is mostly coral-based, with little top soil for crop cultivation. Nevertheless, a relatively large number of its population is still dependent on fishery and livestock production as their livelihood. (CLUP 2014).

8.2.8 Labor Force

Mandaue City

The population in Mandaue City was 323,400 in 2012. Among them, 144,660 were employed accounting for approximately 45% of the population. Among the 144,660 people employed, 71.7% were engaged in the service sector, 27.7% in the industrial sector and 0.7% in the agriculture sector including fisheries (Mandaue City Comprehensive Land Use Plan 2014).

Lapu-Lapu City

In Lapu-Lapu City, 184,232 people or approximately 63% of the total population of 292,530 were employed as of 2007 in the service (65.6%), industrial (29.8%) and agricultural and fisheries (4.5%) sectors (Mandaue City Comprehensive Land Use Plan 2014). According to CLUP (2014), 7,393 people were making a living in 2008 by working in the agricultural sector including fisheries and livestock industry. Among them, the fisheries and livestock industry take the lion's share.

8.2.9 Livelihood

In Mandaue City, the predominant number of workers is those working in the "plant and machine operators and assemblers". Similarly, Lapu-Lapu City has also most of the workers are in "plant and machine operators and assemblers".

Table 8.2.10 Gainful Workers 15 Years Old and Over by Major Occupation Group, Age Group, Sex, and City/Municipality: 2010

Major Occupation Group, and City/Municipality	Total Gainful Workers 15 Years Old & Over	Age Group										
		15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 & over
MANDAUE CITY												
Total	128,418	5,546	19,495	23,102	20,310	16,360	14,044	11,166	8,466	5,341	2,648	1,939
Officials of Government and Special Interest Organizations, Corporate Executives, Managers, Managing Proprietors, and Supervisors	14,135	36	543	1,319	1,991	1,963	2,147	1,857	1,687	1,212	679	701
Professionals	7,274	-	1,082	1,661	1,328	941	820	490	438	268	152	94
Technicians and Associate Professionals	5,875	119	881	1,285	929	778	577	516	393	245	128	25
Clerks	9,052	231	2,230	2,486	1,645	914	602	449	265	173	37	20
Services Workers and Shop and Market Sales Workers	15,004	1,017	3,705	3,457	2,326	1,547	1,079	821	569	243	155	85
Farmers, Forestry Workers and Fishermen	633	15	38	33	69	48	49	79	142	62	31	68
Trade and Related Workers	24,353	727	3,008	3,981	3,961	3,571	3,041	2,636	1,733	975	381	339
Plant and Machine Operators and Assemblers	26,115	888	3,803	4,975	4,723	3,543	2,924	2,256	1,435	958	431	179
Laborers and Unskilled Workers	23,766	2,303	3,877	3,526	3,070	2,823	2,562	1,924	1,616	1,073	597	396
Armed Forces	5	-	-	-	-	-	-	5	-	-	-	-
Other Occupation Not Elsewhere Classified	113	-	10	10	29	19	10	20	10	5	-	-
Not Reported	2,092	211	318	368	240	214	233	114	176	128	58	31
LAPU-LAPU CITY (OPON)												
Both Sexes												
Total	128,606	5,636	18,585	23,200	21,914	17,587	13,883	10,536	7,581	4,884	2,573	2,227
Officials of Government and Special Interest Organizations, Corporate Executives, Managers, Managing Proprietors, and Supervisors	11,449	40	436	1,168	1,620	1,791	1,750	1,536	1,322	757	530	500
Professionals	6,697	-	1,053	1,601	1,200	934	756	424	348	219	122	39
Technicians and Associate Professionals	6,932	169	1,036	1,497	1,318	1,020	683	472	354	215	110	58
Clerks	6,662	173	1,379	1,682	1,225	730	483	487	274	156	55	18
Services Workers and Shop and Market Sales Workers	12,789	783	2,336	2,616	2,255	1,551	1,176	946	521	363	140	102
Farmers, Forestry Workers and Fishermen	6,110	363	626	554	826	716	770	681	496	395	302	382
Trade and Related Workers	24,916	830	3,416	4,412	4,397	3,653	2,767	2,035	1,495	1,065	504	343
Plant and Machine Operators and Assemblers	30,404	1,109	4,657	6,157	5,640	4,527	3,246	2,176	1,479	789	400	224
Laborers and Unskilled Workers	21,238	2,075	3,447	3,185	3,210	2,506	2,153	1,665	1,211	851	400	537
Armed Forces	5	-	-	5	-	-	-	-	-	-	-	-
Other Occupation Not Elsewhere Classified	50	-	10	20	5	-	5	5	5	-	-	-
Not Reported	1,355	93	191	305	219	159	95	110	76	74	10	24

Source: National Statistics Office, *2010 Census of Population and Housing*

Table 8.2.11 Gainful Workers 15 Years Old and Over by Major Kind of Business or Industry, Age Group, Sex, and City/Municipality: 2010

Sex, Major Kind of Business or Industry, and City/Municipality	Total Gainful Workers 15 Years Old and Over	Age Group										
		15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
MANDAUE CITY												
Sex												
Total	128,418	5,546	19,495	23,102	20,310	16,360	14,044	11,166	8,466	5,341	2,648	1,939
Agriculture Forestry and Fishing	1,120	19	72	81	138	102	152	120	189	101	61	85
Mining of Quarrying	355	5	46	50	58	62	34	37	20	14	15	15
Manufacturing	36,247	1,680	6,682	7,596	6,268	4,475	3,413	2,701	1,751	979	394	310
Electricity, Gas, Steam and Air Conditioning Supply	293	-	10	76	55	67	23	9	16	22	14	-
Water Supply, Sewerage, Waste Management and Remediation Activities	399	20	52	36	49	69	83	15	36	26	10	5
Construction	10,217	188	849	1,394	1,684	1,566	1,460	1,288	886	550	193	160
Wholesale and Retail Trade; and Repair of Motor Vehicles and Motorcycles	25,540	1,194	3,963	4,065	3,556	3,115	2,787	2,246	1,954	1,206	730	723
Transportation and Storage	14,686	276	1,229	2,324	2,587	2,199	2,110	1,559	1,079	808	390	125
Accommodation Food Service	5,133	285	980	834	632	477	546	474	387	249	136	133
Information and Communication	1,412	43	242	357	346	158	141	55	31	14	14	9
Other Occupation Not Elsewhere Classified	2,252	35	382	528	376	366	208	181	87	65	19	5
Real Estate Activities	407	-	13	64	47	39	28	52	79	45	29	10
Professional, Scientific and Technical Activities	1,083	20	114	186	164	144	140	115	77	74	20	29
Administrative and Support Service Activities	8,343	114	1,722	2,131	1,636	998	667	441	348	159	60	67
Public Administrative and Defense; Compulsory Social Security	4,521	30	344	573	655	651	607	602	554	309	130	67
Education	3,201	-	443	771	493	409	424	218	158	110	139	35
Human Health and Social Work Activities	2,185	-	464	354	371	312	229	133	147	106	32	38
Arts, Entertainment and Recreation	476	25	87	107	78	89	24	35	22	9	-	-
Other Service Activities	2,209	66	315	430	327	249	296	220	138	66	70	31
Activities of Households as Employers and Undifferentiated Goods and Services and Producing Activities of Households for Own Use	7,395	1,354	1,310	986	698	766	628	617	424	365	164	83
Activities of Extraterritorial Organizations and Bodies	-	-	-	-	-	-	-	-	-	-	-	-
Not Reported	944	190	175	160	92	48	44	48	84	64	29	10

Sex, Major Kind of Business or Industry, and City/Municipality	Total Gainful Workers 15 Years Old and Over	Age Group										
		15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65 and over
LAPU-LAPU CITY (OPON)												
Sex												
Total	128,606	5,636	18,585	23,200	21,914	17,587	13,883	10,536	7,581	4,884	2,573	2,227
Agriculture Forestry and Fishing	6,614	394	656	605	893	761	857	721	571	433	312	411
Mining of Quarrying	250	-	21	25	50	56	55	29	10	-	-	5
Manufacturing	38,348	1,667	7,546	8,856	7,274	4,866	3,328	2,085	1,267	768	375	315
Electricity, Gas, Steam and Air Conditioning Supply	233	-	15	38	44	36	35	25	25	15	-	-
Water Supply, Sewerage, Waste Management and Remediation Activities	315	42	48	80	28	36	34	19	9	5	5	9
Construction	11,799	278	1,149	1,671	2,034	1,888	1,488	1,302	955	585	278	169
Wholesale and Retail Trade; and Repair of Motor Vehicles and Motorcycles	19,172	790	2,327	2,727	2,860	2,602	2,152	1,853	1,538	1,016	624	682
Transportation and Storage	15,690	357	1,235	2,342	2,783	2,795	2,201	1,615	1,206	735	295	127
Accommodation Food Service Activities	6,230	288	1,067	1,296	1,006	782	621	499	356	134	105	73
Information and Communication	1,049	15	195	261	229	148	79	37	50	15	10	9
Other Occupation Not Elsewhere Classified	1,425	-	119	340	298	209	193	142	60	44	15	5
Real Estate Activities	284	-	10	24	50	31	50	44	45	15	5	10
Professional, Scientific and Technical Activities	773	10	54	97	149	126	136	97	60	14	16	14
Administrative and Support Service Activities	6,586	129	1,171	1,543	1,271	831	645	454	214	198	65	67
Public Administrative and Defense; Compulsory Social Security	4,786	46	380	668	764	639	642	557	435	365	187	103
Education	2,980	-	314	760	493	390	367	279	171	117	80	10
Human Health and Social Work Activities	1,805	25	486	366	299	256	135	44	80	73	15	25
Arts, Entertainment and Recreation	648	40	98	116	122	87	77	42	51	5	10	-
Other Service Activities	2,554	130	392	465	433	369	244	262	108	71	25	54
Activities of Households as Employers and Undifferentiated Goods and Services and Producing Activities of Households for Own Use	6,656	1,342	1,211	812	783	674	533	424	348	265	143	120
Activities of Extraterritorial Organizations and Bodies	5	-	-	5	-	-	-	-	-	-	-	-
Not Reported	405	83	91	103	49	5	10	5	25	10	5	20

Source: National Statistics Office, *2010 Census of Population and Housing*

8.2.10 Land Use

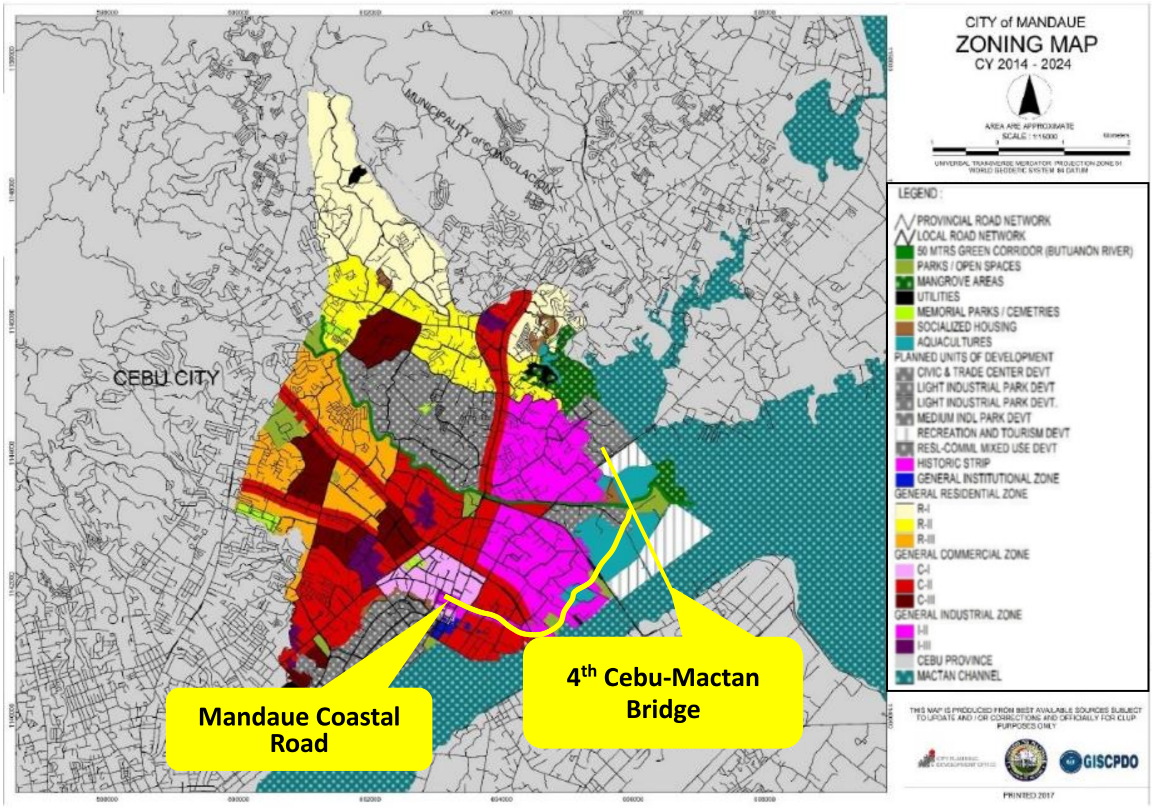
1) Land Use pattern

The existing/actual land use pattern of the areas and vicinities that the 4th Cebu-Mactan Bridge-Mandaue Coastal Road traverses is mixed of residential, commercial, and industrial. The dense settlements in Mandaue are mostly informal settlers along the coastal areas.

Mandaue City

According to the Comprehensive Land Use Plan (CLUP: 2014-2024) of Mandaue City, a large part of the project site falls under a commercial zone. In addition, aquacultures can be seen in the eastern side of the city with areas designated for recreation and tourism. There is an area for industrial park development in the more inland area and a relatively small area of parks/open spaces. A green corridor is also located within the project site.

The road planned to be constructed on Cebu Island (i.e. Mandaue Coastal Road) runs along its southern coast. The western side of the road is an industrial park with facilities such as factories and oil tanks. There is also a high school located approximately 1 km east of the starting point of the planned route. Figure 8.2.15 shows the zoning map of Mandaue City.



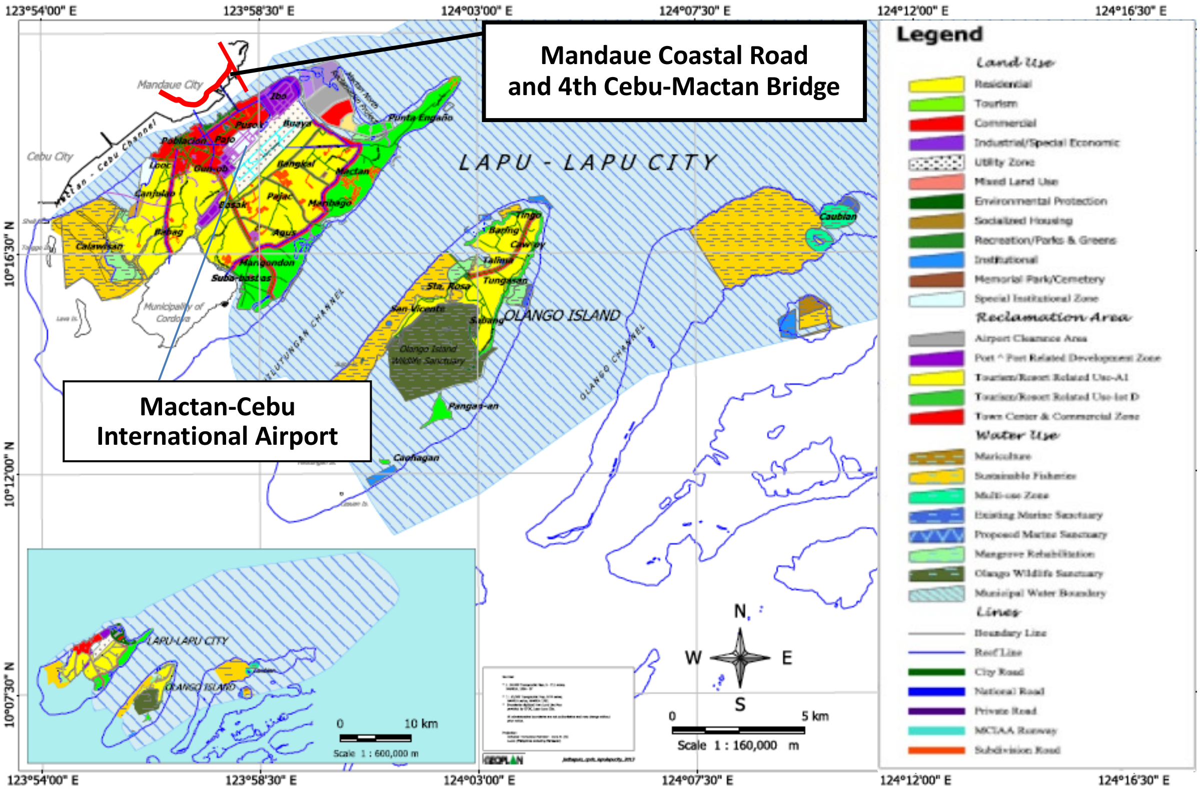
Source: Mandaue City (2014)

Figure 8.2.15 Zoning Map of Mandaue City (2014-2024)

Lapu-Lapu City

According to the City Planning and Development Office (2011) of Lapu-Lapu City, a bulk of the project area that falls within Lapu-Lapu City is considered under the land use plan as ‘commercial area’ and ‘tourism area’. Other land includes ‘industrial/special economic’ and ‘environmental protection’.

Mactan-Cebu International Airport is located within Lapu-Lapu City. The zoning map of Lapu-Lapu City is shown in Figure 8.2.16



Source: Lapu-Lapu City

Figure 8.2.16 Zoning Map of Lapu-Lapu City

Source: JICA Survey Team

Figure 8.2.17 Major Facilities near the Project Site

Figure 8.2.17 shows the location of facilities located along the subject road. The northeast side of the project site is largely an open space. Nevertheless, there is a waste collection site (i.e. open dumping site) and aquacultures in Umapad Barangay.

According to a sea guard, only one aquaculture farm/fish pond (i.e. Batiller Fish Pond) is operating within the coastal area. Some fish ponds are converted to warehouses, reclaimed for other development and some are sold to private entities. According the City Agriculture Office (CAO), the area is no longer suitable for aquaculture operation due to contaminations/seepage from the closed dumpsite and from other sources (e.g. industries).

An area that includes aquaculture ponds located near the 2nd Cebu-Mactan Bridge belongs to the key biodiversity area (KBA) around Mactan Channel as it is claimed to be an important roosting sites for shorebirds. A survey carried out by the Department of Environment and Natural Resources (DENR) in the Philippines have also recorded ecologically-important birds in the area.

The area designated as 'recreation and tourism development' and parks/open spaces are relative to the Mandaue Reclamation Project and Mandaue City Dumpsite Eco park as detailed in 4.1.1.1(4). At the bottom of the 2nd Cebu-Mactan Bridge lies a park where people have been residing illegally in the mangrove forest. These people are said to be making a living by picking wastes at the open dumping site above mentioned, making and selling brooms and carrying out fishing activities at a small scale. The park located at the bottom of the 2nd Cebu-Mactan Bridge, the open dumping site and houses situated in the mangrove forest are shown in Figure 8.2.18.

An illegal reclamation undertaking is ongoing in the mangrove and fish pond area located on the norther side of the Butuanon River. As shown in Figure 8.2.19, the reclaimed area has been expanding rapidly from the west to east cutting mangrove trees.

Park located at the Bottom of the 2nd Cebu-Mactan Bridge in Umapad

Opened Dumping Site

Illegal Houses within the Mangrove Forest

Source: DENR 2018; Sun Star Publishing Inc.
(available at: https://www.sunstar.com.ph/article/116106/)

Figure 8.2.18 Park located at the Bottom of the 2nd Cebu-Mactan Bridge in Umapad, Open

Dumping Site and Illegal Houses in Mangrove Forest

Satellite image as of April 12, 2019, extracted from Google Earth

Satellite image as of April 23, 2019, extracted from Google Earth

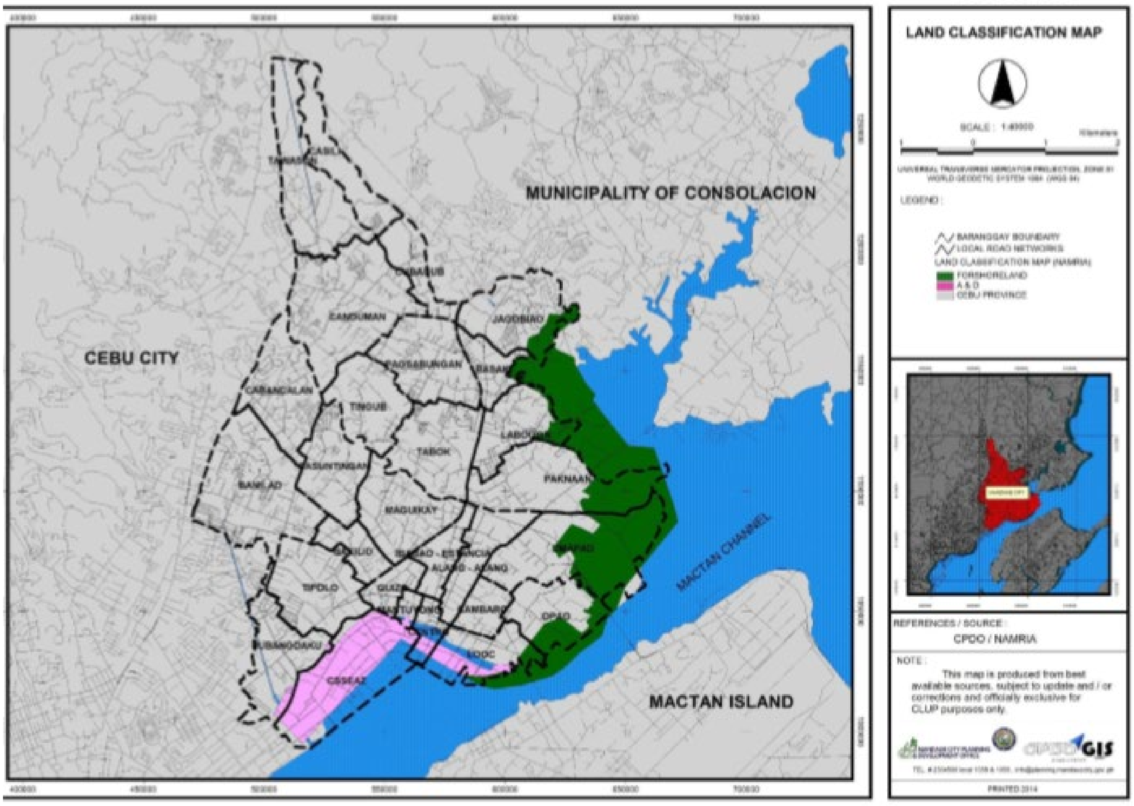
Satellite image as of May 4, 2019, extracted from Google Earth

Source: JICA Survey Team

Figure 8.2.19 Illegal Reclamation in Barangay Paknaan, Mandaue City

2) Land Use Classiffication

The Mandaue City government in its land classification map in the CLUP has identified areas traversed by the ROW alignment of the 4th Mactan Bridge/Mandaue Coastal Road as Alienable and Disposable (A&D) for portions of NRA, Centro and Looc, and the remaining areas as Foreshoreland (Figure 8.2.20).



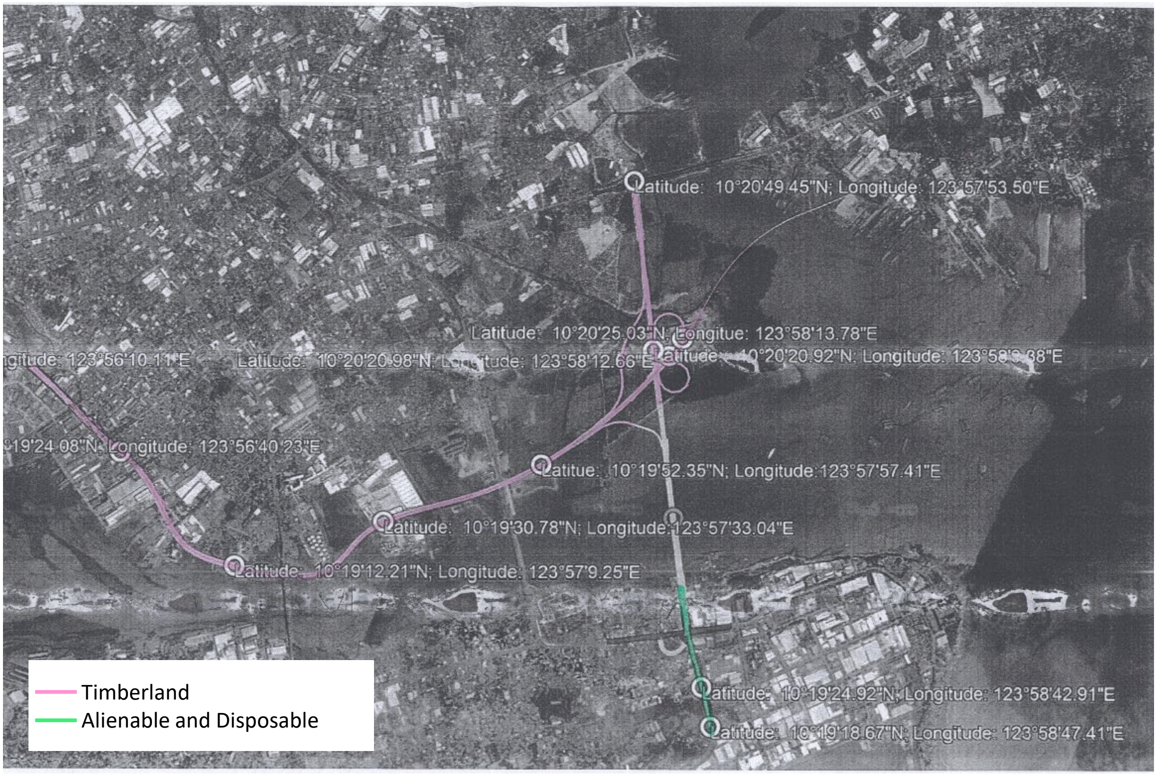
Source: Mandaue City

Figure 8.2.20 Land Classification Map of Mandaue City

The DENR-CENRO Land Use Certification, obtained for the Project on July 15, 2019, indicated that the entire alignment in Mandaue City is within "Timberland", while the portion in Lapu-lapu City as Alienable and Disposable (Figure 8.2.21).

For foreshore lands, the Mandaue City government requires project proponents to enter into a 'Foreshore Lease Agreement" with reference to its City Charter/RA 5519, while for "Timberland Areas" the DENR-CENRO requires a Special Land Use Permit/Forest Land Agreement (SLUP/FLAg).

DPWH, as a government entity and the project proponent, will apply/secure the necessary and appropriate tenurial instrument at the later stages of project implementation, or post ECC, when the parcellary survey is completed.



Source: Mandaue City, JICA Survey Team

Figure 8.2.21 Lands Verification Projection Map (CENRO Certification dated July 15, 2019)

3) Development Projects near the proposed Project area

<u>Mandaue Reclamation Project</u>

Global City Mandaue Corporation and City Government of Mandaue (Joint Venture) will plan to conduct Mandaue Reclamation Project. The alignment of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road will pass through the site of Mandaue Reclamation Project. Therefore, the project proponent shall coordinate with Mandaue City closely. Although an Environmental Impact Assessment (EIA) study was carried out and a public hearing meeting was held for this project in 2017, as of July 2019, an Environmental Compliance Certificate (ECC) has not been issued yet for this project due to diverse issues including legal disputes.

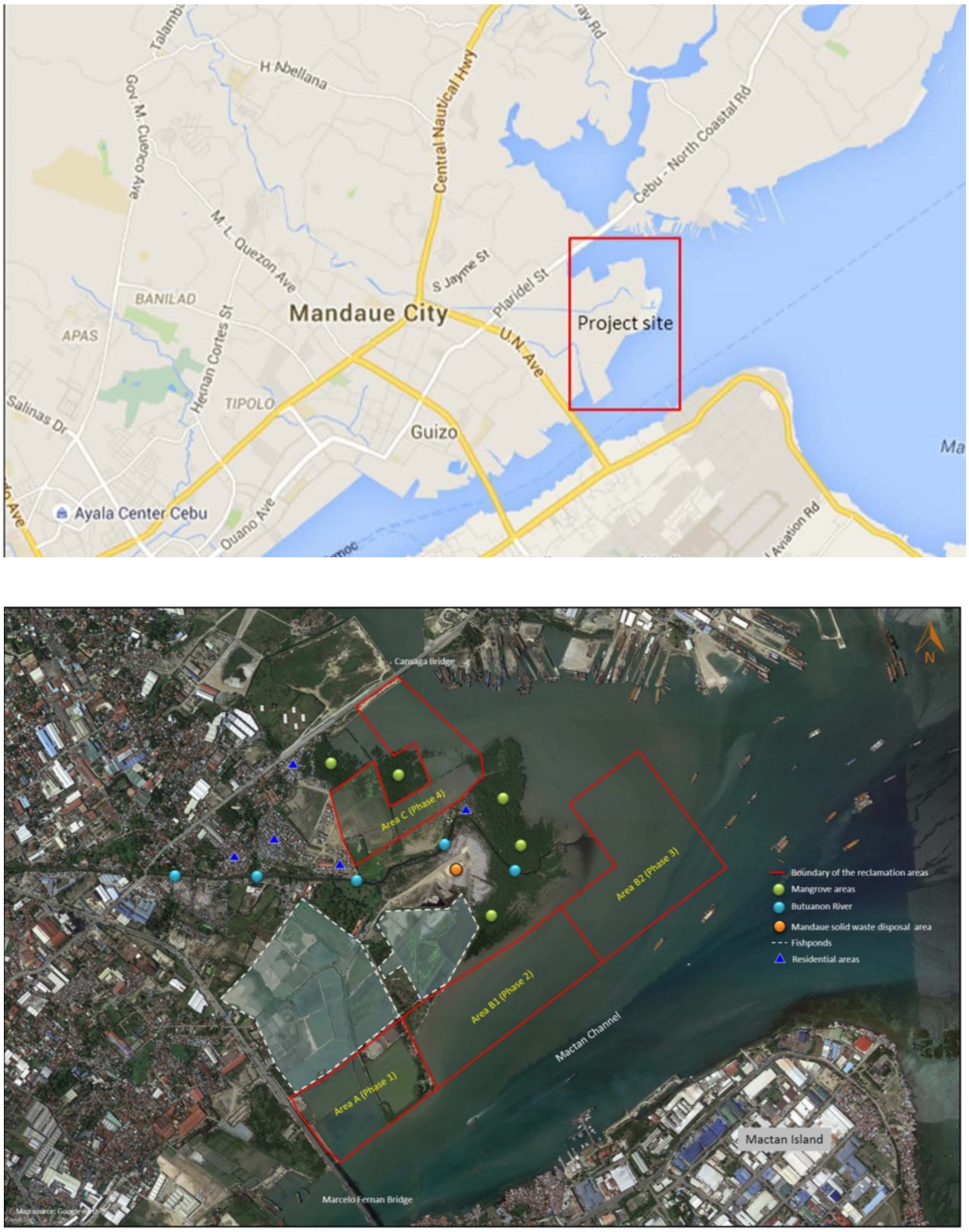
The outline of the Mandaue Reclamation Project is shown in Table 8.2.12.

Table 8.2.12 Project Fact Sheet of Mandaue Reclamation Project

Name of Project:	Mandaue Reclamation Project
Location of Project:	Barangays Paknaan and Umapad in Mandaue City
Project Type:	Reclamation and other land restoration projects (3.3 Category A EMB MC 005 July 2014)
Proponent:	GlobalCity Mandaue Corporation and City Government of Mandaue (Joint Venture)
Year Established:	Proposed
Project rationale:	The City Government of Mandaue has signed a memorandum of agreement (MOA) with the Philippine Reclamation Authority last December 2, 2008 ("2008 PRA MOA"). In this MOA, the city identified a part of its territory for reclamation purposes as part of its patrimonial interest as a local government unit.
Project Duration:	Six (6) years
Project Area:	Approximately 131 hectares (1,310,261.88 m2)

Total project cost:	CONFIDENTIAL
Total manpower:	Max of 70 workers (reclamation phase) 10 (maintenance phase)

Source: GlobalCity Mandaue Corporation and City Government of Mandaue, Executive Summary for the Public of Mandaue Reclamation Project



Source: GlobalCity Mandaue Corporation and City Government of Mandaue, Eexcutive Summary for the Public of Mandaue Reclamation Project

Figure 8.2.22 The location of Mandaue Reclamation Project

Mandaue City Dumpsite Ecopark

The alignment of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road will pass the open dumping site in barangay Umapad in Mandaue City. This dumping site was permanently closed in December 2017 and has been undergoing rehabilitation, in accordance with the Executive Order No. 37 “An Order Declaring the Permanent Closure of Umapad Controlled Dumpsite and Institutionalizing the Synchronized Waste Collection and Disposal System (SWCDS)”. To exuceute properly the closure and rehabilitation, the Mandaue Dumpsite Closure Plan was elaborated (Hydronet, 2018). This plan notes that the Umapad dumpins site, having an approximate 5 hectares area, has a great potential for several redevelopments and land uses after closure. It recommended to be developed as the “Mandaue City Dumpsite Ecopark”, with the three components: Transitional facilities, Public Ecopark and Open Space Facilities, and Educational Facilities. Therefore, the project proponents shall coordinate with the Mandaue City closely.

Source: Mandaue Dumpsite Closure Plan (Hydronet, 2018)

Figure 8.2.23 Conceptual Plan of Umapad Landfill Post-Closure Land Use

8.2.11 Educational Opportunities and Standard

There are 27 publicly-run primary schools and 17 middle schools in Mandaue City. In addition, there are a number of private schools (i.e. primary schools, middle schools and higher educational institutions). One high school located approximately 1 km from the starting point of Mandaue Coastal Road in the west is situated close to the project site. The literacy rate was 96% as of 2014.

All barangays in Lapu-Lapu City, on the other hand, has a public primary school and most of the barangays have a public high school. The literacy rate in Lapu-Lapu City was 95% in 2000 (CLUP 2014).

Literacy of Household Population in Mandaue City and Lapu-Lapu City is shown below.

Table 8.2.13 Literacy of Household Population in Mandaue City and Lapu-Lapu

Age Group and City/Municipality	Household Population 10 Years Old and Over			Literate			Illiterate		
	Both Sexes	Male	Female	Both Sexes	Male	Female	Both Sexes	Male	Female
MANDAUE CITY									
Total	260,647	127,980	132,667	258,961	127,220	131,741	1,686	760	926
10-14	30,254	15,423	14,831	29,921	15,236	14,685	333	187	146
15-19	33,480	15,998	17,482	33,310	15,902	17,408	170	96	74
20-24	37,332	17,907	19,425	37,208	17,868	19,340	124	39	85
25-29	35,125	17,312	17,813	35,027	17,263	17,764	98	49	49
30-34	29,203	14,686	14,517	29,109	14,627	14,483	94	59	34
35-39	23,049	11,673	11,376	22,982	11,634	11,348	67	39	28
40-44	19,569	9,852	9,717	19,469	9,802	9,667	100	50	50
45-49	15,802	7,913	7,889	15,689	7,849	7,840	113	64	49
50-54	12,615	6,305	6,310	12,533	6,276	6,257	82	29	53
55-59	9,058	4,331	4,727	8,965	4,286	4,679	93	45	48
60-64	6,101	2,871	3,230	6,035	2,857	3,178	66	14	52
65 and over	9,059	3,709	5,350	8,713	3,621	5,092	346	88	258
LAPU-LAPU CITY									
Total	269,074	130,742	138,332	266,440	129,389	137,051	2,634	1,353	1,281
10-14	34,734	17,873	16,861	34,360	17,616	16,743	374	257	118
15-19	34,916	16,517	18,399	34,603	16,332	18,271	313	185	128
20-24	36,810	17,168	19,642	36,601	17,049	19,552	209	119	90
25-29	34,980	16,974	18,006	34,829	16,892	17,937	151	82	69
30-34	31,768	15,333	16,435	31,658	15,253	16,405	110	80	30
35-39	25,133	12,587	12,546	24,942	12,465	12,477	191	122	69
40-44	19,828	10,083	9,745	19,674	9,987	9,687	154	96	58
45-49	15,338	7,661	7,677	15,245	7,592	7,652	93	69	25
50-54	11,784	5,926	5,858	11,661	5,866	5,794	123	60	64
55-59	8,693	4,215	4,478	8,607	4,168	4,439	86	47	39
60-64	6,069	2,763	3,306	5,898	2,717	3,181	171	46	125
65 and over	9,021	3,642	5,379	8,362	3,452	4,910	659	190	469

Source: Mandaue City and Lapu-Lapu City

8.2.12 Health Status

Table 8.2.14shows the average birth rate, morbidity rate and mortality rate in 2009-2013 in Mandaue City and Lapu-Lapu City. Among the ten leading causes of morbidity in Mandaue City, upper respiratory tract infection, animal bites, wounds, tuberculosis and pneumonia were the top five causes in the recorded three years (2011–2013). Upper respiratory tract infection shared approximately 41% of all causes of morbidity.

Table 8.2.14 Annual Average Birth Rate, Morbidity Rate and Mortality Rate in Mandaue City and Lapu-Lapu City

City	Birth Rate	Morbidity Rate	Mortality Rate
Mandaue City*	23.8/1,000 people (crude birth rate) 3.3/1,000 people (total fertility rate)	40/1,000 people	3.5/1,000 people (crude death rate) 9.9/1,000 people (infant mortality rate)
Lapu-Lapu City**	30.9 /1,000 people (crude birth rate)	No data	4.6/1,000 people (crude death rate) 4.9/1,000 people (infant mortality rate)

*data of 2009-2013 average; **data in 2010; Source: Mandaue City Comprehensive Land Use Plan 2014

Table 8.2.15 Mandaue City Ten Leading Causes of Morbidity, 2013

MORBIDITY		MORTALITY	
1. Animal Bite	3,729	1. Myocardial Infarction	538
2. URTI	3,477	2. Carcinoma	171
3. Tuberculosis	1,145	3. Pneumonia	89
4. Wounds	1,047	4. Diabetes Mellitus	77
5. Pneumonia	773	5. COPD	53
6. Dengue	458	6. Cerebovascular Accident	51
7.Hypertension	287	7. Hypvolemic Shock	50
8.Bronchitis	150	8. Acute Renal Failure	48
9.Fucunculosis	147	9. Liver Cirrhosis	31
10. UTI	129	10. Traumatic Injuries	21

Source: Mandaue City CLUP

Table 8.2.16 Lapu-lapu City Ten Leading Causes of Morbidity per 1000 pop.

DISEASES	2010		5 YEARS AVERAGE 2005 – 2009	
	NO.	RATE	NO.	RATE
1. Upper Respiratory Tract Infection	23,081	71.64	22,323	79.47
2. Skin Infection	6,521	20.24	4,464	15.75
3. Pneumonia	3,585	11.12	7,397	26.13
4. Bronchitis	2,596	8.05	8,205	27.36
5. Diarrhea	2,134	6.62	2,877	10.16
6. Animal Bite	2,029	6.29	1,130	3.93
7.Hypertensive Vascular Disease	1,859	5.77	2,841	9.63
8.Traumatic Injury	1,607	4.98	2,189	7.45
9.Pulmonary Tuberculosis	894	2.77	705	3.06
10. Parasitism	783	2.43	1,785	6.25

Source: Lapu-Lapu City CLUP

Table 8.2.17 Lapu-lapu City Ten Leading Causes of Mortality per 1000 pop.

DISEASES	2010		5 YEARS AVERAGE 2005 – 2009	
	NO.	RATE	NO.	RATE
1. Pneumonia	306	.94	325	1.12
2. Hypertensive Vascular Disease	288	.89	249	.86
3. Myocardial Infarction	175	.54	148	.50
4. Cancer (all types)	111	.34	120	.32
5. Diabetes Mellitus	109	.33	72	.25
6. Trauma/Gunshot/Stub wound	48	.14	65	.17
7. Congenital Heart Failure	43	.13	111	.37
8. Renal Failure	37	.13	34	.11
9. Pulmonary Tuberculosis	36	.11	43	.14
10. Bleeding Peptic Ulcer	24	.07	30	.10

Source: Lapu-Lapu City CLUP

8.3 Legal and Institutional Framework

8.3.1 Legal and Institutional Framework

Environmental related laws in the Philippines are composed of under the Presidential Decree (PD) No.1151 as environmental policy and PD No. 1152 as environmental regulation in relation to the national policy and regulation. Other major environmental laws are established for natural resources, protection of wild life and bio-diversity, forest resources, mining, coastal and marine, ambient air, water quality, waste and disposal, land use and resettlement, conservation of historical and cultural assets, environmental assessment, and national integrated protected area system. Major environmental related laws and decrees in the Philippines are summarized in Table 8.3.1, and relevant international treaties, agreements and protocols that the Government of the Philippines has ratified in Table 8.3.1.

Table 8.3.1 Environment-related Laws and Regulations in the Philippines

Category	Title	Outline
Environmental Basic Act	Presidential Decree (PD) No. 1151	Environmental policy
	Presidential Decree (PD) No. 1152	Environmental regulation
Natural Resource	Constitution Article 12/Clause 2.	Investigation of natural resources, development use
	Presidential Decree (PD)/No.1198	Protection of natural environment
Wildlife and Ecosystem	Republic Act No. 7586: National Integrated Protected Areas System (NIPAS) Act 1992	Designation and management of national integrated protected areas
	Republic Act No. 11038: Expanded National Integrated Protected Areas System (eNIPAS) (2018)	Expansion of national integrated protected areas
	Republic Act No. 9147: Wildlife Resources Conservation and Protection Act (2001)	Conservation of wildlife and habitat
	Republic Decree No. 826	Preservation of Natural parks and establishment of wildlife protection committee
	Republic Decree No.1086 (1954)	Prohibition of capture of Mindoro buffalo (Tamaraw)
	Republic Decree No.6147	Preservation of Monkey Eating Eagle
	Statement No. 2141	Preservation of wilderness region
	Administrative Order	No.243(1970) Prohibition of slaughter for buffalo
Forest Resources	Presidential Decree (PD) No. 209	Encourage of common forest project
	Presidential Decree (PD) No. 278	Encourage of report on offender against forest law
	Presidential Decree (PD) No. 331 (1973)	Procedural regulation on development application for forest resources and forest land development use
	Presidential Decree (PD) No. 389	Sustainable forest development Forest resources
	Presidential Decree (PD) No. 705 (1975)	Regulation on forest recovery
	Presidential Decree (PD) No. 865	Export of lumber (selective deforestation)
	Presidential Decree (PD) No. 953	Request of forestation
	Presidential Decree (PD) No. 1153	Decree of forestation
	DENR Memorandum No.8 (1986)	Full prohibition of log export
	Notification No. 818	Diminution of forest
	Forest Development Bureau Circular No. 13 (1986)	Full prohibition of land possession within mangrove area, river area, preservation area, wilderness area, National park, wildlife reserve, experimental forest and etc.
Marine	Presidential Decree (PD) No.600 (1974)	Prevention of marine pollution
	Presidential Decree (PD) No. 979	Establishment for oil pollution management center
	Presidential Decree (PD) No. 602 (1974)	Prevention of ocean pollution
Ambient Air	Republic Act No. 8749	National Ambient Air Quality Standards for Source Specific Air Pollutants
	Republic Act No. 3931	Establishment of National air, water pollution control committee, definition of pollution and penalty
	Presidential Decree (PD) No.1181	Air pollution regulation on incidence origin of travelling
	Presidential Decree (PD) No.1160	Barangay captain Community leader on implementation of law on prevention of public nuisance
Water quality	Republic Act No.3931	Establishment of National committee for ambient air pollution management
	Presidential Decree (PD) No.600	Establishment of Philippine coastal guard, measure for marine pollution
	Presidential Decree (PD) No.1252	Establishment of foundation for treatment of mining discharge water
	Presidential Decree (PD) No.602 (1974)	Establishment of National oil pollution management center
	DENR Decree No. 34	Classification of water and use

Category	Title	Outline
	DENR Decree No. 35	Regulation on discharge water for Industrial and urban drainage
Waste disposal	Republic Act (RA) 6969 (1990)	An Act to Control Toxic Substances and Hazardous/Nuclear Wastes, Providing Penalties for Violations thereof, and for their Purposes
	Republic Act (RA) 9003	Ecological and Solid Waste Management Act
	Presidential Decree (PD) No. 825 (1975)	Penalty regulation on illegal dump of disposal, dirt and other wastes
	Presidential Decree (PD) No. 826 (1975)	Regulation on treatment responsibility of solid and liquid wastes by local government
	Presidential Decree (PD) No.1152 (1977)	Regulation on treatment method and treatment management for wastes
	DAO 36 Series of 2004 (DAO 04-36)	DAO 04-36 is a procedural manual of DAO 92-29, a comprehensive documentation on the legal and technical requirements of hazardous waste management
	DAO 98-49	Technical Guidelines for Municipal Solid Waste Management
	DAO 01-34	Implementing Rules and Regulations (IRR) of RA 9003

Source: JICA Survey Team

Table 8.3.2 International Environmental Agreements made by the Philippines

No.	Name of International Agreements	Year
1	Washington Treaty Convention on the international trade in endangered species of wild flora and fauna	1981
2	International tropical timber agreement	1983
3	United Nations convention on the law of the sea	1984
4	World heritage convention concerning the protection of the world cultural and natural heritage	1985
5	Montreal Protocol on substances that deplete the Ozone layer	1991
6	Vienna convention for the protection of the ozone layer	1991
7	Convention on biological diversity	1993
8	Basel convention on the control of trans-boundary movement of hazardous wastes and their disposal	1993
9	Ramsar convention on wetlands of international importance, especially as waterfowl habitat	1994
10	Framework convention on climate change	1994
11	Kyoto protocol	1998
12	Cartagena protocol on bio-safety to the convention on biological diversity	2000
13	Stockholm convention on persistent organic pollutants	2001

Source: JICA Survey Team

8.3.2 EIA System in Philippines

Any private or public projects or activities which are likely to have foreseeable adverse effects on the natural and social environment are required to conduct an Environmental Impact Assessment (EIA) in accordance with the Philippine Environmental Impact Statement System (PEISS). Some of the most important laws and guidelines related to PEISS are shown in Table 8.3.3.

Table 8.3.3 Important Laws and Manuals of PEISS

Laws and Manuals	Description
Presidential Decree No. 1152 (1977)	Philippines' Environmental Code. Comprehensive environmental management with mitigation measures were addressed and concept of the environmental impact assessment was introduced for the first time.
Presidential Decree No. 1586 (1978)	PEISS was established to conduct EIA study for the environmentally critical projects and the projects in the environmentally critical areas.
Presidential Proclamation No. 2146 (1981) and No. 803 (1996)	Proclaiming Environmentally Critical Areas and types of projects as Environmentally Critical Projects and within the scope of PEISS establish under PD No. 1586.
DENR Administrative Order No. 30 Series of 2003 (DAO 03-30)	Providing the implementing rules and regulations for the Philippine Environmental Impact Statement (EIS) System of PD No. 1586.
DENR Administrative Order No. 2017 15	Guidelines on Public Participation under the Philippine Environment Impact Statement System
EMB Memorandum Circular 2007-002	Revised Procedural Manual for DAO 03-30
DENR Memorandum Circular 2010-14	Standardization of Requirement and Enhancement of Public Participation in the Streamlined Implementation of the PEISS
EMB Memorandum Circular 2010-002	Clarification to DENR Memorandum Circular No. 2010-14 and Other EIS System Policy Issuances
EMB Memorandum Circular 2010-004	Guideline for Use of Screening and Environmentally Critical Area (ECA) Mapping Systems
EMB Memorandum Circular 2011-005	Incorporating Disaster Risk Reduction (DRR) and Climate Change Adaptation (CCA) concerns in the PEISS
EMB Memorandum Circular 2014-005	Guidelines of Coverage Screening and Standardized Requirement under the PEISS amending relevant portions of EMB MC 2007-002

Source: JICA Survey Team

The Philippine EIA Process has six sequential stages: 1) Screening, 2) Scoping, 3) EIA Study and Report Preparation, 4) EIA Review and Evaluation, 5) Decision Making, and 6) Post ECC Monitoring, Validation and Evaluation/Audit stage. A summary flowchart of the complete process is presented in Figure 8.3.1.

<u>Screening</u>

The Project proponent confirms the need for environmental impact assessment of the project and the required documents to be submitted to the EMB using the Screening Checklist in the Revised Procedural Manual for DAO 2003-30.

<u>Scoping</u>

The project proponent of an EIA required project examines the tentative scope of the project and subsequently starts the Information, Education and Communication (IEC) activity. The project proponent then identifies stakeholders and conducts public scoping.

The Central / Local EMB establish an EIA Review Committee after receiving necessary documents such as a scoping / screening checklist from the project proponent. The proponent carries out discussions on the project outline with the EIA Review Committee, public scoping, and technical scoping with the EIA Review Committee at any time in the project area.

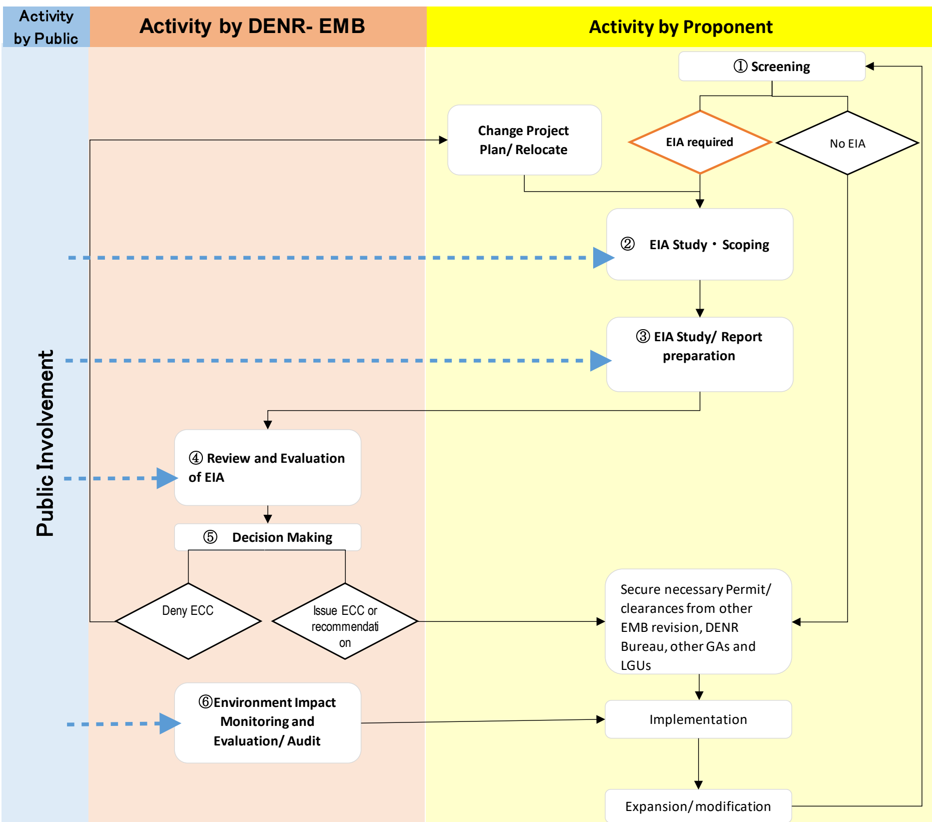
Implementation of EIA and preparation of report

After the EMB approves the scoping / screening checklist and determines the TOR for environmental impact assessment, the project proponent conducts an environmental impact assessment based on the TOR, prepares an EIA report (EIS (Environmental Impact Statement) under Philippine law), and submit the report to the central / local EMB together with the screening checklist.

Review of EIS Report

After EMB receives the application fee for the review from the project proponent, EIA Review Committee and the resource person who has contracted with EMB review the EIA report, and submit additional information request to the proponent during the first EIA review meeting. In addition, site reconnaissance and public hearings are held during this period. The number of days required for the examination is 120 working days if EIA is required.

If a large number of opponents are absent at the public hearing, or if there is a request from stakeholders, public consultation is required to be carried out. If necessary, the second and third EIA Review Team meetings are held, and the proponent is required to explain the unresolved additional information. In response to these, the EIA Review Committee prepares an examination report and submits it to the EMB. The EMB person in charge submits the review report and proposal to the EIA Management Department (EIAMD) Review Section Chief/ Environmental Impact Assessment and Management (EIAM) Division Chief, and upon receipt of confirmation from the EIAMD, the EMB issues an ECC.



Source: Revised Procedural Manual for DENR Administrative Order No. 30 Series of 2003 (2008)

Figure 8.3.1 Summary Flowchart of EIA Process in Philippines

8.3.3 Screening System

The project includes: i) construction and eventual operations of the 4th Cebu-Mactan Bridge (total road length: 3.2 km; four-lane); and ii) development of Mandaue Coastal Road (total road length: 4.9 km; four/six-lane). Table 8.3.4 shows the classification of the project in accordance with the EMB Memorandum Circular 005 (2014). In order to obtain the ECC of this project, preparation and approval of EIS, that is, EIA report is required.

Table 8.3.4 EIA Project Type Categorization Parameters/Criteria

Projects/Description	Covered (Required to secure ECC)			Not Covered (may secure CNC)
	Category A: Environmentally-critical Projects (ECP)	Category B: Non-ECP		Category D
	EIS	EIS	IEE Check list	Project Description
Bridges and viaducts (including elevated roads), new construction	≧10.0 km	≧5km but <10.0 km	≧50m but <5.0 km	≦50m
Roads, new construction	NATIONAL ROAD: ≧20.0 km (length with no critical slope) OR ≧10.0 km (length with critical slope)	PROVINCIAL ROAD and OTHER TYPES OF ROADS ≧20.0 km (length with no critical slope OR ≧10.0 km (length with critical slope)	ALL TYPES OF ROADS: ≧2km but <20km (length with no critical slope OR ≧2km but <10km (length with critical slope)	≦2km

Source: JICA Survey Team based on EMB Memorandum Circular 005 (2014)

The 4th Cebu-Mactan Bridge with a length of 3.2 km – which is within the parameter of >50m but <5.0km, will be within the Category B: Non-ECP[2], will be required to prepare/submit an IEE-Checklist to the Environmental Management Bureau-Regional Office 7 (EMB7) as requisite for the issuance of the project's Environmental Compliance Certificate (ECC). The Mandaue Coastal Road (Viaduct) with a length of 4.9 km, while on the same category with the 4th Cebu-Mactan Bridge, will be required to prepare/submit an Environmental Impact Statement (EIS).

Given that the 4th Cebu-Mactan Bridge could not be operational without the coastal road, the EMB would most likely require that the bridge and the coastal road will be considered as one project and be covered by one EIS (to be issued an ECC). In this regard, the primary consideration/parameter for EIA categorization was the total length of 8.1 km, which already qualify the entire project as an EIS category of Bridges & Viaducts.

8.3.4 Gaps between Philippines and JICA Environmental Guidelines for EIA

The results of a gap analysis between current relevant regulations in the Philippines and the JICA Guidelines, and proposed counter measures to fill the gaps are shown in Table 8.3.5. For example, some of the items that are required to be subject to evaluation during the EIA study under the Philippine law differ from those required under the JICA Environmental Guidelines. But the items required by JICA would all be covered under the subject project. Similarly, the Philippine law allows projects to be carried out in protected areas given that an EIA is carried out and an ECC is issued, while such projects must,

[2] ECP-Environmentally Critical Project

in principle, be undertaken outside of protected areas that are specifically designated by laws or ordinances for the conservation of nature or cultural heritage under the JICA Environmental Guidelines. Nevertheless, this project would not be carried out in any protected area under this project.

Table 8.3.5 Gaps between the Philippine Legislation and JICA Environmental Guidelines on EIA

No.	JICA Guidelines	Legislation of Philippines	Main Gap	Countermeasures for filling gaps
Principle	• Environmental impact must be assessed and examined from the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impact must be examined and incorporated into the project plan. • Projects comply with the laws or standards related to the environment and local communities in the central and local governments of host countries; it also confirms that projects conform to those governments' policies and plans on the environment and local communities.	In the Philippines, the Philippines Environmental Impact Statement System (PEISS) is applied to public and private projects that are expected to affect the natural and social environment. Environmentally critical projects (ECPs) and projects in environmentally critical areas (ECAs) are subject to EIA. These projects must obtain an Environmental Compliance Certificate (ECC) (PD1586) PEISS process manual (2008) by DENR requires that the proponent consider environmental and social impacts of the project and implement the initial scoping in the pre-feasibility study stage, and that the project proponent implement the alternative analysis and incorporate into EIS in the feasibility study stage	No significant gap	Not applicable
Alternatives	Multiple alternatives must be examined in order to avoid or minimize adverse impacts and to choose better project options in terms of environmental and social considerations.	It is necessary to examine alternatives including the case where the project will not be implemented (PD1151) and to describe in the EIS report (PEISS revised procedural manual, 2008).	No significant gap	Not applicable
Impacts to be Assessed	• 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, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale impacts. These also include social impacts.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.	The evaluation items included in EIA study and impact analysis to be included in the EIS report are as follows. Land (land use, geology, topography, soil, land organisms), water (hydrology (including groundwater), ocean, water quality, freshwater and marine organisms), air (including climate change), air quality, noise), people (relocation, migration, indigenous people, public health, community contribution, basic services and resource distribution, transportation, regional environmental management, affected regional assets), (PEISS revised procedural manual, 2008).	No significant gap in the evaluation items and the content, except Vibration, Offensive odors, Landscape, Gender and Children's rights (See Table 8.5.2) Environmental standards have not been established for soil quality, sediment and vibration.	The evaluation items included both in JICA and PEISS guidelines are assessed. Refer to internationally recognized guidelines (WHO, IFC, etc.) or developed country standards and compare and evaluate the expected impacts.
Consultation	• For projects with a potentially large environmental impact, sufficient consultations with	The revised procedural manual (2008) emphasizes public participation, and	No significant gap	Not applicable

No.	JICA Guidelines	Legislation of Philippines	Main Gap	Countermeasures for filling gaps
	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. • In preparing EIA reports, consultations with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records of such consultations must be prepared; • Consultations with relevant stakeholders, such as local residents, should take place if necessary throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared.	specifies that public participation should be implemented through the following activities. • Information, education and communication (IEC) activity • Public scoping • Participation of local stakeholders • Public Hearing • Sharing of ECC and EIA reports Before the public hearing and consultation, the project's EIA report will be available to local EMB offices and local governments. After obtaining the ECC, the ECC will be published along with the EIA Recommendation.		
Information Disclosure	• EIA reports (which may be referred to differently in different systems) must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them; • EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted.	• As a form of disclosure of the EIA findings, Public Hearing is required for all new ECPs for which public scoping was undertaken and for PEIS-based applications. Before the Public Hearing, relevant documents have to be opened to the public. Full copies of the EIA Report are made accessible at the concerned EMB Offices, libraries/development council offices of the host cities. Concerned Barangays are also provided with the Executive Summary of the EIA Report. Copy of ECC is also submitted to other permitting agencies	No significant gaps	Not applicable
Monitoring	• Project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders. • When third parties point out, in concrete terms, that environmental and social considerations are not being fully undertaken, forums for discussion and examination of countermeasures are established based on sufficient information disclosure, including stakeholders' participation in relevant projects. Project proponents etc. should make efforts to reach an agreement on procedures to be adopted with a view to resolving problems.	The project proponent who obtained the ECC shall submit the semiannual Compliance Monitoring Report (CMR) and the quarterly Self-Monitoring Report (SMR) to the EMB. In addition, as a monitoring by a third party, MMT shall submit Compliance Monitoring and Validation Report (CMVR) to the EMB every six months. These are the subject of information disclosure. (PEISS revised procedural manual, 2008)	No significant gap	Not applicable
Ecosystem and Biota	Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests.	All designated, critical habitats shall be protected, in coordination with the local government units and other	In the Philippines, there is no provision to	Comply with the policies of the JICA Guidelines.

No.	JICA Guidelines	Legislation of Philippines	Main Gap	Countermeasures for filling gaps
		concerned groups, from any form of exploitation or destruction which may be detrimental to the survival of the threatened species dependent therein. (RA9147) Project in protected areas are subjected to environmental impact assessment and allowed to be implemented only when the ECC is issued. In addition, project proponent shall plan and implement environmental mitigation measures. (RA7586)	prohibit all projects in important habitats or forests, but appropriate environmental impact assessment is required.	
Indigenous Peoples	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.	National Commission on Indigenous Peoples (NCIP) Administrative Order No. 1, Series of 2006 stipulates the procedures for establishing Free, Prior and Informed Consent (FPIC) with affected communities.	No significant gap	Not applicable

Source: JICA Survey Team

8.3.5 Roles and Responsibilities of the Relevant Agencies

As mentioned above, the Project is required of an EIA by the project proponent (DPWH) to secure ECC. Environmental Impact Statement (EIS) that are prepared based on EIA study is reviewed by EMB. The office to process the ECC application and deciding authority for the project come from the EMB Region VII Office (RO EMB). Roles of the relevant agencies for EIA in the project are show in Table 8.3.6.

Table 8.3.6 Roles and Responsibilities of Concerned Government Agencies on EIA

Relevant Agency		Roles and Responsibilities
Department of Public Works and Highways (DPWH)		As the project proponent, DPWH plays roles as shown below; • Holding of a meeting for Information, Education and Communication (IEC) • Holding a meeting for Public Scoping for EIA • Preparation & submission of project description for scoping (PDS) and Environmental Impact Statement (EIS) • Payment of EIA review support fund • Making the necessary logistical arrangements for public consultation • Submission of final EIS
Department of Environment and Natural Resources (DENR)	RO EMB	Responding to the application from the proponents, management of EIA review committee (EIARC) and the Director of EMB VII will issue the environmental compliance certificates (ECCs) for the project Detailed roles are shown below; • Facilitating of EIA Review Committee (EIARC) (scoping stage and substantive review stage) • Scoping • Procedural screening of EIS • Conduct of public consultation • Preparation of decision document • Approval of ECCs from EMB VII Director

Source: JICA Survey Team

8.3.6 Other Permits and requirements for the Project Implementation

The Project is required the following permits for the implementation as shown in Table 8.3.7.

Table 8.3.7 Required Environmental and Social Permits

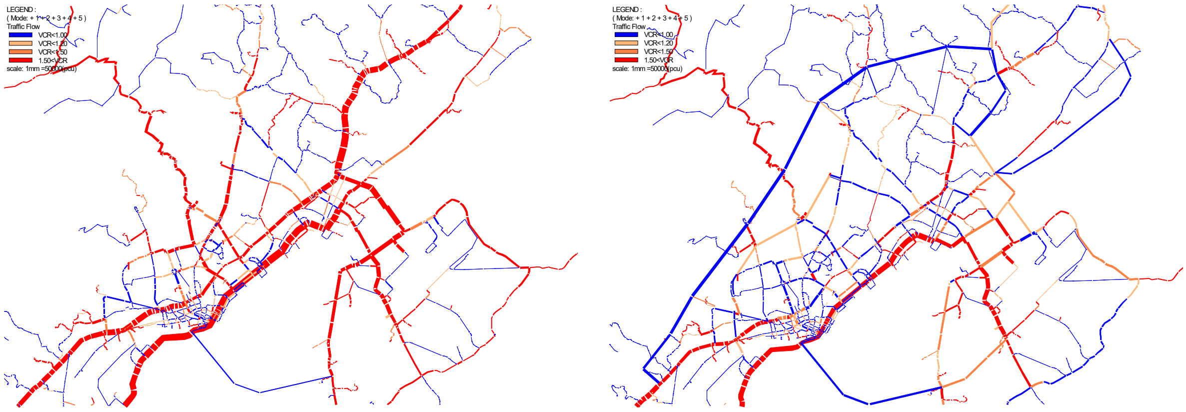
Name of Permits	Laws and Regulations	Rationale	Issuing Agency	Application Procedure
Zoning Certificate	Republic Act (RA) 7160 Local Government Code	Check the compatibility with the land use plan/zoning ordinance of LGUs)	LGUs (City Planning/Development Office)	To be obtained in planning/FS stage
Locational Clearance (if necessary)	Republic Act (RA) 7160 Local Government Code	Proposed project is allowed in a particular zone/district	LGUs (City Planning/Development Office)	To be obtained in planning/FS stage
Certificate of non-overlap (CNO)	Republic Act (RA) 8371 Indigenous People Rights Act	The project site is not overlapping with the IPs ancestral domain claim	National Commission for Indigenous Peoples (NCIP)	To be obtained in planning/FS stage (*Already obtained in July 2019)
Certification for non-coverage of National Cultural Treasure (NCT)/ Important Cultural Property (ICP)	Republic Act No. 10066 National Cultural Heritage Act	The project site is not overlapping with the IPs ancestral domain claim	National Commission for Culture and Arts (NCCA)	To be obtained in planning/FS stage (*Already obtained in July 2019)
Waste Management Plan (WMP) (*to be stipulated in ECC)	Republic Act (RA) 6969 (1990) Republic Act (RA) 9003 Ecological and Solid Waste Management Act	Plan on how the project would manage solid, hazardous, and liquid waste generation.	DENR EMB Regional EMB National Capital Region LGUs	X months prior to the construction (*depending on the condition stipulated in ECC)
Foreshore Lease Agreement	DAO 2004-04 City Charter Republic Act 5519	An agreement executed by and between the DENR and the applicant to occupy, develop, utilize and manage the foreshore lands	DENR	
Special Land Use Permit/Forest Land Agreement (SLUP/FLAg)	DAO 2004-59 DENR Memorandum Order April 2006	A contract between the government and a second party to temporarily occupy, manage and develop in consideration of a government share, any forestland of the public domain for specific use	DENR	
Tree Cutting and/or Tree Earth Balling Permit (*to be stipulated in ECC)	Presidential Decree (PD) No. 953-	Removal of trees Plant of tree	DENR CENRO, PENRO, Region	
Development/Building Permit	Republic Act (RA) 6541 Act to Ordain and Institute a National Building Code Local Ordinances of concerned LGUs	Authority to start construction	LGUs (Office of Building Official)	To be obtained after DD stage
Traffic Impact Assessment (TIA) (If necessary)	Local Ordinances of concerned LGUs	Plan on how the project control/manage the traffic concerns due to the project implementation	LGUs	To be obtained after DD stage
Quarry permit	Republic Act (RA) 7942 Philippine Mining Act	The permits for quarry to contractor	LGUs	Before the construction

Source: JICA Survey Team

8.4 Analysis on Alternatives

8.4.1 ‘No-project’ Option

In order to analyze the traffic situation at the vicinity of the Project site, traffic demand forecasts were carried out. Figure 8.4.1 shows the comparison of future traffic situation between the existing road network and proposed road network by 2030. If there will be no improvement of road network, traffic situation in Metro Cebu will be getting worse and the most of the arterial roads would be chronically congested. But if the proposed projects including 4th Cebu-Mactan Bridge and Mandaue Coastal Road will be implemented, the future traffic situation would be drastically improved.



Without Proposed Projects (Existing Road Network) | **With Proposed Projects (Proposed Road Network by 2030 w/o UMRT Network)**

Note) :VCR < 1.00、 :VCR < 1.20、 :VCR < 1.50、 :1.50 < VCR

Source: JICA Survey Team

Figure 8.4.1 Result of Traffic Demand Forecast (in Year 2030)

Traffic volume across Mactan Channel in 2017 was 99,000 PCU/day which already exceed existing two bridges capacity. This volume is expected to double to 273,000 PCU/day in 2030 leading to further congestion. Even though, the 3rd Cebu-Mactan Bridge (four-lane road) is currently under construction at approximately 7.5 km west of the 1st Cebu-Mactan Bridge, this bridge is expected to meet the traffic demand from the west side of Cebu Island and it is not enough to meet the demand from the east side of the island or from the international airport located in the east side of Mactan Island. Another bridge needs to be constructed in the east side to meet such needs.

As a result of these population growth and urbanization coupled with geographical constraints, Metro Cebu has been facing traffic congestion chronically and the economic loss from congestion is estimated to have reached JPY 840 million in 2014 (JICA Roadmap Study). In particular, traffic is concentrated on the two bridges (i.e. 1st and 2nd Cebu-Mactan Bridges) that connect Cebu and Mactan Island. This has become a bottle neck for the social and economic development of Metro Cebu where the service sector such as tourism plays an important role.

In order to meet the growing demand for transportation, it is necessary to disperse the traffic within the two islands by connecting the islands through a new bridge. It is also important to develop a transportation mode in a way that does not put additional pressure on the urban center in Cebu Island. The subject project aims to provide a bypass route in a way that makes use of the existing road network and thereby meets the demand for transportation while minimizing the environmental impact and scale of resettlement. In case the project did not take place, road will be further congested burdening not only Metro Cebu but also the Philippines as a whole economically. In addition, air pollution and stress caused by the traffic jam will increase the environmental and social costs of the society. For these reasons, the 'no-project' option is not recommended.

8.4.2 Project Option

The project is composed of two components: a) developing a new bridge (i.e. 4th Cebu-Mactan Bridge); and b) developing Mandaue Coastal Road. The study has compared different options for both of these components.

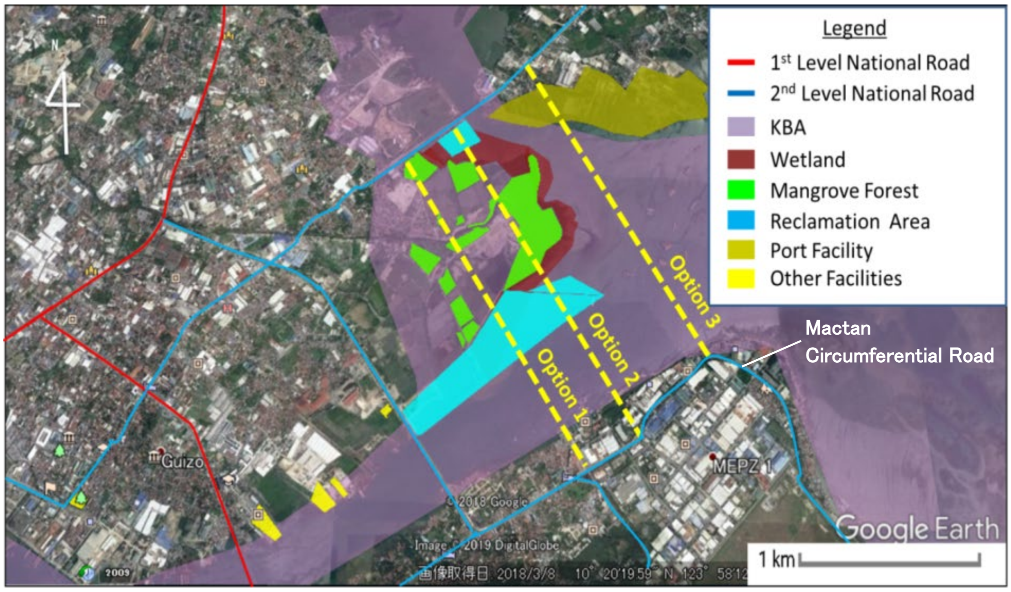
4th Cebu-Mactan Bridge

Location of the bridge was considered from the area east of the 2nd Cebu-Mactan Bridge for the following reasons for a map that shows the location of this project in relation to the 1st, 2nd and 3rd bridge).

- The channel at the west side of the 1st Cebu-Mactan Bridge needs to maintain a navigational clearance of 40m above sea level in order to allow bigger ships transportation. On the other hand, structures cannot be built any higher than 45m from the runway level of Mactan-Cebu International Airport due to its aviation limit.
- The distance between the 1st and 2nd Cebu-Mactan Bridges is 1.4km but port facility is located within this area making it difficult to secure enough space for bridge construction.
- The 1st and 2nd Cebu-Mactan Bridges are expected to meet the traffic demand from the center of Cebu City and Mandaue City while the 3rd Bridge is expected to meet that from the western side of Cebu Island. The 4th Cebu-Mactan Bridge is therefore expected to meet the demands from the eastern side of the main land Cebu.
- Although, there was a recommendation that 4th Cebu-Mactan Bridge should be constructed at the symmetric position against the 3rd Cebu-Mactan Bridge, the idea was rejected because of the aviation limit of Mactan-Cebu International Airport and the navigational clearance of new container port to be constructed in Consolacion.

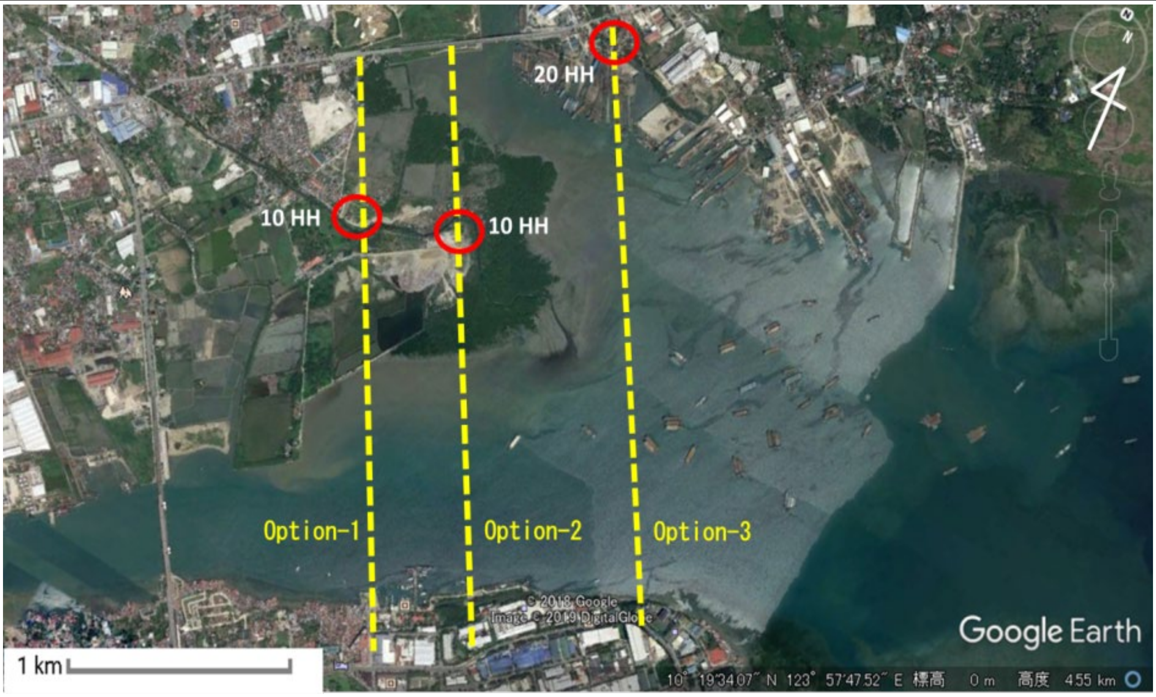
Based on this understanding, the Study Team compared the following three alternative options.

- Option 1: Connect with Mactan Circumferential Road and airport access road
- Option 2: Connect with Mactan Circumferential Road at the entrance of an economic zone
- Option 3: Connect with Mactan Circumferential Road at the east end of Mactan Island



Source: JICA Survey Team based on Google Earth

Figure 8.4.2 Alternative Options for Bridge Location (4th Cebu-Mactan Bridge)



*HH: household
Source: JICA Survey Team based on Google Earth

Figure 8.4.3 Approximate Location and Number of Project-affected Households (4th Cebu-Mactan Bridge)

As a result of a comparision on the three options above mentioned, Option 1 was considered most suitable. The result of comparison is shown in Table 8.4.1.

Table 8.4.1 Comparison of Bridge Location (4th Cebu-Mactan Bridge)

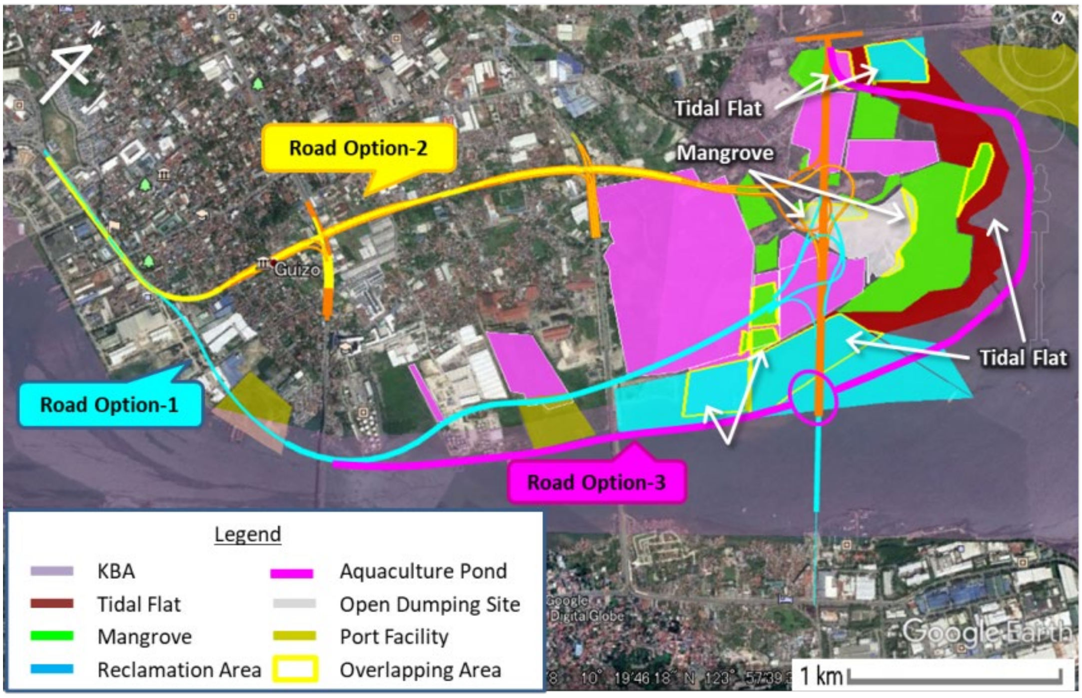
Evaluation Criteria		Option 1	Option 2	Option 3
Construction Cost		low because the length built in the sea is shorter (land: 1.6 km; sea: 1.0 km)	low because the length built in the sea is shorter (land: 1.6 km; sea: 1.0 km)	high because the length built in the sea is longer (land: 0.6 km; sea: 2.0 km)
KBA		affected area: approx. 5.7 ha (2.3 km x 25m)	affected area: approx. 5.7 ha (2.3km x 25m)	affected area: approx. 5.0ha (2.0 km x 25m)
Situation in Cebu Island	Mangrove Forest	affected area: approx. 0.75 ha (300m x 25m)	affected area: approx. 0.85 ha (350m x 25m)	affected area: none (0m x 25m)
	Tidal Flat	affected area: approx. 0.5 ha (200m x 25m)	affected area: approx. 0.6 ha (250m x 25m)	affected area: none
	Housings	approx. 10 houses (50 people) will be affected	approx. 10 houses (50 people) will be affected	approx. 20 houses (100 people) will be affected
	Reclamation Plan ※	passes at one location	passes at two locations	no interference
	Port Facilities	no interference	no interference	interferes
Situation in Mactan Island	Companies	no interference	affects one company	no interference
	Number of Lane sat the Crossing with Mactan Ring Road	6	4	4
	Access Roads	2nd grade national road	road inside economic zone	no road
Evaluation and Reasons		Recommended ・There are relatively few resettlement (approx. 50). ・ The impacts to mangrove forest, tideland and reclaimed land are also limited. ・There is no impact to private companies and harbor facilities. ・ Construction cost is relatively low. ・The connection to an airport is good.	・There are relatively few resettlement (approx. 50). ・The project will cause negative impacts to mangrove forest, tideland, reclaimed land. ・The facilities of private companies are also affected. ・ Construction cost is relatively low.	・ There are relatively much resettlement (approx. 100). ・The harbor facilities are also affected. ・Because of the length of bridge on the sea, the project will cause negative impacts to marine environment. ・It is difficult to connect with coastal road(Need to construct the junction facility on the sea). ・ Construction cost is relatively high.

※There is an city development plan involving reclamation in the area around the subject coastal road (i.e. east of 2nd Bridge). This is included in the Comprehensive Land Use Plan (CLUP) of Mandaue City and private companies are expected to implement the plan. According to Mandaue City, an Environmental Compliance Certificate (ECC) is requested for the plan. Since Mandaue City is giving top priorit to the new Cebu-Mactan Bridge and Coastal Road Construction Project, it is willing to coordinate with the city development plan in case the project interferes with the project.

Mandaue Coastal Road

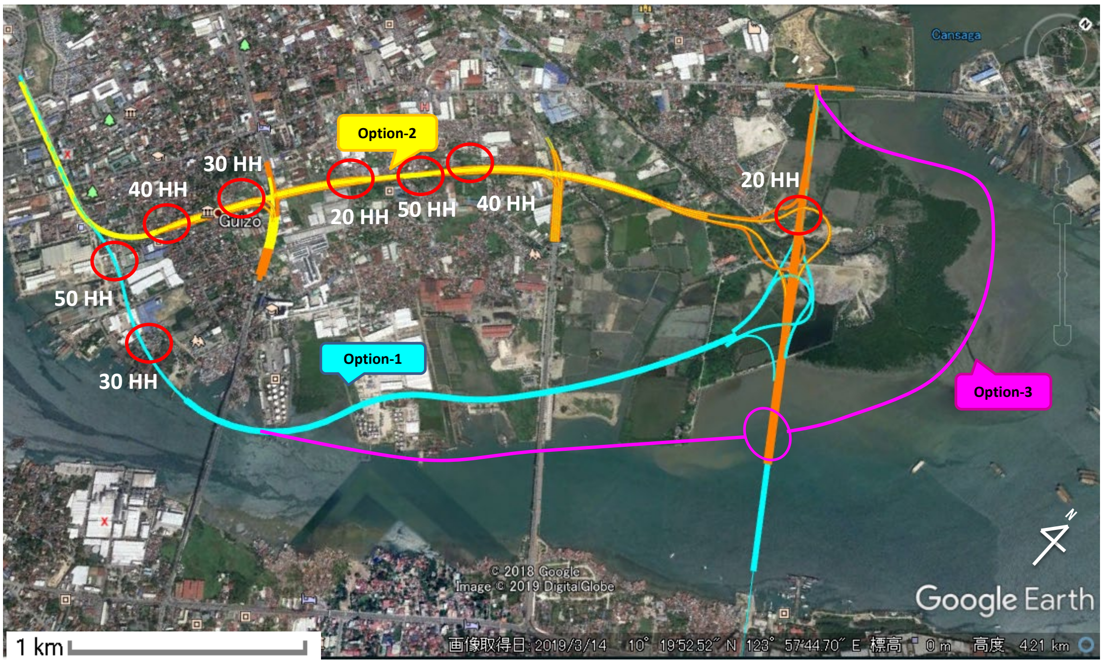
For the Mandaue Coastal Road, the following three route options were compared and analyzed.

- Option 1: route recommended in the JICA M/P Study but modified to avoid the impact on tidal flats and to reflect the results of the discussions made with the stakeholders and municipalities
- Option 2: route that passes through the city center
- Option 3: route recommended in the JICA M/P Study



Source: JICA Survey Team based on Google Earth

Figure 8.4.4 Alternative Options for Route Selection (Mandaue Coastal Road)



*HH: household

Source: JICA Survey Team based on Google Earth

Figure 8.4.5 Approximate Location and Number of Project-affected Households (Mandaue Coastal Road)

The three options were compared and analyzed leading to the conclusion that Option 1 was most suitable. The results of the comparison is shown in Table 8.4.2.

Table 8.4.2 Comparison of Route Alignment (Mandaue Coastal Road)

Evaluation Criteria		Option 1	Option 2	Option 3
Road Length	Approach	0.25 km	0.25 km	0.25 km
	Bridge	5.12 km	4.37 km	6.97 km
	Total	5.37 km	4.62 km	7.22 km
Function	Balance in Traffic Flow (PCU/day)*1	1st Bridge 95,000 (45%) 2nd Bridge 46,200 (22%) 4th Bridge 71,300 (34%)	1st Bridge 83,100 (39%) 2nd Bridge 75,000 (35%) 4th Bridge 54,300 (26%)	1st Bridge 95,000 (45%) 2nd Bridge 46,200 (22%) 4th Bridge 71,300 (34%)
	Traffic Alleviation *	Cebu N Road: -42% Mandaue Causeway: -56%	Cebu N Road: -42% Mandaue Causeway: -59%	Cebu N Road: -42% Mandaue Causeway: -56%
Cost	Construction (ratio)	1.50 (steel plate deck box girder bridge)	1.00 (PC-I Girder bridge)	2.00 (steel plate deck box girder bridge)
	Land Acquisition (excluding compensation)	Mandaue City owns relatively large area of land. Hence, cost is lower than Option 2 but larger than Option 3.	large cost is required as much of the area is private land	cost is low as a large part of the area is above the channel
Accessibility to Bridges	1st Bridge	grade separation (direct connection with IC lump) only access to western side *1st Bridge is expected to be replaced by 2030	grade separation (direct connection with IC lump)	grade separation (direct connection with IC lump) only access to western side *1st Bridge is expected to be replaced by 2030
	2nd Bridge	None	grade separation (direct connection with IC lump)	None
	3rd Bridge	grade separation (full junction)	grade separation (full junction)	grade separation (full junction)
Workability	Construction Period (excl. time for land acquisition)	5 years construction of an elevation bridge in the sea will take longer time than bridge construction on land	3 years	5 years construction of an elevation bridge in the sea will take longer time than bridge construction on land
	Site Accessibility	temporary works such as jetty and barges construction are necessary	access is preferable as there are many cross roads	temporary works such as jetty and barges construction are necessary
	Traffic flow during construction	traffic can be controlled relatively easily as there are limited numbers of cross roads	there are more cross roads than Option 1	traffic can be controlled relatively easily as there are limited numbers of cross roads
Natural Environment	KBA	areas such as the interchange area falls within a KBA	areas such as the interchange area falls within a KBA	In addition to the interchange area, a section crossing the sea (approx. 3km) falls within a KBA
	Mangrove Forest	affected area: approx. 0.7 ha	affected area: approx. 2.0 ha	affected area: none
	Tidal Flat	affected are: none	affected are: none	affected are: approx. 1.25 ha (500 m x 25 m)
Social Environment	Housing	number of PAPs is relatively low (approx. 80 houses; 400 people)	number of PAPs is high (approx. 200 houses; 2,000 people*2)	number of PAPs is relatively low (approx. 80 houses; 400 people)
	Factories	6 factories will be affected within a distance of approx. 0.55 km	10 factories will be affected within a distance of approx. 0.60 km	6 factories will be affected within a distance of approx. 0.55 km
	Port Facilities	coordination is necessary with a port facility (distance affected: approx. 0.5 km)	coordination with a port facility is not necessary.	coordination is necessary with a port facility (distance affected: approx. 1.92 km)
	Reclamation Plan*3	Coordination with a reclamation plan is not necessary.	Coordination with a reclamation plan is not necessary.	coordination is necessary with a reclamation plan (distance affected: approx. 1.5 km)
	Air, Noise and Vibration	no residential land is located along the road and hence the impact is limited	residential land is located along the road and hence the impact is high	no residential land is located along the road and hence the impact is limited
Evaluation and Reasons		Recommended The negative impacts to the	There is a large size of	The impacts to the PAPs

Evaluation Criteria	Option 1	Option 2	Option 3
	PAPs (approx. 400) is the minimum. The impacts to reclaimed land are also limited. Construction cost is moderate.	resettlement (approx. 2,000), and the impact to the surrounding area (residential area) is relatively high. The project will cause negative impact to mangrove forest of the widest range. Construction cost is the lowest.	(approx. 400) is limited. The impacts to private companies are also limited. The impacts to tideland, reclaimed land and harbor facilities are relatively high. Because of the length of bridge on the sea, the project will cause negative impacts to marine environment. Construction cost is the highest.

*1 Results of comparison between existing major cross roads in 2030 and the road networks under the premise that all priority projects recommended in the M/P Study have been realized

*2 Based on experience of a past census survey carreid out in the area, it is possible that two households live within one building (e.g. one household on the first floor and another household on the second floor) in the urban area. Household size in these urban areas was therefore estimated to be double the size of the areas where informal settlers are considered to reside.

*3 An urban development is planned near the coastal road (east of the 2nd Bridge). This is included in the Comprehensive Land Use Plan of Mandaue City and it is expected to be implemented using private fund. According to Mandaue City, an ECC is currently been requested for the project. Mandaue City gives the highest priority to the subject new Cebu-Mactan Bridge and coastal road construction project and hence in case the project interferes with the urban development plan, Mandaue City is willing to make necessary coordinations and implement both projects.

Source: JICA Survey Team

8.5 Scoping and Terms of Reference of the Environmental Survey

This chapter presents the results of screening and scoping for the route alignment selected through the comparison of project alternatives. During the ‘Project on Master Plan Study and Institutional Development on Urban Transport System in Metro Cebu (JICA M/P Study)’ from which the subject project derives, a strategic environmental assessment (SEA) was carried out pointing out the existence of mangrove and important habitat for birds and the necessity of updating marine-related data. Stakeholder meetings were also held as part of the SEA. While opinions were heard here for the master plan as a whole as opposed to the subject project, concerns were raised over an increase in traffic volume and subsequent safety issues, increase in emissions and air pollution, and voices were heard demanding for better services in the public transportation sector. These concerns and demands will be taken into consideration in carrying out the subject project.

8.5.1 Screening

The New Cebu-Mactan Bridge Construction Project, composed of bridge and road construction, was classified as a project that requires an EIS at the technical scoping held on March 3, 2019 in accordancw with EIA laws in the Philipinnes. The Project is classified as a Category A project in accordance with the JICA Guidelines for Environmental and Social Considerations because it involves large-scale involuntary resettlement.

8.5.2 Scoping

Scoping was carried out based on the results of a secondary data review and an initial environmental survey conducted in December 2018, and the technical scoping held by EMB on March 6, 2019, the results of which are shown in Table 8.5.1 and Table 8.5.2.

Table 8.5.1 Results of Scoping

Category	№	Item <Item in the Phillippine Laws>	Evaluation		Reason for Evaluation
			Pre/During Construction	Operation	
Pollution	1	Air Pollution <Air quality & noise>	B-	B-/B+	**Construction Phase:** Temporary negative impacts are expected on air quality due to exhaust gas (NOx and PM) resulted from operation of construction machines and equipment, and traffic congestion by traffic regulations. **Operation Phase:** In areas where new roads are to be constructed, negative impacts are expected on air quality due to exhaust gas resulted from increased number of traffic volume of vehicles, whereas air quality is expected to improve in some areas by easing traffic congestion.
	2	Water Pollution <Water quality>	B-	B-	**Construction Phase:** - If heavy metals are included in the seabed, pollutants may flow into the sea due to the piling along with the installation of the bridge pier. Whether there is an impact or not will be confirmed based on the results of the sediment survey. - Turbid water may be generated in the channel, river and aquaculture ponds as a result of piling for installation of piers and other earth works for constructing a new road. In case the construction period of the reclamation project planned on the southern coast of Cebu Island overlaps with that of the subject project, water in Mactan Channel may be polluted. - Water quality may be deteriorated due to inflow of organic polluted water discharged from base camp into the channel, river and aquaculture ponds. **Operation Phase:** Wastewater from the bridge may cause seawater pollution.
	3	Waste <Abandonment>	B-	D	**Construction Phase:** - Construction waste such as construction residual soil and cut trees may be generated by civil engineering work and excavation. - General waste and manure is expected to be generated from the base camp. **Operation Phase:** No serious impact is expected because there is no activity planned that may generate waste.
	4	Soil Pollution <soil quality>	B-	D	**Construction Phase:** If the excavated soil at the landfill site is contaminated, this may lead to contamination of other soils. The landfill site has been permanently shut down on Oct 12, 2017 in accordance with the Republic Act 9003 (Ecological Solid Waste Management). **Operation Phase:** No serious impact is expected because there is no plan that may lead to soil contamination.
Pollution	5	Noise and Vibration <Noise>	B-	B-/B+	**Construction Phase:** Noise and vibration levels are expected to heighten temporarily due to the operation of construction vehicles and machineries, concrete placement work and the traffic congestion resulted from traffic regulations. **Operation Phase:** Noise and vibration levels are expected to heighten around newly constructed bridge and road, whereas they are expected to be reduced due to a

Category	№	Item <Item in the Phillippine Laws>	Evaluation		Reason for Evaluation
			Pre/During Construction	Operation	
					decrease in traffic volume around existing highways and bridges.
	6	Ground subsidence <Subsidence>	D	D	**Construction Phase / Operation Phase**: No serious impact is expected because there is no activity planned that may lead to ground subsidence such as large scale embankment and pumping.
	7	Odor	B-	D	**Construction Phase:** General wastes from the base camp may generate offensive odors. **Operation Phase:** No serious impact is expected because there is no activity planned that may generate offensive odor.
	8	Bottom Sediment <Soil quality>	B-	D	**Construction Phase:** The bottom sediment of Mactan Channel may be polluted as a result of installation of the bridge pier. **Operation Phase:** No serious impact is expected because there is no plan that may affect bottom sediment.
Natural Environment	9	Protected Area <Encroachment in Protected Area under NIPAS >	D	D	**Construction Phase / Operation Phase:** There are no legally-designated protected areas in and around the project site.
	10	Ecosystem < Environmentally Critical Areas [ECAs], Terrestrial Biology, Freshwater or Marine ecology>	B-	B-	**Construction Phase:** - As the whole project area is included in the KBA, there is concern about the negative impact on mangrove forests, tidal flats, and the organisms that use them (especially birds). - Turbid water caused by piling in the Mactan Channel may affect the ecosystem in and around the bridge construction area. Since distance from the source of pollution (i.e. location of bridge construction) to the coral reef located east and west of Mactan Island is approximately 3km and 7km, respectively, coupled with the fact that the average tidal speed is relatively slow at a rate of 0.82m/s (approx. 2.95km/h), impacts on the coral reef is considered to be relatively minor. - Construction of interchanges that occupy a relatively large area may bring negative impacts to the surrounding ecosystem including mangrove forests. - Construction of bridges and approach roads is expected to cause tree cuttings. **Operation Phase:** The presence of bridges and traffic flow and noise generated from them may affect the ecology of the main species that feed on tidal flats located around the bridge construction area.
	11	Hydrology <Hydrology and oceanography>	B-	B-	**Construction Phase / Operation Phase:** Changes in the flow conditions of seawater due to bridge construction may affect the distribution of the tidal flats.
Natural Environment	12	Geographical Features <Geography, topography and landslides>	C	D	**Construction Phase:** At present, neither the existence of valuable geographical features, nor impacts to them have been identified. The presence and extent of the impact will be clarified through the surveys. **Operation Phase:** Since there is no special topography and geology in the project area and no earth cut is planned, the impact on the geography and geology is expected to be minor.

Category	№	Item <Item in the Phillippine Laws>	Evaluation		Reason for Evaluation
			Pre/During Construction	Operation	
Social Environment	13	Involuntary Resettlement <People>	A-	D	**Pre-/Construction Phase:** Resettlement of about 110 households* are expected within the affected area. *As a result of a quick review made at an early stage of the study with an aim to select the route alignments, 90 households were expected to be subject to resettlement'. A closer investigation into the proposed road and bridge alignment with minor adjustments made has revealed that approximately 110 households may be affected as described here. **Operation Phase:** No serious impact is expected because there is no land acquisition in the operation phase.
	14	Poor People <People>	B-	D	**Pre-/Construction Phase:** Because some parts of the roads pass through the area where informal settlers reside, the lives of the poor who live in this area may be affected. The presence and extent of the impact will be clarified through social surveys. **Operation Phase:** No serious impact is expected because there is no land acquisition in the operation phase.
	15	Ethnic minorities and indigenous peoples <Indigenous people>	C	C	**Construction Phase / Operation Phase:** At present, neither the existence of ethnic minorities and indigenous people, nor impacts to them have been identified. The presence and extent of the impact will be clarified through social surveys.
	16	Local economies, such as employment, livelihood, etc.	C	C	**Pre-/Construction Phase:** - Local economy is expected to be developed through creation of employment opportunities in construction work and business for construction workers. - Livelihood of residents may be affected by land acquisition and resettlement. - New construction of bridge and road may affect the livelihoods of fishery/aquaculture/broom-making workers. The presence and extent of the impact will be clarified through social surveys. **Operation Phase:** - Land acquisition does not occur in the operation phase, whereas the presence of newly constructed bridge and road that narrows the fishing ground/aquaculture ponds may negatively affect the livelihoods of fishery/aquaculture/broom-making workers. - Positive impacts on the local economy such as alleviation of traffic congestion are expected in Cebu City.
Social Environment	17	Land use and utilization of local resources <Land use and classification>	C	C -	**Pre-/Construction Phase:** Construction of bridge may affect negatively land use and utilization of local resources including, but not limited to, fishery/aquaculture/broom-making. **Operation Phase:** Land acquisition does not occur in the operation phase but uncontrolled development along roadside may hinder proper land use and make it difficult for the people to use local resources.
	18		B-	D	**Construction Phase:** Land acquisition and construction work may affect the

Category	№	Item <Item in the Phillippine Laws>	Evaluation Pre/During Construction	Evaluation Operation	Reason for Evaluation
		Water Usage <Hydrology/Hydrogeology /Water quality>			accessibility to drinking water resources such as wells. **Operation Phase:** No serious impact is expected because there is no land acquisition in the operation phase.
	19	Existing social infrastructures and services	B-	B-	**Construction Phase / Operation Phase:** A school located along the road about 1 km from the starting point of the coastal road as well as factories, power plants and oil tanks (e.g. casting flammable items into the tanks) located along the coastal road may be affected.
	20	Social structure such as social capital and local decision-making institutions	B-	D	**Construction Phase:** Restricting access to construction areas may split the communities. **Operation Phase:** No serious impact is expected because there is no activity planned that may affect the social structure.
	21	Misdistribution of benefits and damages	D	D	**Construction Phase / Operation Phase:** Misdistribution of benefits and damages is expected to be minor because the benefit of improved convenience by the bridge and road construction will be equally distributed.
	22	Local conflicts of interest	B-	D	**Construction Phase:** Inter-regional disputes may arise as local inhabitants and local authorities may request for their own preferential treatment (e.g. provision of employment opportunities). **Operation Phase:** No serious impact is expected as explained in "No. 21 Misdistribution of benefits and damages".
	23	Historical/Cultural heritage	B-	B-	**Construction Phase / Operation Phase:** Bantayan sa Hari is located approximately 200 m from the coastal road hence the landscape may be disturbed after the road has been developed and noise will be generated during construction and operation phases. But the northern side faces a road and the southern side is a residential area. Further, an elevated 1st level national road runs at a location 40m west of Bantayan sa Hari already disturbing the landscape and generating noise. Additional impact generated by the project is therefore considered to be minor.
	24	Landscape	C	C	**Construction Phase / Operation Phase:** No serious impact is expected because there is no legally-designated landscape to be protected around the project site. However, construction of a bridge and viaduct will change the landscape, which may be considered by some as a negative impact.
Social Environment	25	Gender	B-	D	**Construction Phase:** There may be differences between men and women in terms of wages and treatment as construction workers. **Operation Phase:** No serious impact is expected because no activity that may affect gender is planned in the operation stage.
	26	Children's rights	C	D	**Construction Phase:** If child labor in construction work is customary, children's right to compulsory education may be hampered. The presence and extent of the impact will be clarified through the survey. **Operation Phase:** No serious impact is expected because operation of bridge and

Category	№	Item <Item in the Phillippine Laws>	Evaluation		Reason for Evaluation
			Pre/During Construction	Operation	
					road is considered not to affect children's rights.
	27	Infectious diseases such as HIV/AIDS	B-	B-	**Construction Phase:** Infectious diseases such as STD may possibly spread due to an inflow of construction workers.
					Operation Phase: The improved access from the airport to the urban area due to the newly constructed bridge and road may increase the number of travelers and spread infectious diseases such as STD.
	28	Working conditions including occupational safety	B-	D	**Construction Phase:** If the contractor fails to take appropriate safety measures, the worker's health and safety are expected to deteriorate.
					Operation Phase: No serious impact is expected because construction of bridge and road is considered to bring no significant change to the working environment of the surrounding local inhabitants.
Others	29	Accidents <Traffic situation>	B-	B-	**Construction Phase:** Operation of construction machines and equipment may cause accidents in the project site.
					Operation Phase: Traffic accidents may occur on the newly-constructed bridge and road.
	30	Trans-boundary impacts or climate change <Meteorology / Climatology>	B-	C	**Construction Phase:** - Cutting mangroves is expected to decrease greenhouse gas absorption. - Operation of construction machines and construction of structures are expected to lead to emission of greenhouse gases.
					Operation Phase: Greenhouse gas emissions are expected to increase in the new bridge and road area, while reduction in greenhouse gas emissions are expected in the whole area by reducing traffic congestion.

Note: Impact Items refer to "JICA Guidelines for Environmental and Social Considerations April 2010"
A+/- Significant positive/negative impact is expected,
B+/- Positive/negative impact is expected to some extent
C Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D No impact is expected
*Number of households expected to be relocated based on the selected route alignment selected through a comparison of alternatives (number of affected households: approx. 90) with further considerations being put into the alignment and connectivity to existing roads.
Source: JICA Survey Team

Table 8.5.2 Scoping Matrix Based on the JICA Guidelines and PEISS (DAO 03-30)

JICA Guide line			Evaluation on the Scoping: Pre/During Construction	Evaluation on the Scoping: Operation	Philippine Environmental Impact Statement (EIS) System (DAO 03-30)	Evaluation on the Scoping by EIARC	Countermeasures for filling gaps
Pollution Control	1	Air Quality	B-	B-/B+	Air Pollution	LS	
	2	Water Quality	B-	B-	**Water Quality**		
					Groundwater pollution	LI	
					Streem water pollution	NR	
					Lake water pollution	NR	
					Marine water pollution	LS	
	3	Waste	B-	D			
	4	Soil pollution	B-	D	Soil erosion	LS	
					Change in soil quality	LI	
	5	Noise and vibrations	B-	B-/B+	Increase in noise	LS	Add survey
	6	Ground subsidence	D	D	Inducement of subsidence	LI	
	7	Offensive odors	B-	D			Add survey
	8	Bottom sediment	B-	D	Change in soil quality	LI	
Natural Environment	9	Protected Area	D	D	Encroachment in Protected Area under NIPAS	LI	
	10	Ecosystem	B-	B-	Encroachment in other Environmentally Critical Areas (ECAs)	LS	
					Terrestrial Ecology		
					Vegetation removal and loss of habitat	LS	
					Threat to existence and/or loss of important local species	LS	
					Threat to abundance, frequency and distribution	LS	
					Hindrance to wildlife access	LS	
					Freshwater Ecology		
					Threat to abundance, frequency and distribution of species	NR	
					Loss of important species	NR	
					Marine Ecology		
					Threat to abundance, frequency and distribution of species	LS	
					Loss of important species	LS	
					Loss of habitat	LS	
	11	Hydrology	B-	B-	**Hydrology/Hydrogeology**		
					Change in drainage morphology	LS	
					Change in stream, lake water depth	NR	
					Reduction in stream volumetric flow	NR	
					Inducement of flooding/	LS	
					Water resources competition	LI	
					Reduction/Depletion of ground water flow	LI	
					Oceanography		

JICA Guide line			Evaluation on the Scoping: Pre/During Construction	Evaluation on the Scoping: Operation	Philippine Environmental Impact Statement (EIS) System (DAO 03-30)	Evaluation on the Scoping by EIARC	Countermeasures for filling gaps
					Change/disruption in circulation pattern	LS	
					Change in bathymetry	LS	
	12	Geographical features	C	D	Change in surface landform/ topography/ terrain/slope	LS	
					Change in sub-surface/ underground geomorphology	LS	
					Inducement of landslides or other natural hazards	LI	
Social Environment	13	Resettlement	A-	D	Displacement of settler/s	LS	
					Change in land ownership	LS	
					Displacement of properties	LS	
	14	Poor	B-	D	In-migration	LS	
	15	Indigenous, or ethnic people	C	C	Presence of Indigenous Peoples	LI	
	16	Local economies, such as employment, livelihood, etc.	B-	D	Local benefits from the project	LS	
	17	Land use and utilization of local resources	B-	B-	Change/Inconsistency in land use	LS	
					In-migration	LS	
	18	Water usage	B-	D	Threat to delivery of basic services	LS	
	19	Existing social infrastructures and services	B-	B-			
	20	Local Institutions, decision making	B-	D	Right of way conflict	LS	
	21	Misdistribution of benefits and damages	D	D			
	22	Local conflicts of interest	B-	D			
	23	Cultural heritage	B-	B-	Cultural change	LI	
	24	Landscape	C	C			Add survey
	25	Gender	B-	D			Add survey
	26	Children's rights	C	D			Add survey
	27	Infectious diseases such as HIV/AIDS	B-	B-	Threat to public health	LS	
	28	Working conditions (Health)	B-	D	Threat to public health	LS	
Other	29	Accidents (Safety)	B-	B-	Traffic congestion	LS	
	30	The impacts to transboundary or global issues	B-	B+	Change in the local climate, e.g., local temperature	LS	
					Contribution to Global greenhouse gas	LS	

Source: JICA Survey Team

8.5.3 ToR for Environmental and Social Considerations Surveys

Based on the results of scoping and reviews of the literature and relevant laws and guidelines in the Philipinnes, the Terms of Reference (ToR) for the baseline survey and impact forecasting have been drafted as shown in Table 8.5.3.

1) EIA Study Schedule

The undertaking of activities for the EIA study, review and approval process started in December 2018 during the coordination-consultation meetings between JICA representative, JICA Survey Team, DPWH, MCDCB, DENR/CENRO/ EMB and the LGUs of Mandaue and Lapu-Lapu Cities.

Table 8.5.3 Schedule of EIA Activities

Project Phases/ Activity	Dec '18		Jan		Feb		Mar		Apr		May		Jun		Jul		Aug		Sept	
			1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2	1	2
1.0 Prelim. Activities, IEC, Perception Survey																				
Coordination Meetings		■	■	■				■												
Preliminary Survey/Data gathering						■	■													
Site Visits and Consultation Meetings with Barangay									■	■										
2.0 Scoping																				
Public Scoping-Mandaue City (3/6/19)							■													
Public Scoping-Lapu-Lapu (4/12/19)									■											
Public Scoping-Mandaue (4/26/19)										■										
Technical Scoping with the EIARC (3/6/19)							■													
3.0 EIA Study/Preparation of EIS & RAP																				
EIA Data Base Assembly. Collection of secondary data, Terrestrial and Aquatic (Marine) flora and fauna inventory, Air/Noise & Water sampling-lab analysis		■	■	■	■	■	■	■	■	■	■									
RAP Census/perception survey, Report preparation & Review										■	■	■	■							
4.0 Public Hearings in Mandaue & Lapu-Lapu													■							
5.0 Additional data gathering, Internal Review & Refinement of EIS-Draft Report														■	■					
6.0 Submission of EIS-Draft Report to EMB, EIARC Review, EIARC technical Meeting & Evaluation																■	■			
7.0 EMB/EIARC Final Review & issuance of Recommendations																		■		

Source: JICA Survey Team

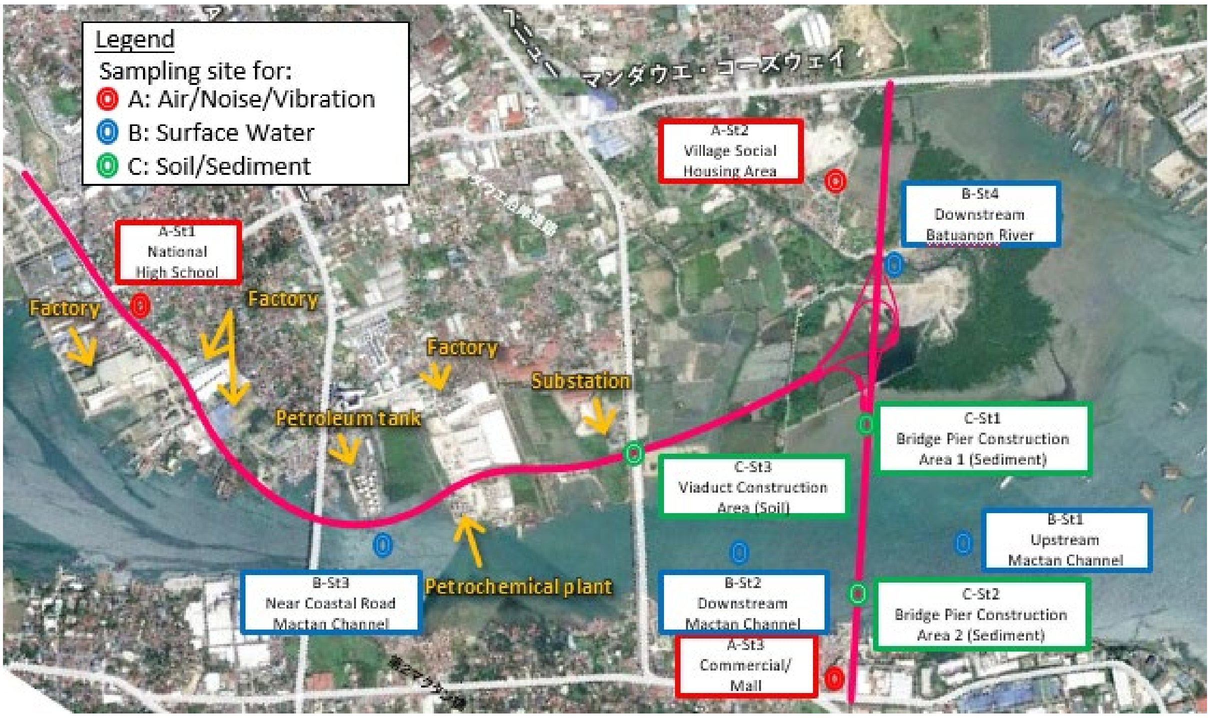
2) EIA Study Area

The EIA study area covers the areas along the route alignment of the Mandaue Coastal Road and the 4th Mactan Bridge located in the affected barangays of Mandaue and Lapu-Lapu Cities, which is categorized into Primary and Secondary Impact Areas. Bases for delineation of the direct and indirect impact areas were the definition given by the Revised DAO 03-30 procedural manual, as follows:

> a) Direct impact area (DIA) is initially delimited during the Pre-EIA Study Stage as the area where ALL project facilities are proposed to be constructed/situated and where all operations are proposed to be undertaken . . . . For most projects, the DIA is equivalent to the total area applied for an ECC.
>
> b) Indirect Impact Area (IIA) during the pre-EIA Study can only be assumed or qualitatively estimated but may be guided by secondary data and information from key interviews of reliable local authorities, e.g. Based on a NAMRIA topographic map, an IIA can be the stretch of the river/s OUTSIDE the project area but draining the project site which can potentially transport Total Suspended Solids and other discharges from the project towards downstream communities.
>
> c) On the other hand, the regional impact zone (RIZ) pertains more to the general area where the impact of the project would be felt, such as the entire municipality, province or region.

Given the above-reference, the Primary or Direct Impact Areas (DIA) are areas to be directly affected by the project's alignment/ROW where acquisition of private properties for the ROW and displacement of residential and commercial/industrial structures/establishments will be required.

On the other hand, the Secondary or Indirect Impact Areas (IIA) are those to be indirectly affected by the noise and vibration disturbance, air pollution, and inconvenienced due to various construction activities during the project implementation. Within this secondary impact areas, sensitive receptors to noise, air, soil and water pollution were identified-such as schools, residences/village. These receptors were also the basis for identifying sampling sites for air, noise, water and soil testing/analysis as shown in Figure 8.5.1.



Source: JICA Survey Team

Figure 8.5.1 EIA Survey Map

3) EIA Methodology

The scoping checklist that was the primary output of the Technical Scoping with the EMB/EIARC served as the Terms of Reference (TOR) for the conduct of the EIA study. The scoping checklist provides the parameters for land, water, air and people that will be sampled and analysis. The following table exhibits the parameters (impacted items) and the measurement methodology including measuring equipment, methods of analysis and analytical instruments information in the implementation plan.

Table 8.5.4 Baseline Survey Items and Methodology

<table>
<tr><th>Impacted Item on JICA Guidelines <Item in Phillippine Laws></th><th colspan="2">Survey Item and Methodology</th><th>Forecast Methodology</th></tr>
<tr><td>Air pollution
<Air quality & noise></td><td colspan="2">(1) Site measurement : 3 points
(2) Item: CO, NO_2, SO_2, PM10, PM2.5
(3) Frequency: Once (24-hour sampling)
Note) Utilize secondary data, if any</td><td>Quantitative forecast (Puff Model) or refer to other example cases</td></tr>
<tr><td>Water pollution
<Water Quality></td><td colspan="2">(1) Site measurement : 4 points
(2) Item: Chromium, Cadmium, Lead, BOD, COD, Oil and Grease, pH, TSS, Total Nitrogen, Total Phosphorus, Turbidity, Temperature, Salinity
(3) Frequency: Once
Note) Utilize secondary data, if any</td><td>Quantitative forecast</td></tr>
<tr><td>Waste
<Abandonment></td><td colspan="2">(1) Site survey: 1 point (Land fill site near the project site)
(2) Item: Summary of the site, Waste to be generated by the project, Construction-derived soil
(3) Frequency: Once
Note) Utilize secondary data, if any</td><td>Quantitative forecast (Calculation based on design drawing and construction plan)</td></tr>
<tr><td>Soil contamination
<Soil Quality / Fertility></td><td colspan="2">Refer to Sediment quality</td><td>Qualitative forecast</td></tr>
<tr><td>Noise and Vibration
<Noise></td><td>Noise
(1) Site measurement: 3 points
Note) In the selection of the measurement location, priority is given to the sensitive receptors (e.g. school and residential area).
(2) Item: Ambient Noise: $L_{Aeq,}$ (Continuous 24hr/weekday) Traffic volume and speed
(3) Frequency: Once
Note) Utilize secondary data, if any</td><td>Vibration
(1) Site measurement: 3 points
Note) In the selection of the measurement location, priority is given to the sensitive receptors (e.g. school and residential area)
(2) Item: Ambient Vibration: Lv10 / 24hr/weekday
(3) Frequency: Once
Note) Utilize secondary data, if any</td><td>Quantitative forecast (Traffic noise L_{Aeq} dB(A) on road boundaries and at points where consideration is required)</td></tr>
<tr><td>Ground subsidence
<Subsidence ></td><td colspan="2">Literature review</td><td>Qualitative forecast</td></tr>
<tr><td>Odor</td><td colspan="2">Refer to design in relation to major activities at candidate sites for base camps</td><td>Qualitative forecast</td></tr>
<tr><td>Sediment quality
<Soil Quality></td><td colspan="2">(1) Site Survey: 3 excavation points
(2) Item: Cadmium, Cyanide, Chromium, Lead, Phosphorus, Arsenic, Mercury, Copper and Selenium
(3) Frequency: Once
Note) Utilize secondary data, if any</td><td>Qualitative forecast</td></tr>
</table>

Impacted Item on JICA Guidelines <Item in Phillippine Laws>	Survey Item and Methodology		Forecast Methodology
Protected area <Environmentally Critical Areas (ECAs)>	Site Survey (1) 500m each side along the bridge and road alignment. For birds, investigate visually the area of about 1 km using binoculars. (2) Item: Fauna and flora, ecosystem, considerable species such as listed species on IUCN Red list. Fauna: Mammals, Birds, Reptiles, Amphibians, Aquatic life (including fish), Insects and Benthos Flora: Land Plants and Aquatic Plant (including mangrove) (3) Frequency: One time (bird migration season is desirable) Note 1) For survey on birds, consider the results of the initial environmental condition survey conducted in December 2018. Note 2) Utilize secondary data, if any	Interview Survey to Experts (1) Discussion points - Possibly affected items - Extent of impact - Mitigation measures - His/her opinion on whether the project is implementable (2) Interviews to at least 2 experts are necessary.	Qualitative forecast
Ecosystem <Terrestrial Biology Freshwater or marine ecology>			
Hydrology <Hydrology and oceanography>	Literature review		Qualitative forecast
Topography and geology <Geography, topography and landslides>	Literature review		Qualitative forecast
Involuntary resettlement <People>	Utilize the results of RAP Survey (The number of PAPs identified based on census, socioeconomic survey, and inventory of loss)		Quantitative forecast
The poor <People>	Utilize the results of RAP Survey (The number of PAPs below poverty line identified based on census, socioeconomic survey, and inventory of loss survey)		Quantitative forecast
Indigenous and ethnic people <Indigenous people (IPs)>	- Interview survey with and request for relevant documents to LGUs - Utilize the results of RAP Survey (Check if ethnic and religious minorities and indigenous people exist based on census and socioeconomic survey)		Qualitative forecast
Local economy such as employment and livelihood <People>	Utilize the results of RAP Survey (Professions identified based on census, socioeconomic survey, and inventory of loss survey. In case that fishing/aquaculture /broom-making ground are affected, ratio of affected people and extent of impact on their revenue)		Qualitative forecast
Land use and utilization of local resources <Land use and classification>	- Review of Comprehensive Land Use Plan prepared by the concerned LGUs - Utilize the results of RAP Survey (Change in land use of affected lands identified based on census, socioeconomic survey, and inventory of loss survey)		Qualitative forecast
Water usage <Hydrology / Hydrogeology/ Water quality>	Literature review		Qualitative forecast
Existing social infrastructures and services <People>	(1) Site survey: 1,000m range along the bridge, approach road and coastal road (2) Item: - Distribution of school, hospital, religious place, community center, and power plant etc. - Vessel traffic in the Mactan channel and type of vessels, etc. (including interview survey) (3) Frequency: Once Note) Utilize secondary data, if any		Qualitative forecast

Impacted Item on JICA Guidelines <Item in Phillippine Laws>	Survey Item and Methodology	Forecast Methodology
Social institutions such as social infrastructure and local decision making institutions <People>	Utilize the design and construction plan within the range of bridges, approach roads, guide banks and revetments (From the viewpoint of splitting of communities, check the road crossing structure, functional maintenance points etc.)	Qualitative forecast (check on design drawing, etc.)
Misdistribution of benefit and damage <People>	Utilize the results of stakeholder meetings for EIA and coordination with PAPs for RAP (Based on the opinion of the residents regarding the impacts expected in this project, understand the level of residents' interest in these items)	Qualitative forecast
Local conflict of interests <People>		Qualitative forecast
Cultural heritage <People>	(1) Site survey: Interview with local authority in charge of Bantayan Sa Hari (2) Item: - Possibly affected items - Extent of impact - Mitigation measures (3) Frequency: Once Note) Utilize the results of RAP survey and stakeholder meetings	Qualitative forecast
Landscape	(1) Site survey: Major points commanding a view of bridge, approach road, approach roads, guide banks and revetments (2) Item: Photograph (3) Frequency: Once	Qualitative forecast
Gender <People>	Utilize the results of stakeholder meetings and focus group discussions (Understand the opinions of women group on gender gap)	Qualitative forecast
Right of children <People>	- Confirmation of Philippine law concerning children's rights and child labor - Interview survey with the Philippine government on the issues including, but not limited to, child labor in construction work around the project site	Qualitative forecast
Infectious diseases such as HIV/AIDS <People>	Utilize the results of RAP survey and stakeholder meetings	Qualitative forecast
Labor environment <People>	Confirmation of labor-related Philippine laws and international standards (IFC)	Qualitative forecast
Accidents <Traffic Situation>	(1) Site survey: Interview with police station and LGUs (2) Item: Number of traffic accident and reasons for accidents (3) Frequency: Once	Qualitative forecast
Cross boundary impacts and climate change <Meteorology / Climatology>	Utilization of traffic volume prediction results to be included in the Survey (Checking CO_2 emission factor by year, vehicle type and speed, and CO_2 emissions by structure, etc.)	Quantitative forecast

Source: JICA Survey Team

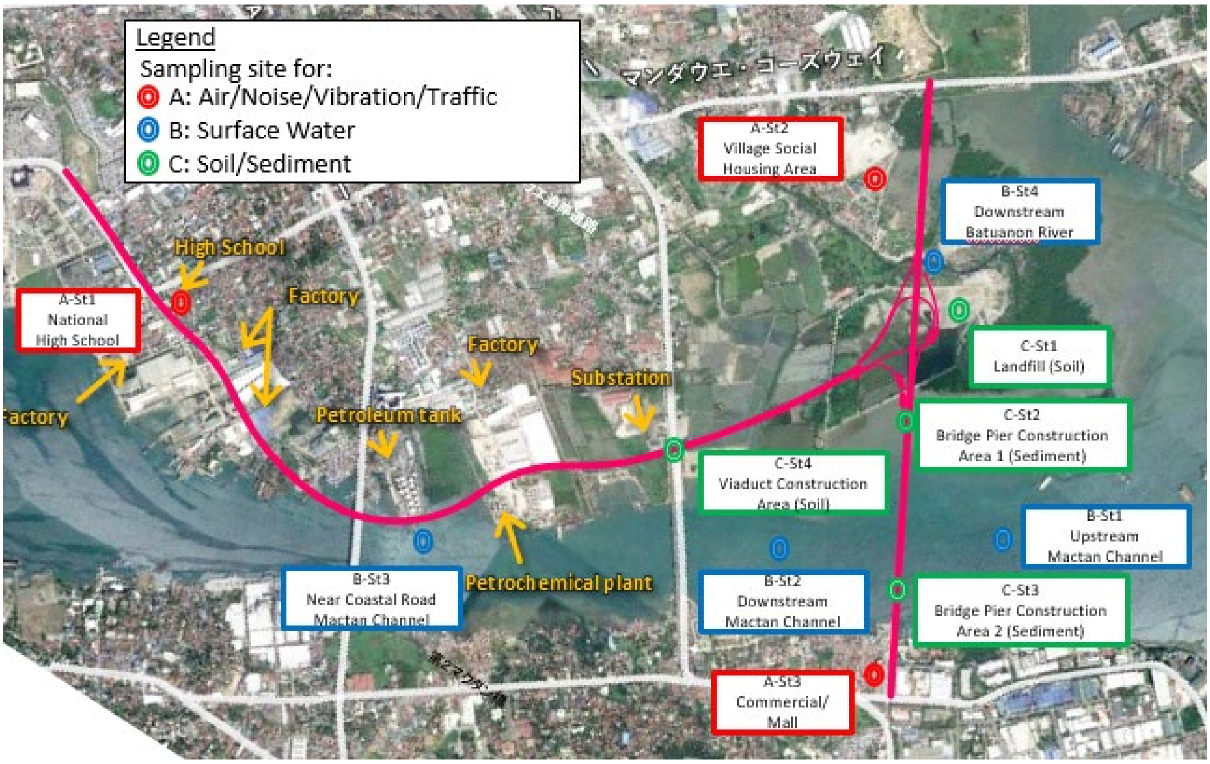
8.6 EIA Survey Result

8.6.1 Air Quality

1) Baseline survey result

Since no secondary data could be obtained on ambient air quality that can serve as a baseline data for the project, air quality was measured under this study.

Baseline survey for air quality and noise was performed at three sampling sites along the proposed 4th Cebu-Mactan Bridge route. Figure 8.6.1 shows the location of each sampling site.



Source: JICA Survey Team

Figure 8.6.1 Sampling points for ambient air quality, noise, and vibration measurements

As shown on Table 8.6.1, the results of 1-hour average values reveal that all the parameters passed within the standard limit set by the National Ambient Air Quality Standards for Source Specific Air Pollutants from Industrial Sources / Operations of the Department of Environment and Natural Resources Administrative Order No. 2000-81 (Implementing Rules and Regulations of the Philippine Clean Air Act of 1999), except for the Particulate Matter 10 conducted at Mandaue City Comprehensive National High School. As shown in Table 8.6.2, the results of 24-hour measurement shows that all the parameters also met the national standards.

Table 8.6.1 Baseline Survey: Measured 1-hr Average Values of Air Quality Parameters

	PM_{10}	$PM_{2.5}$	NO_2	SO_2	CO
Unit	ug/N·cm	ug/Ncm	ug/Ncm	ug/Ncm	ppm
Method of measurement	Gravimetric	Gravimetric	Griess-Saltzman	Pararosaniline	Direct reading, electrochemical sensor
Mandaue Comprehensive National High School (Time of measurement 10:55-11:55 PST)	248	<3	4	9	<1
Village/Social Housing Area (Time of measurement 13:20-14:20 PST)	353	<3	1	16	<1
Commercial Area/Mall (Time of measurement 15:31-16:31 PM)	235	<3	<1	8	<1
Philippine Standard DAO 2000-81 Standards	TSP 300		260	340	30
WHO Air quality guidelines	-	-	200 µg/m3	-	-

Source: JICA Survey Team

Table 8.6.2 Baseline Survey: Measured 24-hr Average Values of Air Quality Parameters

	PM_{10}	$PM_{2.5}$	NO_2	SO_2	CO
Unit	ug/N·cm	ug/Ncm	ug/Ncm	ug/Ncm	ppm
Method of measurement	Gravimetric	Gravimetric	Griess-Saltzman	Pararosaniline	Direct reading, electrochemical sensor
Mandaue Comprehensive National High School	27	0.3	<0.02	23	<1
Village/Social Housing Area	33	0.3	<0.02	25	<1
Commercial Area/Mall	59	0.5	<0.02	22	<1
Philippine Standard DAO 2000-81 Standards	TSP 150		50	150	180
WHO Air quality guidelines	50 µg/m3	25 µg/m3	-	20 µg/m3	-

Source: JICA Survey Team

Figure 8.6.2 Ambient Air Sampling Point at Mandaue Comprehensive National High School

Figure 8.6.3 Ambient Air Sampling Point atVillage/Social Housing Area

Figure 8.6.4 Ambient Air Sampling Point at Commercial Area/Mall

2) **Impact Identification and Assessment**

Construction Phase

The 4th Cebu-Mactan Bridge-Mandaue Coastal Road project's construction has the potential to cause changes in Air Quality. Further, during construction, the installation of structures has the potential to cause changes in Sound Quality and the development of Temporary Ancillary Elements has the potential to cause changes in Air Quality.

Emissions from heavy construction equipment (*e.g.*, trucks, front-end loaders, pavers, and other equipment) will occur from the operation of internal combustion engines, which are typically diesel-fueled.

In addition to combustion gases, there is potential for fugitive dust emissions from activities during Construction. Fugitive dust is particulate matter that originates primarily from the movement of mobile equipment on unpaved surfaces, especially during dry and windy periods.

The potential for dust generation would occur most frequently during periods of high winds or extreme dry periods.

It is anticipated that air contaminant emissions during Construction are likely to represent a very small fraction of emissions when compared to the existing emissions in Metro Cebu

Fugitive dust from the movement of equipment on unpaved surfaces during Construction has the potential to cause adverse environmental effects to ambient air quality if dust mitigation measures are not used.

Operation Phase

During Operation of the Project, vehicle traffic on the 4th Cebu-Mactan Bridge-Mandaue Coastal Road realignment will result in emissions of air contaminants (primarily combustion gases) from fuel combustion. The forecasted traffic volume on 2039, which is employed by the forecast value calculation not only air pollution but also noise and vibration, is shown in Table 8.6.3.

Table 8.6.3 Forecasted Traffic Volume

Location	Station	Road Type	Direction	Large PCU/hour	Small PCU/hour	Total PCU/hour
Mandaue Comprehensive National High School	A-ST1	Flat Road (Current)	To North	2,377	13,471	15,848
			To South	2,318	13,138	15,456
		Elevated Road	To North	5,408	30,644	36,052
			To South	4,717	26,727	31,444
Village Social Housing	A-ST2	Elevated Road	To North	4,350	24,650	29,000
			To South	4,560	25,840	30,400
Commercial Area Mall	A-ST3	Elevated Road (Upper)	To North	975	5,525	6,500
			To South	825	4,675	5,500
		Elevated Road (Lower) (ON/OFF RAMP)	To North	2,475	14,025	16,500
			To South	2,670	15,130	17,800
		ON RAMP	To North	915	5,185	6,100

Source: JICA Survey Team

The Puff model, which is widely used in the analysis of air pollution in Japan, is adopted for quantitative analysis in this case with using traffic volume estimation in year 2039. Prediction points are same as background survey points as shown in Figure 8.6.1. The Puff-model is used to predict the road-contributed density. The result of quantitative forecast is shown in Table 8.6.4. Forecasted values of PM10, NO_2 and SO_2 are satisfied with the Philippine Standard DAO 2000-81 Standards, meaning that the negative impacts of the project are at a negligible level.

For the reference, both baselines and forecasts of PM10 at the Commercial Area/Mall and NO_2 at all three survey points exceed the standards of the WHO Air Quality Gudelines.

However, the impact of the project is minor because the baseline and forecast results are almost equal.

Table 8.6.4 The Result of Air Pollution Forecast

Item, Unit		PM 10	PM 2.5	NO_2	SO_2	CO
Survey Points		µg/Ncm	µg/Ncm	µg/Ncm	µg/Ncm	ppm
Mandaue Comprehensive National High School	Baseline	27	0.3	<0.02	23	<1
	Forecast (2039)	27.7	-	8.8	23.7	-
Village/Social Housing Area	Baseline	33	0.3	<0.02	25	<1
	Forecast (2039)	33.1	-	0.8	25.1	-
Commercial Area/Mall	Baseline	59	0.5	<0.02	22	<1
	Forecast (2039)	59.0	-	2.9	22.4	-
Philippine Standard DAO 2000-81 Standards		TSP 150		50	150	180
WHO Air quality guidelines		50 µg/m3	25 µg/m3	-	20 µg/m3	-

Source: JICA Survey Team

3) Impact Mitigation & Enhancement Measures

Construction Phase

Construction activities (Including the pre-construction demolition activity) that will cause minor to moderate negative air quality impacts in the area are: mobilization and site development works (clearing and grubbing, excavation backfilling). The rest of construction activities will have negligible impacts to air quality.

During construction stage, air quality concerns are more focused on the concentration of high levels of total suspended particulate (PM10) – which is generally, within the primary impact area. Given the project area's size which is not large enough to generate large amount of dust, diesel soot that would be dispersed by wind to the surrounding areas there is not much effects on the ambient air quality on the secondary impact areas.

Vehicular emissions, particularly, from vehicles coming in and out of the project site (notably, heavy dumptrucks/haulers) is expected to contribute to reducing air quality within areas along its road-trips (regional impact area). However, such contribution to the regional degradation of air quality in Metro Cebu is less significant to negligible.

Since, heavy concentration of dusts are primarily attributed to soil disturbance there will be negligible air quality impacts during building construction. As construction of superstructure/building rises, netting will be provided to contained dusts and construction debris from dispersing and falling into nearby areas. A chute will also be provided to convey construction debris from upper floors to lower ground.

With mitigation such as the following measures, air quality impacts are less than significant:

- Regular watering of areas considered as dust generators
- Use only new or properly maintained vehicles, equipment and conduct regularly check to regulate emissions within standard levels
- Transport of excess materials should be undertaken during off-peak traffic periods
- Hauling trucks should be covered with tarpaulin or canvass
- Conduct quarterly air quality level monitoring

Operation Phase

As the quantitative forecast of air quality for 2039 shows (see Table 8.6.4), the 4th Cebu-Mactan Bridge-Mandaue Coastal Road project is expected to bring about no significant adverse impacts on air quality.

The fact that forecast results are almost equal as the baseline figures indicates that the contribution of the project to the change in air quality is at a negligible level. Therefore, no special mitigation measures will be required for the operation phase. Instead, the project may be one of the measures to contributing improvement of air quality by addressing traffic congestion and thereby reducing vehicular emissions.

8.6.2 Water Quality

1) Baseline survey result

The baseline water quality survey was conducted at four (4) sites crossed and aligned by the proposed Project.

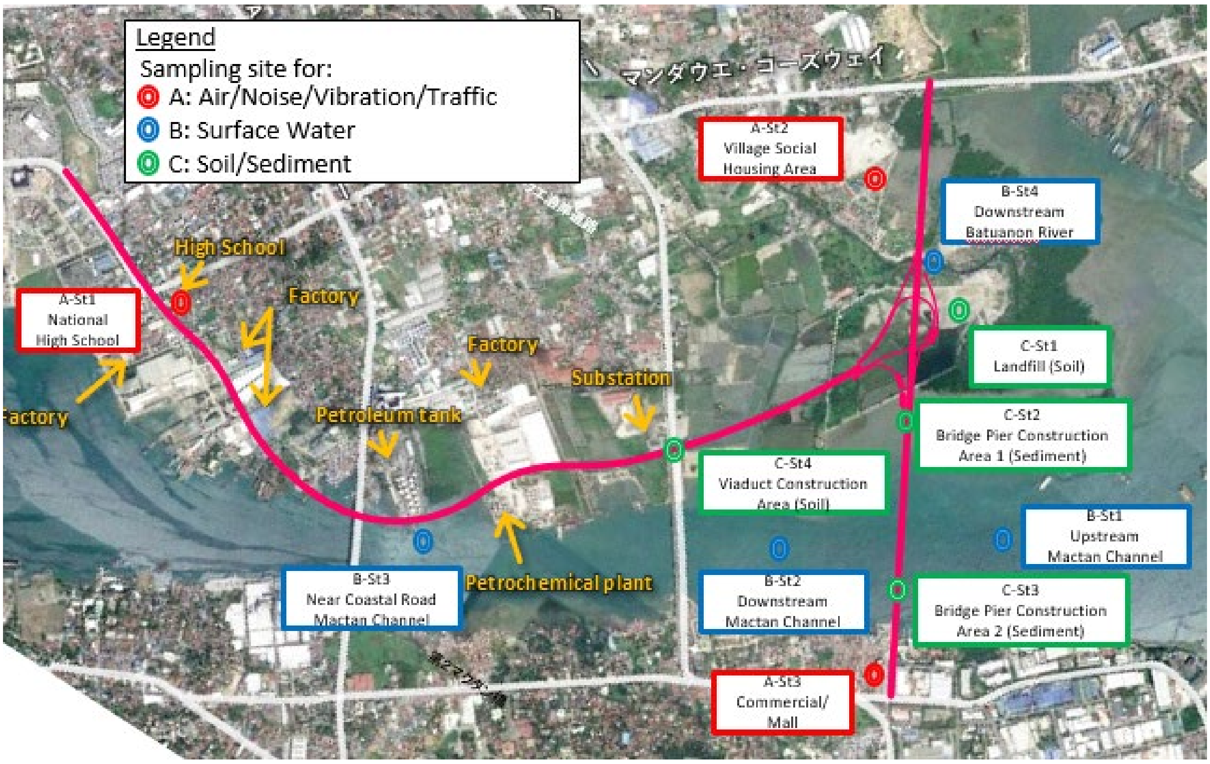


Figure 8.6.5 Water Quality Sampling points

The water quality benchmarks are prescribed Class D Waters for Butuanon River (Downstream), which is primarily used for the Navigable Waters, and Class SC Waters is used for Mactan Channel, which is primarily used for Fishery Water, Recreational water and Marshy and /or mangrove areas declared as fish and wildlife sanctuaries under DAO 2016-08. The results are shown in Table 8.6.5. Almost all parameters are within the standard except BOD of Butuanon River (Downstream). This result might be associated to solid waste generated at the Umapad umping site.

Table 8.6.5 Sampling Results for Butuanon River (Downstream)

	PARAMETERS	UNITS	RESULTS	DENR Standard Class D*	Environmental Quality Standards for Soil Pollution in Japan River Water Class C**	IFC Indicative Values for Treated Sanitary Sewage Dischargesa(2007)
1	pH	-	7.2	6.0-9.0	6.5-8.5	6-9
2	Temperature	°C	29	26-30	-	-
3	BOD	mg/L	**104**	15	5	30
4	COD	mg/L	221	-	-	-
5	TSS	mg/L	73	110	50	50
6	Oil & Grease	mg/L	4	5.0	-	10
7	Salinity	g/kg	0.04	-	-	-
8	Total Phosphorous (P)	mg/L	1.09	5	-	2
9	Turbidity	NTU	27.9	-	-	-
10	Chromium (Cr)	mg/L	<0.02	0.02	0.01	-
11	Cadmium (Cd)	mg/L	<0.003	0.005	0.003	-
12	Lead (Pb)	mg/L	<0.01	0.1	0.01	-

Source: JICA Survey Team
Note: *Classified Water Bodies by EMB Region 7 http://water.emb.gov.ph/?page_id=777
Class D of DENR: NavigableWaters (Waters of the Philippines, including the territorial area and inland waters suitable for water transport)
**River water Class C of EQS in Japan: Fishry Class 3rd and Industry Class 1st

Table 8.6.6 Sampling Results for Marine Water Quality-Mactan Channel

	PARAMETERS	UNITS	RESULTS			DENR Standard Class SC*	Environmental Quality Standards for Soil Pollution in Japan Marin Water Class A**
			1 Upstream Mactan Channel	2 Downstream Mactan Channel	3 New Coastal Road Mactan Channel		
1	pH	-	8.2	8.3	8.3	6.5-8.5	7.8-8.3
2	Temperature	°C	30	30	28	25-31	-
3	BOD	mg/L	1	<1	1	n/a	-
4	COD	mg/L	<5	<5	<5	-	2
5	TSS	mg/L	40	39	32	80	-
6	Oil & Grease	mg/L	<1	<1	<1	3	N/D
7	Salinity	g/kg	40.1	36.4	39.9	-	-
8	Total Phosphorous (P)	mg/L	0.08	0.08	0.11	0.5	0.03
9	Turbidity	NTU	2.68	3.96	4.93	-	-
10	Chromium (Cr)	mg/L	<0.02	<0.02	<0.02	0.05	0.01
11	Cadmium (Cd)	mg/L	<0.003	<0.003	<0.003	0.005	0.003
12	Lead (Pb)	mg/L	<0.01	<0.01	<0.01	0.05	0.01

Source: JICA Survey Team
Note:* Classified Water Bodies by EMB Region 7 http://water.emb.gov.ph/?page_id=777
Class SC: 1) Fishery Water Class III ‐ For the propagation and growth of fish and other aquatic resources and intended for Commercial and sustenance fishing
2) Recreational water Class II ‐ For boating. Fishing or similar activities
3) Marshy and /or mangrove areas declared as fish and wildlife sanctuaries
**Marine water Class A of EQS in Japan: 1) Fishery Water Class I, Recreational water and Natural conservation

2) Impact Identification and Assessment

Construction Phase

The identified causes of impacts on water quality during construction stage include:

- Inclease of turbidity, siltation/sedimentation of Mactan Channel due to movement of loose underwater sediments, soil from construction of viaduct footings/columns (especially, during rains)
- Accidental releases of fuel, oil, lubricant and other chemicals due to road construction and maintenance work may end up contaminating groundwater and surface waters.
- Further bacteriological contamination of the esteros due to improper management of domestic and solid wastes
- Contamination/degradation of water quality may be generated due to drainage outfall

Operation Phase

The identified causes of impacts on water quality during operation stage include:

- Accidental releases of fuel, oil, lubricant and other chemicals due to maintenance work finding its way to waterways
- Wastewater from maintenance works
- Contamination/degradation of water quality due to drainage outfall
- Contamination/degradation of water quality due to storm water run-off/discharge

3) Impact Mitigation & Enhancement Measures

Construction Phase

To reduce minor impacts to less significant/negligible impacts of road construction development works on 'water environment' the following measures shall be implemented:

- Prepare temporary drainage plan with sump pits/sedimentation pond to trap sediments and wastes
- Use of silt fences and sediment traps, cover exposed earth especially before heavy rains are expected.
- Proper handling of oil and lubricants to prevent spillage and contamination of surface and ground waters; (Storage of oil and lubricants in secure areas/places)
- Heavy equipment and machineries shall be well-maintained to prevent discharges from engines and regularly checked for fuel and oil leaks.
- During repair/maintenance of equipment and machinery, containers/drip trays shall be used to collect leakage
- Paint residues and paint (including lacquer, varnishes, glue/epoxy, and other chemicals) containers shall be disposed properly and arrangement will be made with the suppliers for such containers to be return for their proper disposal
- Contractor/Project Management provides toilet/washroom facility for construction workers and require proper sanitation practices
- Provision of garbage bins at the construction areas;
- Regular disposal of wastes generated by the personnel to city approved disposal sites;
- Conduct weekly inspection of the construction areas to ensure proper management of the wastes generated by the construction personnel and
- Adequate maintenance of drainage line/canal (e.g. desilting) and putting-up of catch basins (silt trap) at regular interval.

- Care and maintenance of greeneries, ground cover – specifically, those along the riverbanks and shorelines that would retard storm water run-off and screen discharge of pollutants to surface waters
- Set up filters and catch basins for storm drains, to prevent possible pollutants from being flushed into the sea
- Conduct a quarterly water quality monitoring

Operation Phase

To reduce minor impacts to less significant/negligible impacts of road maintenance works on 'water environment' the following measures shall be implemented:

- Proper handling of oil and lubricants to prevent spillage and contamination of surface and ground waters; (Storage of oil and lubricants in secure areas/places)
- Paint cans, containers of oil, lubricants should be clean and chips, residues should be properly disposed
- Adequate maintenance of drainage line/canal (e.g. desilting) and putting-up of catch basins (silt trap) at regular interval.
- Care and maintenance of greeneries, ground cover – specifically, those along the riverbanks and shorelines that would retard storm water run-off and screen discharge of pollutants to surface waters
- Set up filters and catch basins for storm drains, to prevent possible pollutants from being flushed into the sea

8.6.3 Waste

1) Baseline survey result

Currently, camp yards and a disposal site are planned to be constructed near the Mandaue interchange area in Mandaue city.

(1) Current status of Solid Waste Generation in Mandaue City

The Mandaue City Solid Waste Management Plan (STMP) 2018-2028 noted that the Waste Analysis and Characterization Study (WACS) of Mandue City was conducted in November 2016. WACS is a process of gathering information on the quantity and composition, weight and volume of solid wastes generated from various major sources which includes residential, commercial, industrial and institutional".

Based on WACS in 2016, the total waste generation of the City is 240,364.20 kgs. /day and the per capita generation is 0.6270 kgs/day" from major sources such as residential, commercial and institutions. The total waste generated contains 27.17% biodegradable, 34.86% residual waste, 35.50% recyclable waste, and 2.48% special waste.

Table 8.6.7 Waste Generation of Mandaue City in 2016

Waste Type	Weight (kg/day)	Percentage
Biodegradable	65,295.90	27.17%
Residual	83,783.47	34.86%
Recyclable waste	85,318.1	35.50%
Special	5,966.73	2.48%
Total	240,364.20	100%

Source: The Mandaue City Solid Waste Management Plan (STMP) 2018-2028

(2) Current Solid Waste Management Condition

The Ecological Solid Waste Management Act of 2000 or RA 9003 is an act providing for an ecological solid waste management program, creating the necessary institutional mechanisms and incentives, declaring certain acts prohibited and providing penalties, appropriating funds thereof, and for other purposes.

In response to RA 9003, the City of Mandaue enacted City Ordinance No. 10-2005-343 issued on November 29, 2005, which requires the implementation of solid waste segregation at source and providing penalties for violation. The city government also instituted the Solid Waste Management Board and formulated its Ecological Solid Waste Management Plan.

The management system involves basically still the collections and disposal mindset of the entire citizenry, specifically those within the residential clusters or residential sources and generators, although the commercial and industrial sources and generators have at least the minimal compliance on the segregation of the generated solid waste, owing to the strict enforcement of the RA 9003 and the ECC conformance requirements set forth by the DENR-EMB 7.

Under the Executive Order No. 17, Series of 2016, "Convenning the Solid Waste Management Board of the City of Mandaue, providing for its function and for Other Purpose" and the Executive Order No. 37 "An Order Declaring the Permanent Closure of Umapad Controlled Dumpsite and Institutionalizing the Synchronized Waste Collection and Disposal System (SWCDS)", rules and responsibilities are specified in the provisions to the different departments of the City of Mandaue.

(3) Current state on Final Disposal in Mandaue City

The City has closed the controlled dumpsite located at Barangay Umapad, Mandaue City. The operation of the dumpsite in accepting mixed wastes ended on September 2017. It will be rehabilitated based on the guidelines on safe closure and rehabilitation of open dumpsites.

Presently, the segregated wastes are collected by the barangay garbage truck from the households and are brought/disposed directly to Guun Plastic Recycling Facility. The City has a newly constructed materials recycling facility (MRF) for composting facility manage/supervise by the City Agriculture Office. The presence of scavengers in the umapad controlled dumpsite were organized as were trained in series of livelihood programs initiated by the Department of General Services.

Another facility that the City has a partner or with a joint agreement with is the Asian Energy Sanitary Landfill, a private sanitary landfill operator in Barangay Polog, Consolacion Cebu. The said facility accepts the unaccepted wastes and or not be processed by Guun Plastic Recycling Facility.

As described in Chapter 8.2.10, the Umapad Dumpsite, having an approximate 5 hectares area, is recommended to be developed as the "Mandaue City Dumpsite Ecopark".

2) Impact Identification and Assessment

<u>Pre-/Construction Phase</u>

Pre-construction activities that will result in solid waste generation include the demolition of existing road structures.

During construction phase, excess soil from earthwork activities such as excavation, backfilling and embankment may be generated and domestic waste will also be generated from the construction camp yards.

Wastes generation, consisting of the following types:

- Surplus and construction wastes: scrap metals, concrete rubble etc.
- Domestic wastes (Biodegradable): food and kitchen wastes from temp. canteen
- Sanitary wastes from office and workers toilets, bathrooms
- Others (packaging wastes such as plastics, wood pallets, crates, metal wires, cardboard, sacks, containers, etc.)

Based on the construction plan, a total of around 18,500 m3 of construction debris, or the removal of existing concrete pavement, will be for disposal as shown in Table 8.6.8. The excess soil from earthwork activities such as excavation, backfilling and embankment will be used for redevelopment of "Wetland Park" within the interchange area.

Table 8.6.8 Summary of Excavation work and Removal

Item	Unit	Quantity	Usage/Treatment
Excavation	qu.m	352,249	Reuse for the development of Wetland Park
Back fill	qu.m	277,088	
Removal of Existing Concrete Pavement	qu.m	18,507	Disposal

Source: JICA Survey Team

<u>Operation phase</u>

The operations of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road project will not generate significant amounts of wastes. There could be trash litters from motorists who will throw trash from their vehicle windows.

3) Mitigation measures of Solid Waste Generation

<u>Construction phase</u>

According to Republic Act (RA) 6969-Toxic and Hazardous Substances and Republic Act (RA) 9003-Ecological and Solid Waste Management Act, the project proponents shall require to submit detailed waste management program (WMP) for proper handling, collection and disposal of solid, hazardous and liquid waste to EMB Regional/ Central office and LGUs such as Department of Public service (DPS) prior to construction. Proof of implementation shall be submitted together with Compliance Monitoring Report (CMR). The project proponents shall also require to detailed demobilization plan for the construction yards.

Solid wastes will be transported to MRF for sorting and diversion of wastes to recycles and re-utilization. Construction debris is managed in a variety of ways, ranging from reuse to recycling to disposal in dumpsites/landfills.

<u>Reuse</u>

Most of the excavated excess earth materials from excavation works of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road project will be utilized to backfill depressed areas within nearby areas – thus, avoiding hauling-out and transporting excavated materials to far-away disposal areas.

<u>Recycling</u>

Recycling of wastes will be implemented, as much as possible, through sorting, stockpiling and containing recyclable wastes. Possible materials that could be recovered and recycled are concrete, asphalt, metals, and wood. While, the technologies to recover and process these materials for reuse are available in other countries, it is not yet commonly adopted locally, given the following major barriers:

the cost of collecting, sorting, and processing; the low value of the recycled-content material in relation to the cost of virgin-based materials, and the low cost of landfill disposal. However, locally, buyers of scrap metals are well-established, which could be tapped to dispose saleable construction debris.

Disposal in dumpsites/landfills

In case the proposed WMP will be accepted by EMB Regional/ Central office and LGUs, construction debris or unsuitable material to be reused will be disposed within the Mandaue Interchange area. Other option for excess waste materials, contractors will secure hauling permits and dispose excess earth materials to approved-suitable disposal sites (e.g. projects already issued with ECCs). The candidate sites are described in 8.1.22)(4) and their locations are shown in Figure 8.1.2.

During transport of excess/excavated earth materials for disposal the following will be implemented:

- Schedule equipment move-in to blend with regular non-peak hour day-time vehicular traffic
- Use only new or properly maintained vehicles, equipment
- Hauling trucks should be covered with tarpaulin or canvass
- Remove soil/mud from tires before leaving the area
- Detail street cleaners/sweepers
- Set aside funds to repair roads & other facilities which may be damaged by hauling trucks
- Secure hauling permits and dispose excess earth materials to approved-suitable disposal sites

In addition, proper and diligent management of solid wastes generated by the construction activities, including:

- Temporary stockpiles of excavated materials from foundation works must be properly covered and regularly hauled to DENR-approved disposal sites;
- No stockpiling of construction debris as these will not be utilized anyway;
- Litters and other types of domestic garbage from construction sites and camps must be properly kept in trash bins and regularly disposed through the City garbage collectors

Based on the general solid waste management strategy of Mandaue City, solid waste should be segregated into biodegradable, recyclable, residual, and special waste.

Operation phase

There is a possibility that trash littering from motorists who will throw trash from their vehicle windows. Motorists who will litter the 4th Cebu-Mactan Bridge-Mandaue Coastal Road shall be apprehended and appropriately charge of the violations through improvement/enhancement of current wastes disposal practices and implementation of the Solid Waste Management (SWM) plan.

8.6.4 Soil

1) Baseline survey result

(1) Soil Profile

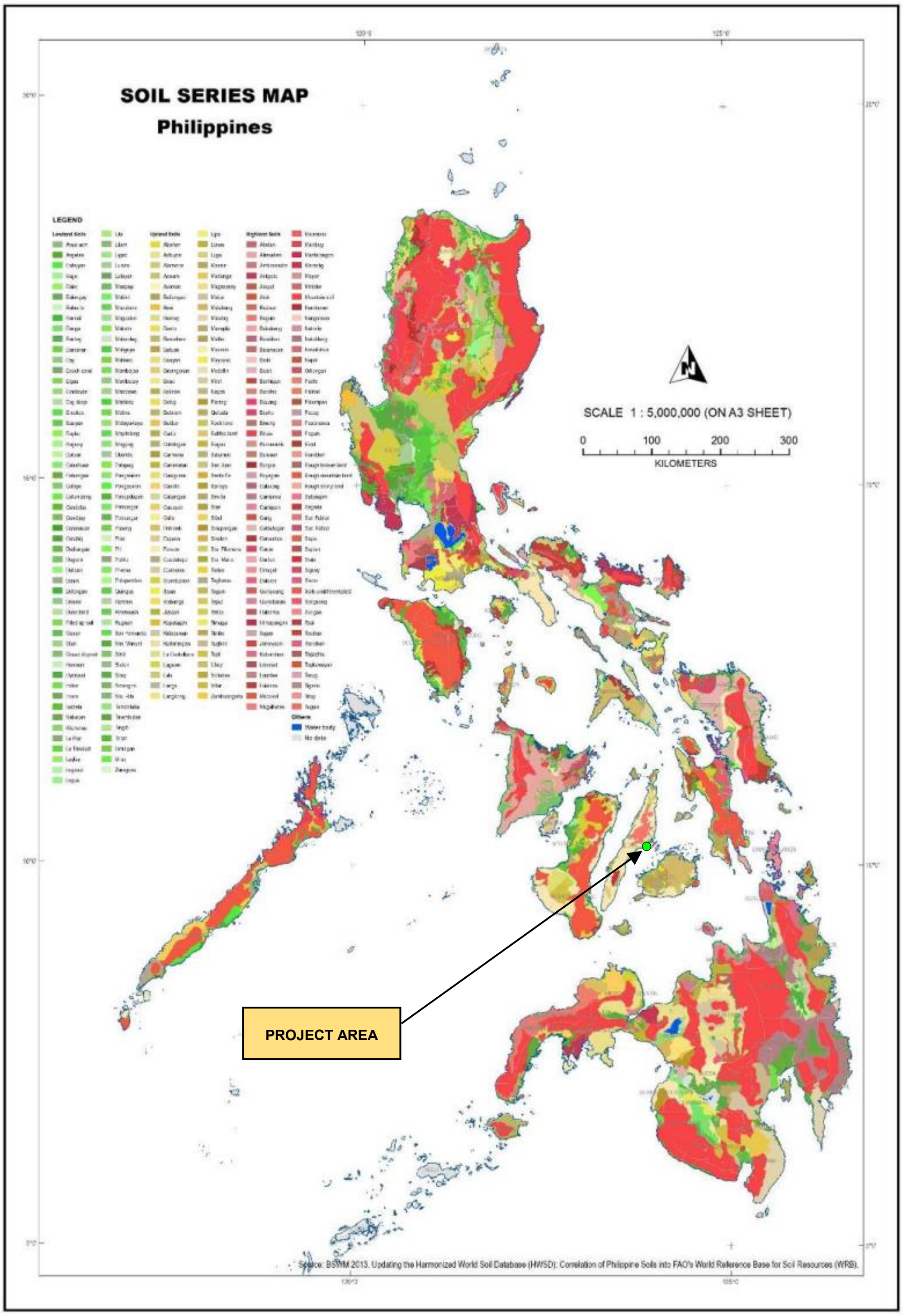
The study area and its vicinities consist of one (1) soil type, which is the Mandaue Clay. This is based from the soil classification made by the Bureau of Soils and Water Management.

Mandaue Clay in the flat areas of study area is the result of weathering of the underlying Quaternary Alluvium. It has a surface soil color of light brown to dark, depending on the amount of organic matter and moisture content. It is friable when just moist, thick and sticky, soft when wet, and hard when dry. The substratum is made up of compact clay loam.

Based on the Soil Series Map of the Philippines (Figure 8.6.6), a soil map showing the distribution of the established Philippine Soil Series, the project area belongs to the Upland Soils, particularly the Faraon Soil Series. This map was compiled and produced by the Soil Survey Division of the Bureau of Soil and Water Management (BSWM) of the Department of Agriculture.

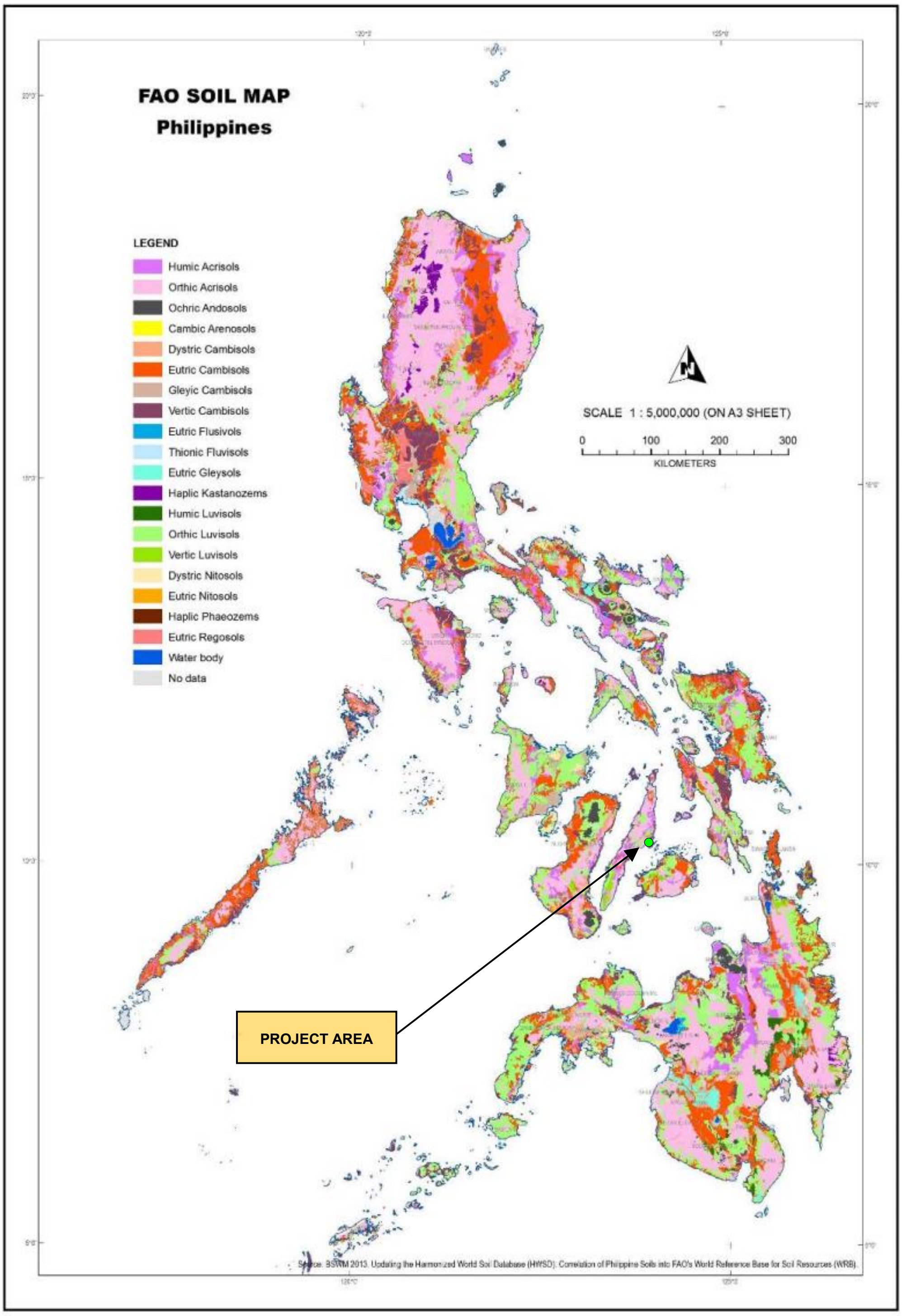
Another Soil Map of the Philippines was classified by the Food and Agriculture Organization (FAO-UNESCO) in the Soil Maps of the World and compiled by BSWM (Figure 8.6.7). The soil type in the project area is classified as Orthic Acrisols, a major type of tropical soils. Acid, low base status (<50% base saturation) and strongly leached. One of the most inherently infertile soils of the tropics, becoming degraded chemically and organically very quickly when utilized. All nutrients, except Al, decreased substantially. Acrisols have very low resilience to degradation and moderate sensitivity to yield decline (*FAO, 1974*).

Soil Erosion Rate Map of the Philippines as prepared by BSWM showed that the project area has a low potential soil loss of about 6.7 to 11.2 tons/hectare/year (Figure 8.6.8). The estimate as compiled by BSWM is based on average annual soil loss for the entire country using the Universal Soil Loss Equation (*BSWM, 2013*).



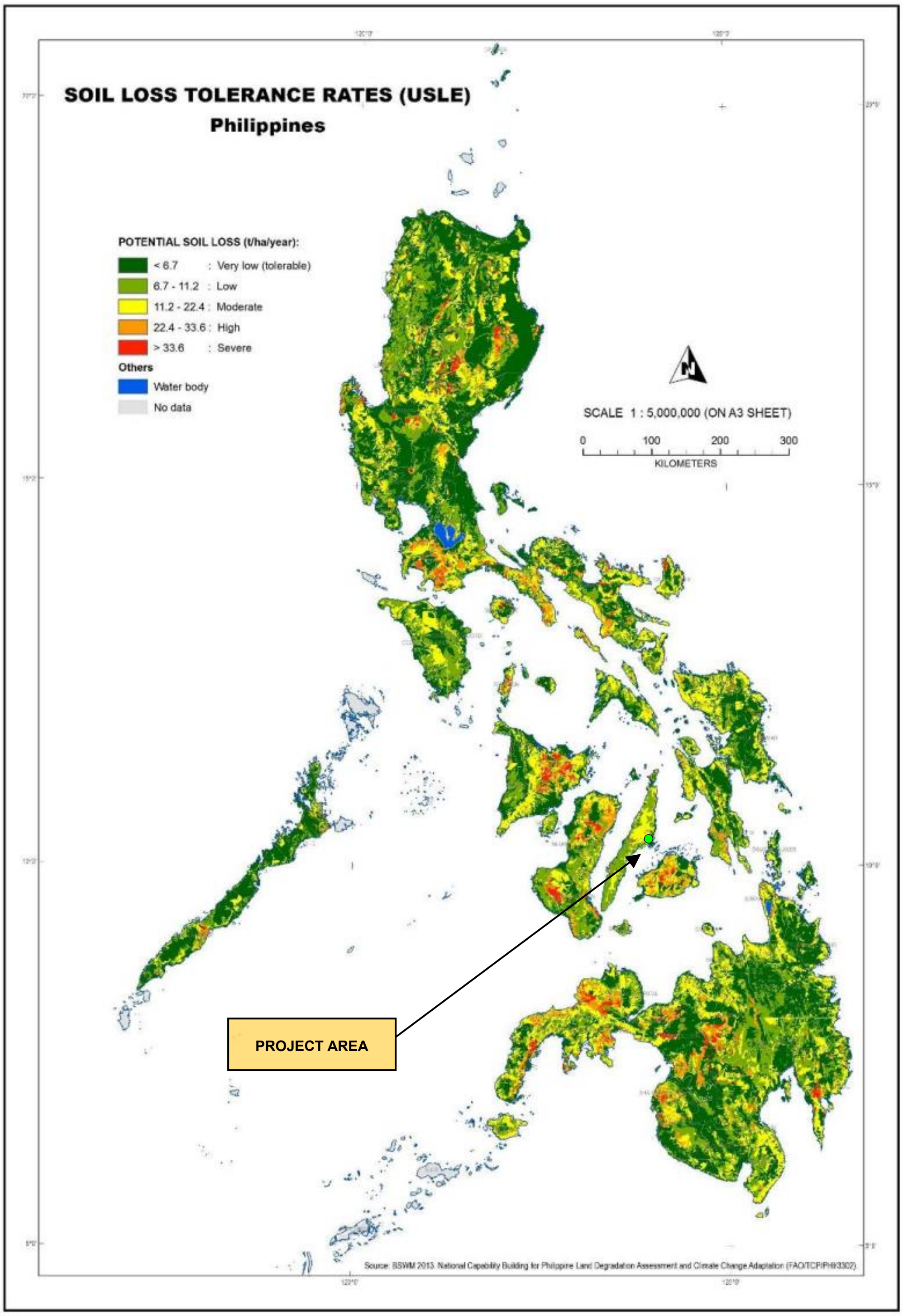
Source: BSWM, 2013

Figure 8.6.6 Soil Series Map of the Philippines showing the Project Area



Source: BSWM, 2013

Figure 8.6.7 FAO Soil Map of the Philippines showing the Project Area

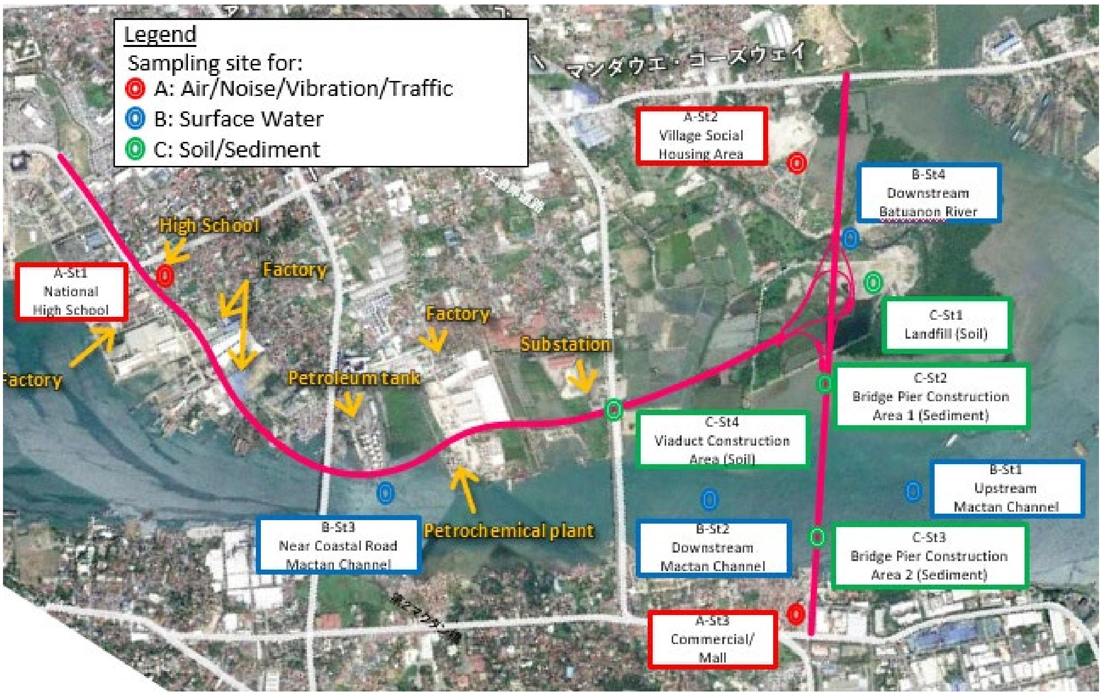


Source: BSWM, 2013

Figure 8.6.8 Soil Erosion Rate Map of the Philippines showing the Project Area

(2) Soil Pollution/ Bottom Sediment

Baseline survey for soil /Sediment quality was performed at four sampling sites along the proposed 4th Cebu-Mactan Bridge route. Figure 4 shows the location of each sampling site.



Source: JICA Survey Team

Figure 8.6.9 Sampling points for soil quality

The sampling result is shown in Table 8.6.9. There are no soil standards in the Philippines, but according to DENR-MC No 2017-003 “The Guidelines for Site Characterization”, US EPA Regional Screening Value (USEPA RSLs) and Dutch Intervention Value (DIV) are recommended to use for Environmental Assessment. Comparing with USEPA RSLs, DIV and Environmental Quality Standards for Soil Pollution in Japan, soil contamination was not confirmed, except the value of cupper at C-St1 near Umapad Dumpsite.

Table 8.6.9 Sampling Results for Soil quality

	unit	C-St1 Landfill	C-St4 Viaduct Construction Area	US EPA Regional Screening Value[1] (Resident/ Industry)	Dutch Standards reference values[2]	Environmental Quality Standards for Soil Pollution in Japan[3]
Cyanide (CN-)	mg/kg	0.05	0.10	23/150		50
Cadmium (Cd)	mg/kg	0.28	<0.03	71/980	12	150
Chromium (Cr)	mg/kg	66.53	30.62		380	250
Lead (Pb)	mg/kg	57.43	27.09	400/800	530	150
Copper (Cu)	mg/kg	952.11	94.02	3100/47000	190	125
Phosphorus (P)	%	0.054	0.065	-	-	-
Selenium (Se)	mg/kg	0.640	0.192	390/5800	100	150
Arsenic (As)	mg/kg	0.50	7.72	0.68/3	55	150
Mercury (Hg)	mg/kg	<0.004	<0.004	11/46	10	15

Source: JICA Survey Team

Note 1 : US EPA Regional Screening Value are presented with target hazard quotients (THQ) of 1.0

2 : Dutch Target and Intervention Values, 2000.Values for soil/sediment have been expressed as the concentration in a standard soil (10% organic matter and 25% clay).

3 :Soil Contamination Countermeasures Act, 2002, Hazardous Category: Class 2 Designated Hazardous Substances

Table 8.6.10 Sampling Results for Sediment

	unit	C-St2 Bridge Pier Construction Area 1	C-St3 Bridge Pier Construction Area 2	US EPA Regional Screening Value[1] (Resident/ Industry)	Dutch Standards reference values[2]	Environmental Quality Standards for Soil Pollution in Japan[3]
Cyanide (CN-)	mg/kg	0.10	0.10	23/150		50
Cadmium (Cd)	mg/kg	<0.03	<0.03	71/980	12	150
Chromium (Cr)	mg/kg	38.53	13.97		380	250
Lead (Pb)	mg/kg	16.82	24.59	400/800	530	150
Copper (Cu)	mg/kg	73.52	56.74	3100/47000	190	125
Phosphorus (P)	%	0.041	0.062	-	-	-
Selenium (Se)	mg/kg	0.117	0.148	390/5800	100	150
Arsenic (As)	mg/kg	7.46	10.71	0.68/3	55	150
Mercury (Hg)	mg/kg	<0.004	<0.004	11/46		15

Source: JICA Survey Team

Note 1 : US EPA Regional Screening Value are presented with target hazard quotients (THQ) of 1.0

2 : Dutch Target and Intervention Values, 2000.Values for soil/sediment have been expressed as the concentration in a standard soil (10% organic matter and 25% clay).

3 :Soil Contamination Countermeasures Act, 2002, Hazardous Category: Class 2 Designated Hazardous Substances

2) Impact Identification and Assessment

(1) Soil erosion

Construction Phase

The 4th Cebu-Mactan Bridge-Mandaue Coastal Road will be constructed as an elevated structure (viaduct) mainly, so that modification of topography due to cut-and-fill work will be limited and the design and the construction plan of viaduct columns will be optimized in the detail design stage.

Even though, there is a possibility that soil runoff will result from limited cut and fill areas, waste soil disposal sites.

Operation phase

During operation stage, there will be no change in topography / geology and soil in the project site. There is a possibility that maintenance of roadway drainage systems, including culvert replacement or repair, which could result in erosion and sedimentation and changes in hydrology. Implementation of established and effective erosion and sedimentation controls will be used during all maintenance of roadway drainage systems, limiting the magnitude of any potential interactions.

(2) Soil Pollution/ Bottom Sediment

Construction Phase

Regarding soil, there is a possibility that soil contamination from accidental releases of chemicals, fuel, oil, lubricants will occur due to the operation of construction equipment.

In addition, excavation work at current open dumping site should be taken care of soil pollution. Based on the Soil sampling, the value of cupper at C-St1 near Umapad Dumpsite is within the US EPA Regional Screening Value (USEPA RSLs) with target hazard quotients (THQ) of 1.0, however it exceeded the Dutch Intervention Value (DIV) and Environmental Quality Standards for Soil Pollution in Japan.

According to the Executive Order No. 37 “An Order Declaring the Permanent Closure of Umapad Controlled Dumpsite and Institutionalizing the Synchronized Waste Collection and Disposal System

(SWCDS)", City of Mandaue has declared that Umapad Controlled Dumpsite in the City of Mandaue be permanently closed and rehabilitated. Solid Waste Management Board (SWMB) shall monitor and evaluate the execution of the closure and rehabilitation and direct the Department of General Services (DGS) to formulate and implement the Closure Plan for purposes of eliminating potential health hazards. Therefore, the project proponents shall coordinate with these two entities, SWMB and DGS, and City Environment & Natural Resource Office (CENRO) closely.

In relation to bottom sediment, no serious impact is expected because the bottom sediment near the construction site of the new Mactan Bridge is not polluted and thus there is no possibility of the bottom sediment stirred up by the installation of piers pollute the surrounding bottom sediment. Hence, no mitigation measure is necessary for bottom sediment.

<u>Operation phase</u>

Regarding soil, there is a possibility that soil contamination from accidental releases of chemicals, fuel, oil, lubricants will occur due to the maintenance work.

3) Impact Mitigation & Enhancement Measures

(1) Soil erosion

<u>Construction phase</u>

During Construction stage, the original topography of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road alignment area changes due to excavation and filling for subgrade/base and road pavement for on-grade road and the columns for inland viaduct.

Mitigation measures to address impacts on topography, slope failures and soil erosion that are being considered and implemented on site are as follows:

- Appropriate soil protection measures when doing excavation for foundation works
- Slope protection such as stone pitching or vegetation are adequate measures to be taken to prevent soil runoff
- Excavated soil (road sub-base, base, foundation works for viaduct columns, etc) be keep away from near banks, waterways
- Provision of drainage sump pits and silt traps
- Others (see mitigation measures for water quality impacts-hydrology/drainage)

<u>Operations phase</u>

During Operation Stage, there will be no change in topography and soils in the project site. Appropriate soil protection measures will be taken, when maintenance work will be conducted.

(2) Soil Pollution/Bottom Sediment

<u>Pre-/Construction phase</u>

Soils may become contaminated during construction works due to leaks and accidental spills of fuels and lubricants from construction vehicles and machineries, as well as other hazardous chemicals like paints and solvents. Releases due to leaks may result in relatively insignificant amount of contaminants in the soil. Potential spills from the equipment and in hazardous materials storage areas could cause a more serious effect. However, given proper spill prevention measures, this event is more unlikely to cause negative adverse effects. The contractors must be required to:

- Establish and implement an emergency and contingency plan in case of spills as well as health and safety management plan
- Store bulk hazardous chemicals in an impermeable area and with appropriate secondary containment and,
- Comply with environmental permitting requirements for the storage, transport, treatment and handling of hazardous substances and wastes
- Conduct a semi-annual soil quality monitoring at 3-4 sampling sites in the interchange area

Regarding the soil contamination at Umapad Dumpsite, the project proponents should follow the Executive Order No. 37 "An Order Declaring the Permanent Closure of Umapad Controlled Dumpsite and Institutionalizing the Synchronized Waste Collection and Disposal System (SWCDS)", and coordinate with the responsible entities of the City of Mandaue, Solid Waste Management Board (SWMB), Department of General Services (DGS) and City Environment & Natural Resource Office (CENRO) closely.

During the pre-construction phase, excess soil from earthwork activities such as excavation, backfilling and embankment may be generated. As the soil of Umapad dumpsite is polluted with copper, rehabilitation must be carried out before any construction work starts in that specific area. The project proponent will conduct a comprehensive soil sampling survey for parameters mentioned in US EPA near the dumping site in the D/D stage to confirm the the level and the range of contamination and provide the results to the Mandaue City as a contribution to the rehabilitation of the dump site. In case that sampling results of excavated soil is still contaminated, construction of any structure shall not be allowed in the contaminated area until the rehabilitation of the soil is completed. The rehabilitation of the soil shall be conducted under the responsibility of the proponent in consultation with the concerned LGU.

During the construction phase, excarvation soil near Umapad Dumpsite will be separated from other excarvation materials and followed the instruction of DENR-EMB (Regional and Central office), DGS and CENRO.

Operations phase

During Operation Stage, there will be no change in topography and soils in the project site. There is a possibility that accidental spills of fuels and lubricants from maintenance vehicles and machineries will occur, but impacts of this will be limited and countermeasure will be the same as the construction stage.

8.6.5 Noise and Vibration

1) Baseline survey result

There are three areas where noise sampling was collected as shown in Figure 8.6.1. The three areas represent sampling in a variety of surroundings such as a school, a residential area and a commercial area.

The noise standards for the different areas are indicated in Table 8.6.11. The national high school, village social housing and commercial mall belong under the AA category, A category and B category, respectively. Since the location of the national high school is directly facing an industrial site, it can be expected to result in a higher noise value. Furthermore, the village social housing and commercial mall are currently directly facing two-lane roads. With the construction and operation of the proposed route, the two-lane roads are expected to increase into four-lane roads, thereby, resulting in additional noise. The corresponding noise standards for four-lane roads are indicated in Table 8.6.12.

International Finance Corporation (IFC) noise standards is shown in Table 8.6.13. According to IFC noise standards, noise impacts should not exceed the levels presented, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site.

Table 8.6.11 Philippine Noise Standards for General Areas

Category of area Unit: L_{Aeq} (dBA)	Morning (5 am - 9 am)	Daytime (9 am - 6 pm)	Evening (6 pm - 10 pm)	Nighttime (10 pm - 5 am)
AA - area which requires quietness such as an area within 100 m from school sites, nursery schools, hospitals, places of worship and special homes for the aged	45	50	45	40
A - General residential areas	50	55	50	45
B - Commercial area	60	65	60	55
C - Light industrial area	65	70	65	60
D - Heavy industrial area	70	75	70	65

Source: National Pollution Control Commission, 1980

Table 8.6.12 Philippine Noise Standards for Areas Directly Facing Four-Lane Roads

Category of area Unit: L_{Aeq} (dBA)	Morning (5 am - 9 am)	Daytime (9 am - 6 pm)	Evening (6 pm - 10 pm)	Nighttime (10 pm - 5 am)
AA - area which requires quietness such as an area within 100 m from school sites, nursery schools, hospitals, places of worship and special homes for the aged	50	55	50	45
A - General residential areas	55	60	55	50
B - Commercial area	65	70	65	60
C - Light industrial area	70	75	70	65
D - Heavy industrial area	75	80	75	70

Source: Vergel, K., Cacho, F., Capiz, C., 2004

Table 8.6.13 IFC Noise Standards

Category of area Unit: L_{Aeq} (dBA)	Morning (7 am - 10 pm)	Nighttime (10 pm - 7 am)
Residential; institutional; educational	50	45
Industrial; commercial	55	50

Source: Environmental, Health, and Safety (EHS) Guidelines, IFC , 2007

Measurement of the noise quality in the three areas was conducted for 15 days in April 2019. The results of the sampling are indicated in Table 8.6.14. Two areas resulted in noise values exceeding the noise standards. As noted in the previous section, the national high school is directly facing a light industrial area. This could have contributed to additional noise generation. Additionally, since it is expected that the proposed route will be a four-lane road the noise standard values will be increased. However, it can also be expected that higher noise values will be generated within these areas in the future.

Table 8.6.14 Measured 1-hr Average Values of Noise Quality

Location	Station	Sampling period	Result (dBA)	Standard for General Area (dBA)	*Standard for areas directly facing four-lane roads (dBA)
Mandaue Comprehensive National High School (Class AA area)	A-ST1	10:55 AM - 11:55 AM	<u>54</u>	50	55
Village Social Housing (Class A area)	A-ST2	01:20 PM - 02:20 PM	<u>57</u>	55	60
Commercial Area Mall (Class B area)	A-ST3	03:30 PM - 04:30 PM	57	65	70

Note: Underlined numbers indicate exceeding the criteria.
Source: JICA Survey Team

In 24 hours noise level monitoring, all locations conducted exceeded the standard limit set by National Pollution Control Commission No. 002 Series of 1980 for Class AA, Class A and Class B in various time zone.

Table 8.6.15 Measured 24-hr Average Values of Noise Quality

Location	Station	Sampling period	Result (dBA)	Standard for General Area (dBA)	*Standard for areas directly facing four-lane roads (dBA)
Mandaue Comprehensive National High School (Class AA area)	A-ST1	Morning (5 AM - 9 AM)	<u>53</u>	45	50
		Daytime (9 AM - 6 PM)	<u>62</u>	50	55
		Evening (6 PM - 10 PM)	<u>56</u>	45	50
		Nighttime (10 PM - 5 AM)	<u>57</u>	40	45
Village Social Housing (Class A area)	A-ST2	Morning (5 AM - 9 AM)	<u>57</u>	50	55
		Daytime (9 AM - 6 PM)	50	55	60
		Evening (6 PM - 10 PM)	<u>56</u>	50	55
		Nighttime (10 PM - 5 AM)	<u>48</u>	45	50
Commercial Area Mall (Class B area)	A-ST3	Morning (5 AM - 9 AM)	<u>62</u>	60	65
		Daytime (9 AM - 6 PM)	62	65	70
		Evening (6 PM - 10 PM)	55	60	65
		Nighttime (10 PM - 5 AM)	50	55	60

Note: Underlined numbers indicate exceeding the criteria.
Source: JICA Survey Team

Figure 8.6.10 Noise Level Sampling point at Mandaue Comprehensive National High School

Figure 8.6.11 Noise Level Sampling point at Village/Social Housing Area

Figure 8.6.12 Noise Level Sampling point at Commercial Area/Mall

2) Impact Identification and Assessment

(1) Noise

Construction Phase

Noise and ground vibrations, particularly during construction stage will certainly affect nearby establishments of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road alignments.

Construction activities increases noise levels within and around the project area. Construction activities resulted to short term, local noise and ground vibration disturbances caused by heavy equipment operation on the site. People's reactions on noise levels could be rated from acceptable, annoyance and discomfort (see Figure 8.6.13).

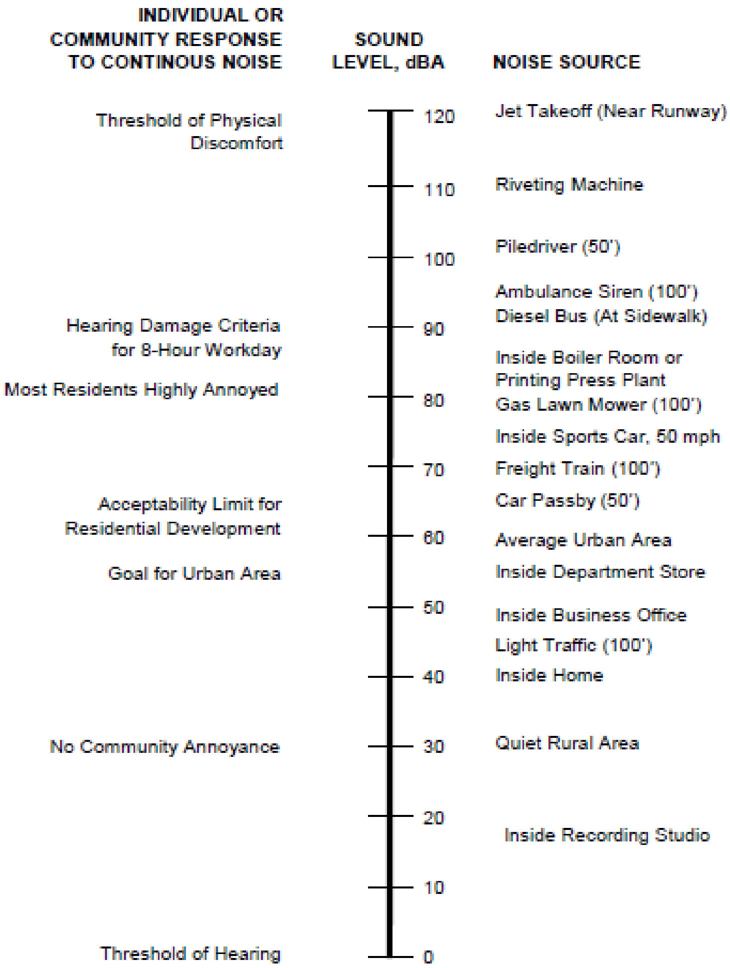


Figure 8.6.13 Typical Sound Levels of Noise Sources and Expected Reactions

Source: Advanced Engineering Acoustics (2010)

1) Forecast Methodology

The Noise during construction stage is coming from the operation of construction machines. The sound level is measured at 1 meters from the machines, the loudest noise from construction machines is 106 dB(A) for pilling work and driving of sheet pile by using earth drill. The noise level assessment during construction will consider sound level in different distances from the origins. Decay Formula Equation will be used in this assessment, which will be done on spare basis, as the Equation (1).

$$L_{p2} = L_{p1} - 20\log(r_2/r_1) \quad (1)$$

When

L_{p1} = Sound level at distance r_1 from the origin

L_{p2} = Sound level at distance r_2 from the origin (forecasted value)

r_1, r_1 = Distance from the origin at sound level L_{p1} and L_{p2}

2) Forecast Point and Forecasted Values

Quantitative forecast is conducted at the points shown in Table 8.6.16. All forecasted point at all points exceed Japanese standards value during construction.

Table 8.6.16 Forecast Result of Noise during Construction

Location	Station	Sampling period	Baseline Result dB(A)	Forecast*1 Result dB(A)	Japanese Standard dB(A)
Mandaue Comprehensive National High School (Class AA area)	A-ST1	Morning (5 AM - 9 AM)	53	103	85
		Daytime (9 AM - 6 PM)	62	103	
		Evening (6 PM - 10 PM)	56	103	
		Nighttime (10 PM - 5 AM)	57	103	
Village Social Housing (Class A area)	A-ST2	Morning (5 AM - 9 AM)	57	86	
		Daytime (9 AM - 6 PM)	50	86	
		Evening (6 PM - 10 PM)	56	86	
		Nighttime (10 PM - 5 AM)	48	86	
Commercial Area Mall (Class B area)	A-ST3	Morning (5 AM - 9 AM)	62	103	
		Daytime (9 AM - 6 PM)	62	103	
		Evening (6 PM - 10 PM)	55	103	
		Nighttime (10 PM - 5 AM)	50	103	

Note)
*1: Results compare the criteria. / Underlined numbers indicate exceeding the criteria.
Source: JICA Survey Team

Operation Phase

The forecast method used is the "ASJ RTN-Model 2013" which is a forecast method of road traffic noise. The forecasted year is 2039, which is more than 10 years in service. The forecast results are shown in Table 8.6.17.

Forecast result on Mandaue Comprehensive National High School (A-ST1) exceeds the IFC standard within 3 dB from the background level (Base Line level) for A-ST1, therefore mitigation measures will be implemented for A-ST1.

Table 8.6.17 Forecast Result of Noise in 2039

Location	Station	Sampling period	Baseline Result dB(A)	Standard for baseline (dBA) *1	Forecast Result dB(A)	Standard for forecast (dBA)
Mandaue Comprehensive National High School (Class AA area)	A-ST1	Morning (5 AM - 9 AM)	53	45	64	56 (*3)
		Daytime (9 AM - 6 PM)	62	50	66	65 (*3)
		Evening (6 PM - 10 PM)	56	45	64	59 (*3)
		Nighttime (10 PM - 5 AM)	57	40	61	60 (*3)
Village Social Housing (Class A area)	A-ST2	Morning (5 AM - 9 AM)	57	50	58	60 (*3)
		Daytime (9 AM - 6 PM)	50	55	52	60 (*2)
		Evening (6 PM - 10 PM)	56	50	57	59 (*3)
		Nighttime (10 PM - 5 AM)	48	45	50	51 (*3)
Commercial Area Mall (Class B area)	A-ST3	Morning (5 AM - 9 AM)	62	60	62	65 (*3)
		Daytime (9 AM - 6 PM)	62	65	62	70 (*2)
		Evening (6 PM - 10 PM)	55	60	56	65 (*2)
		Nighttime (10 PM - 5 AM)	50	55	52	60 (*2)

Note)
*1: Standard for General Area,*2: Standard for areas directly facing four-lane roads, *3: IFC Standard EHS Guide Line within 3 dB from the background level (Base Line) (dBA) / Underlined numbers indicate exceeding the criteria.
IFC Standard: Environmental, Health, and Safety (EHS) Guidelines Noise Management (April 2007)
Source: JICA Survey Team

(2) Vibration

Construction Phase

1) Forecast Methodology

The Vibration during construction is coming from the operation of construction machines. The vibration level is measured at 1 meters from the machines, the highest vibration from construction machines is 56 dB(A) for pilling work and driving of sheet pile by using earth drill. The vibration level assessment during construction will consider vibration level in different distances from the origins. Decay Formula Equation will be used in this assessment, which will be done on spare basis, as the Equation (1).

$$L(r) = L(0) - 15\log10(r/r_0) - 8.68\alpha(r-r_0) \ldots\ldots(1)$$

When

$L(r)$ = Vibration level at forecast point (dB)

$L(0)$ = Vibration level at distance from the origin (vibration at reference point) (dB)

r = Distance from vibration source to forecast point (m)

r_0 = Distance from vibration source to the reference point (5m)

α = Friction damping coefficient (0.01-0.04)

2) Forecast Point and Forecasted Value

Quantitative forecast is conducted at the points shown in Table 8.6.18. There is no forecast value exceeding Japanese standards value of construction vibration.

Table 8.6.18 Forecast Result of Vibration during Construction

Location	Station	Time	Forecast dB	Japanese Standard dB
Mandaue Comprehensive National High School	A-ST1	Day Time Average	46	75
		Night Time Average	46	
Village/Social Housing Area	A-ST2	Day Time Average	23	
		Night Time Average	23	
Commercial Area/Mall	A-ST3	Day Time Average	46	
		Night Time Average	46	

Source: JICA Survey Team

<u>Operation Phase</u>

1) Methodology and Forecast Points

The formulation which has been developed by Ministry of Land, Infrastructure, Transport and Tourism in Japan is used for quantitative traffic vibration forecast with using traffic volume estimation in the 2035. Prediction points are same as during construction points as shown in Figure 8.6.1.

2) Forecast Point and Forecasted Value

The result of quantitative forecast is shown in Table 8.6.19. With regard to applied standard value, Japanese traffic vibration standard is adopted since there are not any standard value on traffic vibration in Philippines. As the result of forecast, all forecasted values are satisfied with Japanese.

Table 8.6.19 Forecast Result of Vibration during Operation Phase

Location	Station	Time	Forecast dB	Japanese Standard dB
Mandaue Comprehensive National High School	A-ST1	Day Time Average	48	75
		Night Time Average	48	
Village/Social Housing Area	A-ST2	Day Time Average	43	
		Night Time Average	43	
Commercial Area/Mall	A-ST3	Day Time Average	46	
		Night Time Average	47	

Source: JICA Survey Team

3) Impact Mitigation & Enhancement Measures

(1) Noise

Construction Phase

In order to minimize the noise distribution levels during the construction phase, temporary noise barrier should be facilitated at all points as table below.

Table 8.6.20 Forecasted Value with Mitigation Measures

<table>
<tr><th rowspan="2">Location</th><th rowspan="2">Station</th><th rowspan="2">Sampling period</th><th>Baseline</th><th>Forecast</th><th rowspan="2">Japanese Standard dB(A)</th><th rowspan="2">Mitigation Measure</th><th rowspan="2">Result with Mitigation Measure dB(A)</th></tr>
<tr><th>Result dB(A)</th><th>Result dB(A)</th></tr>
<tr><td rowspan="4">Mandaue Comprehensive National High School (Class AA area)</td><td rowspan="4">A-ST1</td><td>Morning (5 AM - 9 AM)</td><td>53</td><td><u>103</u></td><td rowspan="12">85</td><td rowspan="4">Temporary Noise Barrier 3m</td><td>83</td></tr>
<tr><td>Daytime (9 AM - 6 PM)</td><td>62</td><td><u>103</u></td><td>83</td></tr>
<tr><td>Evening (6 PM - 10 PM)</td><td>56</td><td><u>103</u></td><td>83</td></tr>
<tr><td>Nighttime (10 PM - 5 AM)</td><td>57</td><td><u>103</u></td><td>83</td></tr>
<tr><td rowspan="4">Village Social Housing (Class A area)</td><td rowspan="4">A-ST2</td><td>Morning (5 AM - 9 AM)</td><td>57</td><td><u>86</u></td><td rowspan="4">Temporary Noise Barrier 2m</td><td>76</td></tr>
<tr><td>Daytime (9 AM - 6 PM)</td><td>50</td><td><u>86</u></td><td>76</td></tr>
<tr><td>Evening (6 PM - 10 PM)</td><td>56</td><td><u>86</u></td><td>76</td></tr>
<tr><td>Nighttime (10 PM - 5 AM)</td><td>48</td><td><u>86</u></td><td>76</td></tr>
<tr><td rowspan="4">Commercial Area Mall (Class B area)</td><td rowspan="4">A-ST3</td><td>Morning (5 AM - 9 AM)</td><td>62</td><td><u>103</u></td><td rowspan="4">Temporary Noise Barrier 3m</td><td>83</td></tr>
<tr><td>Daytime (9 AM - 6 PM)</td><td>62</td><td><u>103</u></td><td>83</td></tr>
<tr><td>Evening (6 PM - 10 PM)</td><td>55</td><td><u>103</u></td><td>83</td></tr>
<tr><td>Nighttime (10 PM - 5 AM)</td><td>50</td><td><u>103</u></td><td>83</td></tr>
</table>

***1:** Results compare the criteria. / Underlined numbers indicate exceeding the criteria.
Source: JICA Survey Team

Temporary noise barriers should be facilitated along the both sides of ROW at A-ST1 and A-ST2, while A-ST3 required it only left side which faces to residential area. The detail of mitigation plans is shown in Table 8.6.21.

Table 8.6.21 Detail of Temporary Noise Barrier

Location	Station	Length(m)	Height(m)
Mandaue Comprehensive National High School (Class AA area)	A-ST1	3,306	3.0
Village Social Housing (Class A area)	A-ST2	600	2.0
Commercial Area Mall (Class B area)	A-ST3	1,726	3.0

Source: JICA Survey Team

Apart from mentioned above, following should be implemented:

- Scheduling of equipment operations during daytime; no nighttime operations (7:00 a.m-7:00 p.m)
- Use only new or properly maintained vehicles, equipment

- Minimize the use of impact devices, such as jackhammers, pavement breakers, and hoe rams
- Installation of noise abatement devices such as mufflers and suppressors to all construction vehicles, machineries, and heavy equipment
- Locate stationary equipment, such as compressors as far as possible from noise sensitive areas.
- Conduct a semi-annual noise level monitoring at sensitive receptor areas

As pile-driving has been identified as the most noisy construction activity, it is recommended that impact-type pile driving should be avoided. Appropriate pile-driving technology for offshore viaduct shall also be required in noise-sensitive receptor area and bird habitat so that the pile-driving will have less disturbance and negative impacts.

Operations Phase

During operation stage, vehicles using the 4th Cebu-Mactan Bridge-Mandaue Coastal Road will generate noise which could cause disturbance especially in Noise-Sensitive Receptors (NSRs) such as churches/places of worships, schools, hospitals, government centers and other institutions. Natural barriers (such as trees/vegetation) and noise attenuation/reduction technologies shall be implemented/instituted in road sections near to NSRs.

As forecast results for the Mandaue Comprehensive National High School (A-ST1) exceeds the IFC standard within 3 dB from the background level (see Table 8.6.22), 2m-height noise barrier on the handrail (1m-height) shall be installed as a mitigation measure. The forecast results with the mitigation measure meet the IFC standards for daytime and nighttime and the Japanese standards for morning and evening time. Therefore, the impact of noise after construction is expected to be sufficiently mitigated and shall be monitored by semi-annual noise level monitoring at sensitive receptor areas.

Table 8.6.22 Mitigation of Forecast Result in 2039 at Mandaue Comprehensive National High School (Class AA area) along the Proposed 4th Cebu-Mactan Bridge route

Location	Station	Sampling period	Baseline Result dB(A)	Standard for baseline (dBA) *1	Forecast Result dB(A)	Standard for forecast (dBA) *2	Mitigation Measure	Result with Mitigation Measure dB(A)	Standard for forecast with mitigation measure dB(A)
Mandaue Comprehensive National High School (Class AA area)	A-ST1	Morning (5 AM - 9 AM)	<u>53</u>	45	<u>64</u>	56	2m-height noise barrier on the handrail (1m-height)	62	70 (*3)
		Daytime (9 AM - 6 PM)	<u>62</u>	50	<u>66</u>	65		65	65 (*2)
		Evening (6 PM - 10 PM)	<u>56</u>	45	<u>64</u>	59		62	65 (*3)
		Nighttime (10 PM - 5 AM)	<u>57</u>	40	<u>61</u>	60		60	60 (*2)

Note)
*1: Standard for General Area,*2: IFC Standard EHS Guide Line within 3 dB from the background level (Base Line), *3: Japan: Ministry of Environment (1998) Environmental Standards for Noise / Underlined numbers indicate exceeding the criteria.
IFC Standard: Environmental, Health, and Safety (EHS) Guidelines Noise Management (April 2007)
Source: JICA Survey Team

Furthermore, setting up the wall can cover drivers' visibility to outside of the road, which contributes to protect the privacy and secure the safety of residential area and factories located along the coastal road. Therefore, it is recommended to install noise barriers, at least, covering from the sensitive area (i.e. schools and hospitals) to the factory area. The detail of mitigation plans is shown in Table 8.6.23.

Table 8.6.23 Detail of Noise Barrier

Beginning Point	End Point	Length(m)	Height(m)
Sta. 0+360	Sta. 3+000	5,280 (2,640 m x 2 sides)	2m-height noise barrier on the 1m-height handrail

(2) Vibration

Construction Phase

As mentioned above, there is no adverse impact on vibration during construction phase, thus no mitigation is required.

Operations Phase

As mentioned above, there is no adverse impact on vibration during operation phase, thus no mitigation is required.

8.6.6 Odor

1) Impact Identification and Assessment

During construction phase, general wastes from the base camp may generate offensive odors. On the other hand, no serious impact is expected because there is no activity planned that may generate offensive odor during operation stage.

2) Impact Mitigation & Enhancement Measures

The mitigation measures for the offensive odor from general wastes are same as the measures for solid waste generation as described in 8.6.33).

8.6.7 Ecosystem (Terrestrial Flora and Fauna or Bird)

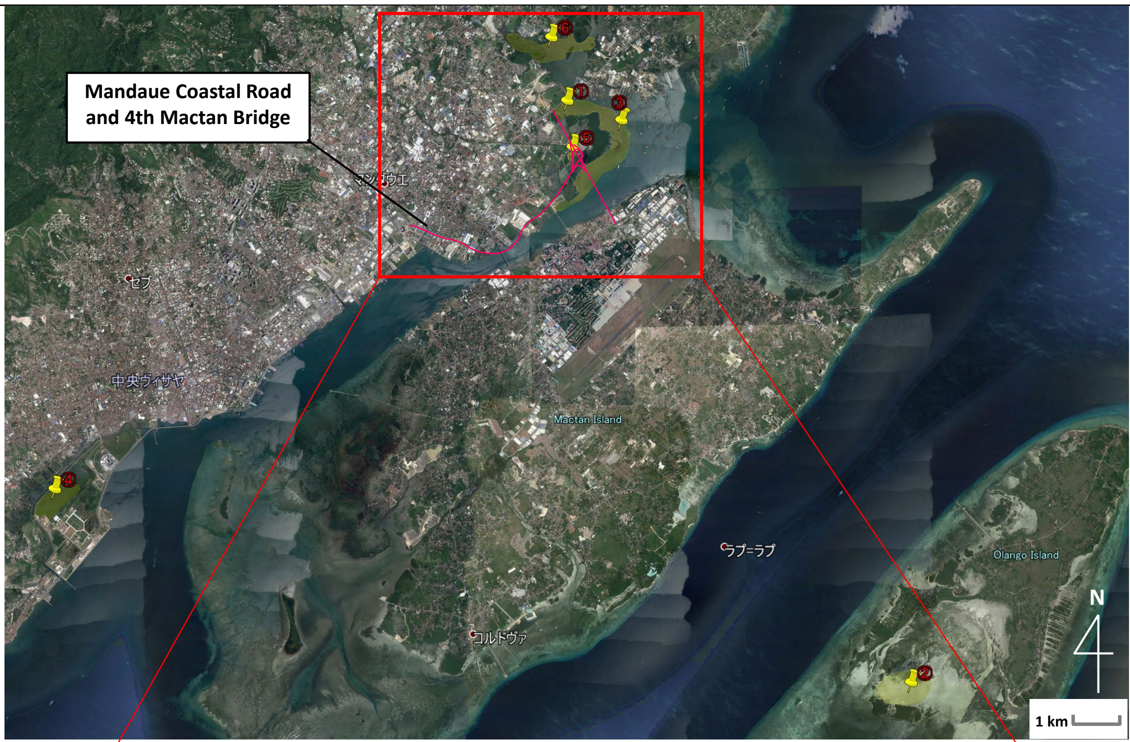
1) Baseline survey result

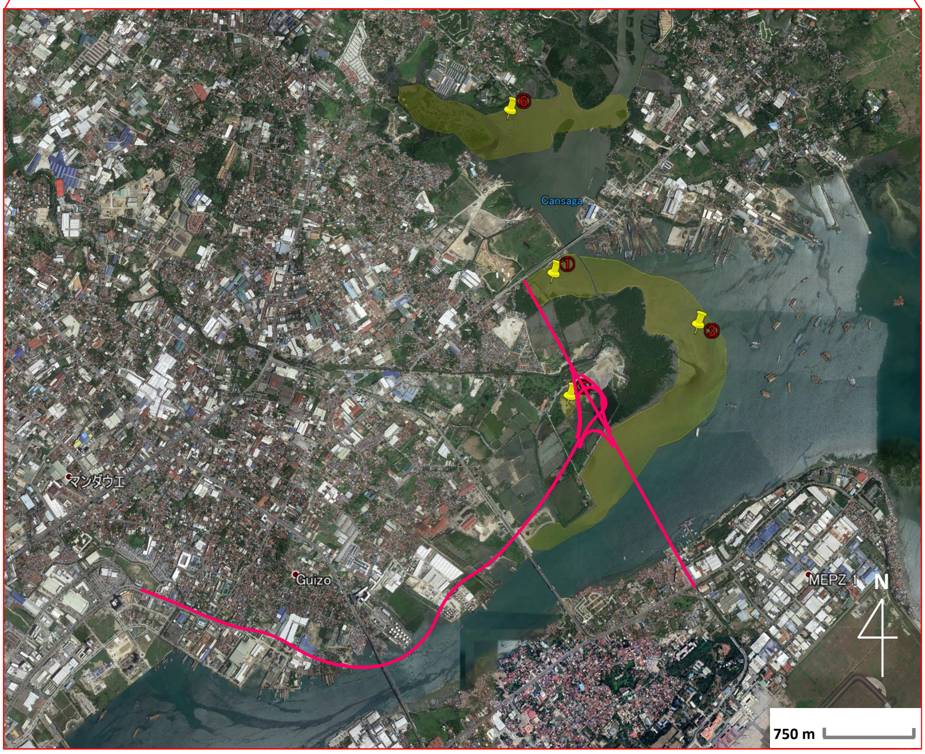
(1) Salient Terrestrial Fauna: Bird / Primary Data

a. Preliminary Bird Survey in December 2018

a.1 Survey Method and Locations

Based on the information above, a preliminary bird survey was undertaken from December 10 to 14, 2018. The Survey Team visually recognized number and species of birds using field glasses, and took photographic records. Observation was done from the sidewalk of Cansaga bay bridge, and from the sea side on boat. The survey areas are shown in Figure 8.6.14.





Source: JICA Survey Team

Figure 8.6.14 Location of Bird Survey

Table 8.6.24 Location (geographical coordinates) of Bird Survey

Location on Map	Name of Survey Area	Longitude	Latitude
①	Cansaga Bay Bridge	10°20'58"	123°58'7"
②	Olango Island	10°24'13"	124°02'7"
③	Cansaga Bay	10°20'33"	123°58'7"
④	Umapad Barangay Waterway	10°16'23"	123°52'14"
⑤	Cansaga Bay Waste Collection Site	10°20'14"	123°58'6"
⑥	Cansaga Inland Bay	10°21'29"	123°57'55"

Source: JICA Survey Team

a.2 Survey Results

The survey found 360 individuals that fall under 11 species in the survey area. If we include those that have been identified in the surrounding areas, the number grows to 540 birds (i.e. 19 species including some unidentifiable ones). Based on the survey, it has been confirmed that the tidal flat facing the mangrove forest located adjacent to the development area in Cansaga Bay is likely to be offering a habitat for herons, snipes and terns (refer to Table 8.6.25 and Table 8.6.26). Threatened species namely Great Knot, Chinese Egrets and Grey-tailed Tattler, on the other hand, were not observed. In consideration of identified importance of the tidal flat in the Cansaga Bay, the road option passing across that area was not prioritized in the alternative analysis (refer to 3.3.2 Analysis on Alternatives).

Table 8.6.25 Birds identified during Bird Survey

Date	Time	Place	Longitude	Latitude	Common Name	Species	Number
Dec 12	12:00-12:30	Cansaga Bay Bridge	10°20'58"	123°58'7"	Mangrove Kingfisher	*Todiramphus chloris*	2
					Swift sp.		≧10
					Little Egret	*Egretta garzetta*	≧50
					Great Egret	*Ardea alba*	1
					Javan Pond Heron	*Ardeola speciosa*	2
					Common Curlew	*Numenius arquata*	1
					Zebra Dove?	*Geopelia striata*	1
Dec 13	8:55-9:45	Olango Island	10°24'13"	124°02'7"	Little Egret	*Egretta garzetta*	≧20
					Bar-tailed Godwit	*Limosa lapponica*	2
					Whimbrel	*Numenius phaeopus*	1
					Wood sandpiper?	*Tringa glareola*	3
					Common Tern	*Sterna hirundo*	≧50
					Mangrove Kingfisher	*Todiramphus chloris*	2
	11:35-12:30	Cansaga Bay	10°20'33"	123°58'7"	Little Egret	*Egretta garzetta*	58
					Intermediate egret	*Egretta intermedia*	5
					Great Egret	*Ardea alba*	4
					Common Tern	*Sterna hirundo*	≧50
	16:00-16:20	Waterway	10°16'23"	123°52'14"	Brahminy Kite	*Haliastur indus*	1
					Little Grebe	*Tachybaptus ruficollis*	2
					Phillipine Duck?	*Anas luzonica*	2
					Moorhen	*Gallinula chloropus*	2
					Black-headed Munia	*Lonchura malacca*	≧20
					Tree Sparrow	*Passer montanus*	≧50
Dec 14	12:08-12:16	Cansaga Bay Waste Collection Site	10°20'14"	123°58'6"	Intermediate egret	*Egretta intermedia*	27
					Little Egret	*Egretta garzetta*	1
					Great Egret	*Ardea alba*	1
					Pied Stilt	*Himantopus leucocephalus*	15
					Whimbrel	*Numenius phaeopus*	2
	14:09-15:07	Cansaga Bay	10°20'34"	123°58'41"	Great Egret	*Ardea alba*	6
					Intermediate egret	*Egretta intermedia*	10
					Little Egret	*Egretta garzetta*	15
					Common Tern	*Sterna hirundo*	≧100
	15:30-15:55	Cansaga Inland Bay	10°21'29"	123°57'55"	Intermediate egret	*Egretta intermedia*	18
					Great Egret	*Ardea alba*	2
					Wood sandpiper?	*Tringa glareola*	2
Total in Project Site							361
Total outside of Project Site							177
					Total	Number of Genus / Number of Species	Number of Individuals
						≧16 / ≧19	≧538

Source: JICA Survey Team

Table 8.6.26 Photos of Birds identified during Bird Survey

<table>
<tr><td>
Many species of swallow were observed at garbage collection plant adjacent to mangroves along Cansaga bay. The mangroves in the project area may have function to purify the polluted water from garbage plant and squatter residential area.</td><td>
Herons and terns were observed at wetland near mangroves which is located behind garbage collection area (10°20‘14”, 123°58'6”).</td></tr>
<tr><td>
Herons and terns were observed at tidal flats at sea side of mangroves in Cansaga bay (10°20‘34”, 123°58’41”).</td><td>
Colony of Little Egret, Intermediate Egret and Great Egret were observed at tidal flats at sea side of mangroves in Cansaga bay.</td></tr>
<tr><td>
Common Terns were observed at tidal flats at sea side of mangroves in Cansaga bay. (10°20‘34”, 123°58’41”)</td><td>
The tidal flats around the mangroves can be recognized as preferable environment for herons and terns, however, the environment of the tideland is deteriorated by plenty garbage or driftwood etc. Thus the environment must be improved properly to conserve the tidal flats for the birds.</td></tr>
</table>

b. Bird Survey in March 2019

b.1 Methodology

Assessment of all terrestrial fauna in mangrove and terrestrial vegetation was conducted following the pre-identified road line alignment in the area (refer to 4.1.1.2 (4) 1) d. Charting and Mapping).

Transect lines were established from segment 1 to 3 inside mangrove forest with at least 100 meters apart. The observer used a handy binocular with field identification guide for Philippine birds and Digital Single Lens Reflex (DSLR) camera for photo documentation. Observations were conducted during 6:00 A.M. to 9:00AM and 4:00PM to 6:00PM on March 30 and 31, 2019. All birds, seen or heard calling, were identified and recorded. Stations 4 to 7 were skipped because the area was claimed by the private individual. The activity was continued in segment 8 to 14. At this time, the point count method was used in the area; the observer waited for at least 3 minutes after arriving and then recorded all birds within a 20-meter radius for five minutes. Each station was placed 200 meters apart.

b.2 Results

Species Composition:

A total of twenty-one (21) species belonging to nineteen (19) families have been identified in the remaining mangrove forest and a terrestrial area along the proposed road alignment in Barangay Paknaan and Umapad of Mandaue City and Barangay Ibo of Lapu-Lapu City. Of the birds listed, Egret spp. is a migratory bird. White-collared Kingfisher is resident, and some are endemic species. The similar characteristics of egrets demonstrates the difficulty of taxonomic identification. With the assistance of local and international bird experts, it is concluded that the Egret spp. observed in this assessment are, most probably, either Great Egret, Intermediate Egret or Little Egret. Nevertheless, it should be noted that no sighting of threatened species such as Chinese Egret in a single-shot survey does not prove that they do not exist.

Species Population

A total number of 175 individuals of bird species were identified in the surveyed area. Of the twenty-one (21) species, Egret spp. (most probably, either Great Egret, Intermediate Egret or Little Egret) recorded the highest number of individuals with a total of 38 followed by Eurasian Tree Sparrow (Passer montanus) (35 number of individuals), Terns spp. (25 number of individuals) and Glossy swiftlet (Collocalia esculenta) with 21 number of individuals, respectively. The rest of the species identified had registered below 15 numbers of individuals (Table 8.6.27). All the species identified in the area belong to Least Concern (LC) under the IUCN Red List.

Table 8.6.27 List of birds found within the Right of Way

Species		No. of Individuals	Status	Current IUCN Red List Category
Family/Scientific Name	Common Name			
A)Alcediniidae *1. Todiramphus chloris*	White-collared Kingfisher	2	Resident	Least concern
B) Apodidae *2. Collocalia esculenta*	Glossy swiftlet	21		Least concern
C) Ardeidae *3. Egretta spp.*	(Great Egret/Intermediate Egret/Little Egret)	38	Migratory	Least concern
D) Ardeidae *4. Nycticorax nycticorax*	Black-crowned night heron	2		Least concern
E) Campephagidae *5. Lalage nigra*	Pied triller	1		Least concern
F) Charadriidae *6. Charadrius mongolus* *7. Pluvialis fulva*	Lesser Sand plover Pacific Golden plover	2 3		Least concern Least concern
G) Columbidae *8. Geopelia striata*	Zebra Dove	4		Least concern
H) Decacidae *9. Dicaeum australe*	Red-keeled flowerpecker	1		Least concern
I)Estrildidae *10. Lonchura atricapilla*	Chestnut munia	12		Least concern
G) Lannidae *11. Lanius cristatus* *12. Lanius schach*	Brown shrike Long-tailed shrike	1 2		Least concern Least concern
K) Laridae *13.Terns Spp.*	Terns *Spp.*	25		Least concern
L) Muscicapidae *14. Cyornis rufigastra*	Mangrove blue-flycatcher	6		Least concern
M) Nectarinidae *15. Cinnyris jugalaris*	Olive-backed sunbird	2		Least concern
N) Passeridae *16. Passer montanus*	Eurasian tree sparrow	35		Least concern
O) Picnonotidae *17. Pycnonotus goiavier*	Yellow-vented bulbul	3		Least concern
P) Rallidae *18.Hypotaenidia torquate*	Barred rail	1		Least concern
Q) Rhipiduridae *19. Rhipidura nigritorquis*	Pied Fantail	7		Least concern
R) Scolopacidae *20.Tringa nebularia*	Common greenshank	2		Least concern
S) Sturnidae *21. Aplonis panayensis*	Asian glossy Starling	5		Least concern
TOTAL		175		

Table 8.6.28 Photos of Fauna Assessment

	
Avifauna survey using a handy binocular to observe a flock of birds within Segment 1 of Road 2 alignment at Barangay Paknaan, Mandaue City, Cebu.	A tern species of bird that belonged to Laridae family is perching on a water hose which crosses bank of Butuanon River from Barangay Paknaan to Barangay Umapad in Mandaue City, Cebu (Station 8-9 of Road 2 alignment).
	
An Egret spp., which shows characteristics of Intermediate Egret, was observed feeding in the open area near Station 1-2 of Road 2 alignment of Barangay Paknaan, Mandaue City.	An Egret spp., which shows characteristics of Little Egret, was spotted in near a fishpond development (segment/station 4 of Road 1 alignment).

(2) Interview to Local Experts on Birds and their Habitats

In general, long-term monitoring data of bird population over two seasons is of great importance to grasp accurately the baseline condition of birds, in particular migratory birds including threatened species, in the project area. This is because the result of one-shot surveys is insufficient to describe the target birdlife accurately due to its temporal and seasonal variations. However, as a result of consultations with relevant organizations/institutions, it is found that there is no such data for the project area unlike Olango Island where DENR has been conducting regular monitoring survey on bird species and population. Hence, to fill the gap and complement the one-shot survey findings, the Survey Team carried out interviews to local experts on birds.

<u>Methodology</u>

The Survey team presented the project brief, with an emphasis on the fact that the entire project area is located in an IBA/KBA because of the sighting records of threatened bird species such as Chinese Egret in 1980s, and asked questions on adverse impacts of the project on birds and their habitats and possible mitigation measures in the semi-structured interviews. A semi-structured interview is a meeting in which the interviewer does not strictly follow a formalized list of questions. They ask more open-ended questions, allowing for a discussion with the interviewee rather than a straightforward question and answer format.

<u>Interviewee</u>

Interviews were carried out to the following local experts. In consideration of the experiences in bird surveys near the Cansaga Bay area as well as the role of designation of this area as an IBA, technical insights from the Philippines Biodiversity Conservation Foundation, Inc., DENR-CENRO, the Former president of Cebu Biodiversity Conservation Foundation, Inc. and Haribon Foundation are referred to.

Table 8.6.29 Interviews with the local experts

Organization/Institution	Experience in bird survey in Cansaga Bay Area
Philippines Biodiversity Conservation Foundation, Inc.	Yes - More than 20 years of bird census in Cebu Region - Chief editor of "State of Cebu's Biodiversity"
DENR-CENRO	Yes - Experience in bird census in Olango Island
Former president of Cebu Biodiversity Conservation Foundation, Inc.(Cebu Chamber of Commerce and Industry)	Yes - Formerly led bird census team in Cebu
Haribon Foundation	Unknown - The organization that designated the IBA in collaboration with Birdlife International
University of Philippines Cebu	No
Freelance Consultant	No
Wild Bird Club of the Philippines	No

<u>Summary of the Interview Results</u>

Table 8.6.30 shows the summary of technical insights provided by the interviewed experts. All of them highlighted the higher importance of Olango Island and Jugan area as birds' roosting and feeding grounds relative to the Cansaga Bay area, as the Cansaga Bay area is highly degraded as birds' habitat due to development carried out over years since 1980s. They also mentioned that they did not have any observation record of migratory endangered species or their nests such as Chinese Egret near the Cansaga Bay area, and that Little Egret, Intermediate Egret and/or Great Egret are often misidentified with Chinese Egret due to their similar characteristics. Nevertheless, they also indicated that some individuals of endangered species including Chinese Egret, recorded to roost and feed in Olango Island, may fly to the Cansaga Bay area to look for alternative feeding ground, when Olango Island is not utilizable due to, for example, high tide time. This is likely not only in the peaks of migration seasons (i.e. December-February towards north and September-October towards south), but also in period other than those seasons, as some individuals are recorded to overstay in the Central Visayas area, including Olango Island, Cansaga Bay area and Jugan area, not flying over to their general destinations in the northern hemisphere (i.e. Siberia and Polustrov Kamchatka) and Southern hemisphere (i.e. Australia and New Zealand). This demonstrates how important it would be conduct regular bird monitoring.

Table 8.6.30 Summary of insights by local experts

Interviewee	Summary
Philippines Biodiversity Conservation Foundation, Inc. (Executive Manager and Operations Manager)	• In 1980s, the continuous area "Jugan- Cansaga bay-Olango Island" used to be an important feeding/roosting area for migratory birds. However, the area surrounding the mouth of Cansaga bay is no more functional as a feeding/roosting area due to heavy siltation of tidal flat and development activities such as reclamation and fishpond operation causing degradation of mangrove forest. Hence, since 2000s, Olango Island and Jugan areas are the only functional and important feeding/roosting grounds for migratory birds. • The peak of migration towards northern hemisphere is December-February, and that of migration towards south (i.e. Australia and New Zealand) is September-October. There are some individuals that do not fly to Australia and New Zealand and overstays in Central Visayas area. It is thus important to carry out regular monitoring not only over two migration seasons but also the period between them. • Endangered migratory bird species such as Chinese Egret have not been observed near the project site, whereas they have been observed in Olango Island and Jugan. Egret species that are often misidentified as Chinese Egret due to similar characteristics are mostly Little Egret, Intermediate Egret or Great Egret (*Indeed, pictures of birds that the Survey Team took during the flora and fauna survey was checked by the Philippines Biodiversity Conservation Foundation, Inc. and no Chinese Egret was identified in the pictures).
DENR (Olango Island-	• DENR just started quarterly water birds census near the Cansaga Bay since January 2019. The 2nd census is to be done in June 2019. Joint monitoring with the new Mactan Bridge project would be

Interviewee	Summary
based Protected Area Coordinator)	appreciated. • In the 1st census in January 2019, any endangered species such as Chinese Egret was not observed near the Cansaga Bay, whereas many of them were recorded feeding and roosting in Olango Island. The egret species found feeding near the Cansaga Bay area included Little Egret and Intermediate Egret. • When Olango Island is in high tide, birds tend to look for other feeding ground, possibly Jugan and Cansaga Bay area. • It is recommended to avoid construction work during low tide when birds come to feed on tidal flats and other wetlands. • Two season survey is needed only for fauna in tidal flats because living conditions are different over seasons (i.e. under and above water). In addition, these invertebrates are important because they serve as resources for migratory birds. • DENR-CENRO agrees on the suggested plan to make the interchange area to be maintained as wetland area for birds to be able to continue to use the area as feeding ground.
Former president of Cebu Biodiversity Conservation Foundation, Inc	• Main feeding and roosting ground of the birds observed near the project site is Olango Island. They are also observed in Talibon, Bohol Island. • Since the mangrove forest facing the Cansaga Bay has already been severely disturbed, it is doubtful whether birds can still roost in that forest. Also, Olango Island is the most important bird habitat in the Central Visayas area. Considering that the quality of the mangrove forest facing the Cansaga Bay in terms of birds' roosting area and that Olango Island can host many birds as feeding and roosting grounds, it is unlikely that the project site (i.e. Cansaga Bay area) is presently an irreplaceable important habitat for bird species, in particular, endangered species. • Even if endangered bird species feed on the tidal flat near the Cansaga Bay and if the tidal flat near the Cansaga Bay is degraded as feeding ground due to road and bridge constructions, I think that endangered species would be hardly affected because they can move to other habitable sites such as Olango Island looking for feeding/roosting grounds. • Given the project site is designated as IBA/KBA, it is recommendable to conduct an orientation on how to deal with sightings of endangered species during construction phase for implementers such as DPWH and contractors. • It would be advisable to integrate in the designing the element that can possibly contribute to the project site becoming a touristic spot making use of the environmental value of IBA/KBA, such as viewpoint of mangrove and tidal flats on the interchange section.
Haribon Foundation	• The project site (ROW) and the surrounding environment is the most ideal habitat for birds because the tidal flats provide feeding ground, while mangrove provides areas for roosting. • Dwindling habitats for birds forces these birds to seek refuge in any place they can find for feeding and resting. • It is recommended to conduct the second stage of the bird survey in the period between September-March where the migratory birds visit the area. The survey should be detailed so as to identify the egret species. Suggest to conduct an RBI (Rapid Biodiversity Inventory). Haribon foundation could do such study. • The construction activities will be the most critical as the area will be highly disturbed and could prevent the birds from accessing their foraging and roosting places. • As for the operation stage, it is still unclear whether the noise could affect the birds—that is, if the environment/habitat will be preserved/maintained or restored back after construction • Construction activities should not significantly pose disturbances to birds during the migration season (September-March). • After construction, the natural habitat shall be restored and the area be declared as a 'critical habitat' to allow local or national protection of the area • There are example that bridges have become 'viewing decks' for bird watching, when the surrounding environments have been restored back to more or less to its original state. • If the disturbance to birds caused by the construction activities will be mitigated, then the project will be implemented • Restoration of the habitat shall be undertaken after the construction stage and measures to protect the area (e.g. declaring it as a critical habitat) shall be implemented all throughout the operational stage of the project. However, declaration of 'critical habitat' shall be made when it is found out appropriate after undertaking an RBI. • The presence of fishponds and swamps provides alternative choices for birds to forage and roost. This area will probably be one of the few remaining areas, including Jugan, which the birds could visit outside of the Olango Island.

(3) Seasonal Variation of Flora and Fauna

To identify the existing terrestrial flora in the project site, an ocular study was undertaken in March 2019, focusing on mangrove and terrestrial tree in accordance with the scoping checklist agreed at the technical scoping with the EIA Review Committee. The study is comprised of an inventory and assessment of the stand structure and species composition of the mangrove and terrestrial trees within the Right of Way (RoW) of the New Mactan Bridge and the Mandaue Coastal Road.

Based on discussions with aforementioned local experts and secondary data analysis, it is concluded that flora and fauna surveys over two seasons (i.e. dry and rainy seasons) are unnecessary except for fauna living on wetland for the following reasons:

- The parameters used for grasping the baseline condition of mangrove and terrestrial trees such as species composition, density and abundances do not vary notably with the season because these parameters change over a longer period of time. Indeed, the FAO's National Forestry Inventory Field Manual Template (2004) recommends to conduct assessments with an interval of over 1 year. The Forestry Agency of Japan also carries out a forest resource assessment once in about five years.
- Aquatic fauna living on wetlands, on the other hand, are susceptible to the seasonal variations of environmental conditions, particularly the amount of water, because their habitats are affected directly, resulting in the change in distribution, species composition and abundance. In addition, understanding the baseline condition of the organisms living on wetland is important because organisms living on wetland, especially macro vertebrates, serve as the food for birds that are among the most salient characteristics of the natural environment in the project area.

(4) Mangrove

<u>Methodology and Survey Locations</u>

Transect lines were run following the center line in the pre-identified stations. Five sampling segments only (Segment 1-2, 2-3, 3-4, 7-8, 11-12, and 12-13) were inventoried for mangrove assessment since other portions of mangrove areas are privately owned with an on-going reclamation activity and the Survey Team was not allowed to pass in these areas.

To facilitate inventory and data collection, transect lines were segmented at every 100 m distance resulting to 40 m x 100 m sampling stations. All mangrove species encountered along the transect line were identified, measured and recorded as to: species; diameter at breast height (DBH); total height; and the regeneration which includes 5cm below in DBH. From the data collected, the following parameters were computed: Frequency (F); Relative Frequency (RF); Relative Density (RDen); Relative Dominance (RDom); a number of trees per hectare; basal area per hectare; and importance value (IV) of mangrove species. The following formulas were used in the computation.

Frequency (F)

$$F = \frac{\text{Total No. of Segments in which Species A occur}}{\text{Total No. of Segments Sampled}} \times 100$$

Relative Frequency (RF)

$$RF = \frac{\text{F Value of Species A}}{\text{Total F Value of All Species}} \times 100$$

Relative Density (RDen)

$$RDEn = \frac{\text{No. of Individuals of Species A}}{\text{Total No. of Individuals of All Species}} \times 100$$

Relative Dominance (RDom)

$$RDom = \frac{\text{Total Basal Area of Species A}}{\text{Total Basal Area of All Species}} \times 100$$

Importance Value (IV)

IV = RF + RDen + RDom

Basal Area

$$\textit{Average BA per ha} = \frac{\text{Total Basal Area (m}^2\text{)}}{\text{Total Area Sampled}} \times 100$$

Regeneration

$$\textit{Regeneration (per sq.m)} = \frac{\text{Total Regeneration Count per Species A}}{\text{Total No. of Regeneration Plots}}$$

The relative location of these study sites is shown in Figure 8.6.15.

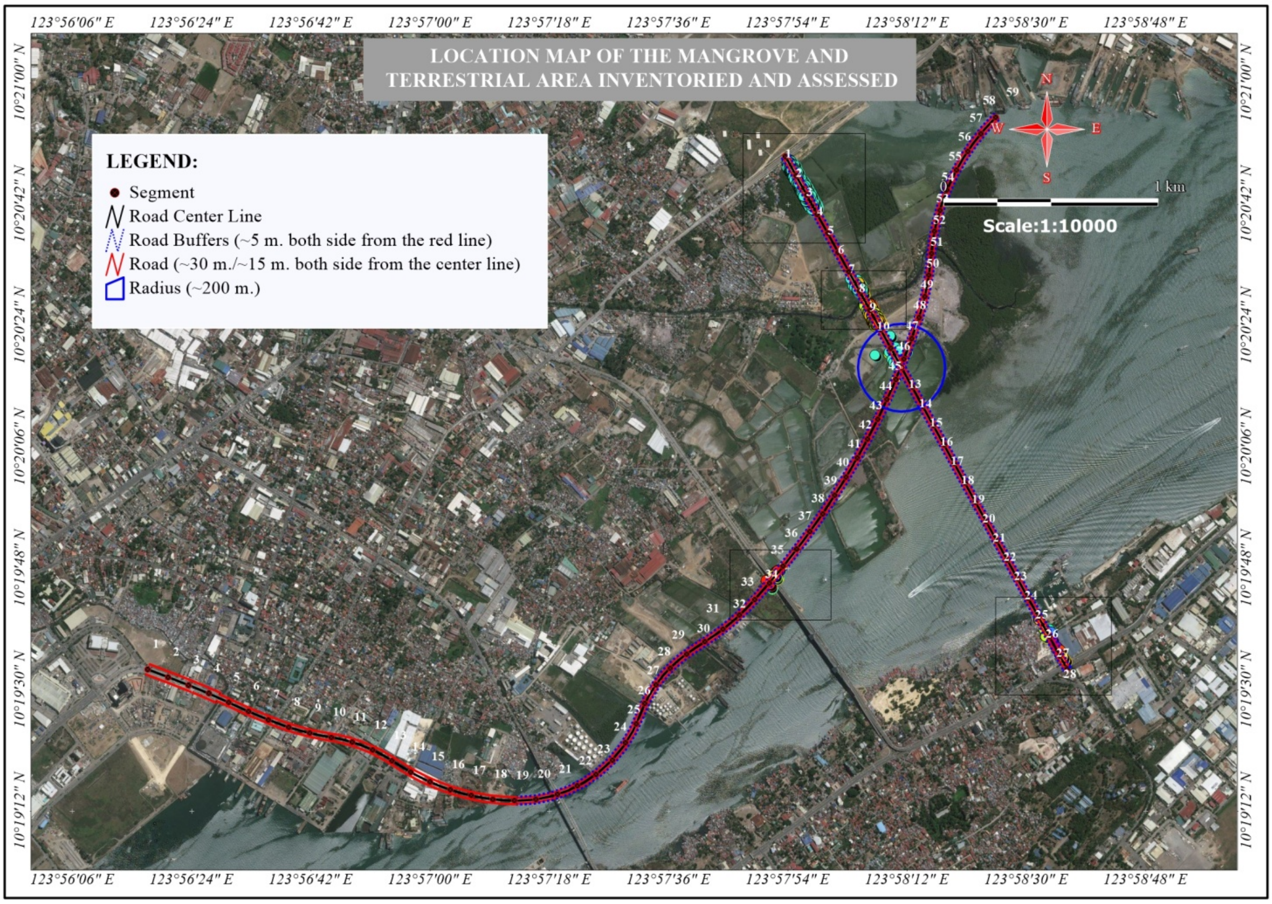


Figure 8.6.15 Location map of mangrove forest and terrestrial areas assessed

Survey Results

The mangrove forest is mainly distributed in Barangay Paknaan and Umapad of Mandaue City in the project site. A total of four species (4) mangrove species belonging to three (3) families were identified in the area, namely: 1) Rhizophora apiculata (Bakauan-lalaki); R. stylosa (Bakauan-bangkau); Avicennia marina (Bungalon); and Sonneratia alba (Pagatpat) as reflected in Table 8.6.32. All species are classified under Least Concern (LC) in the IUCN Red List.

Table 8.6.31 Species composition and diversity of the mangrove forest assessed

Family Name	Scientific Name	Common Name	IUCN Red List
1. Rhizophoracea	1. *Rhizophora apiculata*	Bakuan lalaki	Least Concern (LC)
	2. *Rhizophora stylosa*	Bakuan bangkau	Least Concern (LC)
2. Avicenniacea	3. *Avicennia marina*	Bungalon	Least Concern (LC)
3. Sonneratiaceae	3. *Sonneratia alba*	Pagatpat	Least Concern (LC)

Table 8.6.32 shows the stand structure and characteristics in the mangrove areas assessed. Avicennia marina recorded the highest Importance Value[3] (IV) with a total of 233.64. Ranked second is Rhizophora stylosa with an IV of 26.70 followed by Sonneratia alba (IV of 24.56) and the lowest was Rhizophora apiculata with a total of 16.10 IV only. The rest are of lesser importance in terms of their frequency of occurrence/distribution within the stand, their number of individuals, and the basal area occupied by the main stem.

[3] Importance Value = Relative Frequency + Relative Density + Relative Dominance

Table 8.6.32 Stand structure and species composition of the remaining mangrove forest

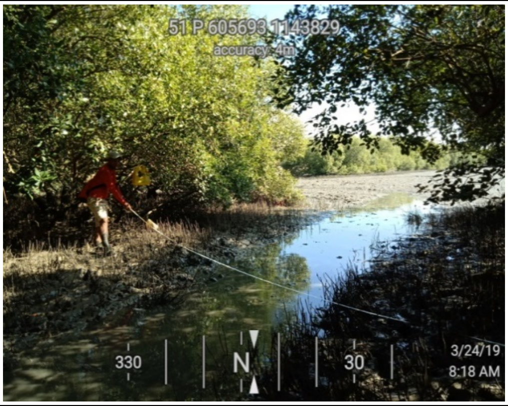
Species	No. of Segment	Total No. of Trees	Total BA (m2)	Frequency	Relative Frequency (%)	Relative Density (%)	Relative Dominance (%)	Important Value	Regeneration (per ha)
Rhizophora stylosa	3	30	0.16	60	23.08	2.63	0.99	26.70	6
Rhizophora apiculata	2	6	0.03	40	15.38	0.53	0.19	16.10	3
Avicennia marina	5	1,096	15.79	100	38.46	96.22	97.95	232.64	925
Sonneratia alba	3	7	0.14	60	23.08	0.61	0.87	24.56	7
TOTAL	**-**	**1,139**	**16.12**	**260**	**100**	**100**	**100**	**300**	**935**

Note)

No. of Segment Sampled: 5

The dimension of Segment: 4 segments with a dimension of 40m x 100m and 1 segment with a dimension of 200m radius located in the pre-identified station 11-12 and station 12-13

Table 8.6.33 Photos of Mangrove Assessment

	
A transect line is laid out to determine the center line of the road alignment that traverses Paknaan mangrove area to the 4th New Mactan Bridge (Road 2).	A first tree corner of the inventoried mangrove area is measured by a survey team member.
	
Measuring a stem/bole (diameter at breast height) of mangrove tree in Barangay Paknaan, Mandaue City, Cebu.	An on-going reclamation activity in mangrove area with significant tree covers at Paknaan road alignment covering Segments/Stations 4 to 7 (i.e., highlighted in red color).
	
Informal settlers in mangrove area that would be affected by the proposed road project (i.e., located at segment 7-8 in Road 2).	Segment 8 of Road 2 shows the inventoried mangrove vegetation and informal settlers.

A panoramic view of the assessed mangrove area at Segments 11 to 13 of Road 2 and Segments 45 to 47 of Road 1 near the landfill, which is marked in red color.

(5) Terrestrial Vegetation

a. Methodology and Survey Locations

Transect lines were run following the center line in the pre-identified stations. Six sampling segments only (Segment 8-9, 9-10, 24-25, 25-26, 33-34, and 34-35) were inventoried since other portions of the proposed roads is mangrove area, abandoned fishpond and landfill areas.

To facilitate inventory and data collection, transect lines were segmented at every 100 m distance resulting in 40 m x 100 m sampling stations. All terrestrial tree species encountered along the transect line were identified, measured and recorded as to species; diameter; merchantable height; total height; and the regeneration. The volume of every tree recorded is based on the "Regional Volume Equation for Standing Trees"[4]. For volume data computation and analysis, the following formula was used.

Volume = 0.4874 X (D^2) x MH

b. Survey Results

b.1 Species Composition and Diversity

A total of thirty one (31) terrestrial tree species belonging to fifteen (15) families were found in the surveyed area. Of the fifteen families, Fabaceae family recorded the highest number of species with a total of eight (8) species followed by Myrtaceae and Miliaceae family having a total of four and three species, respectively. The rest of the families were recorded two and below only.

Of the thirty one (31) species identified, a total of two (2) species are belonging to premium species[5], namely: 1) Molave (Vitex parviflora) and Narra (Pterocarpus indicus). There were five (5) exotic species identified in survey areas such as Auri (Acacia auriculiformis), Mangium (Acacia mangium), Mahogany (Swietenia macrophylla), Eucalyptus camaldulenses, and Gmelina (Gmelina arborea). The rest of the species are indigenous, fruit trees and lesser used species.

[4] DENR Forest Management Bureau Technical Bulletin No. 2

[5] Premium tree species is a tree species, the wood of which has special characteristics, such as strength, durability, beauty, scarcity and rarity or is used for special purpose. The premium species are listed in DAO 78, Series of 1987.

Molave (*Vitex parvoflora*) is included in the list of threatened plants in the Philippines and their category stipulated in DAO No. 1-2007[6], being classified as category B belonging to endangered species, while all other species are not included in the list. In addition, Molave (Vitex parviflora), Narra (Pterocarpus indicus) and Mahogany (Swietenia macrophylla) are listed in the IUCN Red List of Threatened Species and classified under 'Vulnerable (VU)', Endangered (EN) and 'Vulnerable (VU)', respectively.

b.2 Stand Structures and Characteristics

The stand largely comprised of small, medium to large size trees. The large tree was Alstonia scholaris and Ficus balete having a stem diameter of 85.94 cm, 10.0 m in merchantable height, and 20.0 m in average total height, respectively. While the medium size tree was Acacia auriculiformis averaging 22.7 cm stem diameter and 8.43 m in height per tree. Other species are considered small trees having an average diameter ranging from 5.00 cm to 24 cm in diameter per tree. The stand has an average diameter breast height, average merchantable height, and average height of a total of 19.68 cm, 4.40 m, and 8.36 m, respectively (Table 8.6.34).

[6] DENR Administrative Order No. 1-2007, Establishing the National List of Threatedned Philippine Plants and Their Categories and the List of Other Wildlife Species

Table 8.6.34 Species composition, diversity and Stand characteristics of terrestrial trees

Common Name	Scientific Name	List of threatened plants in Philippines (DAO No.1-2007)	IUCN Red List Category	Average Diameter Breast Height (cm)	Average Merchantable Height (m)	Average Height (m)
1. Anabiong	Trema Orientalis	Not included	LC	17.74	2.82	8.43
2. Aroma	Aroma farnesiana	ditto	NE	11.13	2.3	8.8
3. Auri	Acasia auriculiformis	ditto	NE	22.7	2.82	8.43
4. Bagalunga	Melia dubia	ditto	NE	12.8	3.7	7
5. Balete	Ficus balete	ditto	NE	38.78	5.6	16.8
6. Bani	Millettia pinnata	ditto	NE	13.4	1	5
7. Binunga	Azadirachta indica	ditto	LC	11.33	2.85	7.6
8. Colis	Unknown	ditto	-	2.3	3	7
9. Caimito	Chrysophyllum cainito	ditto	NE	22.36	2.6	7.2
10. Dita	Alstonia scholaris	ditto	LC	85.94	10	22
11. E. camaldulensis	Eucalyptus camaldulenses	ditto	NE	18.49	4.2	11.75
12. E. deglupta	Eucalyptus diglupta	ditto	NE	20.67	4.22	13.44
13. Fire Tree	Delonix regia	ditto	LC	16.87	3.13	6.89
14. Gmelina	Gmelina arborea	ditto	LC	27.93	4.93	11.19
15. Guava	Psidium guajava	ditto	LC	8	2	4
16. Guyabano	Annona muricata	ditto	LC	8	2	3
17. Indian Mast Tree	Polyalthia lungifilia	ditto	NE	15.47	4.06	8.42
18. Ipil-ipil	Leucaena leucocephala	ditto	NE	18.6	3.01	0.41
19. Kapok	Ceiba pentandra	ditto	LC	34	4	10
20. Talisay gubat	Terminalia foedisitimma	ditto	NE	7.5	3	5
21. Mahogany	Swietenia macrophylla	ditto	**VU**	14.44	3.27	7.61
22. Mangium	Acacia mangium	ditto	NE	34.3	3.6	10.2
23. Mansanitas	Ziziphus jujube	ditto	NE	12.06	1.71	4.26
24. Misc. spp.	N/A	ditto	-	12.53	33.3	7.46
25. Molave	Vitex parviflora	Endangered species	**VU**	12.23	3.15	7.32
26. Narra	Pterocarpus indicus	Not included	**EN**	16.92	2.6	7.73
27. Neem	Azadirachta indica	ditto	LC	18.71	3.67	8.83
28. Rain Tree	Samanea saman	ditto	LC	22.8	3.5	10.3
29. Talisay	Terminalia catappa	ditto	NE	14.26	4.58	9.15
30. Taluto	Pterocymbium tictorium	ditto	NE	21	4	7
31. Tambis	Syzygium aqeum	ditto	NE	17.5	1.75	7
		AVERAGE		**19.68**	**4.40**	**8.36**

b.3 Volume

The surveyed area has a total number of terrestrial trees of about 1,368 trees with a total volume of about 71.71 m3. Mahogany recorded the highest number of trees having a total of 662 trees. Ranked second and third were narra and molave having a total of 152 trees with 4.32 m3 and 118 trees with a total of 3.14 m3, respectively. It was followed by Ipil-ipil with a total of 74 trees. The rest of the terrestrial species were recorded below 60 trees as presented in Table 8.6.35.

Table 8.6.35 List of the computed volume of terrestrial tree species

SPECIES	DIAMETER CLASS IN DIAMETERS														TOTAL	
	10		20		30		40		50		60		90			
	No. of Indv'l	Vol	No. of Indv'l	Vol	No. of Indv'l	Vol	No. of Indv'l	Vol	No. of Indv'l	Vol	No. of Indv'l	Vol	No. of Indv'l	Vol	No. of Indv'l	Vol
A. Premium species																
1. Molave	85	1.28	27	1.37	6	0.49									118	3.14
2. Narra	88	1.62	64	2.70											152	4.32
SUB-TOTAL	***173***	***2.90***	***91***	***4.07***	***6***	***0.49***									***270***	***7.47***
B- Lesser used species																
1. Acacia auriculiformis	3	0.04	4	0.15	7	0.77	1	0.27							15	1.23
2. Acacia mangium			1	0.27	5	0.72	3	0.82			1	0.35			10	2.16
3. Anabiong	1	0.01	2	0.02	1	0.18									4	0.20
4. Aroma	3	0.04													3	0.04
5. Bagalunga	4	0.07	2	0.09											6	0.16
6. Balite	11	0.30	2	0.06	4	0.98	1	0.50							18	1.84
7. Bani	1	0.01													1	0.01
8. Binunga	8	0.11	4	0.22											12	0.34
9. Colis			1	0.16											1	0.16
10. Dita													1	3.60	1	3.60
11. Eucalyptus camadulensis	8	0.21	24	1.83											32	2.03
12. Eucalyptus deglupta			1	0.08	9	1.43									10	1.51
13. Fire Tree	6	0.12	13	0.84											19	0.96
14. Gmelina	5	0.17	8	0.77	13	1.61	5	1.95	4	2.26					35	6.76
15. Guava	1	0.01													1	0.01
16. Guyabano	1	0.01													1	0.01
17. Indian Mast Tree	29	0.43	18	1.83	6	1.55									53	3.81
18. Ipil-ipil	47	0.53	25	1.41	2	0.21									74	2.15
19. Kaimito	1	0.04	3	0.13			1	0.12							5	0.28
20. Kapok					2	0.45									2	0.45
21. Mahogany	410	7.56	193	9.56	49	6.93	8	1.78	1	0.53	1	0.53			662	26.89
22, Mansanitas	14	0.07	2	0.11											16	0.18
23. Misc. spp.	9	0.14	3	0.13	1	0.09									13	0.36
24. Neem			38	2.51	23	2.46	12	2.45	1	0.15					74	7.58
25. Raintree					6	0.9	4	0.58							10	1.48
26.Talisay	11	0.24	15	1.13											26	1.37
27. Talisay gubat	1	0.01													1	0.01
28. Taluto			1	0.09											1	0.09
29. Tambis			2	0.06											2	0.06
SUB-TOTAL	**574**	**10.12**	**362**	**21.44**	**128**	**17.38**	**35**	**7.89**	**6**	**2.94**	**2**	**0.88**	**1**	**3.60**	**1,108**	**65.73**
TOTAL	**747**	**13.02**	**453**	**25.51**	**134**	**17.87**	**35**	**7.89**	**6**	**2.94**	**2**	**0.88**	**1**	**3.60**	**1,378**	**73.19**

b.4 Charting and Mapping

Charting and mapping were prepared using the gathered coordinates in each mangrove and terrestrial trees identified in the proposed road construction and bridge in Mandaue and Lapu-Lapu City as presented in Table 8.6.36,Table 8.6.37 and Figure 8.6.19 to .

Table 8.6.36 Summary of the number of mangroves and terrestrial trees per station

Station No.	No. of Trees		Remarks
	Mangrove	Terrestrial	
Road 1			
0 to 15		318	Settlement built up areas/Mandaue urban areas (existing road to be improved),
16-17			Old reclaimed area
18-19 to 24-25			Mactan channel
25-26 to 31-32			Old reclaimed areas with the private business claimant (e.g. International Pharmacuetical, Inc.etc.)
32-33			Privately claimed area, but previously reclaimed
33-34		23	Below Marcelo Fernan bridge and utilized for the public plaza of Barangay Umapad
34-35		20	Previously relaimed area near Marcelo Fernan bridge
35-36 to 45-46			Fishpond aquaculture development
46-47 to 49-50			Mandaue sanitary landfill area
50-51 to 58-59			No survey made in these portions/ For future road expansion connecting to Liloan
Road 2			
1-2	323		Mangrove areas
2-3	388		-do-
3-4	298		-do-
4-7			Reclaimed areas
7-8	64		Mangrove areas
8-9		41	Dryland areas/Mandaue Ecopark
9-10		76	-do-
10-11			Dryland/Mandaue sanitary landfill areas
11-12	66		Abandoned fishpond with natural mangrove stand
12-13			Abandoned fishpond
13-14			-do-
14-15 to 15-24			Mactan Channel/sea
24-25		20	Dryland areas (Commercial, manufacturing industries)
25-26		11	-do-
26-34		869	-do-
TOTAL	**1,139**	**1,378**	

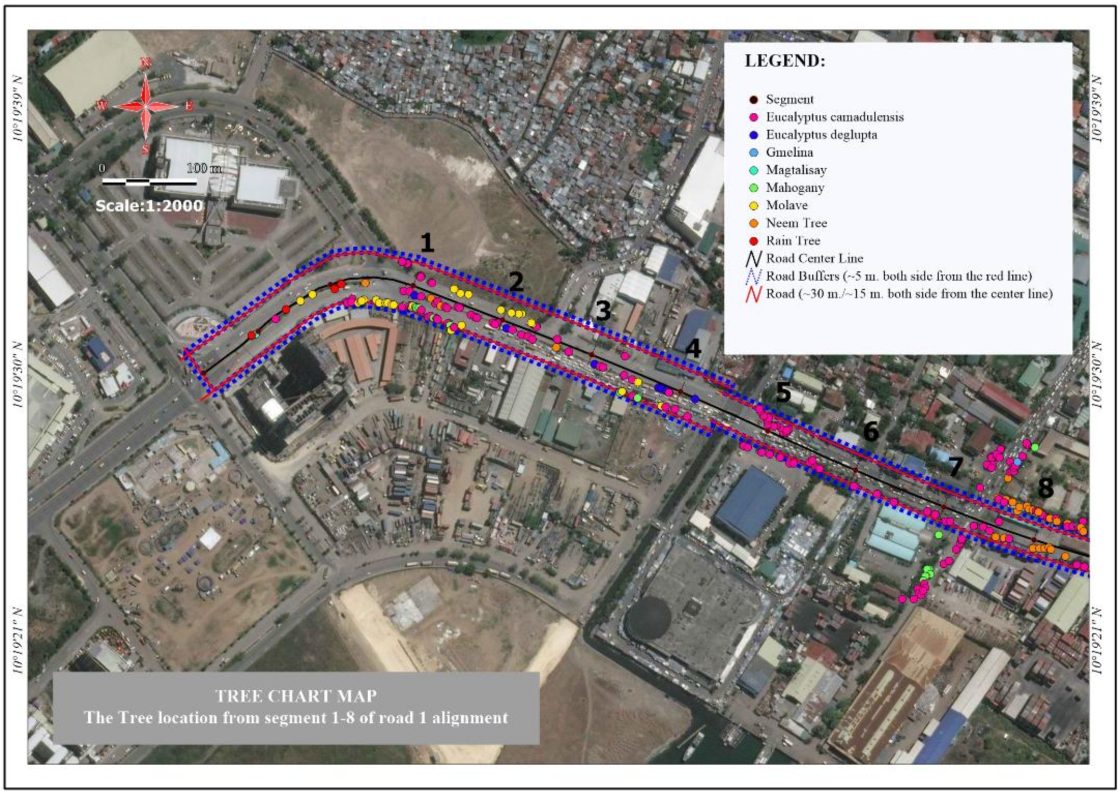


Figure 8.6.16 Chart map of terrestrial trees inventoried and assessed in segment 0- 8 of Road 1

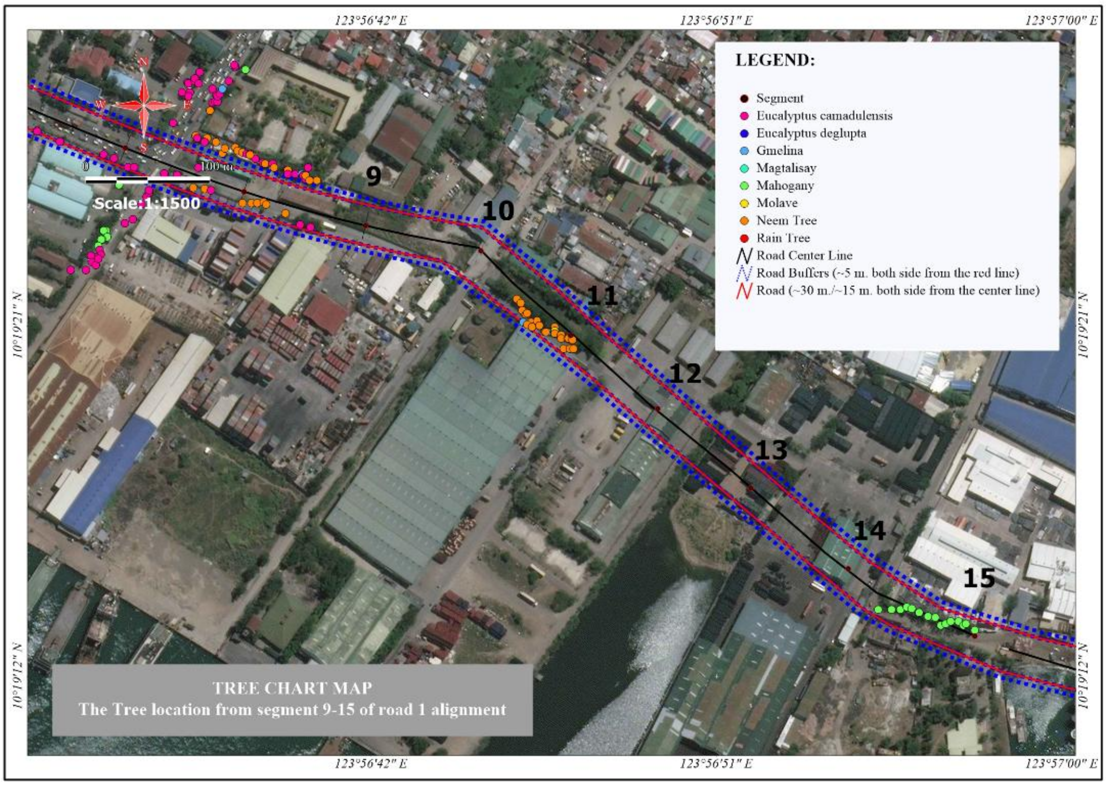


Figure 8.6.17 Chart map of terrestrial trees inventoried and assessed in segment 9-15 of Road 1

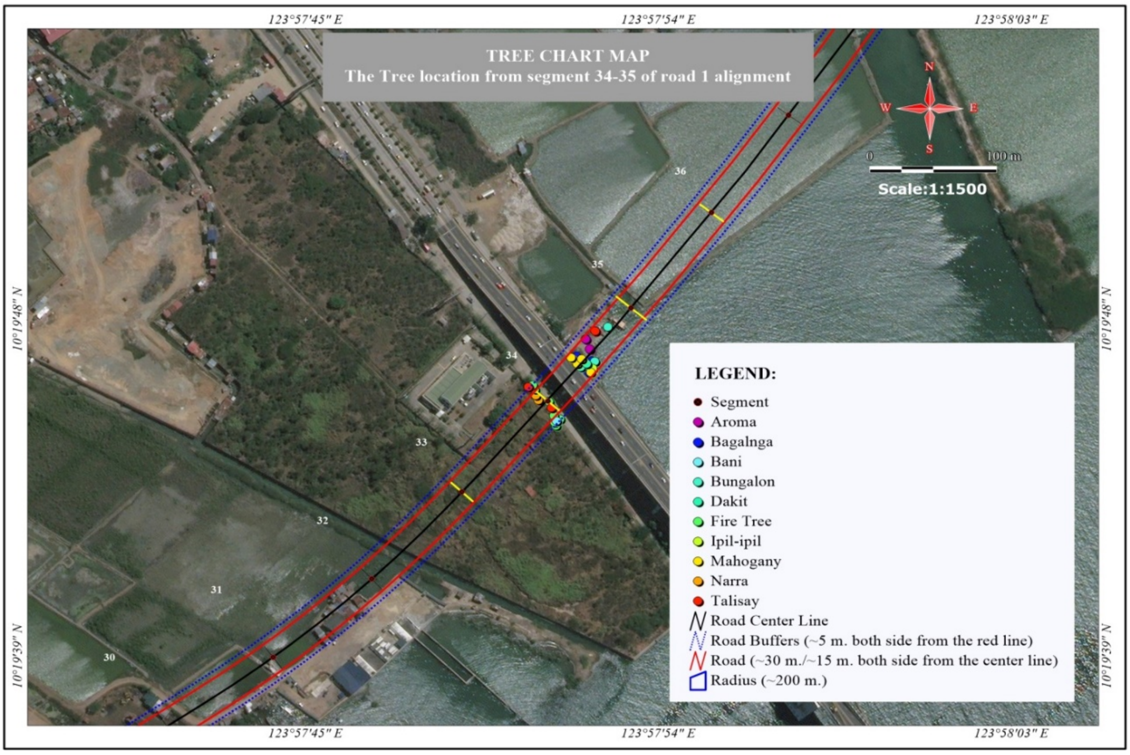


Figure 8.6.18 Chart map of terrestrial trees inventoried and assessed in segment 33-35 of Road 1 at Mandaue City

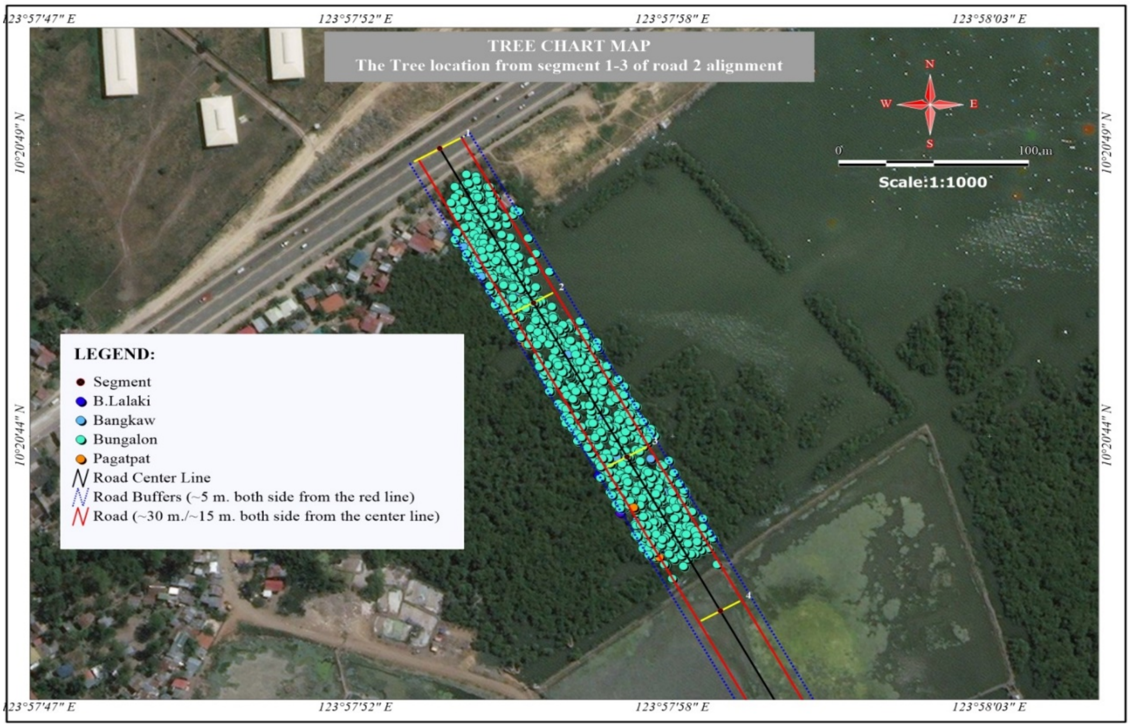


Figure 8.6.19 Chart map of mangrove trees inventoried and assessed in segment 1-4 of Road 2

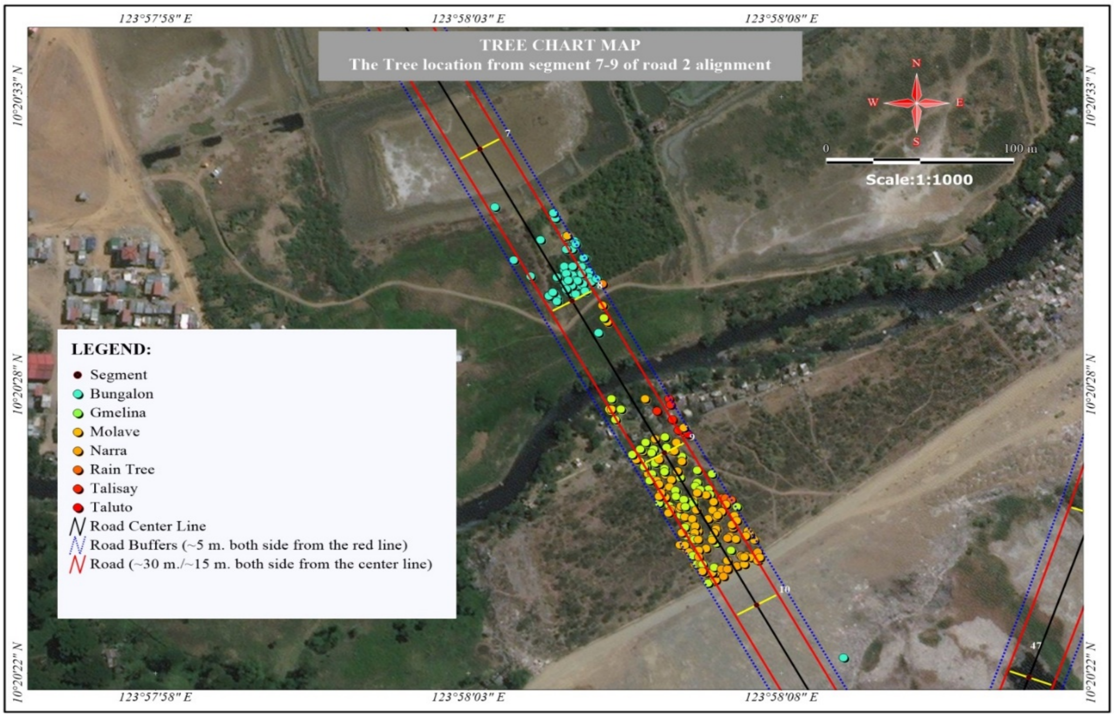


Figure 8.6.20 Chart map of mangrove and terrestrial trees inventoried and assessed in segment 7-9 of Road 2

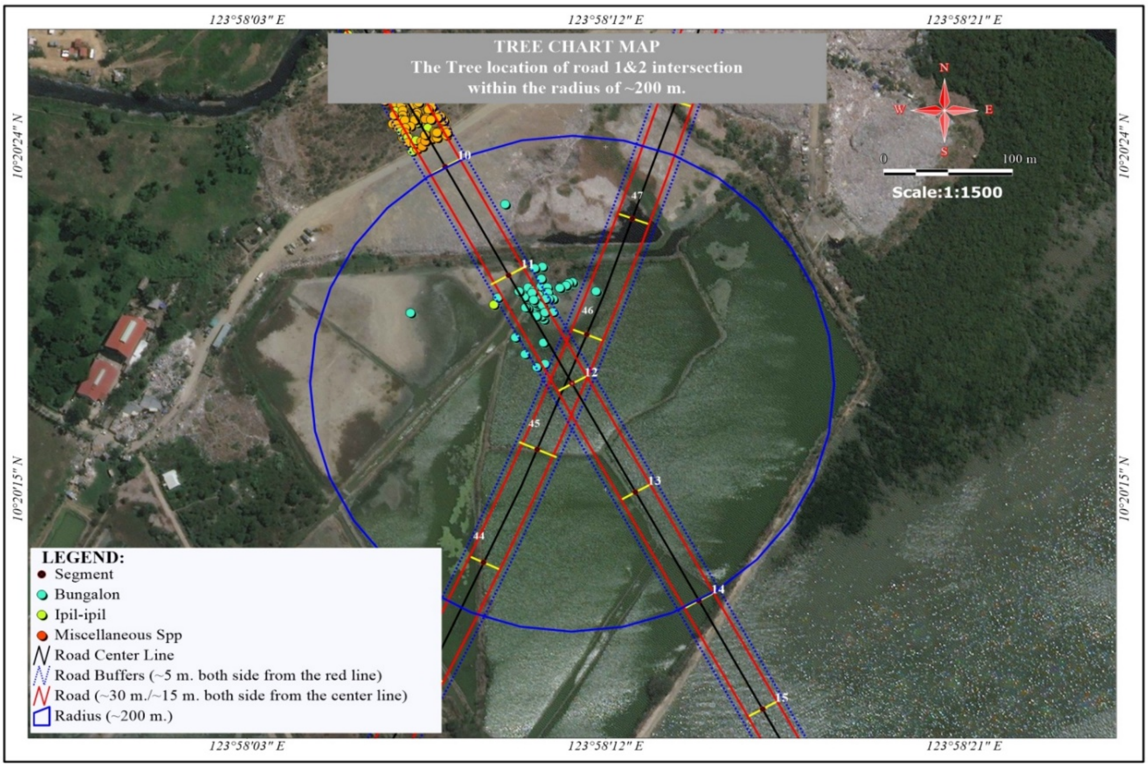


Figure 8.6.21 Chart map of mangrove trees inventoried and assessed in segment 11-13 of Road 1 and 2 intersections (200 m radius)

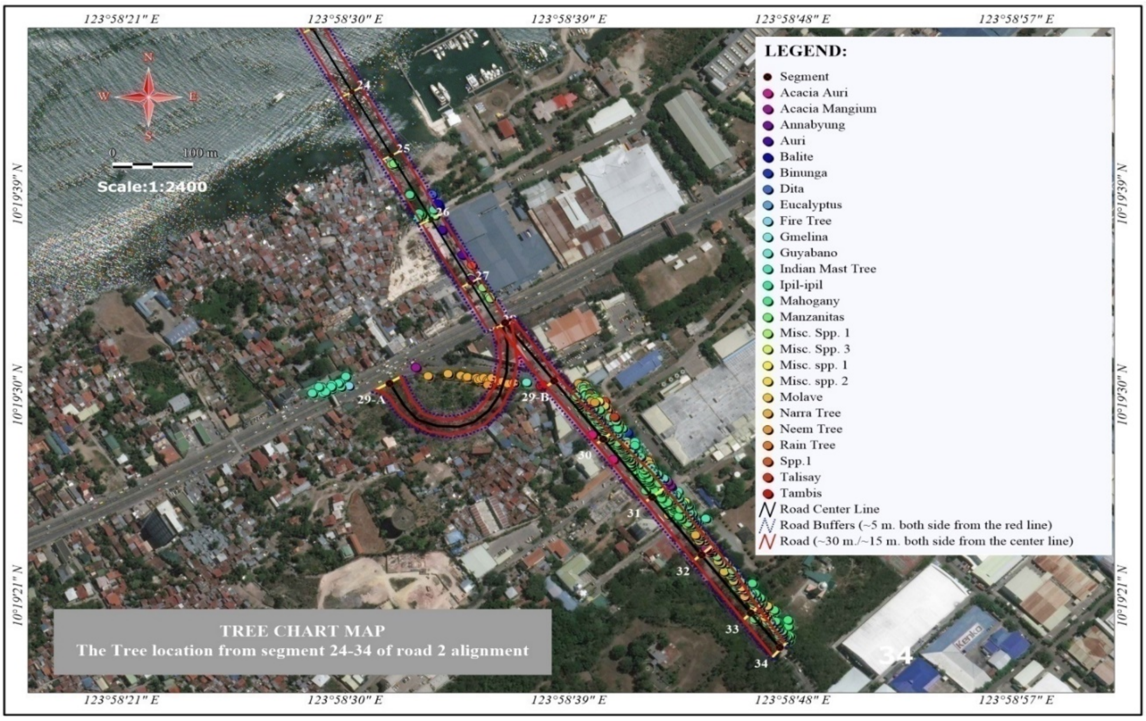


Figure 8.6.22 Chart map of terrestrial trees inventoried and assessed in segment 24-34 of Road 2

Table 8.6.37 Photos of terrestrial vegetation assessment

<table>
<tr><td colspan="2">
</td></tr>
<tr><td colspan="2">Terrestrial vegetation assessment near the open dumping site in Barangay Umapad in Mandaue City. Many of the inventoried trees are premium species such as Molave (Vitex parviflora) and Narra (Pterocarpus spp.).</td></tr>
<tr><td colspan="2"></td></tr>
<tr><td colspan="2">Panoramic view of the assessed terrestrial vegetation at Segment 9 of Road 2 near the open dumping site in Barangay Umapad.</td></tr>
<tr><td>
</td><td>
</td></tr>
<tr><td>Terrestrial tree inventory at Segment 34 of Road 1 below 2nd Mactan Bridge.</td><td>Shrub type of vegetation was noted between Segments 33 and 34 of Road 1. This is privately owned lot and fenced with barbed wire.</td></tr>
</table>

(6) Seagrass

a. Survey Locations

Figure 8.6.23 shows the location for the coastal flora and fauna assessment (i.e. seagrasses, seaweeds assessment, macro invertebrates, and coral reef).

Figure 8.6.23 Location map of the seagrass/seaweed assessed

b. Method

Transect lines were laid parallel to the shore and was extended seaward up to the area where seagrasses no longer exist. Percentage cover of seagrasses were estimated using a 1 m x 1 m quadrat. The quadrat was placed every 10 m interval of the transect line.

c.Survey Results

Seagrass Species Composition and Distribution

Of the assessed area on the proposed Mandaue Coastal Road Project and Construction of the 4th Cebu-Mactan Bridge in Mandaue City and Lapu-lapu City, four (4) seagrasses species were found in the two (2) sampling stations, namely: *Halodule pinifolia*, *Halophila ovalis*, *Halophila decipiens* and *Cymodoc*ea rotundata (Table 8.6.38). All these species are classified under 'Least Concern' in the IUCN Red List.

Among the seagrasses identified, *Halophila decipiens* and *Halodule pinifolia* were observed in both sampling stations assessed which are considered as the dominant seagrass species in the area. It was noted that four seagrass species listed in table were observed in station 1 while only 2 species (*Halophila decipiens* and *Halodule pinifolia*) were observed in station 2. Seagrass species in the assessed area is less diverse compared to other coastal community in the Province of Cebu.

Table 8.6.38 List of seagrass species composition and distribution

Family	Species	IUCN Red List Category	Sampling Site			
			Station 1		Station 2	
			Dry season	Rainy season	Dry season	Rainy season
Hydrocharitaceae	*Halophila decipiens*	Least Concern	Observed	Observed	Observed	Observed
	Halophila ovalis	Least Concern	Observed	N/A	Observed	N/A
	Halodule pinifolia	Least Concern	Observed	Observed	Observed	Observed
Cymodoceaceae	*Cymodocea rotundata*	Least Concern	Observed	N/A	Observed	N/A

Seagrass Percent Cover

Based on the results of the survey in two assessment period, there's no difference in term of species composition. Among the seagrasses identified, *Halodule pinifolia* and *Halophila decipiens* were both observed the dry and wet season which are considered as the dominant seagrass species recorded (Figure 8.6.24). *Halodule pinifolia* had the highest seagrass cover in the both seasons survey while *Cymodocea rotundata* has the lowest seagrass cover. The Seagrass species in the assessed area is less diverse compared to other coastal community in the Province of Cebu. In terms of percentage cover, there is a decrease of seagrass cover from 11.28% in May to 8.03 % in July, probably due to the floods and high levels of water turbidity that affects the light penetration to seagrass beds.

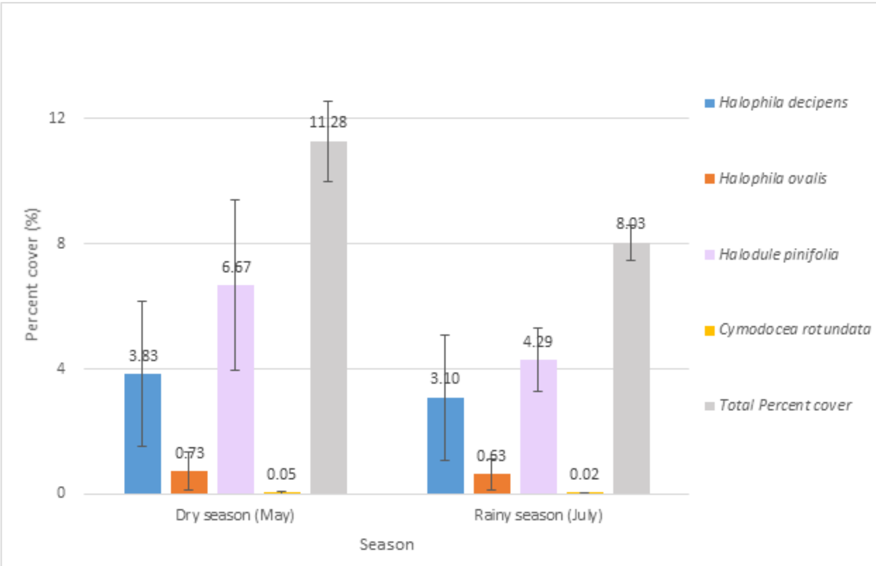


Figure 8.6.24 Mean comparison of seagrass percent cover over two seasons

The result indicates that the seagrass habitats of both stations are disturbed. The poor condition of seagrass was attributed to natural anthropogenic causes. Natural causes include light, temperature, substrate type, organic materials, water movement and sedimentation load. The low percent cover is thought to be caused by the high levels of turbidity which blocks the availability of sunlight for photosynthesis of seagrasses. Anthropogenic activities such as collection of edible marine organisms like mollusks and other anthropogenic factors such as conversion of the seagrass beds into reclamation area, development of port facilities are thought to have influenced the condition of the seagrass/seaweeds. Heavy siltation brought by Butuanon River during rainy season may be another contributing factor to destroy the habitat of seagrass.

(7) Seaweeds

a. Method

Transect lines were laid parallel to the shore and was extended seaward up to the area where seaweeds no longer exist. Percentage cover of seaweeds were estimated using a 1 m x 1 m quadrat. The quadrat was placed every 10 m interval of the transect line.

b. Survey Results

Seaweeds Species Composition and Distribution

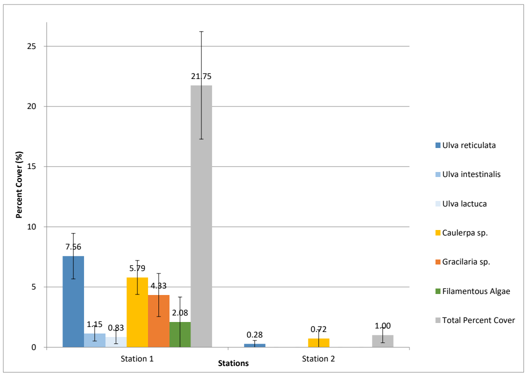
A total of six (6) algae species were found in the two (2) stations: *Ulva reticulata*, *Ulva intestinalis*, *Ulva lactuca*, *Caulerpa sp.*, *Gracilaria sp.* and Filamentous algae (Table 8.6.39). Among the Algae species identified, *Ulva reticulata* and *Caulerpa sp.* were observed in both stations assessed which are considered as the dominant algae species recorded. None of the species identified is classified under the category equivalent or worse than near threatened (NT).

Table 8.6.39 List of seaweeds species composition and distribution

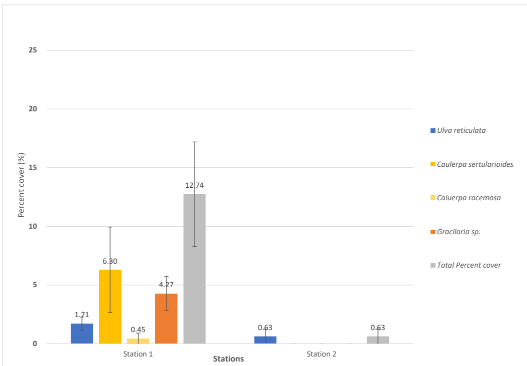
Family	Species	IUCN Red List Category	Sampling Site			
			Station 1		Station 2	
			Dry season	Rainy season	Dry season	Rainy season
Ulvaceae	*Ulva reticulata*	Not Evaluated	Observed	Observed	Observed	Observed
	Ulva intestinalis	Not Evaluated	Observed	N/A	N/A	N/A
	Ulva lactuca	Not Evaluated	Observed	N/A	N/A	N/A
Caulerpaceae	*Caulerpa sp.*	N/A	Observed	Observed	Observed	N/A
Gracilariaceae	*Gracilaria sp.*	N/A	Observed	Observed	N/A	N/A
N/A	Filamentous Algae	N/A	Observed	N/A	N/A	N/A

Percent Cover

Figure 8.6.25 shows the algae percentage cover of the two (2) stations assessed in Mactan, Cebu. In dry season, Station 1 had the higher algae cover of 21.75% than Station 2 with only 1% algae cover. Likewise, in rainy season, Station 1 showed a higher cover of 12.74% than Station 2 with only 0.63%.



Results in the dry season (May 2019)



Results in the rainy season (July 2019)

Figure 8.6.25 Mean seaweed percent cover within the project site

Figure 8.6.26 shows the algae percentage cover over two (2) seasons. Compared to the dry season (i.e. May), there's a decrease of algae cover in rainy season (i.e. July) by 4.7%. Low algae cover in rainy season may be caused by flood that washes away the algae in the area and also by the low sunlight.

Among the algae species identified, *Ulva reticulate*, *Caulerpa sp.* and *Gracilaria sp.* showed relatively high cover in both dry and rainy seasons. The cover of *Ulva sp.* decreases in rainy season, whereas *Caulerpa sp.* and *Gracilaria sp.* show consistent figures over seasons.

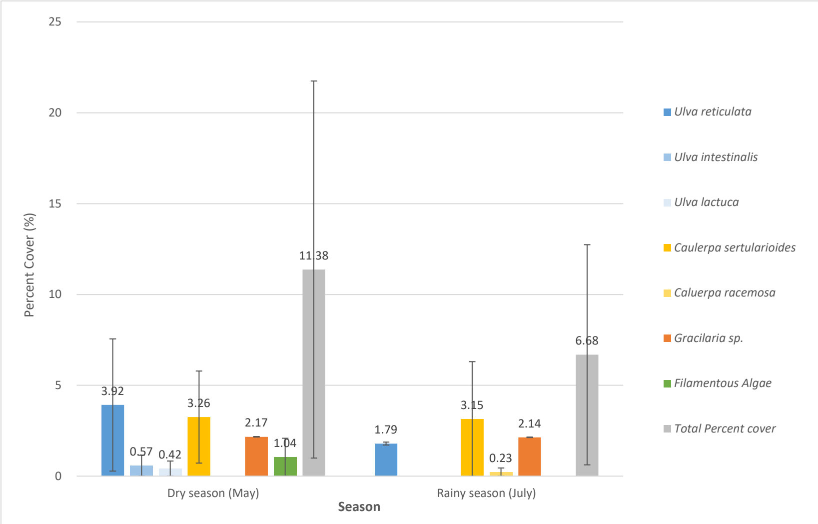
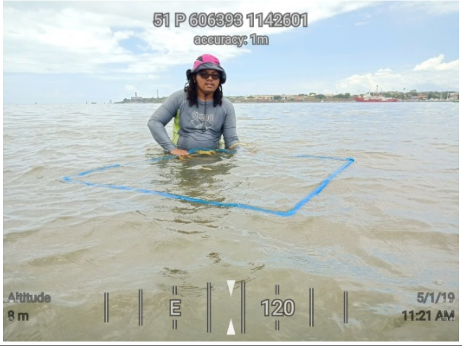
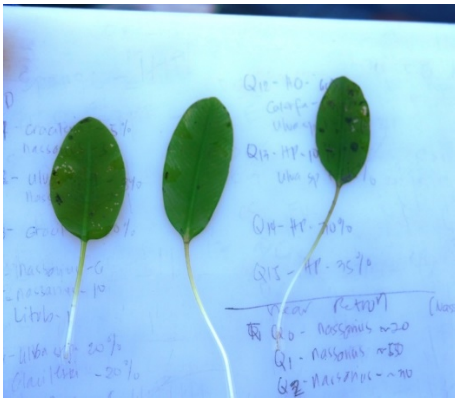


Figure 8.6.26 Mean comparison of seaweed percent cover over two seasons

Table 8.6.40 Photos of seagrass and sea weed assessment

	
A transect line is laid out during seagrass assessment.	A 1m x 1m quadrat is laid out at every 10m in the transect line in Barangay Looc, Mandaue City where the coastal road passes through a viaduct at Mactan Channel.
	
Halophila decipiens is a type of seagrass identified within the quadrat of the transect line laid out in Barangay Umapad, Mandaue City near the planned bridge construction site.	Leaves of *Halophila ovalis* was closely examined during the seagrass assessment in Mandaue City side.
	
Ulva lactuta recorded in the coastal water of the Mandaue City side.	*Gracilaria spp.* recorded in the coastal water of the Mandaue City side.
	
Ulva spp. recorded in the coastal water of the Mandaue City side.	*Caulerpa taxifolia* recorded in the coastal water of the Mandaue City side.

(8) Macro Invertebrate

a. Method

The method used in assessing the macro-invertebrates followed the transect lines used in assessing the seagrass, seaweed and coral reef. All macro-invertebrates organisms within the quadrat for seagrass and seaweed assessment; an imaginary line of 10 meters width of transect for fish and coral were identified and counted.

b.Survey Results

Species Composition

Table 8.6.41 shows that Station 1 recorded 7 species of macroinvertebrate while Station 2 recorded only 1 species. Nassa Mud snails had the highest number of individuals recorded in both stations. Knowing the biology of Nassa mud snails, it usually inhabits on intertidal and sublittoral, temperate to tropical, soft bottoms ("Nassariidae-Nassa mud snail," 2010[7]).

Presence of invertebrates has a positive impact on growth and settlement of corals as they remove algae which can potentially compete against coral for space (McClanahan et al., 1994[8]). Invertebrates grazing open up solid substrates upon which corals settle (Ogden, 1978[9]). It was realized that echinoids are dominant invertebrate species and are vital for maintaining the delicate balance between algae and coral dominated reefs (Sammarco, 1982[10]).

Table 8.6.41 Macro Invertebrate Species Composition and Distribution

Species	IUCN Red List Category	Sampling Site			
		Station 1		Station 2	
		Dry season	Rainy season	Dry season	Rainy season
Anadara sp.	N/A	Observed	Observed	Not Observed	Not Observed
Anomalocardia squamosal	N/A	Not Observed	Observed	Not Observed	Not Observed
Bulla sp.	N/A	Not Observed	Observed	Not Observed	Not Observed
Nassarius sp.	N/A	Observed	Observed	Observed	Observed
Portunus sp.	N/A	Not Observed	Observed	Not Observed	Not Observed
Rhinoclavis sp.	N/A	Not Observed	Observed	Not Observed	Not Observed
Sponge sp.	N/A	Observed	Not Observed	Not Observed	Not Observed

Population Density

Figure 8.6.34 shows that the results of Nassarius spp in dry season and rainy season showed a great different in terms population density. At the Station 1, Nassarius spp showed a total of 21 individuals in dry season, while 131 individuals in rainy season. On the other hand, at the Station 2, Nassarius spp showed a total of 78 individuals in dry season, while 14 individuals in rainy season. This may be explained by the strong wave action and water current observed during the assessment in dry and rainy seasons, respectively.

7 "Nassariidae-Nassa mud snail". SeaLifeBase, 09, September 2010. Retrieved from http://www.sealifebase.ca/Summary/FamilySummary.php?id=2012&lang=eng.

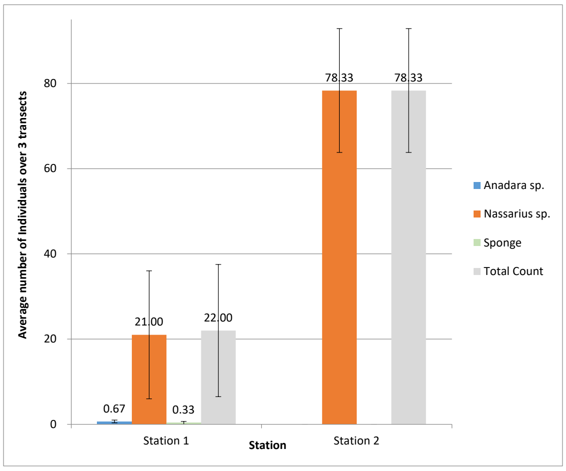
8 McClanahan, T. R. (1994) Kenyan coral reef lagoon fish: effects of fishing, substrate complexity, and sea urchins. Coral Reefs, [Online] 13 (4), 231-240.

9 Ogden, J. C. &Lobel, P. S. (1978) The role of herbivorous fishes and urchins in coral reef communities. Environmental Biology of Fishes, [Online] 3 (1), 49-63.

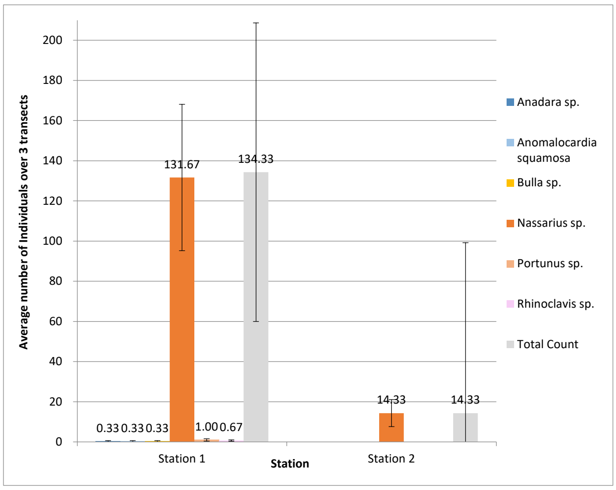
10 Sammarco, P. W. (1982) Echinoid grazing as a structuring force in coral communities: Whole Reef Manipulations. Journal of Experimental Marine Biology and Ecology, [Online] 61, 31-55.

Macro invertebrates are a remarkably diverse group of animals due to the variety of functions they perform such as nutrient recycling, the removal of detritus material, and the consumption of invading algae. Disturbance of marine invertebrates can result in negative ecological impacts upon the reef, such as algae blooms and invertebrate plagues leading to a reduction in coral cover (Dumas et al., 2007[11], Hutchings, 1986[12]).

Based on anecdotal evidence from aquaria, they are generally thought to be primarily opportunistic scavengers, perhaps being even saprophytic, but as also been observed to apparently feed on algae and microbial films as a non-selective surface grazer (World Association of Zoos and Aquariums).



Results in the dry season (May 2019)



Results in the rainy season (July 2019)

Figure 8.6.27 Mean Population Density of Macro Invertebrates within the Project Site

Figure 8.6.28 showed that the rainy season has a higher mean population density of 74.33 individuals than the dry season with 50.17 individuals.

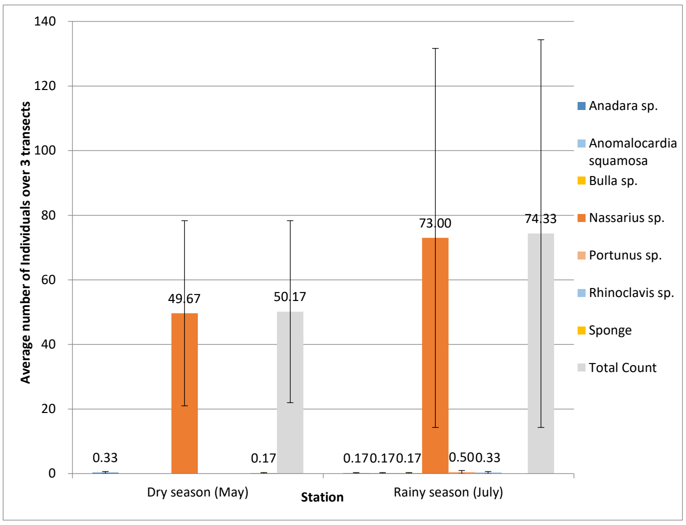


Figure 8.6.28 Mean comparison of Population Density of Macro Invertebrates over Two Seasons

[11] Dumas, P., Kulbicki, S., Chifflet, S., Fichez, R. & Ferraris, J. (2007) Environmental factors influencing the urchin spatial distributions on disturbed coral reefs (New Caledonia, South Pacific). [Online] Journal of Experimental Marine Biology and Ecology, (344), 88-100.

[12] Hutchings, P.A. (1986) Biological destruction of coral reefs. [Online] Coral Reefs 4:239-252.

Table 8.6.42 Photos of macro invertebrate assessment

	
A cockle or locally known as "Litob" (*Tegillarca granosa*) is one of the seashells identified during the assessment of coastal water in Barangay Umapad, Mandaue City. Some subsistence fishermen gather this in the area for home consumption as source of protein.	Nassa mud snail (*Nassarius spp.*) had the highest number of individuals recorded in both station 1 and Station 2.

(9) Coral Reef

a.Method and Survey Locations

A detailed assessment of coral cover was conducted using Point Intercept Transect (PIT). Two (2) transect lines measuring 50m were laid parallel to the shoreline with at least 5m interval between transect lines. All coral life forms intercepted at the point of every 0.50 m of the transect lines were identified and recorded. Corals were then identified up to the genus level. The percentage cover of each life form category was calculated using the following formula:

$$\text{Percent Cover} = \frac{\text{Total No. of Individual Lifeform}}{\text{Total No. of Point-Sampled}} \times 100$$

Coral reef condition was classified into four distinct categories based on the percentage of hard coral cover using the following reference shown in Table 8.6.43.

Table 8.6.43 Coral Category index[13]

Status	Percentage
Poor	0-25%
Fair	26-50%
Good	51-75%
Excellent	76-100%

Figure 8.6.29 shows the location of the sampling stations of coral reef assessment.

[13] English, S., Wilkinson, C., and Baker, V. (1997). Survey Manual for Tropical Marine Resources. Australian Institute of Marine Science. Townsville, Australia.

Figure 8.6.29 Location map of the coral reef assessment

All sampling stations have no corals and reef fishes observed in the area during the assessment. This is probably due to the heavily silted thus, mud deposit are settled on the seafloor. The mud deposit in the entire reef is attributed to heavy siltation brought by Butuanon River during rainy season. The area is very turbid and low visibility of about 0.50 m and it has an average depth of 5.33 m. Other observation on site condition and characteristics of the surveyed sites are presented in Table 8.6.44.

Table 8.6.44 Condition/characteristics of the sampling sites for coral reef assessment

Station No.	Site Condition/Characteristics
1 & 2	• The surveyed site was located in Barangay Umapad, Mandaue City side. • Water is very turbid with visibility of around 0.50 meter only. • Depth of assessed area for coral reef is about 4 meters. • Sea bed is heavily silted thus, mud deposits are found on the seafloor. Thickness of mud ranges from 20-30 cm. • No corals (soft and hard) were observed in the sampled site.
3 & 4	• The surveyed site was located in Barangay Ibo, Lapu-Lapu City side near Cebu Yacht Club and a mini-port. • Water is turbid with visibility of around 0.50 meter only. • Depth of assessed area for coral reef is about 8 meters. • Sea bed is heavily silted thus, mud deposits are found on the seafloor. Thickness of mud ranges from 20-30 cm. • No corals (soft and hard) were observed in the sampled site.
5 & 6	• The surveyed site was located in Barangay Looc, Mandaue City side (the 1st Mactan Bridge) near informal settlers and fuel terminal/oil depot of Petron Corporation-Visayas Cluster. • Water is very turbid with visibility of around 0.50 meter only. • Depth of assessed area for coral reef is about 4 meters. • Seawater current in this particular site is quite strong. • Sea bed is heavily silted thus, mud deposits are found on the seafloor. Thickness of mud ranges from 20-30 cm. • No corals (soft and hard) were observed in the sampled site.

Table 8.6.45 Photos of coral reef assessment

	
A Scuba diver team conducted coral reef assessment within the project site.	A sample of mud soil was taken in the sea floor from the assessed area for coral reef in Mandaue City side. There was no coral observed in the surveyed site.
	
A mud soil was also recorded in the coastal water of Barangay Ibo, Lapu-Lapu City wherein the particular area is directly affected by the bridge construction.	The assessment team found out mud soil in Barangay Looc, Madaue City where the Mandaue Coastal Road passes through a viaduct. The team did not observe the existence of coral in the area due to heavy siltation.

(10) Fish

a. Method

Fish visual census could not carrioud out due to high turbidity at the same sampling sites as coral reef assessment. Hence, basic information on fish in the project site was collected through an interview to the fisherman in connection with their daily fish catch.

b.Survey Results

Table 8.6.46 shows the list of fish catch within the surveyed sites. A total of ten (10) fishes belonging to five (5) families were caught by the fishermen. Fishes and macro-invertebrates that usually caught by fishermen in Mactan are Mullet fish, Pony fish, Cardinal fish, Goby fish, Shrimp and Crab. These marine species are euryhaline where they are able to adapt to a wide range of salinities. In the assessed sites exists a river where the salinity level changes regularly.

Table 8.6.46 List of fish catch based on the interview to the fishermen

Family Name	Species		
	Scientific Name	Common Name	Local Name
Fish			
Mugilidae	*Valamugil buchanani*	Bluetail Mullet	Gisaw/ Banak
	Valamugil seheli	Bluespot Mullet	Gisaw/ Banak
	Ellochelon vaigiensis	Squaretail Mullet	Gisaw/ Banak
Leognathidae	*Secutor insidiator*	Pugnose Ponyfish	Potpot
	Leiognathus equulus	Common Ponyfish	Potpot
Apogonidae	Apogon spp.	Cardinal fish	Ibis
Unknown	Unknown	Unknown	Bugo
Macro invertebrates			
Penaeidae	Metapenaeus spp.	Shrimp/Prawn	Pasayan
	Penaeus spp.	Shrimp/Prawn	Pasayan/Lukon
	Litopenaeus spp.	Shrimp/Prawn	Pasayan
Portunidae	Thalamita crenata	Crenata swimming crab	Kasag

2) Impact Identification and Assessment

(1) Evaluation on the “Critical Natural Habitat”

As explained in “4.1.1.2 (2) Important Bird Area and Key Biodiversity Area”, the entire project area is located in the ‘Mactan, Kalawisan and Cansaga Bays’ IBA/KBA. However, IBA/KBA itself is not necessarily regarded as a “Critical Natural Habitat” in the JICA Guidelines for Environmental and Social Considerations (2010) (hereafter, ‘JICA Guidelines’). Hence, whether the project site is regarded as a “Critical Natural Habitat” was evaluated based on the definitions stipulated in the JICA Guidelines and the IFC Performance Standard 6 “Biodiversity Conservation and Sustainable Management of Living Natural Resources” (2012) as shown in Table 8.6.47 . As a result of the evaluation, it is concluded that the project site does not fall into a “Critical Natural Habitat’.

Table 8.6.47 Evaluation on Applicability of Critical Natural Habitat

No	Definition	Applicability	Reason
1	Habitats important for the species that are classified into "Critically Endangered (CR)", "Endangered (EN)", "Vulnerable (VU)", and "Near Threatened (NT)" under the International Union for Conservation of Nature (IUCN) Red List of Threatened Species	Not Applicable	At Olango Island that is designated as a Ramsar site, located approximately 12 km from the project site in a straight-line distance, species that are classified into "Critically Endangered (CR)", "Endangered (EN)", "Vulnerable (VU)", and "Near Threatened (NT)" were observed. However, the bird survey in December 2018 and March 2019 in the project area did not confirm the existence of the precious species itself and the use of the project site as a roost or feeding ground by the precious species. The existence of valuable species has not been observed in the past several years, even with existing materials. As a result of interviews with several experts who have experience of bird survey around the project area, it became clear that there is no data for long-term monitoring of migratory birds considering the seasonality around the project site. It became clear the following points according to the experiences of the experts. i) Migratory birds that pass through the Philippines, including endangered species, fly to their important refueling site, Olango Island, with the peak of the southward migration from December to February and the peak of the northward migration from September to October. ii) It is hard to think that the mangrove forest and tidal flat near the Cansaga Bay is still functional as feeding and roosting grounds as importantly as Olango Island and Jugan because the mangrove forest and tidal flat near the Cansaga Bay is so much degraded due to development, compared to 1980s, when is the basis of IBA designation. iii) Nevertheless, it is also indicated that the possibility of endangered bird species flying to nearby project sites still cannot be denied because, when Olango Island is in full tide or when there is a shortage of feeding resources there, birds might use the tidal flats and mangrove forests of Jugan and near the mouth of the Cansaga Bay, both of which are outside ROW, as feeding and roosting grounds. In conclusion, since the area including project site is a development area unlike protected Olango Island and endangered species are not observed, the project site does not fall under a particularly "important habitat" for species that are classified into CR, EN, VU and NT.
2	Habitats important for endemic species and/or limitedly distributed species	Not Applicable	Although the woody endemic species (Molave) has been found, the project site is not a particularly important habitat for the species because the species is widely distributed in the Philippines and Indonesia and even in the project site particularly in the Lapu-Laou side. Hence, it is safe to say that the project site is not a habitats important for endemic species and/or limitedly distributed species. Source: http://www.worldagroforestry.org/treedb/AFTPDFS/Vitex_parviflora.PDF
3	Internationally important habitats that support migratory species and/or flock-forming species	Not Applicable	In the bird survey in December 2018, about 360 birds, including herons, sandpipers and terns that are migratory and flock-forming species, were observed in the mangrove forest and tidal flat adjacent to Cansaga Bay. In the bird survey in March 2019, about 175 birds were observed in the ROW passing through the aquaculture ponds and mangrove sparse forests ner the Cansaga Bay Bridge. (Endangered species were not observed in both surveys). However, as mentioned in 1, the project sites in Cansaga Bay area are no longer functional as an important habitat for migratory and flock-forming species unlike Olango Island and Jugan. Hence, it is safe to say that the project site is not an internationally important habitats that support migratory species and/or flock-forming species.
4	Critically endangered ecosystems and/or unique ecosystems	Not Applicable	There is no past studies that proves that the project site is a critically endangered ecosystems and/or unique ecosystems.
5	Areas related to important evolutionary processes	Not Applicable	There is no past studies that proves that the project site is an areas related to important evolutionary processes

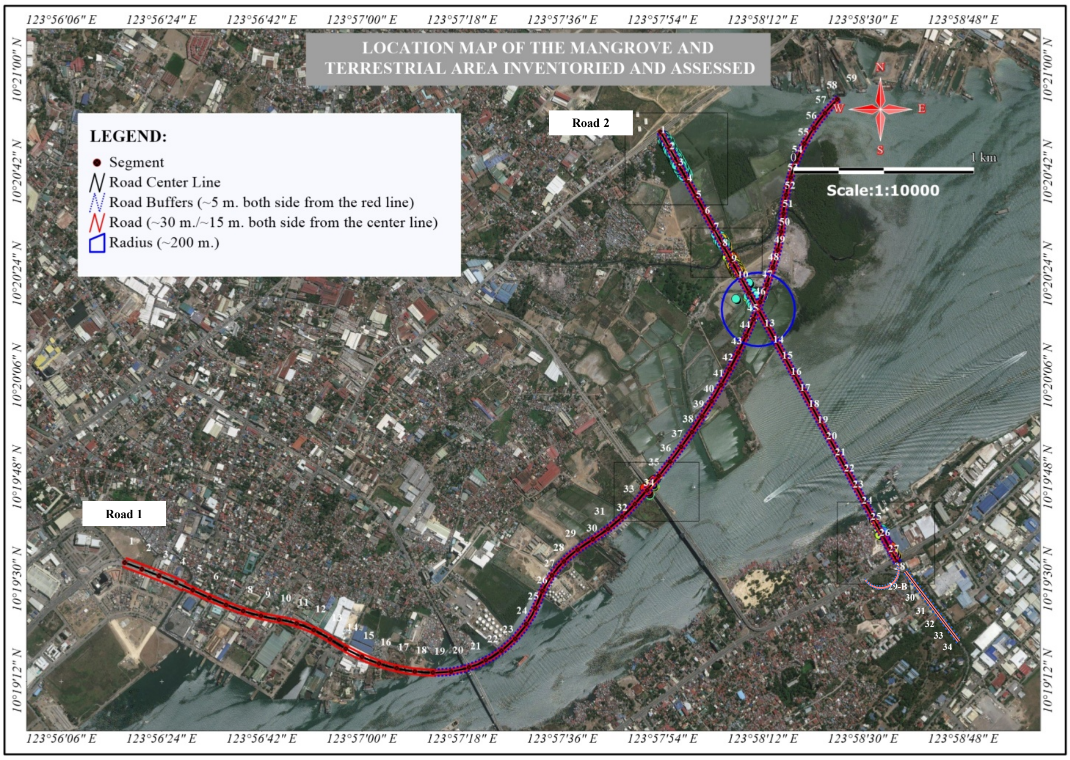
Secondary information and the results of flora and fauna survey suggests that the project site is not a critical natural habitat for migratory birds due to a wide range of development activities, including fishpond and open dumping site, carried out over years. However, mangrove vegetation still exists and a certain number of migratory birds mainly Egret species and resident species are perching on mangroves and feeding on fishponds and surrounding tidal flat.

(2) Potential Impacts to the terrestrial flora and fauna

Construction Phase

Potential impacts from construction activities on the terrestrial flora and fauna include:

- Approximately 2,000 trees will be affected. Among them, 467 terrestrial trees at less than 1.5m height, including 385 trees of important species (i.e. Molave, Narra, and Mahogany) will be earth-balled and re-planted. The remaining 1,609 trees, including 547 trees of important species and 698 mangrove trees will be inevitably cut. Important species include Molave classified under endangered category of the DAO No.1-2007 and under vulnerable category of IUCN Redlist, Narra and Mahogany classified under IUCN Redlist's endangered and vulnerable categories, respectively. Detailed locations of trees that will be relocated and inevitably cut are shown in Figure 8.6.30.



Location		Terrestrial Species												Mangrove			Grand Total		
		Molave			Narra			Mahogany			Less Impt. Spp.								
Rd	Sta.	Rel.	C.	ST	Rel.	C.	ST	Rel.	C.	ST	Rel.	C.	ST	Rel.	C.	ST	Rel.	C.	Total
1	1-9	7	12	19	16	17	33	15	27	42	82	364	446	0	0	0	120	420	540
	11	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	1
	15	1	13	14	0	0	0	0	0	0	0	0	0	0	0	0	1	13	14
	33-34	0	0	0	3	4	7	0	0	0	0	0	0	0	0	0	3	4	7
	34-35	0	0	0	25	24	49	4	3	7	0	0	0	0	0	0	29	27	56
2	1-2	0	0	0	0	0	0	0	0	0	0	0	0	0	182	182	0	182	182
	2-3	0	0	0	0	0	0	0	0	0	0	0	0	0	218	218	0	218	218
	3-4	0	0	0	0	0	0	0	0	0	0	0	0	0	168	168	0	168	168
	7-8	0	0	0	0	0	0	0	0	0	0	0	0	0	64	64	0	64	64
	8-9	2	2	4	0	0	0	1	1	2	0	0	0	0	0	0	3	3	6
	9-10	0	0	0	0	0	0	6	6	12	0	0	0	0	0	0	6	6	12
	10-11	0	0	0	0	0	0	0	0	0	0	0	0	0	66	66	0	66	66
	26-34	265	360	625	9	19	28	30	59	89	0	0	0	0	0	0	304	438	742
TOTAL		**275**	**387**	**662**	**54**	**64**	**118**	**56**	**96**	**152**	**82**	**364**	**446**	**0**	**698**	**698**	**467**	**1,609**	**2,076**

Note: Rd.: Road, Sta.: Station, Rel.: Relocation, C.: Cut, ST: Sub-Total

Figure 8.6.30 Location of Affected Trees

Although important terrestrial tree species, Molave (*Vitex parviflora*), Narra (*Pterocarpus indicus*) and Mahogany (*Swietenia macrophylla*), are classified under endangered and vulnerable categories of the DAO No.1-2004 and the IUCN Redlist, impacts on these species are expected to be minor as long as appropriate mitigation measures are taken appropriately, because the project site is not considered an irreplaceable important habitat for these species due to their wide distribution in Philippines and wordwide.

Molave (*Vitex parviflora*) is a timber tree species that is commonly distributed in secondary and open primary forests at low altitudes and planted in plantations for timber production throughout the Philippines in most or all islands and provinces[14]. In addition, Molave is widely distributed in Bangladesh, Cambodia, India, Indonesia, Laos, Malaysia, Myammar, Phillippiens and Sri Lanka as a native species[15].

Narra (*Pterocarpus indicus*) is a tree species that is widely distributed and commonly used for reforestation in the Philippines (Delos Reyes et al. 2016[16], Finkeldey et al. 1999[17]). Aside from Philippines, Narra is native to Cambodia, Malaysia, Myanmar, Papua New Guinea, Singapore, Solomon Islands, United States of America and Vietnam, and exotic in Puerto Rico[18].

Mahogany (*Swietenia macrophylla*) was introduced to Philippines in early 1900s as park trees in Manila (Ponce 1933[19]), and is presently among the most-planted species for timber production in the country (Abarquez et al. 2015[20]). This species is native to Belize, Bolivia, Brazil, Colombia, Costa Rica, Ecuador, Guatemala, Honduras, Mexico, Nicaragua, Panama, Peru and Venezuela[21].

Taking into account the wide distribution of these species in Philippines, it is safe to say that the project site is not an irreplaceable habitat for these species. Hence, cutting of these species in the project area is not expected to bring a significantly adverse impacts on its distribution at the regional level, as long as relocation and compensatory planting considering the continuity of their distribution is carried out appropriately as detailed in 8.6.73)(1).

- Disturbance to IBA/KBA consisting mangrove, tidal flat and migratory birds:
  i) Small-scale loss of bird habitat such as mangrove, fishpond and tidal flat
  ii) Noise from construction work frightening migratory birds away from the IBA/KBA.
- Residual impacts of land use changes of the surrounding areas into commercial-residential development on the environment

Operation Phase

Potential impacts from operational activities on the terrestrial flora and fauna include:

- Bird kill caused by car-bird collision, especially at the interchange section in the vicinity of fishpond and mangrove forest, which serve as birds' feeding and potential roosting ground, respectively
- Lighting in the interchange area may give adverse impacts on the mangrove forest facing the Cansaga Bay, which is considered a potential birds roosting area.
- Noise disturbance from traveling vehicles to wildlife, especially to migratory birds
- Existence of viaduct as a barrier to movement of wildlife, especially to migratory birds

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[16] DELOS REYES MT, MAGPANTAY GD, CAGALAWAN AJ, LAPIS AB, CALINAWAN NM. 2016. Assessment of Genetic Diversity of Narra (Pterocarpus indicus Willd.) Populations from Various Seed Sources in the Philippines using RAPD. Journal of Environmental Science and Management 19(2): 54–63.
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[19] Ponce SS. 1933. Mahogany as a reforestation crop. The Makiling Echo 12: 7.
[20] Abarquez, A.; Bush, D.; Ata, J.; Tolentino Jr., E. L.; Gilbero, D.; J. Trop. For. Sci. 2015, 27, 314.
[21] Orwa C, A Mutua, Kindt R , Jamnadass R, S Anthony. 2009 Agroforestree Database:a tree reference and selection guide version 4.0 (http://www.worldagroforestry.org/treedb/AFTPDFS/Swietenia_macrophylla.PDF)

Given that the ROW of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road is within a generally already developed area and that there exist alternative natural habitats for migratory birds in adjacent areas, such as the mangrove forest and tidal flats facing the Cansaga Bay, Jugan and Olango Island, all of which are outside the ROW, adverse impacts on migratory birds are expected to be minor, if appropriate mitigation measures are taken in the construction and operation phases. With regard to noise disturbance to migratory birds during construction and operation phase, it was observed, during the bird survey in December 2018, that almost all the observed birds, including migratory Egret species, remained to feed on the tidal flat facing the Cansaga Bay even in a noisy environment (>60dB) caused by aircraft passage. It is thus assumed that migratory birds has adopted to such noisy environment. Nevertheless, appropriate mitigation measures are planned to minimize the impacts.

Based on the indication by the experts that some individuals of migratory birds may not fly to their destinations in the northern and southern hemispheres and overstay in the Central Visayas area, including Olango Island and Cansaga Bay area, and that birds dependent mainly on Olango Island, including endangered species, may use the Cansaga Bay area as an alternative roosting and feeding grounds, it would be advisable to conduct regular monitoring of birds in the construction and operation phases as an important parameters for the potential negative impacts on the KBA/IBA.

(3) Aquatic Flora and Fauna

As described in 8.6.71)(8), Nassarius spp, a kind of mud snail classified as macro invertebrate, shows a seasonal variation in its population density. However, since potential impacts from the project both in construction and operation phases will not vary greatly with the population density of organinsm, potential impacts are expected to be occur in almost the same manner throughout the year.

<u>Construction Phase</u>

Potential impacts from construction activities on the aquatic flora and fauna include:

- Removal of or direct physical injury to aquatic flora and fauna (e.g. seagrasses and sea weeds in Cansaga Bay and Mactan channel) through activities associated with construction of offshore viaduct and bridge;
- Vibration/disturbance from pile-driving
- Turbidity, siltation/sedimentation of Mactan Channel due to movement of loose underwater sediments, soil from construction of viaduct footings/columns
- Release of contaminants, such as fuel and hydraulic fluid from equipment/vehicles for construction; chemicals such as paint; liquid wastes; and sediment-laden run-off from uncleaned/dirty area of construction work sites

<u>Operation Phase</u>

Potential impacts from operational activities on the aquatic flora and fauna include:

- Lighting along the bridge may give adverse impacts on fish in the ocean, which subsequently affect the small-scale fishery being carried out near the project site
- Deterioration of habitat due to release of contaminants, chemicals, liquid wastes, and sediment-laden run-off from uncleaned/dirty area of maintenance work sites

3) Impact Mitigation & Enhancement Measures

(1) Countermeasure for Impacts to Terrestrial Flora and Fauna

Some of the trees affected along the alignment shall be replanted, if they are in considerable size or length. A corresponding replacement for the number of trees removed shall be planted by the proponent or DPWH. The proponent as well as the LGUs shall undertake tree planting programs to more or less offset the GHG emissions from the 4th Cebu-Mactan Bridge-Mandaue Coastal Road project.

Potential impacts on migratory birds shall also be mitigated sufficiently, so that construction activities would not pose significant disturbances to birds during the migration season. To do so, mitigation measures shall be particularly focused on impacts in terms of noise and vibration that are to be generated from construction work. If the mitigation measures in the construction phase mentioned below are carried out properly, impacts to birds can be minimized regardless of whether or not during the migration season of migratory birds.

Based on the mangrove and other terrestrial flora fauna assessment, the mitigation measures and recommendations are shown below:

Pre-Construction Phase

- Providing a temporary fencing to vegetation for their protection to minimize clearing as much as possible.
- 467 terrestrial trees, including 385 trees of important species (i.e. Molave, Narra, and Mahogany) shall be earth-balled and re-planted in areas adjacent to the road alignment to maintain urban greening or green-built zones.
- For 1,609 trees (i.e. 911 terrestrial trees and 698 mangrove trees) that are inevitably cut, compensatory plantation of appropriate species of mangrove and terrestrial trees in compliance with DENR rules such as DMO 2012-02 (100 times of cutting trees) shall be carried out. If the ‘100 times of cutting trees’ rule applies to all the species to be cleared, approximately 91,000 seedlings of terrestrial trees and 70,000 seedlings of mangrove shall be planted as shown in Table 8.6.48. Basically, plantation shall be done in the interchange area as much as possible, and if the area is not sufficient, suitable sites shall be selected in the detail design phase. As compensatory plantation for important species (i.e. Molave, Narra and Mahogany), same species shall be planted taking into account the connectivity to the existing ecosystem. It is desirable that Molave and Mahogany be planted along the Butuanon River where some trees of these species are identified, and Narra be planted near the 2nd Mactan Bridge, where most trees of this species are identified, or other suitable places outside of ROW. Mangrove shall be planted in the northern part of the interchange area, which is also a part of development of the wetland park.

Table 8.6.48 Outline of Tree Cutting and Plantation

Item	Terrestrial Trees				Sub-Total	Mangrove	Grand Total
	Molave	Narra	Mahogany	Less Impt. Spp			
No. of trees to be cut	387	64	96	364	911	698	1,609
No. of trees to be planted	38,700	6,400	9,600	36,400	91,100	69,800	160,900

The above-mentioned tree plantation shall be carried out in the following steps:

1. On the basis of the tree cut permit isseued to DPWH, all trees cut during ROW clearing activities shall be accounted and collected by DENR;
2. DENR shall identify suitable tree planting sites that can accommodate the total number of replacement trees to be planted and prepare the necessary work plan for each plantation site.

Survey, mapping, planning and characterization of the project sites shall be carried out by the DENR Community Environment and Natural Resources (DENR-CENRO) in the locality;

3. Under the supervision of DPWH, the contractor shall be responsible for the tree planting and the maintenance of planted trees during the contract warranty period; and
4. Monitoring shall be carried out quarterly by the Environment Safety and Health Officer (ESHO) of the Contractor supervised by Consultant, DENR and concerned LGUs.

- 4th Cebu-Mactan Bridge-Mandaue Coastal Road design should consider the disturbance to this KBA. The Biodiversity Study, or detailed study on migratory bird and its habitats (i.e. mangrove and tidal flat), shall be conducted twice at each migration season during the Detailed Design phase as input to the detailed engineering design and management of the KBA.

Construction Phase

- Conduct awareness campaign to all relevant construction workers about the careful consideration for IBA/KBA
- Adoption of lower noise and vibration construction method and machines (e.g. avoid impact-type pile driving and employ appropriate pile-driving technology)
- Adoption of temporary jetty construction road to minimize adverse impacts on mangrove and tidal flat
- Conduct bird monitoring every two (2) months (Joint monitoring with DENR CENRO to complement their quarterly monitoring)

Operation Phase

- Installment of road sign warning with birds and KBA at the interchange area to reduce the risk of bird-vehicule collision and to raise awareness of the importance of the area among the public
- Installment of recessed road lighting at the interchange area near the mangrove forest potentially used as roosting ground by birds
- Consideration of installment of more than 4m ‘bird-car collision prevention poles’ or fences at the both sides of the balustrade of the coastal road and the bridge at intervals of around 2m based on the Biodiversity Survey (detailed bird survey) planned at the early stage of DD
- Conduct a semi-annual bird monitoring

During the Detailed Design stage, the Biodiversity Study, or a detailed study on migratory bird and its habitats, shall be carried out during two (2) migration seasons. The result will be provided as an input to determining the design of the road and bridge and further mitigation measures. The tentative outline of the Biodiversity Study is as follows.

Table 8.6.49 Outline of the Biodiversity Survey

a. Endangered bird species survey		
Target		Threatened species (i.e. Chinese Egret, Grey-Tailed Tattler and Great Knot)
Population Count	Frequency Location	2 times during DD phase: Once in each migration season 7 survey points 1. Northern fishpond, 2. Southern fishpond, 3. Mangrove forest facing the Cansaga Bay, 4. Mangrove forest along the Cansaga Bay Bridge, 5. Tidal Flat along the Cansaga Bay, 6. Mangrove forest in the inner Cansaga Bay Area, 7. Jugan
Flying Route & Altitude Survey	Frequency Location	2 times during DD phase: Once in each migration season 7 survey points 1. Northern fishpond, 2. Southern fishpond, 3. Mangrove forest facing the Cansaga Bay, 4. Mangrove forest along the Cansaga Bay Bridge, 5. Tidal Flat along the Cansaga Bay, 6. Mangrove forest in the inner Cansaga Bay Area, 7. Jugan
Roosting Area Survey	Frequency Location	2 times during DD phase: Once in each migration season 4 potential roosting sites 1. Mangrove forest facing the Cansaga Bay, 2. Mangrove forest along the Cansaga Bay Bridge, 3. Mangrove forest in the inner Cansaga Bay Area, 4. Mangrove Forest in Jugan
b. Other Migratory Bird Survey		
Population Count	Frequency Location	2 times during DD phase: Once in each migration season 7 survey points 1. Northern fishpond, 2. Southern fishpond, 3. Mangrove forest facing the Cansaga Bay, 4. Mangrove forest along the Cansaga Bay Bridge, 5. Tidal Flat along the Cansaga Bay, 6. Mangrove forest in the inner Cansaga Bay Area, 7. Jugan

One of the potential adverse impacts is roadkill caused by bird-car collisions on the viaduct, in particular, above the fishponds where a certain number of birds were observed feeding. To minimize the risk and mitigate the impact, the following mitigation measures may be taken: i) installment of road sign warning with birds and ii) recessed road lighting at the interchange area near the mangrove forest potentially used as roosting ground by birds. Furthermore, the following measures will be considered in the D/D phase: i) creation of wetland eco park near the interchange area (refer to Figure 8.6.31), and ii) installment of more than 4m 'bird-car collision prevention poles' at the both sides of the balustrade of the coastal road and the bridge at intervals of around 2m.

'Bird-car collision prevention poles' installed on the

Road sign warning with herons installed on the highway

highway along the heron's nesting sites in Niigata Prefecture, Japan	along the heron's nesting sites in Niigata Prefecture, Japan
Source: Niigata Working Group, Kanto Branch, Japan Society of Civil Engineering (available at http://jsce-niigata.com/introduction/article/033/art033.html)	

Reccesed Road Lighting

Source: Panasonic Corporation

Figure 8.6.31 Potential Mitigation Measures

(2) Countermeasure for Impacts to Aquatic Flora and Fauna

As mentioned in 8.6.72)(3), in spite of the seasonal difference in population densitythat a species of , potential impacts are expected to be occur in almost the same manner throughout the year.

Construction Phase

For impacts on the marine environment, the following are the suggested measures:

- Conservation efforts on the seagrasses have to be pursued by the government (local and national) and the private sector, as these ecological resources are being threatened by the impacts of coastal development and fishing related activities.
- Monitor the distribution and health of surrounding intertidal habitats along or near the vicinity of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road alignment.

The proponent should strictly enforce its contractors to utilize 'Best Management Practices' in pile-driving operations in the marine/offshore areas of the port project, which will meet the following criteria: maximize environmental protection and avoidance of contravention with environmental and safety guidelines and regulations.

When in an aquatic environment, contractors will employ the following basic best management practices:

- All equipment will be maintained in good proper running order to prevent leaking or spilling of potentially hazardous or toxic products. This includes hydraulic fluid, diesel, gasoline and other petroleum products.
- Storage of fuels and petroleum products will comply with safe operating procedures, including containment facilities in case of a spill.
- Pile cut-offs, waste or any miscellaneous unused materials will be recovered for either disposal in a designated facility or placed in storage. Under no circumstances will materials be deliberately thrown overboard.
- Contractors will have emergency spill equipment available whenever working near or on the water.
- Adoption of temporary jetty construction road to minimize adverse impacts on mangrove and

tidal flat

- Avoid pile-driving methodology with sound & vibration impacts destructive to marine env/ habitats & disruptive to fish spawning
- Contractors, where possible, will position their water borne equipment in a manner that will minimize damage to identified fish habitat (mangrove, seagrasses, and coral reefs).
- Coordinate with Bureau of Fisheries and Aquatic Resources (BFAR) on pile-driving schedule that it will not occur or be disruptive during fish spawning season
- Monitoring of sound and vibration level during driving any type of piles with in mind its impacts on fish and their habitat.

Operations Phase

For impacts on the marine environment in the operation phase, the followings are the suggested measures:

- Set up a type of light which does not irradiate the sea surface and outside of the bridge
- Proper handling of oil and lubricants to prevent spillage and contamination of sea water (i.e. storage of oil and lubricants in secure areas/places)

(3) Development of Wetland Park surrounding the interchange section

Considering the technical insights from local experts, fishponds that are being used as alternative feeding grounds by birds other than Olango Island, are recommended to be maintained as any form of wetland, so that birds will be able to continue to use the ground. On the other hand, approximately 700 mangroves at maximum might be inevitably cut near the area where the bridge approach road connects to the existing Cansaga bay bridge, and for this inevitable tree cutting, compensatory plantation of mangrove is required in suitable places. As was recommended by the local experts, one of the keys to maintaining environment is to involve community and responsible organizations. Hence, aiming at restoring the ecological functions of mangrove and wetland and maintaining the area sustainable, reveloping the fishpond area in the interchange section into a wetland eco park will be considered in the D/D phase.

Considering the connectivity to the existing mangrove forest and current land use as fishpond, the northern and eastern parts of the interchange section are recommended to be planted with mangrove or terrestrial species, while the southern and western parts should be maintained as wetland (see **Figure** 8.6.32). The mangrove forest to be expanded is expected not only to restore birds' habitat as potential roosting place, but also restore important mangrove's ecological services in this area, namely filtering pollutants leached from the closed dumping site into Cansaga Bay and Mactan Channel, and preventing sediment runoff into the Butuanon River. Fishponds may be redeveloped as park ponds with board walk along the existing boarders of fishpond lots to minimize the adverse impacts on the ecosystem surrounding the fishponds. The Manko Waterbird and Wetland Center in Okinawa prefecture of Japan may be a good reference example because its environment (i.e. estuarine tidal flat and mangrove swamp), designation as internationally important site (i.e. Ramsar site), and role for the local communities (i.e. "Recreational Ecopark") are similar to the situation in the project area[22]. In addition, bird-car collision prevention poles will be considered to be installed to prevent roadkill from vehicular collisions flying over the proposed wetland eco park.

A basic agreement has been made on the basic concept of the wetland park development in the interchange area and the responsibility of the Mandaue City in its maintenance. It is also confirmed that

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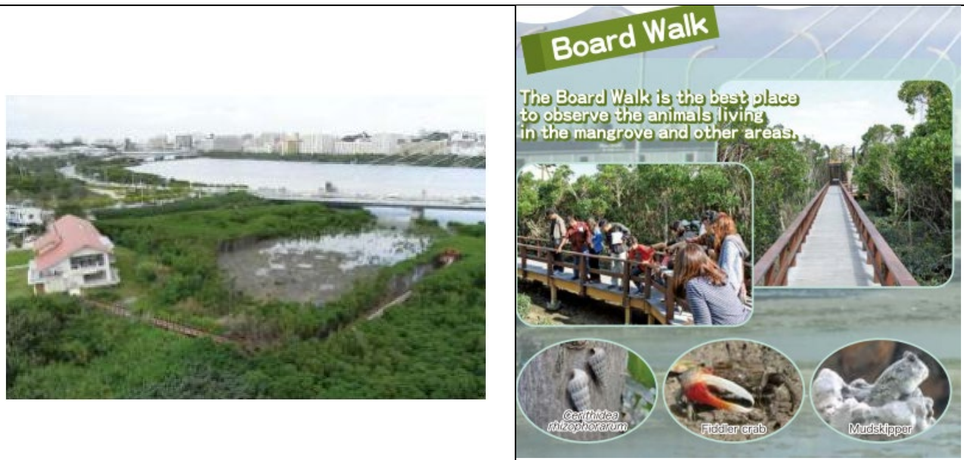
[22] Manko: A Ramsar Site in Japan
http://www.env.go.jp/en/nature/npr/ramsar_wetland/pamph/ramsarpamphen/RamsarSites_en_web56.pdf

the proponent and Mandaue City would coordinate closely to harmonize this 'Wetland Park Concept' and the 'Mandaue City Dumpsite Ecopark' of the City.

Source: JICA Survey Team

Figure 8.6.32 Conceptual Zoning for Proposed Wetland Park



Source: Manko Waterbird and Wetland Center (available at https://www.manko-mizudori.net/reference/)

Figure 8.6.33 Manko Waterbird and Wetland Center

8.6.8 Hydrogeology

1) Baseline

(1) Hydrogeology/Groundwater Conditions

The 4th Cebu-Mactan Bridge-Mandaue Coastal Road alignment is generally located at the coastal area and most portions hugged the coastlines of Mactan channel. Not only the offshore viaduct, but also the inland routes will have an impact on the Marine environment of these areas.

The Mactan Channel is the strait between main island of Cebu and the Mactan Island. The body of water is located within Metro Cebu separating Lapu-Lapu City on Mactan Island from Mandaue City and Cebu City in mainland Cebu. The channel receives water and wastewater from several principal rivers and creeks. The 4th Cebu-Mactan Bridge-Mandaue Coastal Road alignment will pass Batuanon River and its brunch that flow into the channel.

The main water source of Metro Cebu is groundwater, which constitutes 98% of the water supply. Surface water accounts for only a small fraction of 2% (*MCWD databook, 2013*).

Groundwater occurs and moves through interstices in the soil and rocks. This movement is governed by the rock's permeability that, in general, depends on the type and/or age of geological formations. Based on the occurrence and movement of groundwater, the geological formations are divided into three major hydrogeologic groups (*Bureau of Mines, 1986*): Rocks in which flow is dominantly intergranular; Rocks in which flow is through fracture and/or solution openings; Rocks with local or no groundwater

The identified aquifer in the area is within the underlying Carcar coralline limestone. This type of aquifer belongs to the second major hydrogeologic groups, rocks with major flow of the groundwater is through fractures and joints, secondary spaces and/or solutional cavities created by solvent action of the groundwater in the limestone rocks (Figure 8.6.34).

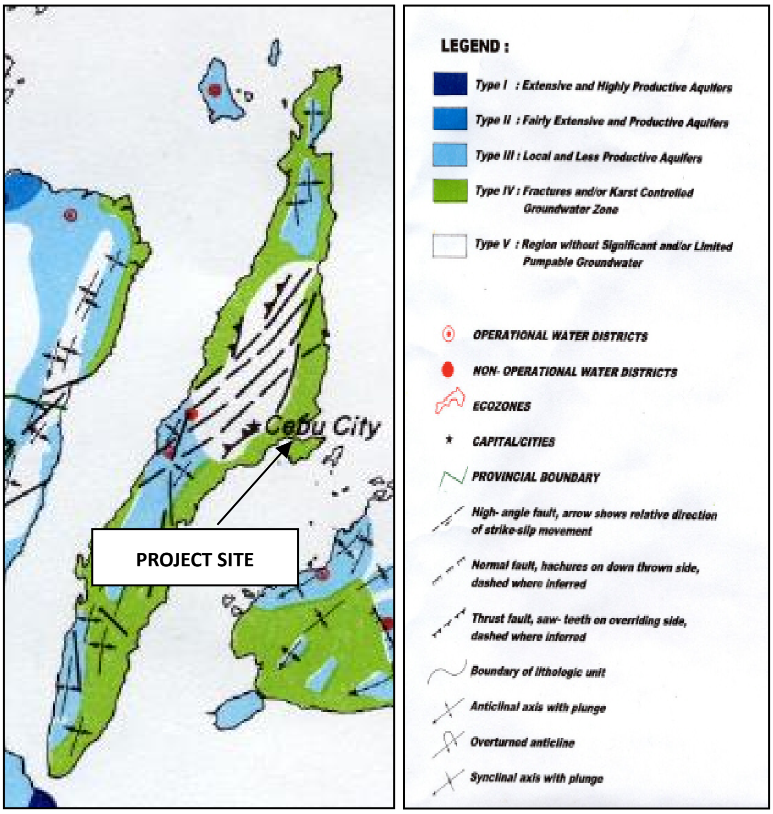


Figure 8.6.34 Regional Hydrogeologic Map of Cebu Island Showing The Study Area of The Proposed 4th Mactan Bridge Project in The Cities of Mandaue and Lapulapu, Cebu

Another identified minor aquifer in the area is within the overlying Quaternary Alluvium consisting of unconsolidated sediments of sand, silt, clay and gravel deposits of variable thickness and extent. This type of aquifer belongs to the first major hydrogeologic groups, rocks in which flow is dominantly intergranular. The rock units of this group generally consist of granular deposits wherein groundwater occurs and moves through pore openings between individual grains and to small extent, through fractures.

Groundwater generally moves from the highest elevation towards the lowest towards the coastline and commonly follows the water flow direction of surface drainage. In the Mandaue City side of the project area, groundwater tends to move from west to the east and exits toward the coastline of Mandaue City and drain into the Mactan Channel. On the other hand, the Lapulapu City side of the project, groundwater tends to move east to west and also exits towards the Mactan Channel.

(2) Water Supply

Metro Cebu's water need is supplied by MCWD, which also covers the areas of Mandaue City, and Lapu-lapu City. It gets most of its water from the underground aquifer through its network of pumping stations. Table 8.6.50 shows the water supply in Metro Cebu.

Table 8.6.50 Existing Water Sources and Rated Production in Metro Cebu, 2013

Sources	Actual Supply (m3/day)	Ratio, (%)
(a) MCWD Service Area	209,252	92
Groundwater	173,183	76.1
Surface water	3.080	1.4
Bulk supply (Private supplier)	28,108	12.4
Desalination (Mactan Rocks)	4,881	2.1
(b) Non-MCWD Service Area	18,273	8
[1] Northern Areas- Danao	5,541	2.4
Southern Areas	12,732	5.6
[2] Minglanilla (Miwasco)	2,690	1.2
[3] Naga (Abejo)	1,200	0.5
[4] San Fernando (LGU)	1,271	0.6
[5] Carcar (Water District)	7,571	3.3
Total Rated Production (m3/day)	227,525	100.0

Source: MCWD Databook.
Notes: 1 Danao Waterworks, 2 Miwasco, 3 Naga Planning, 4 San Fernando,
5 Carcar Water District.

(3) Natural Drainage

The drainage system in Metro Cebu is divided into the same categories for draining rainwater, such as (i) River, (ii) Creek, and (iii) Drainage. The flood-prone areas in Metro Cebu are identified by the respective LGUs. There are many flood-prone areas in the metropolis although flooding happens only when high tide and heavy rain occur at the same time. One of the major problems regarding rivers, creeks and drainages are the presence of informal settlements and irresponsible private property owners along the riverbanks, which generate an enormous amount of garbage that obstructs the flow of natural and man-made waterways. While it is understood that the responsibility to manage the rivers within their jurisdiction is devolved to the LGUs, the overall responsibility is not clearly delegated to a specific office.

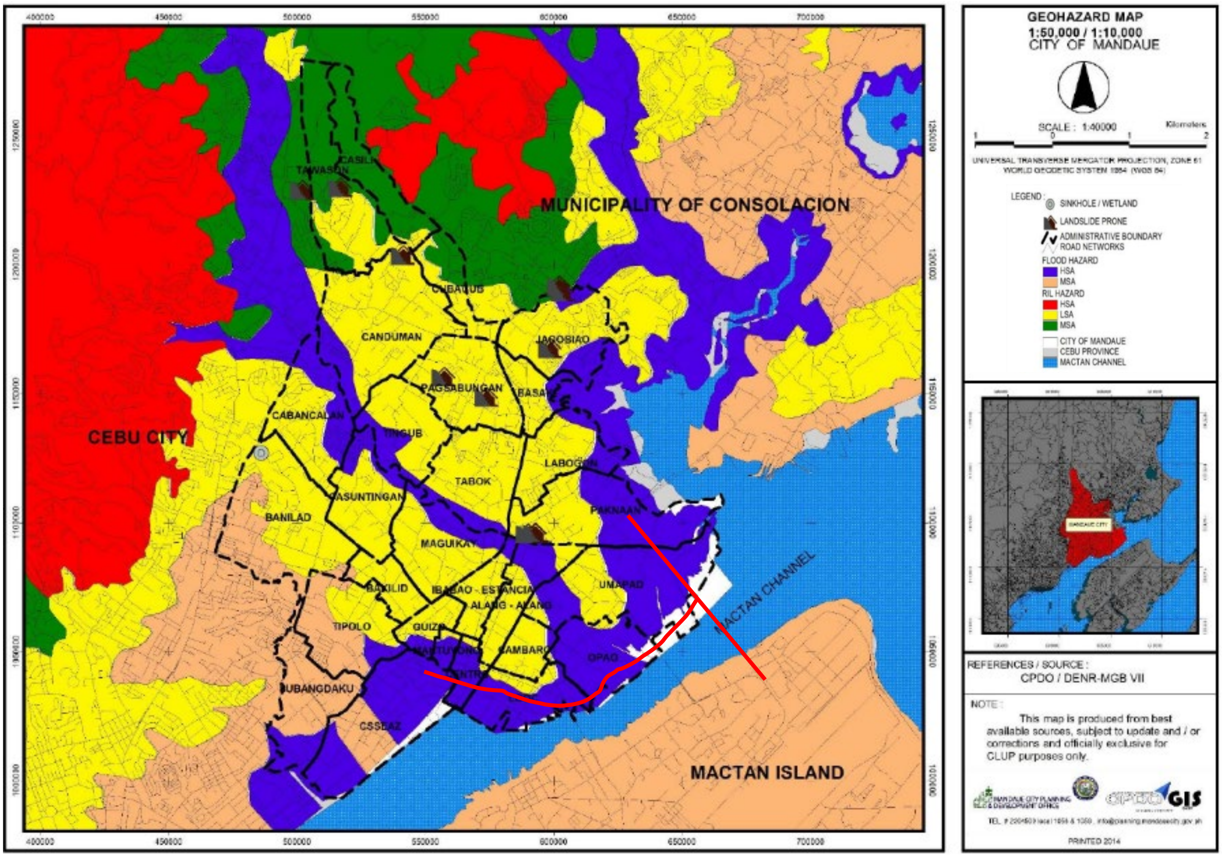
(4) Hydrogeologic/Hydrologic Hazards

The hydrogeologic and hydrologic hazards that were identified to have potential impacts on the proposed project include flooding, coastal hazards such as coastal erosion, storm surge/tsunami and coastal subsidence/sea level rise.

a. Flooding

Flooding results from different causes namely: prolonged periods of precipitation, human actions and other artificial causes such as loss of vegetations and constrictions of streams. Degree of damages brought about by floodwaters differs depending on the water velocity, depth of water, duration, rate of rise, sediment load, and frequency of occurrence and the seasonality of the floods.

Based on the 1:50,000 scale Landslide and Flood Susceptibility Map of Cebu Quadrangle as prepared by the Mines and Geosciences Bureau (MGB-7), the project area and its vicinities in the Mandaue City side have high susceptibility to flooding (Figure 8.6.35). A section of the project in the Mandaue City side is located near the mouth of Butuanon River. During a combination of heavy and continuous rains with high tide, the coastal areas near the mouth of the river is prone to flooding.



Source: Mandaue City

Figure 8.6.35 Geo Hazard Map of the Project Site

b. Coastal Hazards

b.1 Coastal Erosion

All coastlines are susceptible to erosion or tidal inundation depending upon the elevation, topography, gradient and structural protections such as sea walls, groins and levees.

The coastline of the project site will be susceptible to coastal erosion during the development if ever areas near the shoreline will be backfilled with filling material. During the backfilling activities, it should be protected by sea wall or any other structures so that the filling material will not be easily eroded by waves to the sea during strong winds and storms.

b.2 Storm Surge/Tsunami

Storm surge is an abnormal rise in sea level accompanying a hurricane or other intense storm, and whose height is the difference between the observed level of the sea surface and the level that would have occurred in the absence of the cyclone. Storm surge is usually estimated by subtracting the normal or astronomic high tide from the observed storm tide. When storm surge is combined with a normal astronomical high tide, a storm tide is created.

Tsunami or seismic sea waves on the other hand, are long waves generated by sudden displacement under water, most commonly the sudden displacement along a submarine fault associated with an earthquake.

Historical storm surges map of the Philippines showed that Cebu Island including the project site is not hit by any strong storm surges (Figure 8.6.36).

Tsunamis are not experienced in Cebu Island including the project basically due to its strategic location being geographically near Leyte and Camotes Islands on the eastern side.

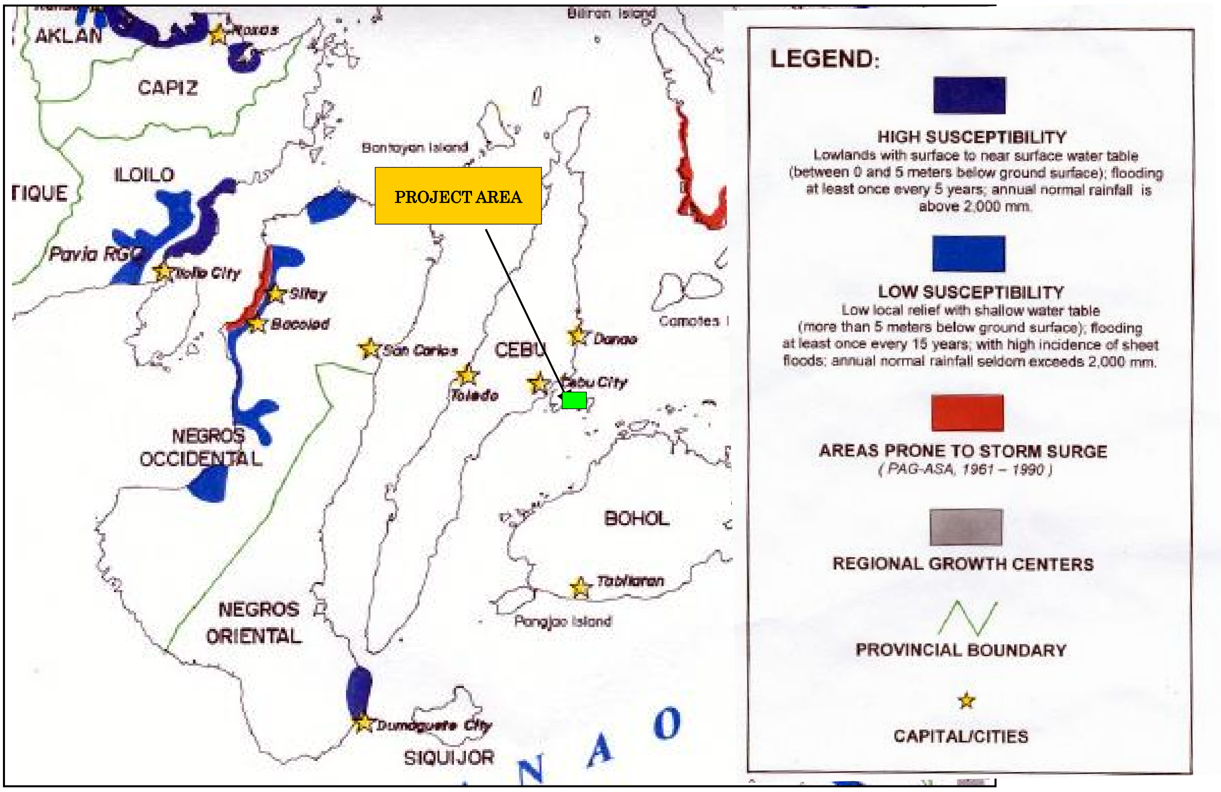


Figure 8.6.36 Historical Storm Surge Map of the Philippines *(1961-1990) (DENR, DILG, LWUA, MGB, NAMRIA, NWRB & PAG-ASA)*

If ever the coastal area of project will be hit by strong storm surges and tsunamis, it will be protected by the coastal configuration in which it is located in the inner section of the Mactan Channel. The coastal area of proposed project is protected by the nearby Mactan Island from typhoons coming from the east. The presence of several existing shipyards located further to the northwest of project towards the mouth of Cansaga Bay indicates that the coastal area within the project site is relatively safe from storm surges and/or tsunami.

b.3 Coastal Subsidence/Sea Level Rise

Coastal subsidence refers to large-scale lowering of the natural ground surface. One form of land subsidence results from very slow movements in the earth's crust (tectonic movement) that cause a net lowering of the land surface over thousands of years. Another cause of subsidence results from the over extraction of water, oil or natural gas from underground aquifers. Ongoing extraction of this fluid can result in collapse (compaction) of the sedimentary strata forming the aquifer and hence lowering of the overlying land surface.

Coastal zones are particularly vulnerable to climate variability and change sea level rise which is an increase in sea level can be a product of global warming through two main processes: expansion of sea water as the oceans warm, and melting of ice over land. Global warming is predicted to cause significant rises in sea level over the course of the twenty-first century. The possible impacts of sea level rise in the coastal zone may include increased coastal erosion, higher storm-surge flooding, more extensive coastal inundation, increased flooding and potential loss of life, changes in surface water quality and groundwater characteristics. At present, there are no noticeable evidences of sea level rise in the coastal front of the project site. The coastline is not of submergent type which has experienced a rise in sea level, due to a global sea level change.

2) **Impact Identification and Assessment**

(1) Change in Hydology

Construction Phase

The 4th Cebu-Mactan Bridge-Mandaue Coastal Road project **c**onstruction will have negligible to moderate impacts on the hydrology and water quality.

The identified causes of impacts on hydrology during construction stage include:

- Disruption of natural drainage pattern due to modification of topography
- Increase in run-off due to exposed soils, disturbance of soils which may result to localized flooding, sedimentation, etc.;
- Ponding of water in and around foundation excavations and subgrades supporting slabs on fill

Before the construction, existing informal settlers at the the riverbank of Butuanon River will be provided with the compensation and assistance. The construction site of the ramp of the interchange is next to this area. Even though localized flooding may happen when high tide and heavy rain occur at the same time, no impacts are expected to this area.

(2) Water resource

Construction Phase/ Operation Phase

Water usage for construction work will impact to water usage in local community.

Potential environmental effects of the Project on groundwater resources may occur as a result of construction vibrations from heavy equipment and excavation can temporarily affect well water quality (ex. Turbidity and discoloration). However, there would be no significant impact given the following:

- The nearest National Water Resource Board (NWRB) water permittee to the project site (i.e. Deep well at San Miguel Corporation) is located at 1.2 km, which is distant from any activities of the project that may impact on water resources[23]. Hence, the project is unlikely to affect any source of water supply.
- The area in the vicinity of the project site is also suffering from salt water intrusion, which makes deep wells in the area no longer viable to supply domestic water to the community.

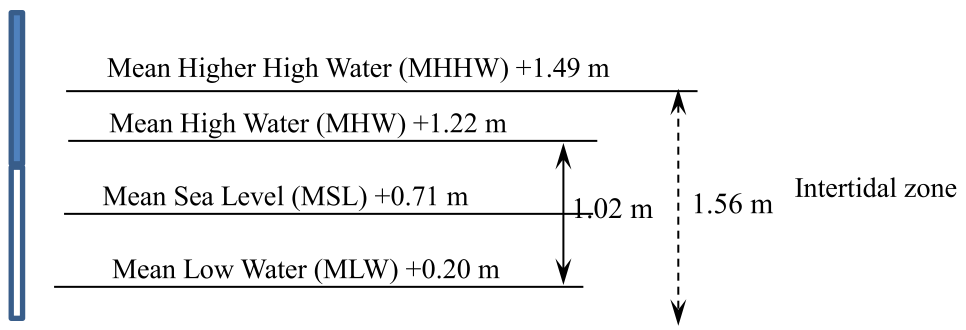
(3) Oceanographical Conditions

Construction Phase/ Operation Phase

The 4th Cebu-Mactan Bridge-Mandaue Coastal Road will be constructed as an elevated viaduct mainly, so that modification of topography due to cut-and-fill work will be limited. However, the modifications of topography/terrain will disrupt drainage pattern, causes erosion/transport of sediments and pollutants to surface waters are considered adverse impacts to coastal processes and change of the characteristics of beach if not mitigated properly.

The tide conditions in the project site are shown in **Figure** 8.6.37. The tide component of Cebu is dominated by the components of the semi-diurnal tides. It also has a tendency of diurnal inequality where the tide level at high tide / low tide, which occurs twice a day, sometimes changes differently. The difference between Mean High Water (MHW) and Mean Low Water (MLW) of the day is 1.02 m.

The definition of tidal flat in Japan refers to the intertidal zone between mean monthly highest water level and mean monthly lowest water level. On the other hand, in tide statistics in Cebu, only Mean Higher High Water (MHHW) is defined. Therefore, the difference between Mean Lower Low Water (MLLW) and MLW is equal to the difference between Mean Higher High Water (MHHW) and MHW. In addition, MLLW is set to −0.07 m, and 1.56 m of difference between MHHW and MLLW is defined as an intertidal zone (See Figure 8.6.37).



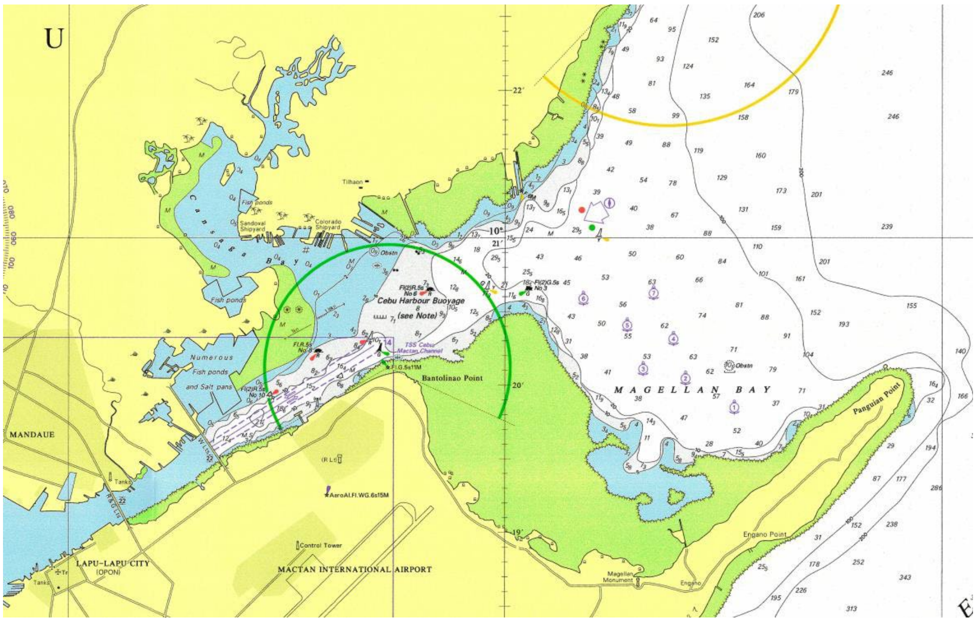
Source: Tide and Current Tables Philippines 2019, arranged by JICA Survey Team

Figure 8.6.37 Tide water level（Intertidal zone）

Based on the hydrographic chart (see Figure 8.6.38), the velocity of tidal current at the piers is 1 knot (0.51 m / sec) in the southwest direction when the tide is high, and 1.8 knots (0.93 m / s) in the northeast direction when the tide is low. However, this is near the channel, and is not the velocity of tidal current at the tidel flat where mangrove grows naturally.

[23] National Water Resource Board (available at http://www.nwrb.gov.ph/index.php/products-and-services/water-permittees)

The deepest bottom of the new bridge is -19.8 m, and in Mactan side, there is a tidal flat where mangroves grow naturally over 800 m and its elevation is equivalent to intertidal zone.



Source: United Kingdom Hydrographic Office

Figure 8.6.38 Hydrographic chart

In the case that piers are installed in the water area, the ground surface around the piers will be lowered due to scouring the bottom by the flow around the piers.The size of the scouring phenomenon relates to parameters such as the bridge width and other shapes, the velocity of tidal current, and water depth. In the case that the water depth is shallow and the velocity of tidal current is low, the amount of scouring is generally small.

The water depth near the bridge pier located in the tidal flat is less than 1 m from the MHHW. At shallow water depths in tidal flat, the velocity of tidal current is estimated to be very low due to the flow resistance of the mangrove ground roots.

Therefore, its hydraulic influence and topographical change of tidal flat are considered to be minor.

3) Impact Mitigation & Enhancement Measures

Construction/ Operations Phase

(1) Change in Hydrology

Construction Phase

There is a possibility that the construction work will cause disruption of natural drainage pattern due to modification of topography and increase in run-off due to exposed soils. The adequate drainage system such as the crossing drainage pipe will be set to avoid or mitigate these impacts.

In addition, the following mitigation measures will be implemented.

- Limiting the area of exposed soil
- Building of bund/dikes effectively enclosing water-areas prior to landfilling for coastal road
- Iimplementation of erosion control measures, including temporary diversion berms/sandbagging, drainage swales and siltation basins

- Loose earth materials stockpile be kept away from banks and near waters (waterways, sea)

Operations Phase

Proper drainage and stormwater management to prevent the 4th Cebu-Mactan Bridge-Mandaue Coastal Road from causing flooding, contamination of surface and ground waters should be conducted.

(2) Impact to water resource

Construction Phase

- Sourcing of water from outside of the communities within the project area
- Implement water saving/conservation measures of water use for construction works/activities
- Recycled water or water from waterways and marine waters shall be used for ground sprinkling or dust-suppression measures

(3) Oceanographical Conditions

Construction/ Operations Phase

Mitigation measures on impact to oceanographical conditions is similar with “Change in Hydrogeology” shown in above section.

Regular and constant monitoring of coastal/marine areas for possible deterioration of aquatic resources and marine water quality, and ceanographical conditions should be implemented by the contractor and the project proponent.

- Building of bund/dikes effectively enclosing water-areas prior to landfilling for coastal road
- Proper handling of Oil and lubricants to prevent spillage and contamination of surface and ground waters; heavy equipments and machineries shall be well-maintained to prevent discharges from engines
- Paint residues and paint (including lacquer, varnishes, glue/epoxy, and other chemicals) containers shall be handled & disposed properly and arrangement will be made with the suppliers for such containers to be return for their proper disposal
- Regular maintenance of drainage system (e.g. desilting)
- Care and maintenance of greeneries, ground cover –specifically, those along the shorelines that would retard run-off from flowing into open waters

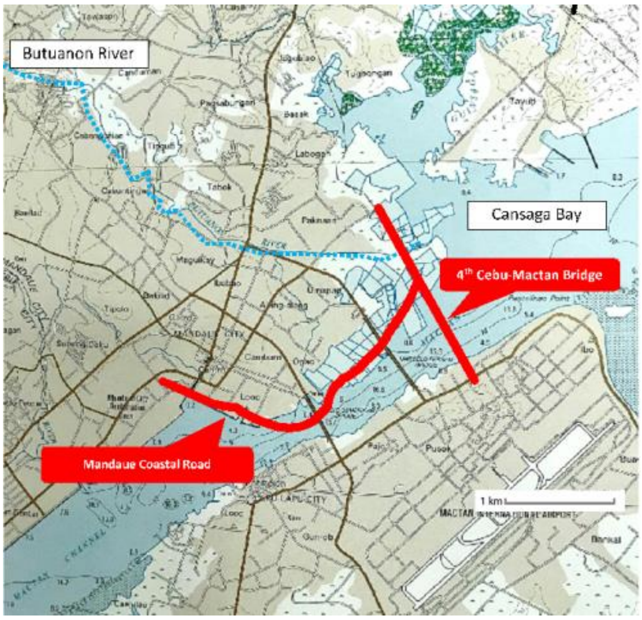
8.6.9 Geographical Features

1) Baseline

(1) Topography

Metro Cebu is located at the center of Cebu Island. High land and mountains rise behind the more urbanized area that is largely limited to the coastal areas. The altitude in Cebu Island is approximately 0 m above sea level in the coastal areas in the east while it reaches over 500 m above sea level in the highlands in the west. Metro Cebu is largely composed of sedimentary rocks as is in other areas in Cebu Island.

“The general topography of 4th Cebu-Mactan Bridge-Mandaue Coastal Road alignment and surrounding areas are generally flat to nearly level being in the lowlands coastal regions.



Source: NAMRIA

Figure 8.6.39 Topographic Map of Project Site

(2) Geology

The proposed 4th Cebu-Mactan Bridge Project in the island of Cebu geologically falls within the Central Physiographic Province of the Philippines, which is composed of cordilleras, lowlands, troughs and offshore basins. The island lies towards the central portion of the Visayan Basin and moderately interrupted by the uplift of the Cebu geoanticline in Late Miocene to Pliocene. The basement is mainly Cretaceous to lower Tertiary metavolcanics and metasediments. These are intruded by diorite stocks and batholiths (*BMG, 1982*).

The complex geological development of Cebu Island is produced by periodic magmatism and forearc basin deposition. Arc magmatism is believed active until Pliocene time. The development of the Visayan Sea Basin during Eocene-Pleistocene time provided a suitable environment and ample space for periodic deposition of the clastics and non-clastic units/formations. The latest episodic event of submarine deposition before the final stage of uplift is the building up of algal-reefal limestone of the Carcar Formation, which is presently fringing the entire Cebu Island.

The prominent structural features in Cebu Island are the major northeast-southwest trending structural grain lineation, which are distinctly defined by nearly vertical fault system.

Santos Ynigo (1958) has further subdivided Cebu Island into three structurally distinct units namely: the Northern Highland Area, Central Highland Area and the Southern Highland Area. The principal fault systems bounding these areas are believed to have vertical movements early during the Cretaceous to Tertiary period but later exhibited left lateral strike slip movements. Block faulting specifically in Central Cebu Highlands has also been reported and plays a very important role in the emplacement of acid plutonic intrusives width associated metallization in portions.

Cebu Island has a NNE-SSW trending mountainous axis, about 160 km long and is flanked by intermediate highlands heavily dissected by deep narrow valleys with steep slopes. Narrow coastal plains skirt the hilly terrain and are principally coral reefs mantled by alluvial sediments.

Four (4) geomorphologic features are found in the regional vicinities of study area, namely:

1. The first geomorphologic feature is that of the flat low-lying Quaternary Alluvium which consists of detrital deposits sand, silt, gravel and clay in beaches, alluvial plains and river beds.

The entire project area is part of this feature and are often flood prone.

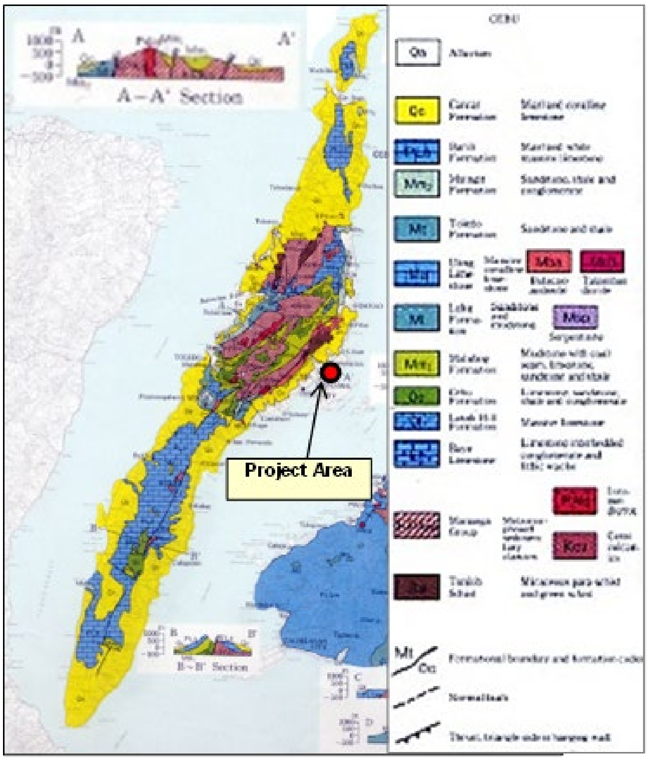
2. The second and third features are represented by the limestone of the Carcar Formation. The limestone exhibits two distinct geomorphological regions. The second feature is where ground elevation rises gently from just above sea level inland near the coast to about 50 meters above sea level to form low lying limestone foothills.
3. The third geomorphologic feature is where ground reaches elevations of over 200 meters above sea level, forming the rugged deeply dissected limestone hills of the Carcar Formation.
4. The fourth is the sharp crested narrow parallel ridges of the older Mananga Formation. These rocks are variably weathered with extensive severe erosion. It is located in the mountains further to the west of study area in Central Cebu.

The project area is located on the east central portion of Cebu Island. The stratigraphy of this region reveals a complex sequence of lithologic units deposited from Cretaceous to Quaternary periods. The rock formations in the vicinities of the project site include the Quaternary Alluvium and the underlying Carcar Limestone Formation. Following is the stratigraphic sequence arranged from oldest to youngest within the regional vicinities of project site (*Bu. of Mines, 1983*):

<u>*Mananga Group*</u>

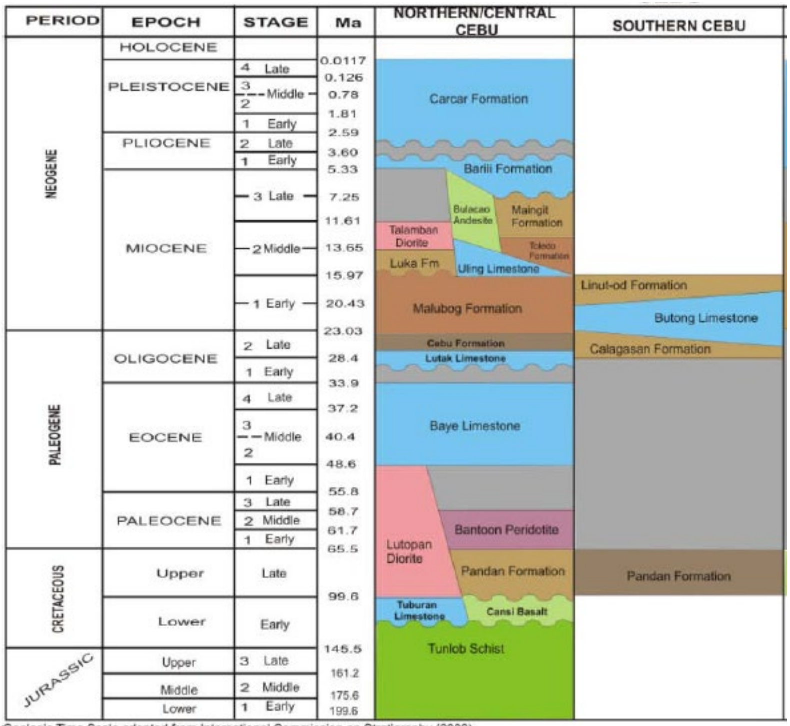
It is consisting of a sequence of andesitic to basaltic pyroclastics and lava, limestone and clastic sedimentary rocks, which is Cretaceous to Paleocene in age. It is found further NW of project area.

Unconformable overlying the Mananga Group is the late Eocene to early Miocene sedimentary formations consisting of the Lutak Hill Formation, Cebu Formation and Malubog Formation. The Lutak Hill formation is mainly limestone with basal sandstone containing Lepidocyclina and Nummulites. The Cebu Formation consists of an upper Orbitoidal limestone, a lower clastic unit with coal measures and a basal conglomerate. The Malubog Formation is composed of mudstone, shale and occasional beds of conglomerate, limestone and coal.



Source: JICA-MMAJ, 1990

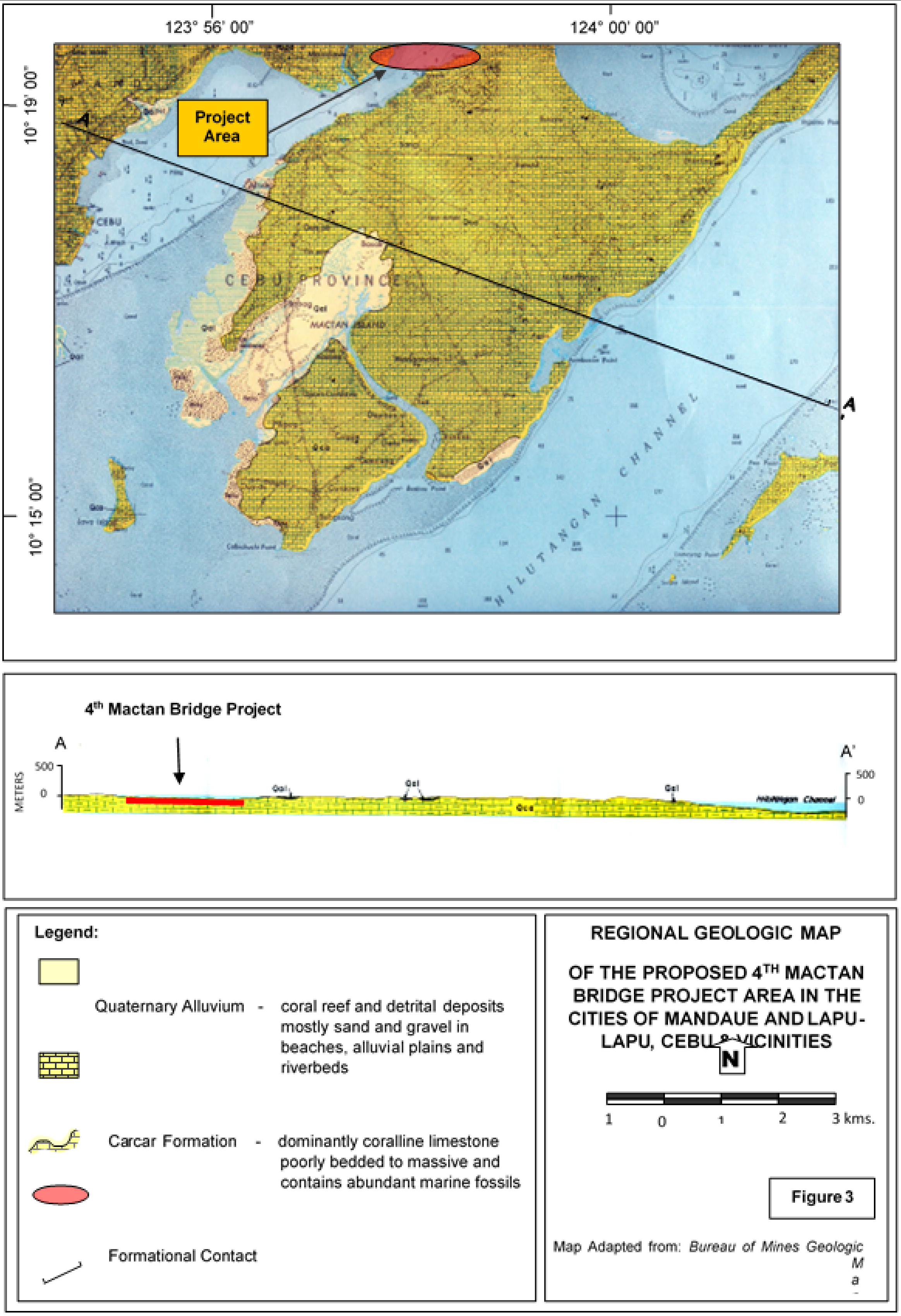
Figure 8.6.40 Regional Geologic Map of Cebu Island Showing the Study Area



Geologic Time Scale adopted from International Commission on Stratigraphy (2009)

Source: MGB

Figure 8.6.41 Stratigraphic Column of Northern/Central Cebu and Southern Cebu (*MGB, 2010*)



Source: MGB

Figure 8.6.42 Regional Geologic Map

Middle Miocene rock formations unconformably overlie the older rocks. First in the sequence is the Luka Formation consisting of interbedded sandstone and mudstone with conglomerate and limestone lenses. The Uling Limestone comes next and is a generally hard, massive limestone but partly porous and coralline. At the top of the sequence is the Toledo Formation consisting of thin to thick bedded sandstone and shale with occasional lenses of conglomeratic limestone and calcarenite.

The Late Miocene Maingit Formation unconformably overlies the older rocks. The formation is composed of granule to cobble conglomerate with interbedded shale, sandstone, limestone and conglomeratic limestone in the lower part.

Unconformably overlying older formations is the Barili Formation of Late Miocene to Early Pliocene age. This consists of a Lower Limestone member which is generally brown in color, hard, coralline, and porous and an Upper Marl member which is poorly bedded and slightly sandy.

Carcar Formation

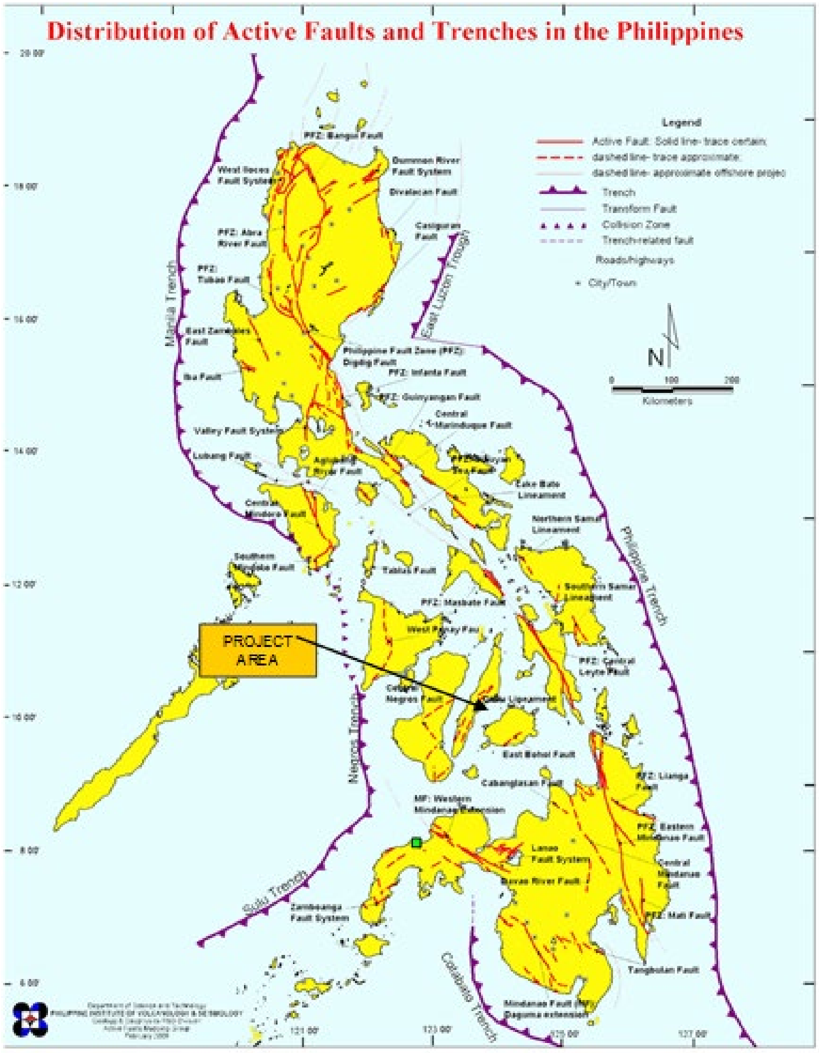
It is dominantly massive to bedded coralline limestone, which is most widespread along the coastal areas of the island. It has a Plio-Pleistocene age. This type of formation is exposed further NW of the project.

Quaternary Alluvium

Composed mostly of detrital deposits mostly sand and gravel in beaches, alluvial and riverbeds. This type of formation underlies the whole project site including the Seismicity

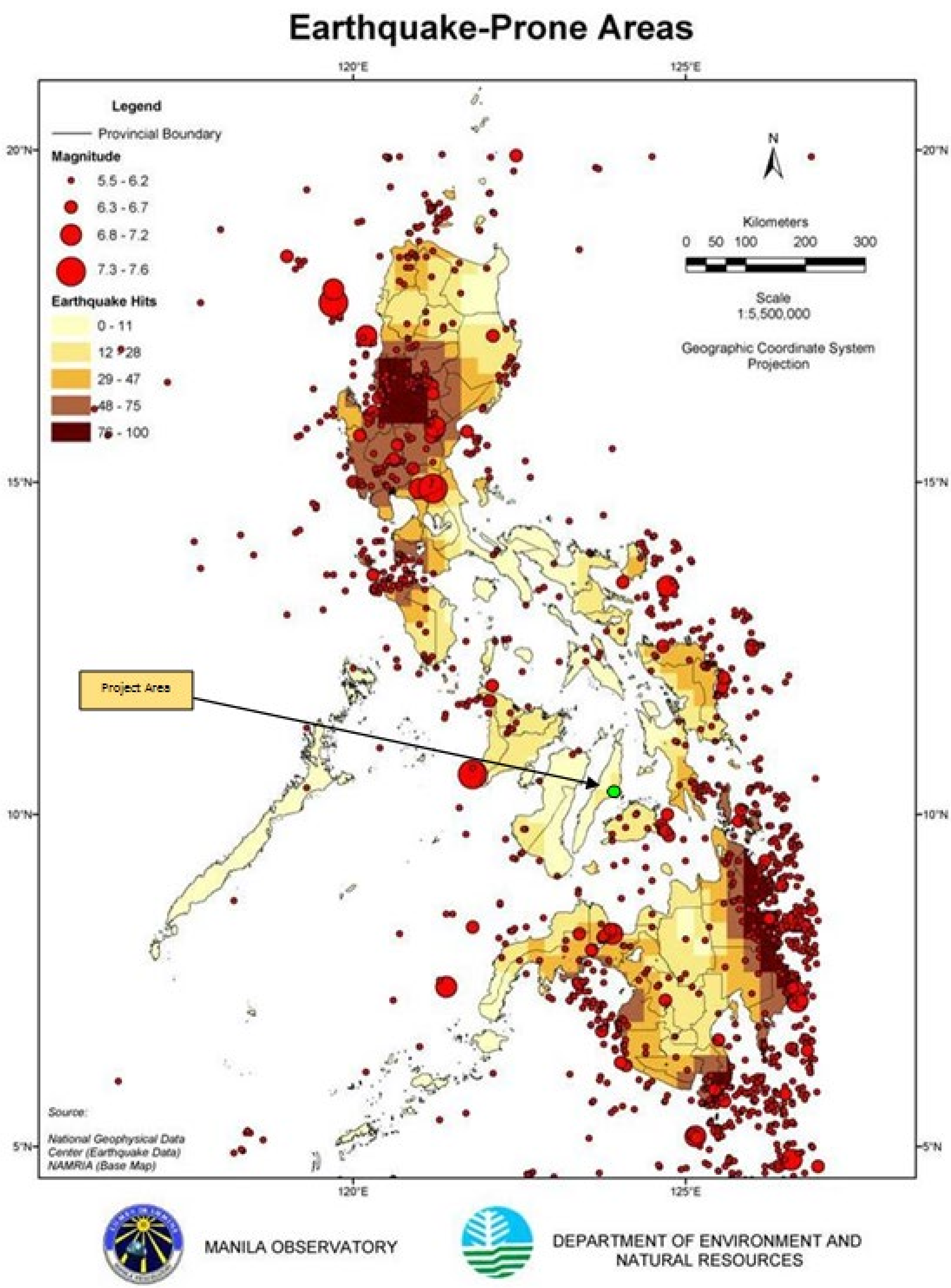
Active seismic generators of the Philippine Archipelago are associated with mobile belt boundaries specifically along convergent zones as exemplified by the East- Luzon-Philippine trench to the east and the Manila-Negros-Sulu-Cotabato trenches to the west where the Philippine Sea Figure and the Eurasian Figure are being consumed respectively (Figure 8.6.43). Furthermore, several active fault systems within the Philippine Arc itself more importantly the sinistral Philippine Fault systems are also active and even worst contributors to damaging earthquakes. The distribution and concentration of the destructive earthquakes in the Philippines as per past records showed that these are directly associated with active subduction zones and/or mobile fault zones.

Cebu Island being geographically located distal from the primary earthquake generators as explained above has the least chances of experiencing major and destructive earthquakes, as exemplified by the earthquake frequency distribution in the Philippines done by Philippine Institute of Volcanology and Seismology (PHILVOLCS) (Figure 8.6.44). Thus, the low number of recorded earthquakes in the island of Cebu also suggests low seismicity or seismic activity level in the project area.



Source: PHIVOLCS, 2000

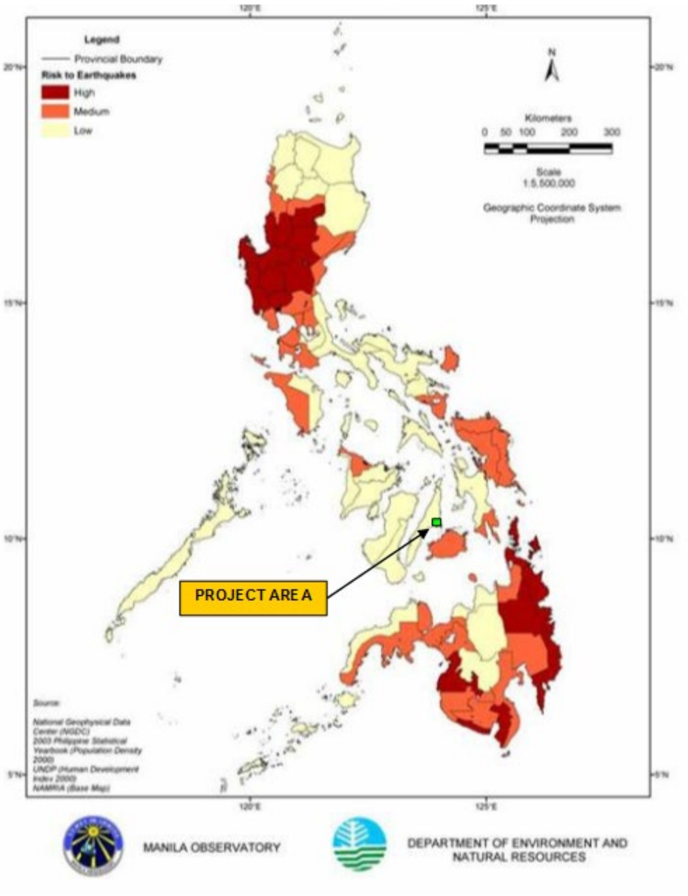
Figure 8.6.43 Tectonic Map of the Philippines showing the Project Area



Source: PHIVOLCS, 2000, DENR-Manila Observatory

Figure 8.6.44 Earthquake-prone Area Map of the Philippines showing the Project Area

In a provincial scale of risk assessment, the Province of Cebu including the proposed project in the Cities of Mandaue and Lapulapu, have a general low risk to earthquake (Figure 8.6.45).



Source: DENR-Manila Observatory

Figure 8.6.45 Earthquake Risk Map of the Philippines

2) Impact Identification and Assessment

Pre- Construction and Construction Phase

Modification of topography, soil disturbance and loss of top soil due to excavation (mostly of viaduct columns), will have negative and irreversible impacts, however the magnitude is considered as minor to moderate.

The 4th Cebu-Mactan Bridge-Mandaue Coastal Road will be constructed as an elevated structure (viaduct) mainly, so that modification of topography due to cut-and-fill work will be limited and design and construction plan of viaduct columns will be optimized in the detail design stage.

The aligment of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road does not pass active fault. The project area and its vicinities in the Cities of Mandaue and Lapulapu, Cebu have low susceptibility to earthquake induced and rainfall induced landslides because the area is generally flat. The impact on this parameter is insignificant and negligible as the area along existing road is already developed land and opening of new road areas are limited used for fish ponds.

Loss of top soil is related to its inherent value for vegetative cover (greeneries, breathing space), however, the impact on this parameter is also insignificant and negligible as the area along existing road is already developed land. In opening of new routes there may be marginal and backyard crops cultivation and livestock raising activities which may be affected, but because the areas are within an urban area it is no longer significantly utilized for agricultural purposes.

The impact on change in sub-surface/ underground geomorphology due to pile-driving will be limited as construction plan of viaduct columns will be optimized to prevent subsidence at the point near the buildings such as a house or the factory, including the establishment of sand guards prior to construction. The detailed setting position is settled at the time of a detailed design.

There is a possibility that the construction work will cause disruption of natural drainage pattern due to modification of topography and increase in run-off due to exposed soils. (See 8.6.4)

Operation Phase

During operation stage, there will be no change in topography and geology in the project site.

3) Impact Mitigation & Enhancement Measures

Pre-Construction Phase

Although historical seismic data from PHIVOLCS show that only small magnitude earthquakes occur in Cebu Island and the project area, the probability of occurrence of high magnitude earthquakes is not discounted, because of the presence of the tectonically active Negros Trench located southwest of Cebu and Negros Island. This trench may possibly produce high magnitude earthquakes and can trigger earthquake-induced geohazards such as ground shaking and liquefaction.

Mitigation measures to address impacts on ground shaking and liquefaction that are being considered are as follows:

- Undertake site-specific seismic risk characterization and estimates of how the ground beneath the structure will move in the final design of the structures; and
- Design and construct structures that will address seismic hazards

The 4th Cebu-Mactan Bridge-Mandaue Coastal Road will be constructed as an elevated viaduct mainly, so that DPWH Guide Specifications LRFD Bridge Seismic Design Specifications (“BSDS”), 2013 is applied for the seismic design of structures.

Construction Phase

During Construction stage, the original topography of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road alignment area changes due to excavation and filling for subgrade/base and road pavement for on-grade road and the columns for inland viaduct.

Mitigation measures to address impacts on topography that are being considered and implemented on site are as follows:

- Limiting land clearing and excavation within the affected areas of the primary impact area and excavating within the desired level only
- Proper and appropriate excavation and embankment protection such as sheet piles.

Operation phase

During Operation Stage, there will be no change in topography and soils in the project site, as the change in topography and soils resulting from the construction stage will be the final grade elevations of on-grade road and the coastal road alignment, as well as the columns for the viaduct all throughout the operations stage.

8.6.10 Project Affected Families and Establishments

1) Impact Identification and Asessment

(1) Project-affected Persons and Companies

The survey revealed that there were 42 land owners, two (2) lessees (companies), 33 non-residential structure and improvement (e.g. fences) owners that belong to mainly private companies and government bodies, eight tenants and 243 persons that belong to 69 households affected by the project. A bulk of the people, companies and government bodies affected are located in Mandaue City including all affected households while 10 land owners and 10 improvement owners are located in Lapu-Lapu City. All of the 69 households (i.e. informal settlers) are all expected to be relocated.

(2) Household Income

The Philippine Statistics Authority (PSA) reported that the poverty threshold per family per month rose by 10.9% in the Philippines to PhP 10,481 in 2018 from PhP 9,453 in 2015. The PSA explained that this is the level of income needed to meet both basic food and nonfood needs of a family of five in one month[24].

A total of 21 households (30.43% of the total PAFs) has a monthly income range of PhP 1,001-5,000 while 13 households (18.84% of the total PAFs) is on the range of PhP 5,001-10,000. 12 households (17.37% of the total PAFs) have an income range of PhP 10,001-15,000, and four households (5.80% PAFs) have a monthly income range of less than PhP 1,000. Three households (4.35% of the total PAFs) has PhP 30,001-50,000 and two (2) households have an income range of PhP 15,001-20,000. It means 38 households fall under the poverty threshold of PhP 10,481 per month set by NEDA.

(3) Access to Basic Social Services

Source of Drinking Water

A total number of 31 or 44.93% of the PAFs has a water source from piped water provided by the Metropolitan Cebu Water District (MCWD) and five or 7.25% of them from the piped water (other source). 14 households or 20.29% use dug well, nine or 13.04% buy bottled water and one household or 1.45% rely on a spring. None of them collects rainwater or use cart with small tank/drum. Three households use other sources.

Sanitation Facilities

A majority of the PAFs utilized flush/pour flush to septic tank type of toilet. A total number of 26 or 37.68% utilized flush/pour flush to pit latrine has a total number of three or 4.35%, those who utilized pit latrine has a total number of six or 8.70%, four or 5.80% use composting toilet, 12 or 17.39% uses the public/common toilet while nine or 13.04% has no facilities and the remaining three or 4.35% uses other types of toilet facility.

Electricity

Of the 69 PAFs, seven or 10.14% PAFs were affected uses kerosene, 14 or 20.29% have access to electricity, 37 or 53.62% PAFs utilized other lighting facilities such as solar.

[24] https://businessmirror.com.ph/2019/04/11/poverty-rate-down-to-21-on-higher-income-neda/

Cooking Facilities

The sources of cooking fuels utilized by the PAFs are wood, LPG, kerosene, electricity and butane. 21 PAFs utilized wood, followed by 18 of them that utilized LPG. 13 households used butane and seven relied on charcoal. Three households used electricity and two PAFs utilized other cooking facilities.

2) Impact Mitigation & Enhancement Measures

During the pre-construction stage all acquisition activity for the land required will be completed. This requires relocation/resettlement of Project Affected Families (PAPs) living in government-owned properties, payment of entitlements, and purchase of private lots/properties.

(1) Compensation and Assistance

To mitigate the impacts to Project Affected Families and Establishments, the "Resettlement Action Plan" was presented the compensation and assistances need to be provided under the project to the PAPs. It is designed to enhance or at least restore the livelihoods of all PAPs in real terms relative to pre-project levels and to improve the living standards of the displaced poor and other people that are considered vulnerable. It should be noted that all compensation and support will be provided to the PAPs prior to resettlement.

(2) Resettlement of Project Affected Families (Informal Settlers)

As indicated in the survey results, 79% of the Project Affected Informal Settlers (in Mandaue City as there are none in Lapu-lapu City) were in favor of the option of resettlement housing. Those that chose this option all preferred residential subdivision/house and lot package as opposed to the condominium building units. Their preference for the location of the housing package was within five km radius from their existing residence. However, the Mandaue City government has indicated the lack or non-availability of affordable lands in the City for resettlement sites. The Local Shelter Plan (2018-2026) has identified 8,760 displaced households needing relocation, which includes families living in the danger areas and doubled-up households. However, HUDO indicated that they received offers to sell from private individuals properties which the City is planning to develop into relocation sites, which could also accommodate the PAFs. These candidate sites include:

- A 1.8 hectares land in Brgy. Polog, Consolacion, approximately 8-10 kilometers from the PAFs current dwellings/abode
- A half-hectare land area in nearby Brgy. Labogon, Mandaue City, but is considered by the City Government as too expensive for the socialized housing/resettlement Site.

8.6.11 Indigenous People

1) Baseline

The result of initial investigation/inquiry of the study team suggest that there are no IPs in the area that will be affected by the project, given the following:

- The PAHs socio-economic survey results indicated that no project-affected persons belong to any IPs (none checked the known IPs in the ethnicity list)
- Verbal inquiry with resource persons (HUDO, local officials, etc) noted the absence of IPs in the affected barangays
- A list of identified IPs and their locations indicated that there are no IPs in Mandaue and affected barangays.*(https://en.wikipedia.org/wiki/Indigenous_Peoples%27_Rights_Act_of_1997#cite_ref-:0_2-4)*

2) Impact Identification and Assessment

Following the request from the proponent/Survey Team, the National Commission on Indigenous Peoples (NCIP), Cebu Provincial Office issued, on July 29, 2019, a Certificate of Non-Overlap proving that the alignment of the proposed bridge and road and its vicinities has no presence of IPs living within the area, or does not overlap with any ancestral domain area of any Indigenous Cultural Communities or Indigenous Peoples (ICCs/IPs).

3) Impact Mitigation & Enhancement Measures

No significant adverse impacts are expected.

8.6.12 Local Economy

1) Baseline

(1) Fishery

In order to investigate as much as possible the present conditions of the fishery and aquaculture in the project site such as the scale of fishery and aquaculture, fish catch, management body, income and livelihood, aside from secondary data collection/analysis, focus group discussions with fisher folks and interviews to fishery groups and agricultural department of the LGUs were carried out at the scoping stage and draft final report stages both in the cities of Mandaue and Lapu-Lapu as shown in 8.11.4. Based on the collected information, the present conditions of fishery and aquaculture in the proiject site is described below.

Mandaue City

According to Comprehensive Land Use Plan (CLUP) of Mandaue City, there are still some small areas for fishing grounds and aquaculture farming in Mandaue City. In the year 2012, about 91 tons of fishing/aquaculture products were produced: marine fishing ground 35 ton, inland fishing ground (i.e. river, lake, macrsh/swamp) 6 ton, and fispond/cages 50 ton. However, since this catch is sold for local consumption only as explained in CLUP and by a fisherman at the focus group discussion meeting (see 2.3.5), it is safe to say that this industry does not play a significant role in the local economy.

Table 8.6.51 shows the details of fishing activities in Mandaue City by fishing ground as of 2019. Within the project site, there are fishing grounds in Barangays Paknaan, Looc and Umapad. Number of fishermen within these 3 barangays is 60. Daily fish capture per fisherman is 1-5 kg that is equivalent to PhP 250-1,250.

Table 8.6.51 General Information on Fishery in Mandaue City

No.	Fishing Grounds	Barangays	No. of Fishermen	Fish Capture per fisherman (kg)	Kind of Fish Caught	Fishing Gear Used
1	Mandaue Municipal Water, Consolacion Municipal Water, Liloan, Lapu-Lapu.	**Paknaan**	28	2-5 kg a day PhP500- PhP 1,250	Mamsa, Dewet, Pot-pot, Obod, Kobal-Kobal, Oyap, Dduhaw	Hook & Line
4	Mandaue Municipal Water, Consolacion.	Labogon	22	2-3 kg a day PhP 500- PhP 750	Potpot, Dewet, Duhaw, Obod, Kobal-Kobal, Oyap, Mamsa	Gil Nets Hook & Line
2	Mandaue Municipal Water, Consolacion.	**Looc**	20	1-4 kg a day PhP 250- PhP 1,000	Danggit, Kitong, Dewet, Pot-Sot, Duhan, Solid, Hinok, Libgaw	Hook & Line
5	Mandaue Municipal Water, Consolacion & Liloan.	Jagobiao	19	2-8 kg a day PhP 375- PhP 2,000	Duhaw, Danggit, Bogaong, Pot-Pot, Hinok, Ambian, Oyap, Dewet, Solid	Gil Nets Hook & Line
3	Mandaue Municipal Water, Consolacion.	**Umapad**	12	2-4 kg a day PhP 500 - PhP 1,000	Danggit, Kitong, Dewet dewet, Pot-Pot, Duhan, Solid, Hinok, Libgaw	Hook & Line
6	Mandaue City Sea Water, Consolacion.	Basak	5	2-4 kg a day PhP 500 - PhP 1,000	Danggit, Kitong, Dewet, Pot-Pot, Duhan, Solid, Hinok, Libgaw	Hook & Line

Source: City Agriculture Office, Mandaue City, 2019

Table 8.6.52 shows the number of vessels registered at the City Agriculture Office of Mandaue City. Twenty eight (28) motorized vessels are registered at Barangay Paknaan, 7 at Umapad and 5 at Looc. Four (4) non-motorized vessels are registered at Barangay Paknaan, 5 at Umapad and 15 at Looc.

Table 8.6.52 Registered Fishing Vessels in Mandaue City

Barangay	Motorized	Non-Motorized
Paknaan	28	4
Labogon	18	4
Jagobiao	11	6
Umapad	7	5
Looc	5	15
Basak	2	3
Total	*71*	*37*

Source: City Agriculture Office, Mandaue City, 2019

Lapu-Lapu City

According to Comprehensive Land Use Plan (CLUP) of Lapu-Lapu City, the fishing grounds of the city are classified as off-shore and inland. The offshore fishing grounds are the sea waters of Olango Island, Pusok, and Punta Engano. The inland fishing grounds are the marshes of Barangay Babag, and Calawisan and the fishponds in Canjulao and fish cages in Caubian. No production data are currently available.

Accroding to the City Fishery Aquatic Resource Management Council (CFARMC) in Lapu-Lapu, along mainland Mactan Island particularly in places that are already considered as highly urbanized, some marginal fisherfolks can be found along Barangay Pusok, Ibo, Buaya and Punta Engano, but in a minimal number as compared to Olango Island, where most of the fishing community and individual fisherforks are found. Most of the fisherforks found along the Mactan Island belong to the informal settlers and many engaged in hook and line fishing with their fishcatch averaging less than 3 kg a day. There are no fishpond in the aforementioned barangays, whereas fishpen can be found along barangay Ibo and Buaya. Most of these fisherforks are conducting their fishing activities along the mouth of Mactan Channel towards Camotes Sea. The problem confronted by Lapu-Lapu City is the use of illegal fishing by some firefolks such as dynamite, cyanide and the use of fine mesh net.

Based on the statistics provided by the concerned institutions and the results of the FGDs, the major fishing grounds within and near the project site is described in Figure 8.6.46. The distance from the bridge construction site to the main coastal fishing grounds in the cities of Mandaue and Lapu-Lapu are approximately 550m and 1km, respectively.

Source: JICA Survey Team

Figure 8.6.46 Major Fishing Grounds in the Cities of Mandaue and Lapu-Lapu

As to fishery activities in the mangrove area in Barangay Paknaan in Mandaue City traversed by the ROW near its connecting point to the existing Cansaga Bay Bridge, no information has been collected that there are fisher folks carrying out fishery in this area as results of an interview to Barangay captain and visual observation by members of the EIA team during the mangrove tree assessment in this area (Figure 8.6.47).

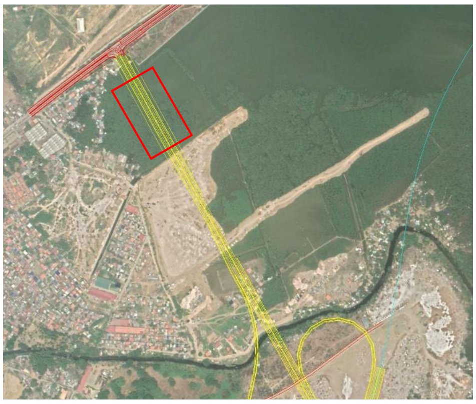


Figure 8.6.47 Mangrove Area in Barangay Paknaan in Mandaue City

As mentioned in Table 8.11.12, there is one operational aquaculture farm (i.e. Batiller Fish Pond) in Barangay Umapad, Mandaue City that is located within the ROW of the project whose land size is approximately 2.35 ha (23,500 m2) as shown in Figure 8.6.48. On the other hand, as mentioned in Table 8.11.15, there is no existing fishpond operation within the project and its adjacent areas in Lapu-Lapu City.

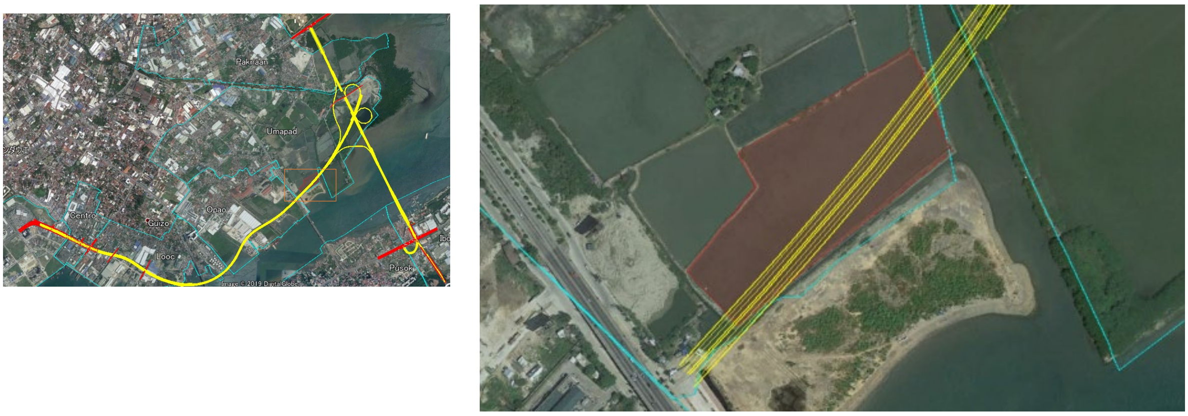


Figure 8.6.48 Location of an Operational Aquaculture Farm in Mandaue City

(2) Broom-Making

Broom-making using buri tree (palm tree) is known to be done in Barangay Paknaan, Mandaue City. One of the steps for making broom is to soak buri stem in pond until the fibers come loose, and this activity is said to be carried out in mangrove and abandoned fishponds in Barangay Paknaan (Figure 8.6.49). Based on the interviews to the Captain of the Barangay Paknaan, Mandaue City and the broom-making operators, it is found out that the soaking area for the broom-making activities is largely confined at a single location set-aside by the barangay with an area of approximately 5,000 m^2 as illustrated as the point 2 in Figure 8.6.50, and thus there are no soaking activities within the ROW of the 4th Cebu-Mactan Bridge and the Mandaue Coastal Road.

The pathways illustrated by arrows in Figure 8.6.50 provide access to some informal settlers living within the mangrove near to the Cansaga bay. The 1st (upper arrow) represents a dirt footpath along the edge of the reclamation development, while the 2nd (middle arrow) represents a footpath that is more developed and passable by lighter vehicles. This also provide access to the mangrove eco-park and the informal settlers along the Butuanon River/landfill site.

Figure 8.6.49 Soaking Areas for Broom-Making in Barangay Paknaan, Mandaue City

Entire Area Relevant to Broom-Making

Point 1: Road entrance, access to existing housing site, soaking area, mangroves, and the informal settlers along the Butuanon River and the Landfill.

Point 3: Drainage Canal/Waterway

Point 2. Access Road with the soaking area on the right side of the road.

Figure 8.6.50 Location of Broom-Making Activity Related Sites

2) Impact Identification and Assessment

(1) Fishery

The major fishing grounds of fisher folks are relatively far from the bridge construction site. It is thus estimated that, during construction, the fisher folks would mainly use those fishing grounds if they remain accessible. On the other hand, as raised by fisher folks at the focus group discussion, construction work of bridge piers may limit the accessibility of fisher folks to their main fishing grounds by blocking the channel (i.e. Cansaga bay area for Mandaue fisher forlks and north east part of Mactan Island for Lapu-Lapu fisher folks). Hence, mitigation measures to secure the accessibility to the fishing grounds and the safety for the fisher folks crossing the construction site are necessary.

Deterioration of water quality, which may affect fish catch negatively, will be limited because no large-scale excavation or backfilling is planned. Possibility of water quality deterioration remains when foundation construction and pile driving are carried out. Therefore, mitigation measures to minimize the advere impact on water quality shall be taken.

Although fishing activities were not observed in the mangrove area in Barangay Paknaan in Mandaue City, there is a possibility of small-scale gleaning of snail, crabs and shrimps done by local people. Even if so, since they can continue their gleaning by moving to continuous mangrove and wetland area in the surrounding area, impacts on their livelihood is limited. However, temporary disturbance of the gleaning activity due to construction works is expected.

There is an operational aquaculture farm in Barangay Umapad, Mandaue CIty that is located within the ROW of the project. This aquaculture farm will be physically affected by the construction of viaduct. Hence, appropriate compensation shall be provided.

(2) Broom-Making

As described in 8.6.121)(2), since there are no soaking activities within the ROW of the 4th Cebu-Mactan Bridge and the Mandaue Coastal Road and the collection of material for broom-making (i.e. palm tree) will not done within or near the ROW, in general, the project will not affect the broom-making industry-particularly, the soaking and material collection areas. However, construction works may prevent or limit inflow of seawater to the mangrove/fishpond area located at the south of the alignment, which will affect the soaking area. Furthermore, during construction, there will be a need for access of construction vehicles and equipment to the project site and the need for staging areas near or within the vicinity of the soaking areas.

On the other hand, operations of the 4th Cebu-Mactan Bridge may bring positive benefits through creation of opportunities of bringing clients/markets, in particular tourists, to the community.

(3) Enhance the Employment/Livelihood Condition

The project's requirement for skilled and unskilled construction workers will cause generation of local employment. The salaries and wages of these local hires could circulate in the area and contribute to the consumption of local goods and services.

3) Impact Mitigation & Enhancement Measures

(1) Fishery

To mitigate the impacts on the accessibility of fisher folks to their main fishing grounds, access channel will be secured across the bridge construction site between bridge pier construction spots so that fisher folks can pass through the channel even during construction of the bridge. Safety for fisher folks is expected to be secured because the distance between bridge piers is as wide as 80 m. Furthermore, the safety of fishing boats shall be more secured through organizing traffic by arranging patrol vessels to avoid collisions between construction vessels and fishing boats.

As mitigation measures for water quality deterioration, construction methods with less impact shall be taken. For bridge foundation, pile bent type will be adopted where possible, which minimize excavation. For cast-in-place pile, casing pipe will be set and excavation and casting concrete will be carried out within the pipe. In addition, silt fence shall be used during construction.

To minimize temporal disturbance to the possible gleaning ground in the mangrove area due to construction works, it is planned that the bridge of the section concerned will be constructed from the temporary jetty to minimize the landform alteration of the ground and thereby surrounding mangrove forest and wetland environment. In the operation phase, since sea water can flow in between the bridge piers as tides flow, continuity of the natural environment will be secured, and thus natural restauration of mangrove forest and wetland environment will not be impeded.

Compensation cost for the aquaculture farm in Barangay Looc, Mandaue City that are located within the ROW and thus physically affected will be provided. The area affected and the unit cost are 2.35ha and PHP170,107,000, respectively, so the total cost is estimated to be PHP 399,751,450. The details will be included in the Right of Way Action Plan/ Resettlement Action Plan (RAP).

(2) Broom-Making

To mitigate the blockage of footpaths during construction, access to cross the project road shall be secured by aggregating somewhere if the distant is short so that water can flow to the soaking areas and people can move crossing the construction sites.

(3) Enhance the Employment/Livelihood Condition

The 4th Cebu-Mactan Bridge project will generate employment opportunities during construction and operation stage not only directly but indirectly (support facilities/amenities/livelihood) and will give priority to residents of the affected Barangays in Mandaue and Lapu-Lapu cities who are qualified. 4th Cebu-Mactan Bridge project will create jobs for a number of families and will boost local economies.

As a part of RAP, livelihood assistance and training program will be provided for PAPs by concerned governments such as Department of Social Welfare and Development (DSWD) Region VII, Technical Education and Skills Development Authority (TESDA) Region VII, Department of Labor and Employment (DOLE) Region VII, and Department of Trade and Industry (DTI) Region VII.

8.6.13 Local Institutions, Decision Making

There are several stakeholders of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road Project including, but not limited to, LGUs, Barangay, and Fisheres group. Table 8.6.53 shows the stakeholders of the project. According to DAO 30-03 and JICA ESC Guideline, the project implementation must be coordinated with these stakeholders and refrect the comments and requests from the stakeholders to the project plan. Therefore, the project will not affect decision making of these stakeholders.

Table 8.6.53 The list of Stakeholders of the Project

Tyep	Name of Organizations, Institute
Central Govenment	NEDA
LGUs	Mandaue City, Lapu-Lapu City, Consolacion City
	City Environment & Natural Resources Office (CENTRO)
	Metro Cebu Development and Coordinating Board (MCDCB)
	Regional Development Council-Economic Development Committee (RDC-EDC)
Other Public Authority	Cebu Port Authority (CPA)
	Coastal Guard
Local Community	Barangay Umapad, Paknaan, Pusok, Opao
FGDs	

Source : JICA Survey Team

8.6.14 Misdistribution of benefits and damages/ Local conflicts of interest

1) **Impact Identification and Assessment**

Misdistribution of benefits and damages is expected to be minor because the benefit of improved convenience by the bridge and road construction will be equally distributed. In addition, the damage by the construction will be compensated properly. Thus, no mitigation measure is necessary for misdistribution of benefits and damages.

Below are anticipated impacts in terms of local conflicts of interest.

(1) Impacts on the Accessibility/Hindrance to Port/Docking Facilities and Operations

Offshore viaducts of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road may limit accessibility and hindrance to port/docking facilities along the Mactan Channel, particularly that of Ting Guan; Oil Depot/Terminal facilities of Petron, Arctura, and Total; and Shipyards of VM Cabahug.

The owners of these port/docking facilities requested that the Viaduct design shall consider a higher elevation (minimum of 40 meters high) to allow docking/manuevering of vessels.

The oil depot/fuel terminal operators also raised the risks/dangers of the Viaduct it poses to the highly inflammable and potentially explosive depot.

(2) Impacts on Other Projects

GlobalCity Mandaue Corporation and City Government of Mandaue (Joint Venture) plan to conduct "Mandaue Reclamation Project". In addition, City Government of Mandaue also plan to redevelop Umapad landfill site as "Eco Park". The alignment of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road will pass the site of these projects. It is thus necessary for the proponent to continue consultation with City Government of Mandaue, especially during the Detailed Engineering Design to avoid negative impact to surrounding area.

In addition, illegal reclamation ongoing in the Barangay Paknaan overlap the alignment of 4th Cebu-Mactan Bridge-Mandaue Coastal Road. This problem shall be resolved before the construction works of the project starts in a legal manner.

2) **Impact Mitigation & Enhancement Measures**

(1) Impacts on the Accessibility/Hindrance to Port/Docking Facilities and Operations

To mitigate the impacts on the accessibility/hindrance to port/docking facilities and operations, the following measures may be possible: i) the viaduct will be constructed over the towage facility or ii) the towage facility will be relocated to the outside of the ROW. Further consultations with the owners and management of the port/docking and fuel terminal facilities shall be conducted, especially during the Detailed Engineering Design so that the concerns of these facilities shall be addressed and considered in the final Engineering Details.

(2) Impacts to Other Projects

To mitigate the impacts on other projects such as "Mandaue Reclamation Project" and "Umapad landfill Eco Park", further consultations with City Government of Mandaue shall be conducted, especially during the Detailed Engineering Design to avoid negative impact to surrounding area.

The piers of the Cebu-Mactan Bridge is planned to be constructed on the land that will be reclaimed under the Mandaue Reclamation Project. Since a private developer's undertaking and a public work do not always have common interests, a close coordination with the company is expected to be necessary, with the assistance of Mandaue City as a member of the joint venture.

With the 4th Cebu-Mactan Bridge/Mandaue Coastal Road interchange being planned right in the middle of the Umapad Landfill (open dumping site), a close coordination with Mandaue City may also be necessary for their Post-Closure Plan to be updated to accommodate this new development project.

As long as the City Government is involved in other projects, whether a member of joint venture in the Mandaue Reclamation Project or responsible organization in the Umapad Landfill Eco Park, consultation and coordination can be relatively smooth.

However, there is an ongoing illegal reclamation done by a private company. According to Mandaue City, they will try to solve this issue in a legal manner in July 2019.

8.6.15 Existing Social Infrastructures and Services

1) Impact Identification and Assessment

As shown in Figure 8.2.17, the alignment of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road will pass an industrial area, where hazardous facilities of private companies such as petrochemical factories and oil tanks are located. If the clearance between these facilities and the coastal road is unsatisfactory and any physical barrier is not installed along the road, there may be a risk of casting flammable items into these hazardous facilities. Hence, appropriate mitigation measures are necessary to be taken.

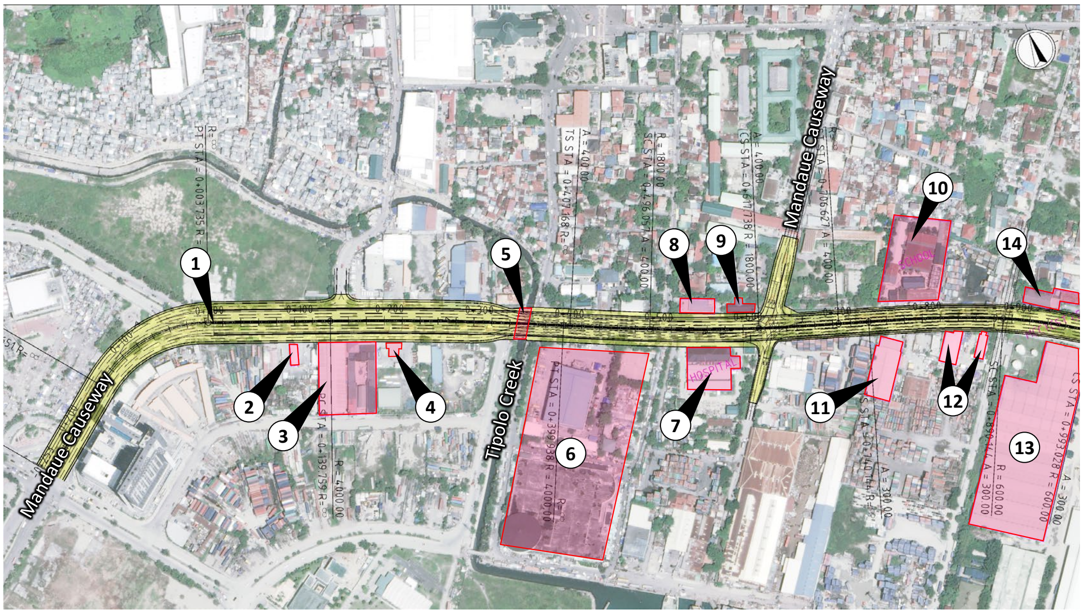
2) Impact Mitigation & Enhancement Measures

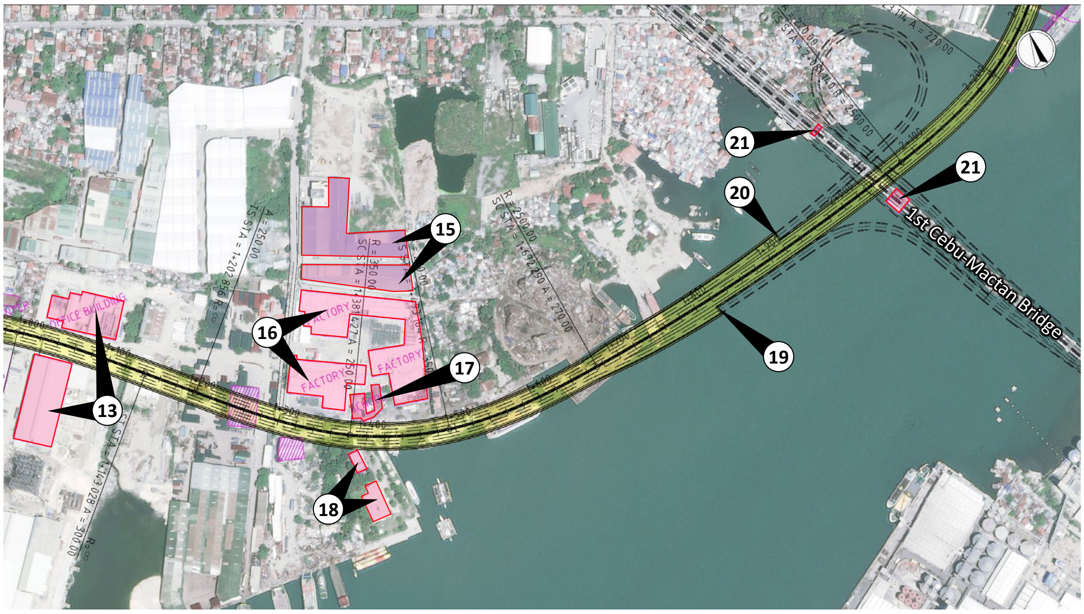
As shown in Table 8.6.54 and Figure 8.6.51, all the industrial facilities near the alignment of the Coastal Road including hazardous facilities such as oil tanks, LPG tanks and pipe lines were avoided or secured with satisfactory clearances from the road both horizontally and vertically, when determining the alignment. Furthermore, as mentioned in 8.6.53)(1), noise barrier that will be installed along the alignment will cover the whole area where all the industrial facilities listed below are situated, and thus also serve as a 'physical barrier' to minimize the risk of casting flammable to the hazardous facilities.

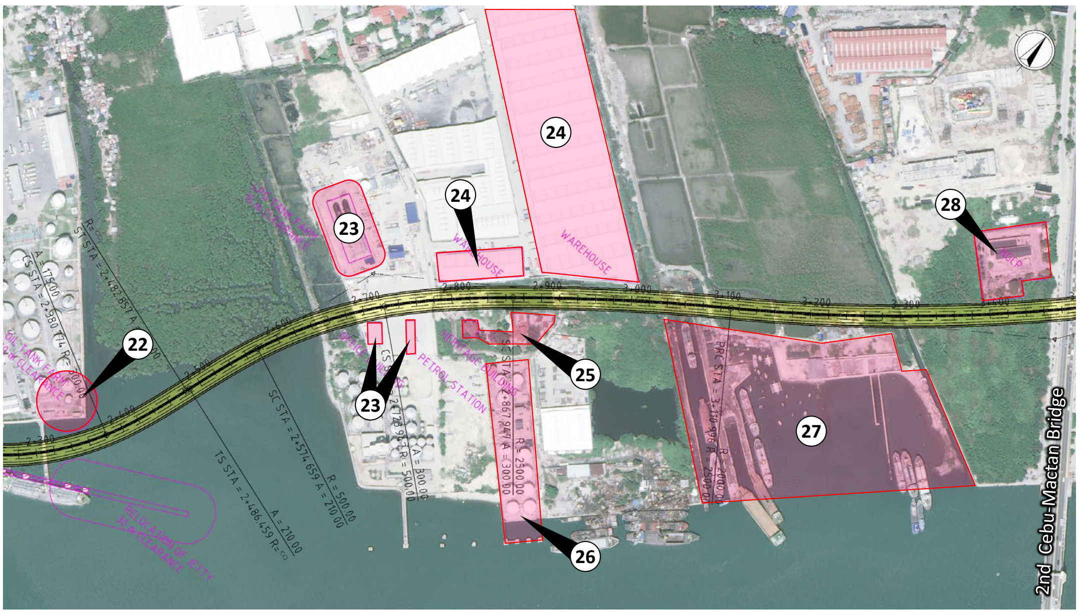
Table 8.6.54 Industrial Facility Relevant Control Points for Alignment of Mandaue Coastal Road

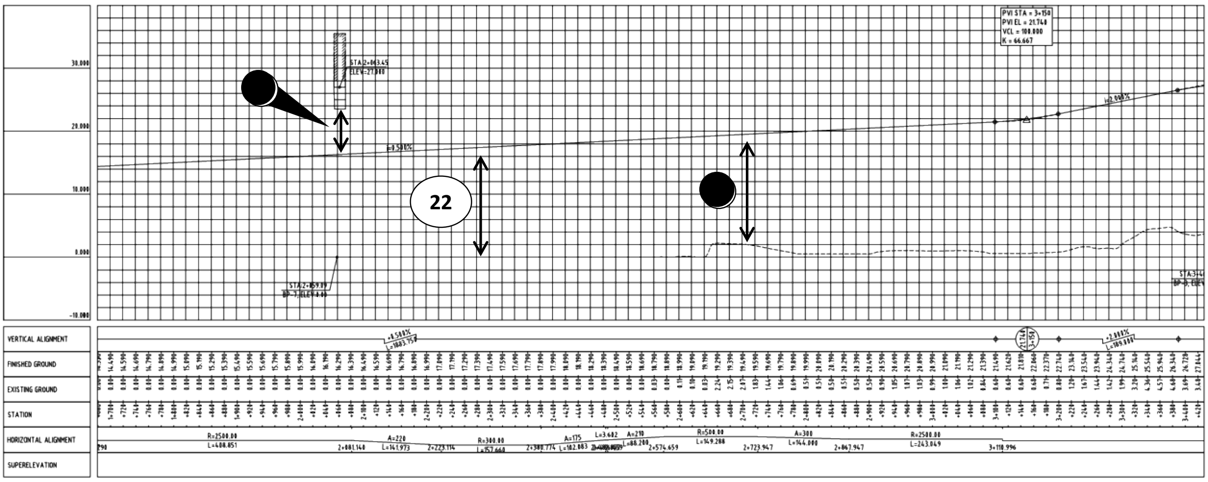
No.	Control Point	Description
Horizontal Alignment		
2	Petron Petrol Station	Avoid building
3	Factory	Avoid building
11	Factory	Avoid building
12	Mabuhay Vinyl Corporation	Avoid buildings
13	San Miguel Food	Avoid buildings
15	Warehouse	Avoid buildings
16	DUPONT	Avoid building
22	Petron Corporation Mandaue Terminal	Avoid oil tanks (30 m clearance)
23	Arctura Tank Terminal	Avoid buildings, LPG tank
24	Warehouse	Avoid buildings
26	Tank farm	Avoid
Vertical Alignment		
22	Petron Corporation Mandaue Terminal	Provide 10 m clearance over the pipe line

Source: JICA Survey Team


Mandaue Causeway
Tipolo Creek
Mandaue Causeway
1
2
3
4
5
6
7
8
9
10
11
12
13
14


1st Cebu-Mactan Bridge
13
15
16
17
18
19
20
21
21
FACTORY
FACTORY
FACTORY
OFFICE BUILDING


2nd Cebu-Mactan Bridge
22
23
23
24
24
25
26
27
28
WAREHOUSE
WAREHOUSE
PETROL STATION



Source: JICA Survey Team

Figure 8.6.51 Control Points for Alignment of Mandaue Coastal Road

8.6.16 Land use change

1) Impact Identification and Assessment

(1) Change in Land Use Pattern/ Zoning

Construction Phase

During Construction, changes in Land Use could occur as a result construction and related activities. Site Preparation (e.g., clearing and grubbing, excavation, placement of fill, cutting and grading, ditching) will result in the loss of land and changes to, or loss of, access to property.

The Installation of Structures (i.e., the widening of ROW, upgrading of road, pile-driving and footings/columns/piers for offshore and onshore viaduct) may result in temporary interruptions to recreational activities such as fishing in the immediate vicinity of the Project.

Surfacing and Finishing activities could cause interruption to surrounding land use activities (including recreational activities) due to increased noise and decreased air quality (e.g., increased dust and emissions).

Temporary ancillary elements associated with the Project (i.e., temporary access roads, borrow areas, petroleum storage areas) will result in temporary loss of land and changes to, or loss of, access. The Transportation of Materials and Equipment will result in increased truck traffic and associated noise. Storage of materials will result in a temporary loss of land and changes to, or loss of, access.

Operation phase

During Operation and Maintenance of the Project, the 4th Cebu-Mactan Bridge-Mandaue Coastal Road and its associated traffic may cause new area development. On the other hand, there is a possibility that a value of property and land use activities will fall as a result of noise, dust, and air emissions.

Positive environmental and social effects of the Project presence on Land Use include increase of economic opportunities due to enhance accessibility of the areas along the 4th Cebu-Mactan Bridge-Mandaue Coastal Road by both investors and market clientele.

(2) Cumulative Impacts from Mandaue Reclamation Project

Potential impact of each project

- 4th Cebu-Mactan Bridge Construction Project: Environmental and social impacts that may be caused by the 4th Cebu-Mactan Bridge Construction project are described in Table 8.8.1 Environmental Management Plan Matrix.
- Mandaue Reclamation Project: Identified environmental and social impacts of the Mandaue Reclamation Project are shown in Table 8.6.55.

Table 8.6.55 Identified adverse impacts of Mandaue Reclamation Project

Land	***During Reclamation Work*** Changes in land use, Encroachment in Environmental Critical Areas (ECA), Possible tenurial or land issues, Impacts to fauna and flora at the mangrove areas, and Loss of mangrove species ***During Maintenance Phase*** Soil Erosion and Contamination
Water	***During Reclamation Work/ During Maintenance Phase*** Change in drainage morphology, inducement of flooding and water pollution of the Butuanon River and marine waters
Air	***During Reclamation Work*** No significant impacts on the ambient air. ***During Maintenance Phase*** Fugitive dust generation during high wind and dry soil conditions.
People	***During Reclamation Work/ During Maintenance Phase*** Displacement of land, Change in land ownership, Affected structures, Loss of business and/or income, Public access and access to sea water, Displacement of docking area, Threat of flooding, In-migration, Health hazards, Generation of solid waste, Increase in traffic, Disturbances on peace and order

Source: GlobalCity Mandaue Corporation and City Government of Mandaue, Executive Summary for the Public of Mandaue Reclamation Project

Cumulative impacts

Construction/Reclamation Work Phase

In case the construction/reclamation phases of the said two projects are overlapping, the following cumulative impacts are considered likely to occur.

- Increased land use change due to bridge/road construction and reclamation
- Increased noise generated from construction machinery frightens birds feeding in the vicinity of the construction site such as neighboring tidal flat and mangrove forest
- Increased water pollution of marine water affect marine fauna and flora
- Increased dust and emissions (i.e. degradation of air quality)
- Increased restriction of access to sea water by local fisher folks
- Increased traffic by construction vehicles

Operation phase

During the operation/maintenance phase of the said two projects, the following cumulative impacts are considered likely to occur.

- Reduction of tidal flat area as well as some mangrove trees that serve as birds' feeding ground
- Shrinkage of fishing grounds and restricted access to sea for local fisher folks

(3) In-Migration, Proliferation of Informal Settlers

During the construction phase, land may be required for providing construction workers and staff with temporary housing in the vicinity of the project site. During the operation phase, there is a possibility that new informal settler will in-migrate to the project area, especially bottom of the elevated structures.

2) Impact Mitigation & Enhancement Measures

(1) Control of Land use pattern/ Zoning

The local governments should promote sustainable urban developments, one of which is the introduction of new urban planning paradigm concepts of high-density concentrated, mixed-use, and redevelopments/reuse of previously developed land. The 4th Cebu-Mactan Bridge-Mandaue Coastal Road project provides an opportunity for the LGUs and City/Municipal planners to implement 'Transit-Oriented Development (TOD)'

Construction phase

The proponent and its contractors instituted measures to reduce disturbance to neighboring residents around the secondary impact area, and is being guided by the following conditions.

- Scheduling heavy construction works during the daytime (avoiding noisy activities during the nighttime);
- Construction activities that necessitate utilizing portion of the road/street (such as concrete pouring) should be undertaken upon permission by the CITY TRAFFIC MGT and outside of traffic rush-hours;
- Construction activities should not in any way be a hindrance to the operations in neighboring area.

The Project is expected to have impact on existing landscape, too. The identified impact may be mitigated by proper design of the 4th Cebu-Mactan Bridge. In addition a new urban landscape that will be harmonized with the existing landscape along Mactan Channel and Mandaue Coastal Road facilities will be proposed.

Operation phase

As indicated, the operations of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road project will not significantly influence land use patterns in the area, as it is in conformance and in line with Metro Cebu's sustainable urban development as envision in the Roadmap study. However, with or without the project there will be changes in the physical and biological environments as urban growth and expansion changes the physical, biological, economic and social landscape of the City.

With improve transportation and mobility, the cities of Mandaue, Lapu-lapu, and the rest of the localities of the province will open-up to investment opportunities and sustain economic growth and development. This will have a positive impact on the enhancement of the land use pattern of these localities.

(2) Mitigation measures for Cumulative Impacts from Mandaue Reclamation Project

Mitigation measures that the 4th Cebu-Mactan Bridge Construction will take are as follows.

- Scheduling heavy noise generating activities in the daytime and avoiding birds' feeding time as much as possible
- Storage of oil and lubricants in secure areas/places
- Sprinkling of water (sea-water) in open dusty areas
- Using well-maintained vehicles, machineries, and heavy equipment
- Securing a route for small vessels of fisher folks during the bridge pier construction

However, mitigation measures of the 4th Cebu-Mactan Bridge Construction Project only may not be sufficient to mitigate the cumulative impacts above. It is thus recommended to the Mandaue Reclamation Project that their major mitigation measures to address the adverse and enhance beneficial impact relate to issues on land use, access to the sea, marine water quality, air pollution, mangrove areas, and socioeconomic aspects (livelihood, income loss, health, traffic). Measures to enhance the beneficial impacts relate to employment opportunities, economics, and LGU income through taxes. In addition, a bird expert from the Philippines Biodiversity Conservation Foundation stated that as reclamation will bring about significant impacts to bird habitat, maximum consideration shall be given from the environmental aspect, in particularly bird inhabitation.

(3) In-Migration, Proliferation of Informal Settlers

To minimize the need to provide housing for the construction crew, to the extent possible, local labor shall be hired.

8.6.17 Cultural Heritage

1) Baseline survey result

Bantayan sa Hari, designated by the National Commission Culture and Arts as a historic site, is located near the project site in Mandaue City. It is considered to have been built in the early 19th century to serve as a watch tower to protect the local people from the Moro Pirates. It is also shown in the seal of Mandaue City (see below). The distance between Bantayan sa Hari and the project site is about 200 m. A picture of Bantayan sa Hari and Mandaue City's seal are shown in Figure 8.6.52 with its location indicated in Figure 8.6.53.

Source: Peanut Browas (available at: http://www.peanutbrowas.com/blog/watching-history-unfold-at-the-bantayan-sa-hari)

Figure 8.6.52 Bantayan sa Hari (left) and Seal of Mandaue City (right)

Source: JICA Survey Team

Figure 8.6.53 Location of Bantayan sa Hari

2) Impact Identification and Assessment

(1) Cultural, Historic, Archaeologic and Aesthetics Value

In accordance with the DPWH Department Order No. 12, Series of 2019 titled 'Strict Preservation and Conservation of National Cultural Heritage', the proponent together with the Study Team had a consultation/coordination meeting with the National Commission for Culture and Arts (NCCA) on May 22, 2019, where the project brief was presented. At the meeting, the NCCA indicated that in principle they have no objections with the project as the ROW/Alignment will not directly nor has significant impact on nearby identified historical/heritage sites/structures. The clearance for the project, or the Certification for Non-Coverage of National Cultural Treasure (NCT)/ Important Cultural Property (ICP) was issued on July 9, 2019 by the NCCA.

(2) Change of the local landscape

The construction of a bridge and viaduct will change the landscape, which may be considered by some as a negative impact. To mitigate negative impact, the design of the 4th Mactan Bridge and viaduct of Coastal Road should be harmonize with local land scape. The lighting system should also be considered as new landscape of this area.

3) Impact Mitigation & Enhancement Measures

No significant adverse impacts are expected.

8.6.18 Working Conditions (Health) and Infectious Diseases

1) Impact Identification and Assessment

The 4th Cebu-Mactan Bridge-Mandaue Coastal Road Project activities, if not carried out in a careful and safe manner, could result in risks to the public or workers. All forms of illness will have a probability of occurring among the workers and staff of the project, and might spread to the public. These will contribute to the increase in the morbidity rates of the barangay and the City.

The Project will comply with all requirements of the Occupational Health and Safety standards, thus the impacts on Public Health and Safety will not be significant from the perspective of worker safety and occupational exposure.

The proponent shall require the contractor to provide its own medical services to meet first-aid and emergency cases prior to referral to the advance medical facilities. The contractor shall ensure worker's safety.

2) Impact Mitigation & Enhancement Measures

Construction and operations of any project is subject to occupational health and safety legislations, with standards implemented by the Department of Labor and Employment (DOLE) that is aimed at the protection of public and worker safety.

The proponent shall require the contractor to submit an Occupational Health and Safety Management Plan prior to commencement of work. The proponent shall also require the contractor to provide its own medical services to meet first-aid and emergency cases prior to referral to the advance medical facilities.

The contractor shall ensure worker's safety and provide-among others, the following:

- Personal Protective Equipments (PPE), e.g. helmets, masks, rubber boots, etc.
- Safety guidelines and signs,
- Appropriate sanitary facilities
- Safety equipments – e.g, fire extinguishers, first aid stations and emergency vehicles

To avoid the hazards of communicable and infectious diseases, the contractor shall also require the medical certificates to ensure workers to fit to work.

8.6.19 Threat to Delivery of Basic Social Services/Resource Competition

1) Impact Identification and Assessment

(1) Power Consumption

During construction stage, there will be demand for power for utilization in the construction works (e.g. operation of the equipments, lighting etc). In addition, during the operations stage there will be be demand for power for roadside lighting.

(2) Water Usage

During construction stage, there will be demand for water supply for utilization in the construction works (e.g. concrete mixing, etc). However, during the operations stage there will be very minimal usage of water.

2) Impact Mitigation & Enhancement Measures

(1) Power Consumption

<u>Construction phase / Operation phase</u>

During construction stage, the construction works needs the power for operation of the equipment, lighting.

Basically, the electricity will be purchased by contractor from local electricity companies, named Visayan Electric Company (VECO) and Mactan Electric Company (MECO). Power generators will be prepared as a countermeasure for power failure and other construction works.

In addition, during the operations stage there will be demand for power for the lighting. LED lighting system can save power consumption, comparing with conventional lighting system.

(2) Water Usage

Construction phase / Operation phase

Water supply of the PAFs in Barangays Looc, Opao, Umapad, and Paknaan are described in 8.6.101)(3). Around 45% of the PAFs has a water source from piped water provided by the MCWD and around 20% of the PAFs use dug well. The location of these well is out of ROW, so the direct impact to these wells are not expected. However, if the constructions work such as excavation for viaduct will have indirect impact to ground water flow, the proponents should investigate and compensate for it.

During construction stage, there will be demand for water supply for utilization in the construction works (e.g. concrete mixing, etc). However, during the operations stage there will be very minimal usage of water.

The water will be supplied by the Metropolitan Cebu Water District (MCWD) both for construction stage and operation stage. Water saving/ conservation measures for construction and maintenance works/ activities should be implemented by contractors. As described in 4.2.3.1, recycled water, rain water or water from waterways shall be used for ground sprinkling or dust –suppression.

8.6.20 Generate the Traffic Congestion

1) Impact Identification and Assessment

During the construction phase of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road will result in temporary traffic disruptions or disturbances-especially works undertaken on existing routes that is within the 4th Cebu-Mactan Bridge-Mandaue Coastal Road alignment (both at grade and terrestrial viaduct).

During Operation, the long term environmental effects of the Project will be positive with an improved transportation network and an increase in public safety.

Environmental effects on Transportation resulting from the maintenance phases of the Project 4th Cebu-Mactan Bridge-Mandaue Coastal Road are anticipated to be localized, short term, and minimal in number. Construction and Maintenance activities may result in temporary traffic disruptions or disturbances. Where possible, these disruptions will be minimized and timed to avoid both daily and seasonal peak traffic periods.

Corner of Mandaue Causeway in front of Mandaue City Hospital

Intersections of Lapu-Lapu Interchange

Source: JICA Survey Team

Figure 8.6.54 Situations of Generate the Traffic Disruption and Congestion

2) Impact Mitigation & Enhancement Measures

<u>Construction phase</u>

Because of the mobilization of heavy vehicles, construction activities and staging of works, it will be unavoidable to restrict some roadway. This will lead to increased traffic congestion and changes in traffic patterns.

A Traffic Management Plan (TMP) that details the activities to adequately manage traffic flow will be developed in the detailed design phase and strictly implemented in the implementation phase. The preliminary conceptual TMP for the project is described below.

1. General for Temporary Traffic Control

Temporary traffic control is a major concern to be addressed by the Traffic Management Plan. The needs and control of all road users (motorists, bicyclists, tricyclists, and pedestrians within the construction site of 4th Cebu-Mactan Bridge and Mandaue Coastal Road through a temporary traffic control zone) are considered to be most critical during the construction works, utility relocation work, maintenance operations and management of traffic incidents under the Project.

Temporary traffic control plans and devices shall be the joint responsibility of DPWH, the Supervision Consultant and the Contractor, and the LGUs (particularly, the Traffic Enforcement Agency of Mandaue City (TEAM) and the City Traffic and Management System (CTMS) of Lapu-lapu City) who are having jurisdiction for guiding road users. There shall be adequate statutory authority for the implementation and enforcement of needed road user regulations, parking controls, speed zoning and the management of traffic incidents. Such statutes shall provide sufficient flexibility in the application of temporary traffic control to meet the needs of changing conditions in the temporary traffic control zone.

The Contractor will produce a final Traffic Management Plan for approval of DPWH and local authorities.

Figure 8.6.55 Images of Temporary Traffic Control

2. Principles of Temporary Traffic Control

Road user and worker safety and accessibility in temporary traffic control zones should be an integral and high-priority element of every project from planning through design and construction. Similarly, maintenance and utility work should be planned and conducted with the safety and accessibility of all motorists, bicyclists, tricyclists, pedestrians and workers being considered at all times.

3. Temporary Traffic Control Zones

A temporary traffic control zone is an area of the Project road with construction, maintenance or utility activities. The zone is typically marked by signs, channeling devices, barriers, pavement markings, and/or work vehicles. It extends from the first warning sign or high-intensity rotating, flashing, oscillating or strobe lights on a vehicle to the END ROAD WORK sign or the last temporary traffic control device.

Most temporary traffic control zones are divided into following four areas:

- Advance warning area

  The advance warning area is the section of the roadway where road users are informed about the approaching work area and what to expect ahead.

- Transition area

  The transition area is the area where road users are redirected out of their normal path of travel.

- Activity area

  The activity area is the area where works are physically being carried out and is set aside for works, machinery, equipment and storage of materials.

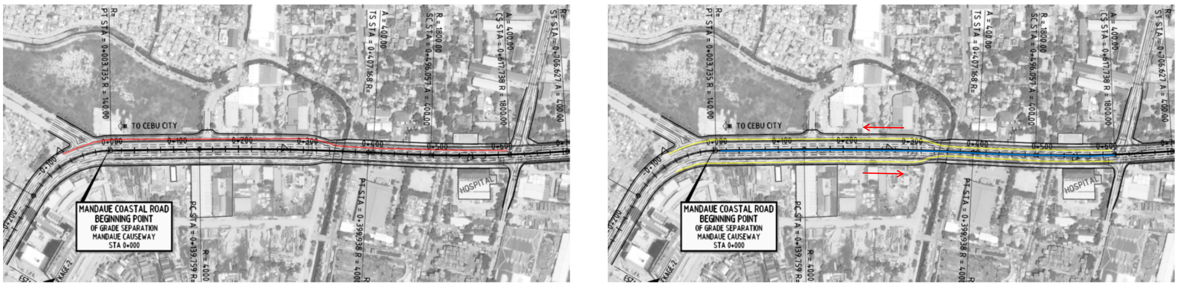
- Termination area

  The termination area is the area where traffic resumes normal operations after passing the worksite.

4. Traffic Management Plans for Strategic Locations

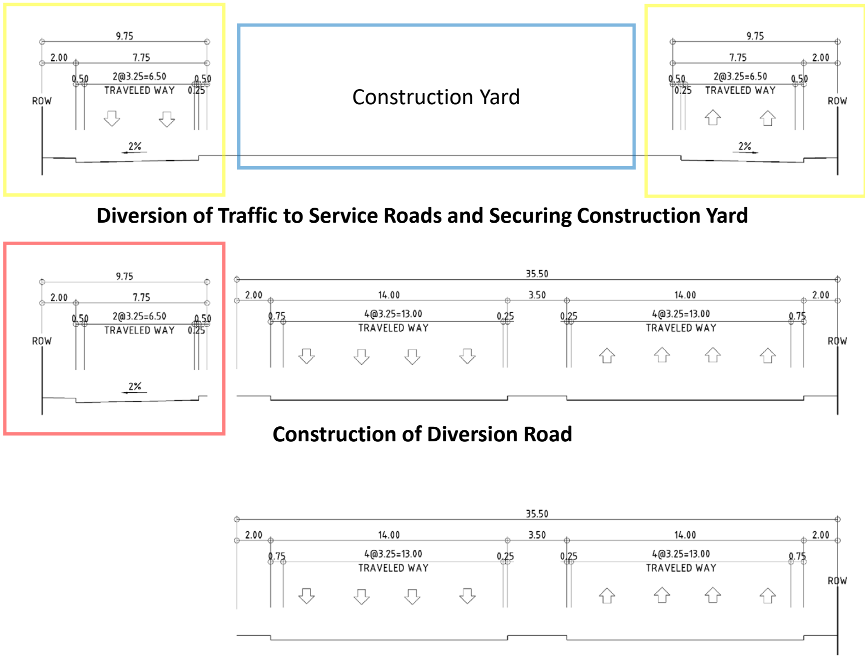
For the construction works of 4th Cebu-Mactan Bridge and Mandaue Coastal Road, the following locations may be crucial in terms of traffic management plan because as a result of traffic analysis, they have high velocity, large volume traffic that require carefully planned detours and construction stagings during the construction. Details of traffic management plans for each location will be developed during the detailed design phase.

- The beginning 1 km-long section of Mandaue Coastal Road where the widening of the existing road (Mandaue Causeway) from the corner of Bai Hotel up to the corner of Mandaue City Hospital is required. For traffic flow and vehicular access to continue service roads will be established to divert traffic from the causeway construction yard (see Figure 8.6.56 and Figure 8.6.57);
- At-Grade Intersection of 4th Cebu-Mactan Bridge and Mandaue Causeway;
- Intersections of Lapu-Lapu Interchange; and
- Other intersecting roads crossings



Source: JICA Survey Team

Figure 8.6.56 Service Road on the along the sides of the Causeway Construction Yard



Source: JICA Survey Team

Figure 8.6.57 Elevation/profile of the Service Road and the Causeway Construction Yard

Operation Phase

The Local Government Code has explicitly indicated that the LGUs has traffic management jurisdiction within their respective political boundaries. However, Metropolitan Cebu's traffic situation calls for close coordination between cities and municipalities to harmonize and jointly address the worsening traffic congestion of the metropolis. For this, the "Master Plan Study and Institutional Development on Urban Transport System in Metro Cebu (JICA Project Team) recommended for the establishment of the

Metropolitan Cebu Traffic Management Board (MCTMB) to coordinate traffic and implement transport programs and projects in the Metro. Once the MCTMB (or any equivalent metropolitan-wide traffic body) will be realized and operational, the traffic management for the 4th Mactan Bridge and Coastal road will be under the jurisdiction of this body.

8.6.21 Gender and Children's rights

Two (2) sessions of focus group discussions with women's associations were carried out, and their opinions, concerns, and recommendations in relation to the project were directly collected. Women constituted at least 30% of the total participants at every public consultations and focus group discussions held except for the 1st Public Scoping in Mandaue City, and not a few female participants spoke out at the question and answer sessions. Furthermore, twelve (12) female household heads out of 69 were identified and answered to the perception survey.

Based on the information collected through the aforementioned activities, there were no perceived impacts related to gender inequality or children's right abuse including the employment of children below 15 years old. It is thus important for the project proponents to follow acts and regulations on gender and human rights in order to prevent future problems in these aspects. Relevant acts and regulations are shown in Table 8.6.56.

Table 8.6.56 The list of laws and reguration on Gender and Human Rights

Title	Contens
The Philippine Constitution of 1987	• Article II recognizes the role that women play in the construction of the state, and claim the guarantee of gender equality based on the law.
Republic Act 9710 and Implementing Rules and Regulations (series of 2010) known as the "Magna Carta of Women"	• The rights of women are defined as follows: gender equality in front of the law; protection from any violence; participation and representation; equal education opportunities and eradication of discrimination; scholarships and training; equal rights with marriage and family relations; comprehensive health services and information/education; and nondiscrimination in employment
Executive Order No.153 (2002)	• It aims at curbing professional squatter activity and enhancing national momentum towards eradicating syndicates.
National Commission on Indigenous Peoples (NCIP) Administrative Order No. 1, Series of 2006	• It stipulates the procedures for establishing Free, Prior and Informed Consent (FPIC) with affected communities
A Tool Kit for Making Road Infrastructure Projects Gender Responsive	• It serves as a guideline showing the procedures that aim to carry out activities that contribute to gender mainstreaming at all stages of road improvement projects.
Republic Act 9231 known as Anti Child Labor Law	• Specifically limits the employment of children below 15 years old, restricts the hours of work of working children, expands working children's access to education, social, medical and legal assistance.
Republic Act 7658 known as the "Special Protection of Children Against Child Abuse, Exploitation and Discrimination Act"	• An act prohibiting the employment of Children below 15 years of age in public and private undertakings.

Source : JICA Survey Team

8.6.22 Greenhouse Gas (GHG) Emission

Construction Phase

Greenhouse Gas (GHG) Emissions from heavy construction equipment (*e.g.*, trucks, front-end loaders, pavers, and other equipment) will occur from the operation of internal combustion engines, which are typically diesel-fueled.

The amount of greenhouse gas emissions can be calculated through [reference formula 1]

[Reference formula 1]

$$PE_{E,y} = \Sigma\, CW_k \times EF_{cons}$$

$PE_{elec,y}$	:	Emissions from Construction Woark (tCO2/year)
CW_k	:	Construction Work by type k (km)
EF_{cons}	:	Emission factor (gCO2/km)

Table 8.6.57 Parameter of Construction Work by type

Parameter	Description	Value	Unit
CW_k	Embankment	2.33	km
	Bridge (steel)	2.25	km
	Bridge (PC)	7.61	km

Source: JICA Survey Team

Table 8.6.58 Parameter of Emission Factor

Parameter	Description	Value	Unit
EF_{cons}	Embankment	2,267.80	gCO2/km
	Bridge (steel)	1,287.00	gCO2/km
	Bridge (PC)	1,400.70	gCO2/km

Source: Highway Technology Reserch Center, Japan

Removal of trees along the 4th Cebu-Mactan Bridge-Mandaue Coastal Road alignment and could have adverse environmental impacts, as these trees have a function of carbon sink. The impact from the reduction in existing green areas at the time of construction can be estimated from the change in the carbon accumulation, and calculated according to [formula 2].

[Reference formula2]

$$C_{LB} = B_{Total} \times A \times CF \times 44/12$$

$$B_{Total} = B_{AG} + B_{BG}$$

$$B_{BG} = B_{AG} \times R$$

C_{LB}	: carbon accumulation per unit area for Forest Area, etc. (tCO2)
A	: area of Forest Area, etc. (ha)
CF	: carbon content of trees in Forest Area, etc. (t-C/t-dm)
B_{Total}	: total biomass in Forest areas, etc. (t-dm/ha)
B_{AG}	: above-ground biomass in green areas, etc. (t-dm/ha)
B_{BG}	: below-ground biomass in green areas, etc. (t-dm/ha)
R	: ratio of below-ground biomass to above-ground biomass (below-ground/above-ground)

Table 8.6.59 Parameters for Carbon loss from Tree Cutting

Parameter	Description		Value	Unit	Source
A	Land area of organic soils		13.3884	ha	Study team
B_{AG}	Above ground biomass	Tropical forest	348	t-dm/ha	Table 3A.1.2, IPCC GPG-LULUCF
R	Root-to-shoot ratio	Secondary Tropical/Sub Tropical	0.42		Aneex 3A.1,Table 3A.1.8, IPCC GPG-LULUCF
CF	Carbon fraction of dry matter	Tropical/Sub Tropical	0.47	t-C/t-dm	2006 IPCC Guideline AFOLU, Table 4.3.

Note: CO2 Emission by Construction Activities is shown in Table 8.6.60. Total CO2 generated by construction work and tree cutting is 30,218 t CO2.

Table 8.6.60 Sumarry of CO2 Emission by Construction Activities

Activities	Type of Structure	Unit (CO2 t/km) for 4 lanes	Total Length (km)/ 4-lanes	Generated CO2 t
Construction work	Embankment	2,267.80	2.33	5,273
	Bridge (steel)	1,287.00	2.25	2,891
	Bridge (PC)	1,400.70	7.61	10,652
Tree cutting				11,402
Total				30,218

Source: JICA Survey Team

Operation Phase

During Operation of the Project, vehicle traffic on the 4th Cebu-Mactan Bridge-Mandaue Coastal Road will result in GHG emissions from fuel combustion.

[Reference formula 3]

$$PE_{E,y} = \Sigma\, VK_{k,y} \times EF_{v,k}$$

$PE_{elec,y}$	:	Emissions from Vehicle (tCO2/year)
VK_k	:	Vehicle-km by type k (million veh*km/year)
$EF_{v,k,}$	:	Emission factor by Vehicle type k, speed (gCO2/km)

Table 8.6.61 Summary of Traffic Demand Forecast

		Ave. Speed (km/h)	Vehicle-km (million veh*km/day)	
			Passenger Car	Truck
2030	with project	20.1	31.60	1.48
	without project	19.9	31.79	1.49
2050	with project	20.0	34.20	2.41
	without project	19.5	34.40	2.41

Source: JICA Survey Team

Table 8.6.62 Emission factor by Vehicle type, Speed

Year	Vehicle type	Ave. Speed(km/h)		Emission factor by Vehicle type, Speed(gCO2/km)			
		Without Project	With Project	Without Project		With Project	
				Small	Large	Small	Large
2019	2009	20.12	0.00	200.1	907.9		
2020	2010	20.10	0.00	175.7	907.9		
2021	2011－14	20.08	0.00	175.8	908.2		
2022	2011－14	20.06	0.00	175.9	908.5		
2023	2011－14	20.04	0.00	175.9	908.9		
2024	2011－14	20.02	0.00	176.0	909.2		
2025	2015－	20.00	0.00	139.2	814.0		
2026	2015－	19.98	20.12	139.2	814.0	138.9	812.3
2027	2015－	19.96	20.12	139.2	814.0	138.9	812.3
2028	2015－	19.94	20.11	139.2	814.0	138.9	812.4
2029	2015－	19.92	20.11	139.2	814.0	138.9	812.5
2030	2020	19.90	20.10	160.2	869.3	159.5	866.2
2031	2020	19.88	20.09	160.3	869.5	159.5	866.3
2032	2020	19.86	20.09	160.4	869.8	159.5	866.4
2033	2020	19.84	20.08	160.5	870.1	159.5	866.5
2034	2020	19.82	20.08	160.5	870.4	159.5	866.6
2035	2020	19.80	20.07	160.6	870.7	159.5	866.6
2036	2020	19.78	20.07	160.7	871.0	159.6	866.7
2037	2020	19.76	20.06	160.8	871.3	159.6	866.8
2038	2020	19.74	20.06	160.9	871.6	159.6	866.9
2039	2020	19.72	20.05	161.0	871.9	159.6	866.9
2040	2030	19.70	20.05	140.9	821.7	139.7	816.9
2041	2030	19.68	20.04	141.0	822.0	139.7	816.9
2042	2030	19.66	20.04	141.0	822.3	139.7	817.0
2043	2030	19.64	20.03	141.1	822.5	139.7	817.1
2044	2030	19.62	20.03	141.2	822.8	139.7	817.2
2045	2030	19.60	20.02	141.2	823.1	139.7	817.2
2046	2030	19.58	20.02	141.3	823.3	139.7	817.3
2047	2030	19.56	20.01	141.4	823.6	139.8	817.4
2048	2030	19.54	20.01	141.5	823.9	139.8	817.5
2049	2030	19.52	20.00	141.5	824.1	139.8	817.5
2050	2030	19.50	20.00	141.6	824.4	139.8	817.6

Source: JICA Survey Team, based on the Ministry of Land, Infrastructure, transportation and Tourism, Japan

Table 8.6.63 Emission from Vehicle Operation

Interporlation between 2019 to 2050

Year	Million-Vehicle-km				Average Travel Speed (kph)		CO2 Emission						
	W/o Project		W/ Project		W/o Project	W/ Project	W/o Project		Total/WO	W/ Project		Total/W	Difference
	Small	Large	Small	large	-	-	Small	Large		Small	large		WO-W
2019	30.36	0.99			20.1		2,217,147.11	326,693.07	2,543,840.18	2,217,147.11	326,693.07	2,543,840.18	0.00
2020	30.49	1.03			20.1		1,955,513.65	341,947.51	2,297,461.16	1,955,513.65	341,947.51	2,297,461.16	0.00
2021	30.62	1.08			20.1		1,964,725.84	357,320.80	2,322,046.64	1,964,725.84	357,320.80	2,322,046.64	0.00
2022	30.75	1.12			20.1		1,973,945.20	372,704.98	2,346,650.18	1,973,945.20	372,704.98	2,346,650.18	0.00
2023	30.88	1.17			20.0		1,983,171.71	388,100.06	2,371,271.78	1,983,171.71	388,100.06	2,371,271.78	0.00
2024	31.01	1.22			20.0		1,992,405.40	403,506.04	2,395,911.44	1,992,405.40	403,506.04	2,395,911.44	0.00
2025	31.14	1.26			20.0		1,582,221.22	374,934.85	1,957,156.08	1,582,221.22	374,934.85	1,957,156.08	0.00
2026	31.27	1.31	31.07	1.30	20.0	20.1	1,588,852.92	388,604.05	1,977,456.97	1,574,891.09	385,277.59	1,960,168.68	17,288.29
2027	31.40	1.35	31.20	1.35	20.0	20.1	1,595,484.62	402,273.25	1,997,757.87	1,581,659.08	398,975.56	1,980,634.64	17,123.24
2028	31.53	1.40	31.34	1.39	19.9	20.1	1,602,116.32	415,942.45	2,018,058.77	1,588,428.45	412,675.94	2,001,104.39	16,954.38
2029	31.66	1.45	31.47	1.44	19.9	20.1	1,608,748.01	429,611.65	2,038,359.67	1,595,199.20	426,378.75	2,021,577.95	16,781.72
2030	31.79	1.49	31.60	1.48	19.9	20.1	1,859,218.49	473,369.50	2,332,587.99	1,839,009.11	469,159.33	2,308,168.44	24,419.55
2031	31.92	1.53	31.72	1.52	19.9	20.1	1,867,537.83	485,041.16	2,352,578.99	1,846,505.06	480,673.67	2,327,178.73	25,400.26
2032	32.05	1.57	31.85	1.56	19.9	20.1	1,875,892.91	497,000.38	2,372,893.29	1,854,031.50	492,470.58	2,346,502.08	26,391.21
2033	32.17	1.60	31.97	1.60	19.8	20.1	1,884,283.86	509,254.24	2,393,538.10	1,861,588.54	504,557.00	2,366,145.54	27,392.56
2034	32.30	1.64	32.10	1.63	19.8	20.1	1,892,710.85	521,809.98	2,414,520.83	1,869,176.31	516,940.04	2,386,116.35	28,404.48
2035	32.43	1.68	32.23	1.67	19.8	20.1	1,901,174.02	534,675.05	2,435,849.07	1,876,794.94	529,626.97	2,406,421.91	29,427.16
2036	32.56	1.72	32.36	1.72	19.8	20.1	1,909,673.53	547,857.05	2,457,530.59	1,884,444.56	542,625.25	2,427,069.81	30,460.78
2037	32.68	1.77	32.48	1.76	19.8	20.1	1,918,209.53	561,363.80	2,479,573.32	1,892,125.28	555,942.53	2,448,067.80	31,505.52
2038	32.81	1.81	32.61	1.80	19.7	20.1	1,926,782.16	575,203.27	2,501,985.43	1,899,837.24	569,586.62	2,469,423.85	32,561.58
2039	32.94	1.85	32.74	1.84	19.7	20.1	1,935,391.59	589,383.67	2,524,775.26	1,907,580.55	583,565.55	2,491,146.10	33,629.16
2040	33.07	1.90	32.87	1.89	19.7	20.0	1,700,713.26	568,970.20	2,269,683.46	1,675,659.94	563,304.03	2,238,963.97	30,719.49
2041	33.20	1.94	33.00	1.94	19.7	20.0	1,708,308.83	582,995.84	2,291,304.67	1,682,487.06	577,128.45	2,259,615.51	31,689.16
2042	33.34	1.99	33.13	1.98	19.7	20.0	1,715,936.98	597,366.97	2,313,303.95	1,689,341.93	591,292.13	2,280,634.06	32,669.89
2043	33.47	2.04	33.27	2.03	19.6	20.0	1,723,597.86	612,092.08	2,335,689.94	1,696,224.66	605,803.40	2,302,028.06	33,661.88
2044	33.60	2.09	33.40	2.08	19.6	20.0	1,731,291.60	627,179.88	2,358,471.48	1,703,135.38	620,670.77	2,323,806.15	34,665.33
2045	33.73	2.14	33.53	2.13	19.6	20.0	1,739,018.33	642,639.30	2,381,657.64	1,710,074.18	635,903.00	2,345,977.18	35,680.46
2046	33.87	2.19	33.66	2.18	19.6	20.0	1,746,778.21	658,479.49	2,405,257.70	1,717,041.20	651,509.02	2,368,550.22	36,707.48
2047	34.00	2.24	33.80	2.24	19.6	20.0	1,754,571.35	674,709.83	2,429,281.18	1,724,036.53	667,498.02	2,391,534.56	37,746.62
2048	34.13	2.30	33.93	2.29	19.5	20.0	1,762,397.91	691,339.91	2,453,737.82	1,731,060.31	683,879.40	2,414,939.70	38,798.11
2049	34.27	2.35	34.07	2.35	19.5	20.0	1,770,258.02	708,379.56	2,478,637.59	1,738,112.63	700,662.78	2,438,775.40	39,862.18
2050	34.40	2.41	34.20	2.41	19.5	20.0	1,778,151.83	725,838.88	2,503,990.71	1,745,193.62	717,858.02	2,463,051.64	40,939.07
												Total	750,879.55

Source: JICA Survey Team

Summary of CO_2 emission and reduction by the Project by 2050 is shown in Table 8.6.64. The value will be 720, 662 t CO_2.

Table 8.6.64 Sumarry of CO2 Emission by the Project

Activities	tCO2
Construction phase	30,218
Operation phase (-2050)	750,880
Diference	**720,662**

Source: JICA Survey Team

8.7 Environmental Impact Assessment

The result of Environmental Impact Assessment is shown in Table 8.7.1

Table 8.7.1 Environmental Impact Assessment after EIA Study

JICA Guide line	Evaluation: Scoping – Pre/During Construction	Evaluation: Scoping – Operation	Evaluation: EIA – Pre/During Construction	Evaluation: EIA – Operation	Philippine Environmental Impact Statement (EIS) System (DAO 03-30)	Evaluation: Scoping	Evaluation: EIA	Reason for Evaluation
Air Quality	B-	B-/B+	B-	D	Air Pollution	LS	LI	**Construction Phase:** Temporary negative impacts are expected on air quality due to exhaust gas (NOx and PM) resulted from operation of construction machines and equipment, and traffic congestion by traffic regulations. **Operation Phase:** No serious impact is expected because the baseline and forecast results are almost equal.
Water Quality	B-	B-	B-	B-	**Water Quality**			**Construction Phase:** Turbid water may be generated in the channel and river as a result of piling for installation of piers and other earth works for constructing a new road. In case the construction period of the reclamation project planned on the southern coast of Cebu Island overlaps with that of the subject project, water in Mactan Channel may be polluted. **Operation Phase:** Wastewater from the bridge may cause seawater pollution.
					Groundwater pollution	LI	LI	
					Stream water pollution	NR	LS	
					Lake water pollution	NR	NR	
					Marine water pollution	LS	LS	
Waste	B-	D	B-	B-				**Construction Phase:** Construction waste such as construction residual and cut trees may be generated by civil engineering work and excavation. General waste and manure is expected to be generated from the base camp. **Operation Phase:** There is a possibility that solid waste will be disposed at roadside.
Soil pollution	B-	D	B-	D	Soil erosion	LS	LI	**Construction Phase:** Impacts is limited as the structure of the project will be viaduct mainly, so that modification of topography due to cut-and-fill work will be limited and the design and the construction plan of viaduct columns will be optimized in the detail design stage. **Operation Phase:** There will be no change in topography and soils in the project site.

					Change in soil quality	LI	LS	**Construction Phase:** There is a possibility that excavated soil at the landfill site is contaminated; this may lead to contamination of other soils. The landfill site has been permanently shut down and started rehabilitation by the City of Mandaue, so excavation soil at landfill site will be separated and followed the instruction by the City of Mandaue. **Operation Phase:** There is a possibility that soil contamination from accidental releases of chemicals, fuel, oil, lubricants will occur due to the maintenance work, but it will be managed by the contractor, so that serious impact is not expected.
Noise and vibrations	B-	B-/B+	B-	B-/B+	Increase in noise	LS	LS	**Construction Phase:** Noise and vibration levels are expected to heighten temporarily due to the operation of construction vehicles and machineries, concrete placement work and the traffic congestion resulted from traffic regulations. **Operation Phase:** Noise and vibration levels are expected to heighten around newly constructed bridge and road, whereas they are expected to be reduced due to a decrease in traffic volume around existing highways and bridges.
Ground subsidence	D	D	D	D	Inducement of subsidence	LI	LI	**Construction Phase / Operation Phase**: No serious impact is expected because there is no activity planned that may lead to ground subsidence such as large scale embankment and pumping.
Offensive odors	B-	D	B-	D				**Construction Phase:** General wastes from the construction yard may generate offensive odors. **Operation Phase:** No serious impact is expected because there is no activity planned that may generate offensive odor.
Bottom sediment	B-	D	D	D	Change in soil quality	LI	LS	**Construction Phase:** No serious impact is expected because the bottom sediment near the construction site of the new Mactan bridge is not polluted and thus there is no possibility of the bottom sediment stirred up by the installation of piers pollute the surrounding bottom sediment. **Operation Phase:** No serious impact is expected because there is no plan that may affect bottom sediment.
Protected Area	D	D	D	D	Encroachment in Protected Area under NIPAS	LI	LI	**Construction Phase / Operation Phase:** There are no legally-designated protected areas in and around the project site.
Ecosystem	B-	B-	B-	B-	Encroachment in other Environmentally Critical Areas (ECAs)	LS	LS	**Construction Phase / Operation Phase:** As the whole project area is included in the important bird area (IBA) and key biodiversity area (KBA), there is concern about the negative impact on mangrove forests, tidal flats, and the organisms that use them (especially birds).
					Terrestrial Ecology			**Construction Phase:** Construction of interchanges that occupy a relatively large area may bring negative impacts to the surrounding ecosystem including mangrove forests. Construction of bridges and approach roads is expected to cause tree cuttings. Approximately 700 mangrove trees and 1400 terrestrial trees along the project alignment will be affected. Construction will disturb IBA/ KBA consisting mangrove, tidal flat and migratory birds.
					Vegetation removal and loss of habitat	LS	LS	

					Threat to existence and/or loss of important local species	LS	LS	Terrestrial trees to be possibly removed includes Molave classified under endangered category of the DAO No.1-2007 and under vulnerable category of IUCN Redlist, Narra and Mahogany classified under IUCN Redlist's endangered and vulnerable categories, respectively.
					Threat to abundance, frequency and distribution	LS	LS	**Operation Phase:** Land use changes of the surrounding areas into commercial-residential development will impact on the environment. The presence of bridges and traffic flow and noise generated from them may affect the ecology of the main species that feed on tidal flats located around the bridge construction area.
					Hindrance to wildlife access	LS	LS	
	B-	B-	B-	B-	**Freshwater Ecology**			**Construction Phase:** Release of contaminants, such as fuel and hydraulic fluid from equipment/vehicles for construction, chemicals, liquid wastes, and sediment-laden run-off from uncleaned/dirty area of construction work sites will affect the habitat condition.
					Threat to abundance, frequency and distribution of species	LS	LS	
					Loss of important species	LS	LS	**Operation Phase:** The presence of bridges and traffic flow and noise generated from them may affect the ecology of the main species that feed on tidal flats located around the bridge construction area.
	B-	B-	B-	B-	**Marine Ecology**			
					Threat to abundance, frequency and distribution of species	LS	LS	**Construction Phase:** Removal of or direct physical injury to aquatic flora and fauna (e.g. seagrasses and sea weeds in Cansaga Bay and Mactan channel) through activities associated with construction of offshore viaduct and bridge. Turbidity, siltation/sedimentation of Mactan Channel due to movement of loose underwater sediments, soil from construction of viaduct footings/columns will occur. Vibration/disturbance from pile-driving will occur.
					Loss of important species	LS	LS	**Operation Phase:** The presence of bridges and traffic flow and noise generated from them may affect the ecology of the main species that feed on tidal flats located around the bridge construction area.
					Loss of habitat	LS	LS	**Construction Phase / Operation Phase:** Release of contaminants, such as fuel and hydraulic fluid from equipment/vehicles for construction, chemicals, liquid wastes, and sediment-laden run-off from uncleaned/dirty area of construction work sites will affect the habitat condition.
Hydrology	B-	B-	B-	D	**Hydrology/Hydrogeology**			**Construction Phase:** Changes in the flow conditions of seawater due to bridge construction may affect the distribution of the tidal flats. **Operation Phase:** There is no activity in operation of road and bridge to impact for Hydrology. The modifications of topography/terrain will be limited, but there is a possibility that it will disrupt drainage pattern, causes erosion/transport of sediments to surface waters.
					Change in drainage morphology	LS	LI	

					Change in stream, lake water depth	NR	NR	
					Reduction in stream volumetric flow	NR	NR	
					Inducement of flooding	LS	LS	**Construction Phase:** Increase in run-off due to exposed soils, disturbance of soils which may result to localized flooding, sedimentation, etc.; **Operation Phase:** No serious impact is expected because there is no land acquisition in the operation phase.
					Oceanography			**Construction Phase / Operation Phase:** Changes in the flow conditions of seawater due to bridge construction may affect the distribution of the tidal flats. The modifications of topography/terrain will be limited, but there is a possibility that it will disrupt drainage pattern, causes erosion/transport of sediments to surface waters which are considered adverse impacts to coastal processes and change of the characteristics of beach.
					Change/disruption in circulation pattern	LS	LI	
					Change in bathymetry	LS	LI	
Geographical features	C	D	B-	D	**Geology/Geomorphology**			
					Change in surface landform/ topography/ terrain/slope	LS	LI	**Construction Phase:** Modification of topography, soil disturbance and loss of top soil due to excavation (mostly of viaduct columns) will have negative and irreversible impacts, however the magnitude is considered as minor to moderate.
					Change in sub-surface/ underground geomorphology	LS	LI	**Operation Phase:** There will be no change in topography and soils in the project site.
					Inducement of landslides or other natural hazards	LI	LI	**Construction Phase / Operation Phase:** Historical seismic data from PHIVOLCS show that only small magnitude earthquakes occur in Cebu Island and the project area. Even though, the design of the structure will be considered the probability of occurrence of earthquakes.
Resettlement	A-	D	A-	D	Displacement of settler/s	LS	LS	**Pre-/Construction Phase:** Resettlement of 69 households (243 persons) is expected within the affected area.
					Change in land ownership	LS	LS	**Operation Phase:** No serious impact is expected because there is no land acquisition in the operation phase.
					Displacement of properties	LS	LS	
Local economies, such as employment, livelihood, etc.	C	C	B-/B+	B+	Local benefits from the project	LS	LS	**Pre-/Construction Phase:** Local economy is expected to be developed through creation of employment opportunities in construction work and business for construction workers. Livelihood of residents may be affected by land acquisition and resettlement. New construction of bridge and road may affect the livelihoods of fishery/aquaculture/broom-making workers. **Operation Phase:** Land acquisition does not occur in the operation phase, whereas the presence of newly constructed bridge and road that narrows the fishing ground/aquaculture ponds may negatively affect the livelihoods of fishery/aquaculture/broom-making workers. Positive

								impacts on the local economy such as alleviation of traffic congestion are expected in Cebu City.
Local Institutions, decision making	B-	D	D	D	Right of way conflict	LS	LS	**Construction Phase / Operation Phase:** According to the system of public involvement, the social structure and decision making will not affected by the project. Thus, no serious impact on local institutions and decision making is expected.
Misdistribution of benefits and damages	D	D	D	D				**Construction Phase / Operation Phase:** Misdistribution of benefits and damages is expected to be minor because the benefit of improved convenience by the bridge and road construction will be equally distributed. In addition, the damage by the construction will be compensated properly.
Local conflicts of interest	B-	D	B-	D				**Construction Phase:** Impacts on the accessibility/hindrance to port/docking facilities and operations will occur due to the bridge and road construction. In addition, there are several projects to be coordinated with the construction of bridge and road. **Operation Phase:** No serious impact is expected as explained in "Misdistribution of benefits and damages".
Existing social infrastructures and services	B-	B-	B-	B-				**Construction Phase / Operation Phase:** Hazardous facilities such as petrochemical factories and oil tanks located along the coastal road may be affected (e.g. casting flammable items into the tanks).
Poor	B-	D	B-	D	In-migration (Proliferation of informal Settlers)	LS	LS	**Pre-/Construction Phase:** There are 38 PAFs whose monthly income is less than the poverty threshold set by the Philippine Statistics Authority (PSA). **Operation Phase:** No serious impact is expected because there is no land acquisition in the operation phase.
Indigenous, or ethnic people	C	C	D	D	Presence of Indigenous Peoples	LI	NR	**Construction Phase / Operation Phase:** Neither the existence of ethnic minorities and indigenous people, nor impacts to them have been identified.
Land use and utilization of local resources	C	C	B-	B-/B+	Change/Inconsistency in land use	LS	LS	**Pre-/Construction Phase:** Construction of bridge may affect negatively land use and utilization of local resources including fishery/ recreational activities, etc. **Operation Phase:** With improve transportation and mobility, the cities of Mandaue, Lapu-lapu will open-up to investment opportunities and sustain economic growth and development. But, uncontrolled development along roadside may hinder proper land use and make it difficult for the people to use local resources.
					In-migration (Proliferation of informal Settlers)	LS	LS	**Construction Phase:** During the construction phase, land may be required for providing construction workers and staff with temporary housing in the vicinity of the project site.

								Operation Phase: There is a possibility that new informal settler will in-migrate to the project area, especially at the bottom of the elevated structures.
Cultural heritage	B-	B-	D	D	Cultural change	LI	NR	**Construction Phase / Operation Phase:** There are no existing materials of cultural, historical nor archaeologic significance present in the area that could be impacted by the project.
Landscape	C	C	D	D				**Construction Phase :** No serious impact is expected because there is no legally-designated landscape to be protected around the project site. **Operation Phase:** Presence of a bridge and viaduct may change the landscape, so the design and lightning system should be considered to harmonize with local land scape. .
Gender	B-	D	D	D				**Construction Phase / Operation Phase:** No serious impact is expected because no activity that may affect gender is planned in the construction and operation phases.
Children's rights	C	D	D	D				**Construction Phase / Operation Phase:** No serious impact is expected because no activity that may affect children's rights is planned in the construction and operation phases.
Water usage	B-	D	B-	D	Water resources competition	LI	LI	**Construction Phase:** Land acquisition and construction work may not affect the accessibility to drinking water resources such as wells. **Operation Phase:** No serious impact is expected because there is no activitiy that may affect water resource in the operation phase.
					Reduction/Depletion of ground water flow	LI	LI	**Construction Phase:** There is a possibility that is construction activities which may affect groundwater flows such as excavation for viaduct. **Operation Phase:** No serious impact is expected because there is no activitiy that may affect groundwater flow in the operation phase.
					Threat to delivery of basic services	LS	LS	**Construction Phase:** There will be demand for water supply for utilization in the construction works. **Operation Phase:** No serious impact is expected because there is no activitiy that may affect water usage in the operation phase.
Infectious diseases such as HIV/AIDS	B-	B-	B-	B-	Threat to public health	LS	LS	**Construction Phase:** Infectious diseases such as STD may possibly spread due to an inflow of construction work **Operation Phase:** The improved access from the airport to the urban area due to the newly constructed bridge and road may increase the number of travelers and spread infectious diseases such as STD.
Working conditions (Health)	B-	D	B-	D				**Construction Phase:** If the contractor fails to take appropriate safety measures, the worker's health and safety are expected to deteriorate. **Operation Phase:** No serious impact is expected because construction of bridge and road is considered to bring no significant change to the working environment of the surrounding local inhabitants.
Accidents (Safety)	B-	B-	B-	B+	Traffic congestion	LS	LS	**Construction Phase:** Operation of construction machines and equipment may cause accidents in the project site.

								Operation Phase: Long term environmental effects of the project will be positive with an improved transportation network and an increase in public safety.
The impacts to transboundary or global issues	B-	C	B-	B+	Change in the local climate, e.g., local temperature	LS	LS	**Construction Phase / Operation Phase:** Construction of bridges and roads is expected to cause tree cuttings, and the pavement of road will disturb the natural drainage. It will cause the change in the local climate, in particular, local temperature.
					Contribution to Global greenhouse gas	LS	LS	**Construction Phase:** Construction of bridges and roads is expected to cause tree cuttings. It is expected to decrease greenhouse gas absorption. Operation of construction machines and construction of structures are expected to lead to emission of greenhouse gases. **Operation Phase:** Greenhouse gas emissions are expected to increase in the new bridge and road area, while reduction in greenhouse gas emissions are expected in the whole area by reducing traffic congestion.
Note 2: Rating based on JICA ES Guideline A±: Significant positive/ negative impact is expected. B±: Some positive/ negative impact is expected. C: Extent of positive/ negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses.) D: No impact is expected. IEE/ EIA is not necessary.					Note1: Relevance based on PD and Project Location LS: Likely Significant LI: Likely Insignificant NR: Not Relevant			

8.8 Environmental Management Plan

The Environmental Management Plan (EMP) covers the construction and operations of 4th Cebu-Mactan Bridge-Mandaue Coastal Road Project. The EMP is inclusive of the enhancement/mitigation measures as exhibited in the EMP matrix shown in Table 8.8.1.

Table 8.8.1 Environmental Management Plan Matrix

Env. Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures	Responsible Party	Est. Cost/	Guarantee
PRE-CONSTRUCTION	**: Preparation of sub-studies, archt & Eng Design, procurement of permits/ clearances, consultations etc.)/ Clearing along ROW**				
Soil pollution (near Umapad Dumpsite)	• Soil contamination due to excavation work near Umapad Dumpsite	• Conduct a comprehensive soil quality survey in the D/D and provide the results to the Mandaue City as a contribution to the rehabilitation of the dump site. • Rehabilitation of soil in consultation with the concerned LGU	DPWH, D/D Consultant	Design & consultancy fees:	ECC, SOP
Ecosystem / The impacts to transboundary or global issues	• Removal of up to 2,000 trees (approx. 470 terrestrial trees possibly relocatable and approx. 700 mangrove trees and 900 terrestrial trees inevitably cut) • Possible earth-ball and relocation of Molave classified under endangered category of the DAO No.1-2007 and under vulnerable category of IUCN Redlist, Narra and Mahogany classified under IUCN Redlist's endangered and vulnerable categories, respectively· • Change in the local climate, in particular, local temperature • Decrease of greenhouse gas absorption due to removel of trees. • Invrease of green house gas emission due to operation of construction machines	• Compliance with the conditions stipulated in the permits / clearances (e.g. ECC, Tree Cutting Permit, etc.) issued for the Project • Providing a temporary fencing to vegetation for their protection to minimize clearing of vegetation as much as possible • Replantation of approx. 470 terrestrial trees, less than 1.5m height, including threatened species Molave, Narra and Mahogany • Compensatory plantation of mangrove and terrestrial trees in accordance with DENR relevant regulation(s) (Plant approx. 70,000 seedlings of mangrove and approx. 90,000 seedlings of other terrestrial tree species)	DPWH, Contractor supervised by Consultant, DENR-FMB and concerned LGUs	Temporary fencing cost: Tree replanting cost: Tree seedling planting cost:	ECC, SOP

Env. Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures	Responsible Party	Est. Cost/	Guarantee
	• Disturbance to KBA	• Conduct the Biodiversity Survey (detailed bird survey) two (2) times during the migration seasons during Detailed Engineering Design as an input to the design of coastal road, interchange and bridge and for consideration of further measures to minimize the disturbance to IBA/KBA (i.e. development of wetland park and installment of bird-car collision prevention poles)	DPWH, D/D Consultant, DENR, LGU	Design & consultancy fees: [redacted] Wetland park development: [redacted] Installment of bird-car collision prevention poles: [redacted]	ECC
Geographical features	• Damage to components of the construction work (Ground shaking, ground rupture)	• Undertake site-specific seismic risk characterization and estimates of how the ground beneath the structure will move; and Design and construct structures that will address seismic hazards	DPWH, D/D Consultant	Design & consultancy fees:	ECC, SOP
Resettlement/Poor	• Loss of land, property and establishments along/within the ROW of Bypass road alignment	• Resettlement, compensation, assistance and rehabilitation of affected residents (PAFs) & establishments; implementation of RAP	DPWH, LGU, PAFs	RAP Budget (can be adjusted to accommodate changes after D/D): [redacted]	RAP, ECC
	• Improvement of living conditions	• Livelihood rehabilitation assistance in the form of skills training and other development activities shall be provided in coordination with other concerned government agencies if the present means of livelihood is no longer viable and the PAP will have to engage in a new income activity; and • Financial assistance to augment loss of income during initial months of relocation	DPWH DSWD, DOST NGOs, etc..	RAP Budget:	RAP, ECC
Misdistribution of benefits and damages/Local conflicts of interest	• Informed/empower the public to participate in the decision-making process	• Transparent and participatory approaches and methodologies, Consideration of community needs/aspirations (Conduct of IEC, public consultations)	DPWH	Conduct of IEC and public consultations: [redacted]	Standard procedures & guidelines (JICA, EMB, DOLE)

Env. Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures	Responsible Party	Est. Cost/	Guarantee
Existing social infrastructures and services	• Relocation of utilities (e.g. electric poles, water lines, communication lines, etc.) along right of ways	• Necessary planning and coordination with concerned authority and local body; Prior notice to and consultation with concerned authority, local body and public to be affected so as to ensure that work does disrupt services	DPWH, VECO, MCWD, Telcos, LGU, etc.		Agreement with Utilities-services providers
CONSTRUCTION	**:Site Preparation, Roadbed Preparation ,Installation of Structures, Temporary ancillary elements**				
Air quality	• Movement of construction vehicles and equipment's will generate fugitive dusts • Exhaust emissions from construction machineries and equipment	• Regular sprinkling of water of areas considered as dust generators • Use only new or properly maintained vehicles, equipment and conduct regularly check to regulate emissions within standard levels • Transport of excess materials should be undertaken during off-peak traffic periods • Hauling trucks should be covered with tarpaulin or canvass • Conduct quarterly TSP, PM10, NO2, SO2 level monitoring	DPWH., Contractor, Site Manager	Monitoring cost:	ECC, SOP
Water Quality	• Increase turbidity and sediment load due to transport of wastes and sediments to surface water, Mactan Channel, Cansaga Bay and Silot Bay, waters	• Prepare temporary drainage plan with sump pits/sedimentation pond to trap sediments and wastes; • Use of silt fences and sediment traps, cover exposed earth especially before heavy rains are expected. • Conduct a quarterly Total Suspended Solids (TSS) and heavy metal level monitoring	DPWH., Contractor, Site Manager	Monitoring cost:	ECC, SOP
	• Pollution of receiving water bodies due to fuel and oil leaks from vehicles and other equipment	• Proper handling of oil and lubricants to prevent spillage and contamination of surface and ground waters; (Storage of oil and lubricants in secure areas/places) • Heavy equipment's and machineries shall be well-maintained to prevent discharges from engines and regularly checked for fuel and oil leaks. • During repair/maintenance of equipment and machinery, containers/drip trays shall be used to collect leakage • Paint residues and paint containers shall be handled & disposed properly and arrangement will be made with the suppliers to be return for their proper disposal • Conduct quarterly oil & grease content monitoring	DPWH., Contractor, Site Manager		ECC, SOP

Env. Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures	Responsible Party	Est. Cost/	Guarantee
	• Further bacteriological contamination of the esteros due to improper management of domestic and solid wastes	• Contractor/Project Management provides toilet/washroom facility for construction workers and require proper sanitation practices; • Provision of garbage bins at the construction areas; • Regular disposal of wastes generated by the personnel to city approved disposal sites; • Conduct weekly inspection of the construction areas to ensure proper management of the wastes generated by the construction personnel and • Conduct quarterly total coliform monitoring	DPWH., Contractor, Site Manager	To be included in the contractor's cost:	ECC, SOP
Waste/ Offensive odors	• Wastes generation, consisting of the following types: · Surplus and const. wastes: scrap metals, concrete rubble etc. (estimated volume: around 18,500 m3) · Domestic wastes (Biodegradable): food and kitchen wastes from temp. canteen · Sanitary wastes from office and workers toilets, bathrooms • Others (Packaging wastes such as plastics, wood pallets, crates, metal wires, cardboard, sacks, containers, etc.)	• Detailed waste management program will be prepared by contractor including the following; · Solid wastes to be moved/transported to materials recycling facility (MRF) for sorting and diversion of wastes to recycles and re-utilization · Concrete rubbles and other excess materials to be reused for backfilling of the project sites/areas · Secure hauling permits and dispose excess earth materials to approved-suitable disposal sites · Residuals to be segregated into biodegradable, recyclable, residual, and special waste and disposed through the City garbage collectors • Temporary stockpiles of excavated materials from foundation works must be properly covered and regularly hauled to DENR-approved disposal sites; • No stockpiling of construction debris as these will not be utilized anyway; • Litters and other types of domestic garbage from construction sites and camps must be properly kept in trash bins and regularly disposed through the City garbage collectors	DPWH., Contractor, Site Manager	To be included in the contractor's cost:	ECC, SOP
Soil pollution	• Slope failure • Soil runoff due to cut and fill areas, and waste soil disposal sites • Movement of excavated soil to waterways	• Take appropriate soil protection measures when doing excavation for foundation works • Ensure slope protection such as stone pitching or vegetation to prevent soil runoff • Keep excavated soil (road sub-base, base, foundation works for viaduct columns, etc) away from waterways • Provide drainage sump pits and silt traps	DPWH., Contractor, Site Manager	To be included in the contractor's cost:	ECC, SOP

Env. Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures	Responsible Party	Est. Cost/	Guarantee
Soil pollution	• Soil contamination due to excavation work near Umapad dumpsite • Soil contamination due to leaks and spills of fuels, lubricants, solvents • Endangerment of health and safety of worker and community by exposure to hazards	• Establish and implement health and safety management plan and emergency and contingency plan in case of spills; • Excavation soil near Umapad Dumpsite will be separated from other excavation materials and followed the instruction of DENR-EMB, DGS and CENRO. • Store bulk hazardous chemicals in an impermeable area and with appropriate secondary containment; • Comply with environmental requirements for the storage, transport, treatment and handling of hazardous substances and wastes • Conduct a semi-annual soil quality monitoring	DPWH., Contractor, Site Manager	Monitoring cost:	ECC, SOP
Noise and Vibrations	• Noise from movement of vehicles (trucks, cars) coming-in and out of the facility—disturbance to residents along Access St. • Noise from Pile driving activities	• Provision of temporary noise barriers such galvanized iron sheets, particularly in noise-sensitive receptor areas • Schedule heavy noise generating activities from 7am-7pm. • Use only new or properly maintained vehicles, equipment • Minimize the use of impact devices • Installation of noise abatement devices such as mufflers and suppressors to all construction vehicles, machineries, and heavy equipment • Locate stationary equipment, such as compressors as far as possible from noise sensitive areas. • Avoid impact-type pile driving and employ appropriate pile-driving technology in noise-sensitive receptor areas and bird habitats • Conduct quarterly noise level monitoring at sensitive receptor areas	DPWH., Contractor, Site Manager	Temporary noise barriers cost: Monitoring cost: Included in air quality monitoring	ECC, SOP
Ecosystem (Terrestrial Flora and Fauna)	• Small-scale loss of bird habitat such as mangrove, fishpond and tidal flat • Noise from construction work frightening migratory birds away from the IBA/KBA.	• Conduct awareness campaign to all relevant construction workers about the careful consideration for IBA/KBA • Adoption of lower noise and vibration construction method and machines • Adoption of temporary jetty construction road to minimize adverse impacts on mangrove and tidal flat • Conduct bird monitoring every two (2) months	DPWH, Consultant, DENR, LGUs	Consultant:	ECC

Env. Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures	Responsible Party	Est. Cost/	Guarantee
Ecosystem (Aquatic Flora and Fauna)	• Removal of or direct physical injury to aquatic flora and fauna (e.g. seagrasses and sea weeds) through the construction of offshore viaduct and bridge • Vibration/disturbance from pile-driving	• Monitor the distribution and health of surrounding intertidal habitats along or near the vicinity of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road alignment. • Position the water borne equipment in a manner that will minimize damage to identified fish habitat (mangrove, seagrasses, and coral reefs) • Avoid pile-driving methodology with sound & vibration impacts destructive to marine env/ habitats & disruptive to fish spawning • Coordinate with Bureau of Fisheries and Aquatic Resources (BFAR) on pile-driving schedule • Monitoring of sound and vibration level during driving any type of piles with in mind its impacts on fish and their habitat.	DPWH., Contractor, Site Manager	To be included in the contractor's cost:	ECC, SOP
Hydrology	• Disruption of natural drainage pattern • Increase in run-off due to alteration of topography and reduction of infiltration resulting to localized flooding,	• Setting the adequate drainage system such as the crossing drainage pipe; • Limiting the area of exposed soil, • Building of bund/dikes effectively enclosing water-areas prior to landfilling for coastal road • Implementation of erosion control measures such as temporary sandbagging, drainage swales and siltation basins • Loose earth materials stockpile be kept away from banks and near waters (waterways, sea)	DPWH., Contractor, Site Manager	To be included in the contractor's cost:	ECC, SOP
Geographical features	• Alteration in topography due to site development (inland areas): clearing, backfilling, grading, foundation works, etc.: • Soil disturbance and loss of top soil due to excavation	• Limiting land clearing and excavation within the affected areas of the primary impact area and excavating within the desired level only • Proper and appropriate excavation and embankment protection techniques, such as sheet pile.	DPWH., Contractor, Site Manager	To be included in the contractor's cost:	ECC, SOP
Local economies, such as employment, livelihood, etc.	• Enhancement of employment and /or livelihood opportunity that will lead to economic growth.	• Provide the priority for local hiring • Encourage patronage for local goods & services	DPWH., Contractor,	To be included in the contractor's cost	ECC, Contractors Contract

Env. Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures	Responsible Party	Est. Cost/	Guarantee
Misdistribution of benefits and damages/Local conflicts of interest	• Loss/limitations and hindrance of access by vessels to establishments with port/docking facilities	• Bridge design to accommodate/consider higher clearance to allow vessels to access and dock to establishments, such as shipyards, oil depot/fuel terminals and other establishments with docking facilities	DPWH, LGU, port/ docking facilities owners and operators		D/D, ECC
Existing social infrastructures and services	• Risk of casting flammable into hazardous facilities	• Install temporary noise barrier along the alignment as a physical barrier	DPWH., Contractor, Site Manager	To be included in the contractor's cost:	ECC, SOP
Land use and utilization of local resources	• Change/Disturbance in land use pattern due to road construction & ancillary facilities	• Scheduling heavy construction works during the daytime; • Construction activities that necessitate utilizing portion of the road/street should be undertaken upon permission by the City Traffic MGT and outside of traffic rush-hours; • Construction activities should not be a hindrance to the operations in neighboring area.	DPWH., Contractor, Site Manager and LGUs of Mandaue, and Lapu-lapu	To be included in the contractor's cost:	ECC, Zoning
Land use and utilization of local resources (Cumulative Impacts from Mandaue Reclamation Project)	• Increased land use change, noise, water pollution, dust and emissions • Increased traffic by construction vehicles • Increased restriction of access to sea water by local fisher folks	• Mitigation measures on air quality, noise level and water quality described in this EMP. • Implementation of the Traffic Management Plan (TMP) and rerouting plans in coordination with Mandaue Reclamation Project • Securing a route for small vessels of fisher folks during the bridge pier construction	DPWH., Contractor, Site Manager and LGUs	To be included in the contractor's cost:	ECC, SOP
Land use and utilization of local resources (In-migration)	• Construction workers and staff will require temporary housing	• To the extent possible, local labor will be hired to minimize the need to provide housing for the construction crew.	DPWH., Contractor	To be included in the contractor's cost:	Contractors Contract
Water usage	• Wastage of water resource through improper usage during construction • Competing use with the community •	• Sourcing of water from outside of the communities within the project area • Implement water saving/conservation measures of water use for construction works/activities • Recycled water or water from waterways and marine waters shall be used for ground sprinkling or dust-suppression measures •	DPWH., Contractor, Site Manager	To be included in the contractor's cost:	ECC, SOP

Env. Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures	Responsible Party	Est. Cost/	Guarantee
Infectious diseases such as HIV/AIDS/ Working conditions	• Increased risk of accidents due to improper work ethics, which may threat health and safety of workers and local residents	• Contractors shall submit an Occupational Health and Safety Management Plan prior to commencement of work • Appropriate personal protective equipment (PPE) must be provided to all construction workers • Safety guideline and signs will be prepared for workers • First aid stations supervised by the Environment and Safety Health Officer (ESHO) of the Contractor will be located within the construction site; and • Emergency vehicles will be on stand-by within the construction area at all times	DPWH., Contractor, Site Manager	PPE cost:	ECC, SOP
	• Hazards of communicable and infectious diseases	• Contractors shall submit an Occupational Health and Safety Management Plan. • Medical certificates will be requested to ensure workers are fit to work; • Appropriate sanitary facilities shall be provided at all construction sites.	DPWH., Contractor, Site Manager	To be included in the contractor's cost	ECC, SOP

Env. Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures	Responsible Party	Est. Cost/	Guarantee
Accidents (Safety)	• Increase traffic density due to movement of vehicles/trucks hauling construction materials to site, causing traffic congestion along access roads • Safety of pedestrians, passersby, as well as residents	• Strict implementation of the Traffic Management Plan (TMP) and rerouting plans; • Traffic flow restrictions will be minimized during daytime hours; • Schedule equipment move-in to blend with regular non-peak hour day-time vehicular traffic; • Placement of traffic decking will be done in stages; • Work will be performed during night time to the extent possible; • The minimum width of lanes will be maintained in accordance with the requirements of City Traffic MGT; • Parking time of idle dump trucks and the other construction vehicles along constricted areas will be limited; and • Well-trained traffic aides and flagmen duly deputized by City Traffic MGT will be designated at critical construction areas to direct traffic • All excavation sites and the storage site of hazardous substances will be enclosed with corrugated metal sheet barriers to limit access to public, especially children; • Installation of adequate lighting and reflectorized warning signs along the entire stretch of the construction site	DPWH, Contractor LGUs Traffic Management Office	To be included in the contractor's cost	ECC, TMP/TIA SOP
CONSTRUCTION	**: Demobilization/Clean up**				
Air quality	• Dust re-suspension due to abandoned construction spoils/debris	• Conduct a site inspection at the work sites to ensure that construction spoils/debris are properly disposed to approved disposal sites and not abandoned in the construction areas	DPWH., Contractor, Site Manager	To be included in the contractor's cost:	ECC, SOP
Water quality	• Further contamination of the waterways crossed by the alignments due to abandoned wastes and construction spoils	• All temporary sanitation facilities, especially the portable toilets are properly dismantled and no domestic wastes are abandoned; and • Conduct a site inspection at the work sites to ensure that construction spoils/debris, solid, and domestic wastes are properly disposed to approved disposal sites and not abandoned in the construction areas	DPWH., Contractor, Site Manager	To be included in the contractor's cost:	ECC, SOP

Env. Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures	Responsible Party	Est. Cost/	Guarantee
Waste	• Excess soil generation from earthwork activities such as excavation, backfilling and embankment • Disposal of a total of around 18,500 m^3 of construction debris	• Detailed waste management program and Demobilization plan for the construction yards will be prepared which including the following; • Reuse excavated excess soil to backfill depressed areas within or nearby the area; • Recycle construction debris through sorting and stockpiling; • Take appropriate measures, such as covering hauling trucks with tarpaulin or canvass, in transporting excess/excavated earth materials to disposal site; and • Take proper and diligent management of solid waste, such as covering temporary stockpiles of excavated materials and hauling regularly to DENR-approved disposal sites.	DPWH., Contractor, Site Manager	To be included in the contractor's cost:	ECC, SOP
Existing social infrastructures and services	• Possible long-term interruption of basic social service utilities such as power and water supplies	• Contractors/Sub-Contractors must ensure that all affected service utilities are immediately and properly restored to their normal operation; and • Conduct a joint site inspection involving the ESHO of the Contractors, leaders of affected barangays, and representatives of concerned utility companies to ensure immediate restoration of affected service utilities	DPWH., Contractor, Site Manager		ECC, SOP
Infectious diseases such as HIV/AIDS	• Possible spread of communicable diseases due to abandoned wastes	• Ensure that all temporary sanitation facilities, particularly portable toilets, are properly dismantled and all residual wastes are properly disposed to the disposal sites duly-approved by the DPS; and • Conduct a joint site inspection at the work sites involving the ESHO of the Contractors, community leaders, and representatives of Health and Sanitation Office, DPS to validate compliance of the Contractor	DPWH., Contractor, Site Manager	To be included in the contractor's cost:	ECC, SOP
OPERATION PHASE	**: Project presence, Infrastructure Maintenance, Vegetation Management**				
Water Quality	• Accidental releases of fuel, oil, lubricant and other chemicals due to maintenance work finding its way to waterways • Wastewater from maintenance works	• Proper handling of oil and lubricants to prevent spillage and contamination of surface and ground waters; (Storage of oil and lubricants in secure areas/places) • Paint cans, containers of oil, lubricants should be clean and chips, residues should be properly disposed	DPWH., facilities Manager, LGU	Part of Maintenance Cost of the Facilities:	ECC, policy, operational guidelines
	• Contamination/degradation of water quality due to drainage outfall	• Adequate maintenance of drainage line/canal (e.g. desilting) and putting-up of catch basins (silt trap) at regular interval.	DPWH., facilities Manager, LGU	Monitoring cost:	ECC, policy, operational guidelines

Env. Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures	Responsible Party	Est. Cost/	Guarantee
	• Contamination/degradation of water quality due to storm water run-off/discharge	• Care and maintenance of greeneries, ground cover – specifically, those along the riverbanks and shorelines that would retard storm water run-off and screen discharge of pollutants to surface waters • Set up filters and catch basins for storm drains, to prevent possible pollutants from being flushed into the sea • Conduct a semi-annual water quality monitoring			
Water Quality (Marine water)	• Sedimentation of marine water • Contamination of marine water by pollutants	• Regular maintenance of drainage system (e.g. desilting) • Care & maintenance of greeneries, ground cover – specifically, those along the shorelines that would retard run-off from flowing into open waters	DPWH	Operational budget (TBD)	ECC, Admin policy, operational guidelines
Waste	• Pollution from littered uncollected garbage	• Improvement/enhancement of current wastes disposal practices and implementation of the Solid Waste Management (SWM) plan	DPWH., facilities Manager, LGU		ECC, policy, operational guidelines
Soil pollution	• Soil contamination from accidental releases of chemicals, fuel, oil, lubricants will occur due to the maintenance work	• Immediately collect and contain spilled oil, lubricants and other chemicals • Proper management of wastes • Secure storage of oil, lubricants • Proper handling and maintenance of equipment, machineries, vehicles • Conduct semi-annual soil quality monitoring	DPWH, facilities manager, LGU	Part of Maintenance Cost of the Facilities: Monitoring cost: [redacted]	ECC, operations manual for Bypass road
Noise and vibrations	• Traffic Noise	• Installment of 2m-height noise barriers on the 1m height handrails • Conduct a semi-annual noise level monitoring	DPWH	Installment of noise barrier (H=2.0m): [redacted] Monitoring cost: [redacted]	ECC, Admin policy, operational guidelines

Env. Component likely Affected	Pollution/Impact Source & Potential Impact	Prevention or Enhancement/ Mitigation Measures	Responsible Party	Est. Cost/	Guarantee
Ecosystem (Terrestrial Flora and Fauna)	• Road kill of birds caused by car-bird collision especially at the interchange section in the vicinity of fishpond and mangrove forest • Lighting in the interchange area may give adverse impacts on the mangrove forest facing the Cansaga Bay, which is considered a potential birds roosting area	• Install road sign warning with birds and KBA • Install recessed lighting system at the interchange area near the mangrove forest • Consider the installment of bird-car collision prevention poles/fences based on the results of the Biodiversity Survey (detailed bird survey) planned at the early stage of DD • Consider the development of wetland park based on the results of the Biodiversity Survey (detailed bird survey) planned at the early stage of DD • Conduct a semi-annual bird monitoring	DPWH., Contractor, Site Manager	Installation of Warning Sign: [redacted] Installation of Bird-car Collision Prevention Pole: [redacted] Wetland Park Development: [redacted] Monitoring cost: [redacted]	ECC, SOP
Ecosystem (Aquatic Flora and Fauna)	• Lighting along the bridge may give adverse impacts on fish in the ocean • Deterioration of habitat due to release of contaminants, chemicals, liquid wastes, and sediment-laden run-off from uncleaned/dirty area of maintenance work sites	• Set up a type of light which does not irradiate the sea surface and outside of the bridge • Proper handling of oil and lubricants to prevent spillage and contamination of sea water (i.e. storage of oil and lubricants in secure areas/places)			
Infectious diseases such as HIV/AIDS/Working conditions (Health)	• Health/Accident	• Submission of medical certificate of workers to the contractors	DPWH, Contractor	Operational budget (TBD)	ECC, Admin policy, operational guidelines

8.9 Environmental Monitoring Plan

Section 9 of the DAO 2003-30 Implementing Rules and Regulations prescribed the monitoring of projects with ECCs through the following: Self-monitoring and Third Party Audit, and the Multi-Partite Monitoring Team. It also prescribed the establishment of an Environmental Guarantee Fund (EGF).

Environmental Monitoring Plan (EMoP) for the project is shown in Table 8.9.2, and draft monitoring form for EIA activities is shown in Appendix 2.

8.9.1 Self-Monitoring Plan

An Environmental Unit (with the Pollution Control Officer) – specifically established for the 4th Cebu-Mactan Bridge -Mandaue Coastal Road Project shall undertake self-monitoring a during the construction and operation phases of the project to determine the project’s impacts on the receiving environment. The EU/PCO will be tasked to regularly submit its Compliance Monitoring Report (CMR) and Self-Monitoring Reports (SMR) that will serve as reference/indication that the project has complied with its environmental requirements.

Monitoring activities, basically, focused on the compliance to the ECC conditions and the project’s Environmental (Impact) Management Plan, and monitor the effectiveness of environmental measure on prevention of actual project impact.

For social impacts – the Right of way Action Plan/Resettlement Action Plan (RAP) will be prescribing an institutional arrangement/ mechanism that will implement the RAP recommendations- such as, livelihood programs and projects and social services.

The Proponent may commission third party experts to undertake monitoring on its behalf. The third party monitoring agent (TPMA) shall be tasked to perform all environmental compliance and monitoring activities in behalf of the project proponent (DPWH). It shall closely coordinate with the stakeholders, organize and undertake IEC meetings prepare and submit CMRs and SMRs, compile monitoring reports, and regularly update the DPWH on the progress of such activities.

The stakeholders consist of the following:

(i) Affected Barangay Local Government Units (BLGU);
(ii) DENR-EMB7;
(iii)City Engineering Office of City of Mandaue and Lapu-lapu City;
(iv)City Health and Sanitation Office of City of Mandaue and Lapu-lapu City;
(v) City Waste Management and Disposal Department of City of Mandaue and Lapu-lapu City;
(vi)Cebu Police District
(vii) Traffic Management Group of City of Mandaue and Lapu-lapu City
(viii)Fisheries-related offices (i.e. MAO, MFARMC, BFARMCs, etc.)
(ix)Mactan-Cebu Bridge Management Board (MCBMB)
(x) Utility companies
(xi)Locally accredited NGOs (e.g. Haribon Foundation) and POs in the affected communities
(xii) Ecosystem experts from University of Philippines, Cebu; and
(xiii)Other sectors that may be identified prior to implementation of the Project

Significant environmental impacts stated in the EMP are not expected to persist after the construction phase, and could be addressed through the mandates of concerned LGUs. The engagement of the TPMA may be terminated upon project completion and upon compliance with the decommissioning plan.

8.9.2 Multi-Sectoral Monitoring Framework

MMTs are organized to encourage public participation, to promote greater stakeholder vigilance and to provide appropriate check and balance mechanisms in the monitoring of project implementation. The MMT is recommendatory to EMB.

According to DAO 2017-15, section16.1, MMTs shall only be for Environmentally Critical Projects (ECP). Given that the 4th Cebu-Mactan Bridge-Mandaue Coastal Road project is Category B: Non-ECP project, so that the formation of an MMT will not be required.

The Environmental Management Bureau-7, through its Monitoring Section, will continue to monitor the project's compliance to its ECC conditions and Environmental Management Plan

Provided in Table 8.9.1 is the Third Party Monitoring Agent (TPMA) framework for the proposed Project. It presents the envisioned list of stakeholders who would play a role in the monitoring activities, the basis for selecting them, and their proposed role and responsibilities.

Table 8.9.1 Third Party Monitoring Framework

	Members	Basis of Selection	Role and Scope of Monitoring Activity
1	DENR EMB-7	DENR Representative	• Ensures strict adherence with the policies and implementing rules and regulations governing the preparation and submittal of the CMRs and SMRs; • Initiates transmittal to the EMB Central Office for resolution, regional or project specific issues where consensus or decisions cannot be made at the regional level; and • Concurs with and sign the CMRs and SMRs
2	DPWH	Implementing Agency	• Provides necessary budget/funds for the monitoring activities; • Makes available to the third party monitoring agent all project information, such as the EMP necessary to determine compliance with the environmental requirements and commitments to the extent that such information is not subject to any restrictions and confidentiality; • Coordinates with, and allows the TPMA to inspect and observe construction and operation activities of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road Project; and • Reviews and signs the TPMA monitoring reports
3	DENR-FMB	Responsible for the greening program	• Designates a representative who shall participate in actual monitoring work of DENR-designated reforestation area; • Concurs with and signs the TPMA monitoring reports
4	Barangay Chairpersons	As representative of the communities affected by the Project	• Advises the TPMA of any complaints, information or reports from LGUs concerning the Project; • Concurs with and signs the TPMA monitoring reports; and • Participates in meetings provided for in the IEC Framework so that they can provide feedback to affected communities
5	Ecosystem experts from University or NGOs		• Advises the TPMA on ECO Systems concerning the Project; • Concurs with and signs the TPMA monitoring reports; and • Participates in meetings provided for in the IEC Framework so that they can provide feedback to affected communities

8.9.3 Environmental Guarantee Fund

The EMB7 shall determine if an Environmental Guarantee Fund (EGF) will put-up for the 4th Cebu-Mactan Bridge-Mandaue Coastal Road Project, if the project pose a significant public risk or where the project requires rehabilitation or restoration (see The EGF shall be used to implement damage prevention measures, environmental education, scientific or research studies, IEC, training on environmental risk or response to environmental accidents. In the case of the 4th Cebu-Mactan Bridge-Mandaue Coastal Road Project, public risk is presumed through the presence of activities and/or structures that could endanger life, property and the environment in case of failure.

Table 8.9.2 Environmental Monitoring Plan (EMoP)

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling Methodology and Measurement Plan			Lead Person	Annual Estimated Cost	ENVIRONMENTAL QUALITY PERFORMANCE LEVELS (EQPL) MANAGEMENT SCHEME					
								EQPL RANGE			MANAGEMENT MEASURE		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
I. PRE-CONSTRUCTION PHASE													
Soil Pollution	Soil pollution near the dump site	Aldrin, Chlordane, Total DDT (DDT+DDE+DDD), Diedrin, Endrin, Heptachlor, HCB, Mirex, Toxaphese, PCBs Total, Dioxins (I-TEQ)	Soil Sampling and Analyses in accordance with the prescribed procedures described in DMC 2017-03	Semi-Annual during the D/D	At one (1) sampling location: Umapad dumpsite	DPWH, D/D Consultant, LGU	Consultant:	–		Screening values for soil described in DMC 2017-03	–		
Ecosystem	Cutting of trees along the alignment	Locations of trees cut, species and numbers of trees cut, volume of trees cut	Ocular inspection	Daily during site clearing along the ROW	All the project affected area (along the ROW)	Environment Safety and Health Officer (ESHO) of the Contractor	Part of the operational funds of the Project Management Office for monitoring/ management	–		–	–		
	Replacement of cut trees along alignment (incl. relocation and compensatory plantation)	Locations reforested, species and numbers of trees relocated and planted, survival rate of the relocated trees and seedlings planted	Ocular inspection	Quarterly (until the 3-year maintenance period is completed)	Designated tree planting site and/or reforestation area designated by the DENR	ESHO of the Contractor	Monitoring cost part of Tree Plantation Management & Maintenance: budget TBD	–		85-90% survival rate of the seedlings planted as prescribed by the DENR Central Office	–		
	Disturbance to KBA	Population Count, Flying Route & Altitude, Roosting Area, etc.	Ocular inspection	Semi-annual during the DD (two migration seasons)	KBA/IBA	ESHO of the Contractor, D/D Consultant	Consultant						

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling Methodology and Measurement Plan			Lead Person	Annual Estimated Cost	ENVIRONMENTAL QUALITY PERFORMANCE LEVELS (EQPL) MANAGEMENT SCHEME					
								EQPL RANGE			MANAGEMENT MEASURE		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
Geographical features	Ground shaking, ground rupture	Situation of ground	Site-specific seismic risk characterization	Once during the DD	All the project affected area (at the buildings along the ROW)	DPWH	To be included in engineering cost						
Resettlement	Displacement of commercial establishments along the proposed alignment	Compensation for affected land, structures and improvements	Random observations/visits and consultations with the PAPs	Quarterly until the end of RAP implementation	Affected families at their current pre-project residence and their relocation site of the PAPs	DPWH	To be determined and finalized during the RAP updating in the Detailed Engineering Design Phase						
	Improvement of living conditions	Resettlement of Informal Settlers Families (ISFs) to the relocation sites	Random observations/visits and consultations with the PAPs	Quarterly until the end of livelihood restoration program		DPWH, NHA							
Misdistribution of benefits and damages Local /conflicts of interest	Informed/empower the public to participate in the decision-making process	Number of participants, attributes (sex, age, occupation, etc.)	Information. Education, and Communication (IEC)	Monthly during Construction Phase or as needed	All the project affected area	DPWH	To be determined						
Existing social infrastructures and services	Relocation of utilities along right of ways	Relocation of electric poles, water lines, communication lines, etc.	Ocular inspection	Annual	Affected utilities along right of ways	DPWH	To be determined						

Key Environmental Aspects per Project Phase	Potential Impacts per Environmental Sector	Parameter to be Monitored	Sampling Methodology and Measurement Plan			Lead Person	Annual Estimated Cost	ENVIRONMENTAL QUALITY PERFORMANCE LEVELS (EQPL) MANAGEMENT SCHEME					
								EQPL RANGE			MANAGEMENT MEASURE		
			Method	Frequency	Location			Alert	Action	Limit	Alert	Action	Limit
II. CONSTRUCTION PHASE													
Air Quality	Increase in particulate matter and gaseous air contaminants	TSP, PM10, NO_2, and SO_2,	Air quality sampling and analyses using the following methodologies: 1. TSP, PM10 High Volume-Gravimetric Method; 2.SO_2 Impinger-Pararosaniline Colorimetric Method; 3. NO_2 Impinger-Griess Saltzman Reaction Method *Note: 24-hour sampling at eachstations*	Quarterly	At three (3) sampling locations: A-St1 National High School A-St2 Village Social Housing Area A-St3 Commercial/Mall	PCO of the Contractor	Total sampling cost: [redacted]	–		TSP	–		
Water Quality	Water contamination	pH, Oil & Grease, BOD, Total and Coliform Fecal, COD, TSS, Chromium (Cr), Cadmium (Cd) and Lead (Pb)	Water Sampling and Analyses in accordance with the prescribed procedures described in DAO 2016-08	Quarterly	At four (4) sampling locations: B-St1 Upstream Mactan Channel B-St2 Downstream Mactan Channel B-St3 Near Coastal Road Mactan Channel B-St4 Downstream Butuanon River	PCO of the Contractor	Total sampling cost: [redacted]	–		For Class "D" freshwater and "SC" marine water	–		
Waste/ Offensive	Generation of solid waste; Land and	Proper waste management and	Checking compliance to RA 9003 –	Weekly	All construction sites	PCO of the Contractor	To be included in						

odors	water contamination; aesthetic impacts; spread of diseases	disposal	Ecological Solid Waste Management Act and RA 6969 – Toxic and Hazardous Substances			and DPWH	engineering cost			
Soil Pollution	Slope failure, soil runoff and movement of excavated soil to waterways	Situation of soil runoff and movement on slopes	Ocular inspection	Quarterly (until the 3-year maintenance period is completed)	All the project affected area (Slopes and waterways)	ESHO of the Contractor	To be determined			
	Soil pollution	Cu Other parameters to be decided in consultation with DENR-EMB	Soil Sampling and Analyses in accordance with the prescribed procedures described in DMC 2017-03	Semi-Annual (dry and wet season)	At three (3) sampling locations: 1. Northern side of fishpond 2. Southern side of fishpond 3. C-St1 Landfill	PCO of the Contractor	Total sampling cost: [redacted]	–	Screening values for soil described in DMC 2017-03	–
	Soil contamination due to oil on lubricant spill	Oil spill	Ocular inspection	Weekly Immediately after the spills	All construction sites	PCO of the Contractor and DPWH	To be included in engineering cost			
Noise and vibrations	Increase in noise level	Noise level (dBA)	*Note: 24-hour sampling at each stations*	Quarterly	At three (3) sampling locations: A-St1: National High School A-St2: Village Social Housing Area A-St3: Commercial/Mall	PCO of the Contractor	Included in the air quality sampling		Standard for areas directly facing four-lane roads for Class AA Class A and Class B	
Ecosystem	Continued use of wetland area as feeding ground by migratory birds	Species and number of migratory birds	Ocular inspection	Every two months (Joint monitoring with DENR-CENRO to complement their quarterly monitoring)	Wetland areas near the interchange section	DENR-CENRO Consultant	Consultant: [redacted]			

Ecosystem(aquatic flora and fauna)	Removal of direct physical injury to aquatic flora and fauna	Result of monitoring for aquatic flora and fauna	Ocular inspection	Monthly during Construction Phase or as needed	All the project affected area	ESHO of the Contractor	To be determined			
	Vibration/disturbance from pile-driving	Vibration during construction	Ocular inspection	Monthly during Construction Phase or as needed	All the project affected area	ESHO of the Contractor	To be determined			
Hydrology	Disruption of natural drainage pattern and increase in run-off	Situation of soil runoff and movement on slopes	Ocular inspection	Quarterly (until the 3-year maintenance period is completed)	All the project affected area (Slopes and waterways)	ESHO of the Contractor	To be determined			
Geographical features	Alteration in topography, soil disturbance and loss of top soil	Rate of land modification	Ocular inspection	Quarterly (until the 3-year maintenance period is completed)	All the project affected area	ESHO of the Contractor	To be determined			
Local economies, such as employment, livelihood, etc.	Enhancement of employment and /or livelihood opportunity that will lead to economic growth.	Number of workers and means of livelihood	IEC	Monthly during Construction Phase or as needed	All the project affected area	DPWH	To be determined			
Misdistribution of benefits and damages/ Local conflicts of interest	Loss/limitations and hindrance of access by vessels to establishments with port/docking facilities	Content of the complaint	IEC	Monthly during Construction Phase or as needed	All the project affected area	ESHO of the Contractor	To be determined			
Existing social infrastructures and services	Possible long-term interruption of basic social service utilities	Power and water supplies	IEC	Monthly during Construction Phase or as needed	All the project affected area	ESHO of the Contractor	To be determined			
Land use and utilization of local	Change/Disturbance in land use pattern	Change of land use	IEC	Monthly during Construction	All the project affected area	DPWH,LGU	To be determined			

resources				Phase or as needed						
Land use and utilization of local resources (Cumulative Impacts from Mandaue Reclamation Project)	Cumulative impacts including increased land use change, noise, water pollution, dust and emissions, traffic by construction vehicles, restriction of access to sea water by local fisher folks	According to monitoring data of land use change, noise, water pollution, dust and emissions, traffic	IEC	According to each monitoring data	All the project affected area	ESHO of the Contractor	To be determined			
Land use and utilization of local resources (In-migration)	Construction workers and staff will require temporary housing	Situation of temporary housing	Ocular inspection	Monthly during Construction Phase or as needed	All the project affected area	ESHO of the Contractor	To be determined			
Water usage	Competing use with the community	Usage situation of water supply	IEC	Monthly during Construction Phase or as needed	All the project affected area	DPWH,LGU	To be determined			
Infectious diseases such as HIV/AIDS/ Working conditions (Health)	Possible spread of communicable diseases due to abandoned wastes	Number of patients with communicable diseases	IEC	Monthly during Construction Phase or as needed	All the project affected area	ESHO of the Contractor	To be determined			
Accidents (Safety)/Working conditions (Health)	Increased risk of accidents due to improper work ethics	Number of accidents	IEC	Monthly during Construction Phase or as needed	All the project affected area	ESHO of the Contractor	To be determined			
Accidents (Safety)	Aggravation of existing traffic problem	・Implementation of TMP approved by City Traffic Management; ・Implementation of minimized restriction of traffic	Ocular inspection	Weekly	At critical traffic areas	ESHO of the Contractor	Included in the construction cost	–	–	–

		flow during day time hours; · Implementation of equipment move-in at non-peak day-time; · Implementation of placement of traffic decking in stages; · Limitation of parking of idle dump trucks and other construction vehicles along the constructed area; Designation of well-trained traffic aide/flagman at critical construction areas.								
III. OPERATION PHASE										
Water Quality	Accidental releases of fuel, oil, lubricant and other chemicals, contamination/degradation of water quality	Accidental releases record	Ocular inspection	Semi-annual or as needed	All the project affected area	PCO of the DPWH	[redacted]			
Water Quality	Sedimentation of marine water	Water quality	Ocular inspection	Semi-annual or as needed	All the project affected area	ESHO of DPWH	To be determined during D/D			
Waste	Pollution from littered uncollected garbage	Situation of uncollected garbage on roadside	Ocular inspection	Semi-annual or as needed	All the project affected area	ESHO of DPWH	To be determined during D/D			
Soil pollution	Soil contamination from accidental releases of chemicals, fuel, oil, lubricants	Situation of soil contamination	Ocular inspection	Semi-annual	All the project affected area	PCO of the DPWH	[redacted]			
Noise and vibrations	Traffic Noise	Noise level (dBA)	*Note: 24-hour sampling at each station*	Semi-annual or as needed	At three (3) sampling locations: A-St1: National High School A-St2: Village	PCO of the DPWH	[redacted]		Standard for areas directly facing four-lane	

					Social Housing Area A-St3: Commercial/Mall				roads for Class AA Class A and Class B	
Ecosystem (Terrestrial Flora and Fauna)	Replacement of cut trees	Survival rate of the seedlings planted	Ocular inspection	Quarterly (until the 3-year maintenance period is completed)	Designated tree planting site and/or reforestation area designated by the DENR Central Office	ESHO of DPWH	To be determined and finalized during implementation of the project based on current prices of seedlings	–		
	Continued use of wetland area as feeding ground by migratory birds	Species and number of migratory birds	Ocular inspection	Semi-annual (northward migration and southward migration periods)	All the project affected area	DENR-CENRO Consultant				
Ecosystem (Aquatic Flora and Fauna)	Deterioration of habitat due to lighting along the bridge and release of contaminants, chemicals, liquid wastes, etc.	lighting system and water quality management	Ocular inspection	Semi-annual or as needed	All the project affected area	ESHO of DPWH	To be determined during D/D			
Infectious diseases such as HIV/AIDS / Accidents (Safety)	Health/Accident	Situation of health and accident	IEC	Annual	All the project affected area	ESHO of DPWH	To be determined during D/D			

Note:
ESHO – Environment Safety and Health Officer, TMP – Traffic Management Plan, PCO – Pollution Control Officer, DPWH – Department of Public Works and Highways, DENR-EMB – Department of Environment and Natural Resources-Environmental Management Bureau, LGU – Local Government Unit, DAO – DENR Administrative Order, BOD – Biochemical Oxygen Demand, TSP – Total Suspended Particulates, TSS – Total Suspended Solids, IEC – Information. Education, and Communication

8.10 Institutional Arrangement

The institutional plan shall ensure the judicious implementation of sound environmental management within the 4th Cebu-Mactan Bridge/Mandaue Coastal road areas of operation. Specifically, it aims to ensure the following (as indicated in the DAO 2003-30 Revised Procedural Manual (RPM) for the PEISS IRR):

a) Project compliance with the conditions set in the ECC;
b) Project compliance with the Environmental Management Plan (EMP);
c) Effectiveness of environmental measures on prevention or mitigation of actual project impacts vis a vis the predicted impacts used as basis for the EMP design; and
d) Continual updating of the EMP for sustained responsiveness to project operations and project impacts.

The DAO 2003-30 RPM has indicated primary actors/key players that will made-up the institutional set-up for monitoring projects issued with ECC, namely: project proponent and the EMB. The RPM defined the roles and responsibilities of these players:

Project Proponent/DPWH:

Proponents issued ECCs are primarily responsible for monitoring their projects. The Proponent, through its Environmental Unit or Environmental Officer, is required to submit a standardized semi-annual ECC CMR to the designated monitoring EMB office on a semiannual frequency. The CMR requirement is to report performance at three (3) levels, at the minimum, as follows: a) performance against the ECC conditions; b) performance against the EMP; and c) performance against the monitoring of actual impacts (including residual impacts) as against predicted impacts in the EIA Report and as related to current project operations. The detailed report on compliance to environmental standards specific to environmental laws shall be submitted through the Self-Monitoring Report (SMR) as required by DAO No. 2003-27 on a quarterly basis to the concerned EMB RO.

The DPWH has an Environmental and Social Safeguards Division (ESSD) under the Office of the Undersecretary for Planning that is tasked to ensure the integration and implementation of environment and social safeguards.

The general function of the ESSD shall be to

i. Prepare/reviews environment impact statement (EIS), initial environmental examination (IEE), project description (PD), environmental management plan (EMP), and Right of way action plan/resettlement action plan (RAP);
ii. Conduct environmental assessment/screening, scoping;
iii. Conduct monitoring of impacts and compliance of projects;
iv. Identify and manage climate change issues and concerns (e.g. rainwater collection system, cleaning/clearing of waterways, non-structural measures, etc.);
v. Assist in the conduct of public consultation;
vi. Assist in the conduct of environmental sampling and monitoring;
vii. Develop Gender and Development (GAD) plans and programs, among others.

The ESSD is divided into three (3) units, namely: (i) Environmental Safeguards Section (ESS), (ii) Social Safeguards and Right-of-Way Section (SSROW); and (iii) National Sewerage and Septage Management Program Section (NSSMP)

The ESSD is mainly responsible for monitoring the overall operation and effectiveness of the EMP during the construction and operational phases.

Based on the monitoring result, DPWH as project proponent has to update the EMP as the need arises.

An Environment Safety and Health (ESH) Officer shall be assigned by the main Contractor during the construction phase. In coordination with the Senior Environmental Specialist of Construction Supervision Consultant, he shall be responsible for implementing the Environmental Management Plan (EMP) and the Environmental Monitoring Plan (EMoP)

Aside from the above-mentioned tasks, the main duties of the ESH Officer shall be to:

i. Ensure that all other concerned supervisors and staff understand and properly undertake their responsibilities;
ii. Ensure that environmental monitoring activities are being done promptly and in an accurate manner;
iii. Implement an effective preventive and corrective control system, particularly in terms of environmental emergency preparedness and response procedures;
iv. Conduct or initiate training of contractors (and sub-contractors, if any) on environmental awareness; and
v. Collate performance data and prepare reports, which include an assessment of performance in comparison with the EMP objectives and targets, for submittal to the Construction Supervision Consultant's Senior Environmental Specialist. To ensure effectiveness of the IEC, he shall also act as a liaison between PMO-UPMO, and the primary stakeholders, particularly the LGUs concerned, other government agencies, and more importantly, the affected barangays. This task is particularly important in terms of receiving comments, views, complaints (if any), and other concerns from the stakeholders mentioned.

The main Contractor shall also engage a Safety Officer to review and recommend amendments and updates to DPWH's and authorized company circulars and bulletins pertaining to environmental safety, with special attention to the protection of human lives and properties against fire, and natural disasters such as typhoons, earthquake, and other calamities. In coordination with the ESH Officer, he shall also be in charge of posting environmental information and internal/external communications that pertain to environmental quality and safety.

Aside from these two (2) key staff, each Sub-Contractor shall be required to assign Environmental Coordinators to undertake site supervision and inspection, during the implementation of the Environmental Monitoring Plan, as well as in maintaining cleanliness and aesthetic appeal, at construction areas. Each shall be responsible for liaising with other government agencies with regards to licensing and securing permits, as required.

<u>Pollution Control Officer (PCO).</u> The accredited Pollution Control Officer shall have the following duties and responsibilities (DAO 21):

(1) Attend to the requirements of the establishment or agency prior to the construction or installation of pollution control facilities including the application and securing of necessary pollution permits and renewal thereof;
(2) Monitor activities pertaining to the installation or construction of pollution source and control facilities with the end in view of ensuring their compliance with the air, noise and water quality standards; the PCO and the head of establishment shall be held responsible for any violations of PD 984 and its implementing rules and regulations committed by establishment where the officer is employed;
(3) Supervise the proper operation and maintenance of pollution control facilities of the establishment or agency;

(4) Report within reasonable time to the Facility Manager the breakdown of any pollution control facility, and the estimated and actual date of completion/repair and operation;
(5) Promptly submit validated/certified as correct by the General Manager periodic reports as stipulated in Section 7 hereof or as required by the Department (otherwise, said reports shall not be accepted as evidence in a pollution case);
(6) As the Environmental liaison officer he shall keep himself abreast with the requirements of the DENR-EMB and the latest available technology on the prevention, control and abatement of pollution;
(7) Maintain liaison with the city/provincial/municipal or local pollution control officers;
(8) Attend the meetings for Pollution Control Officers which may from time to time be called by the Department;
(9) Facilitate compliance of the establishment he represents with the requirements that may from time to time be prescribed by the DENR-EMB;
(10) Recommend to the management the installation and operation of additional equipment for the pollution abatement facilities; and
(11) Handle other matters of environmental concern as required by his employer.

The main Contractor shall also engage a Safety Officer to review and recommend amendments and updates to DPWH's and authorized company circulars and bulletins pertaining to environmental safety, with special attention to the protection of human lives and properties against fire, and natural disasters such as typhoons, earthquake, and other calamities. In coordination with the ESH Officer, he shall also be in charge of posting environmental information and internal/external communications that pertain to environmental quality and safety.

Aside from these two (2) key staff, each Sub-Contractor shall be required to assign Environmental Coordinators to undertake site supervision and inspection, during the implementation of the Environmental Monitoring Plan, as well as in maintaining cleanliness and aesthetic appeal, at construction areas. Each shall be responsible for liaising with other government agencies with regards to licensing and securing permits, as required.

<u>EMB:</u>

The EMB shall be primarily responsible for the over-all *evaluation/audit* of the Proponent's monitoring activities.

<u>Other Parties/Stakeholders:</u>

While the formalized multi-partite monitoring team is not anymore mandatory, other parties such as the City and Barangay local government units, National and other Government Agencies, and community/people's organization have their respective roles and responsibilities in the monitoring of project implementation and the proponent's environmental performance.

The City and Barangay government units is in the forefront in making sure that the project complies with local laws and environmental requirements including compliance to the ECC and its corresponding Environmental Management Plan (EMP) during construction and operation stage. The City's Environment and Natural Resources Office (CENRO) of both Mandaue and Lapu-lapu Cities are specifically tasked to ensure environmental protection and conservation in their jurisdictions. The Barangay governments are usually the first to received complaints from the residents on the project's adverse impacts on the communities, thus, it has to be proactive in monitoring the project's environmental performance to avoid any untoward incidents that will negatively affect the community.

Government Agencies-aside from the EMB, such as the DENR-CENRO has specific functions to monitor project's impacts to mangroves and other environmental resources within the timberland and foreshore areas.

Resettlement Implementation Committee (RIC)

In order to ensure that the project's impacts on the affected families/households will be addressed a Resettlement Action Plan (RAP) is being prepared, with its recommendations integrated in this project's Environmental Impact Management Plan. The RAP establishes the Resettlement Implementation Committee (RIC) which is a local coordinating and consultative body organized for the implementation of RAP and set up by UPMO by entering into an MOA with concerned parties, prior to the commencement of the detail design. RIC is composed of and functions as follows.

Composition:

- City Mayor or representative
- UPMO/Field Office
- City Government Officers
- Barangay Chairperson of each affected barangay
- Representative of PAPs of each affected barangay
- Representative of non-governmental organizations operating within the jurisdiction of the city
- Representatives of assisting regional government offices such as NHA, Department of Labor and Employment (DOLE), Technical Education and Skills Development Authority (TESDA), Department of Social Welfare and Development (DSWD), Department of Trade and Industry (DTI) and others if necessary.
- Functions:
- Assist UPMO in preparing and validating the list of PAFs and affected assets
- Assist UPMO and ESSD in the conduct of consultation meetings and information dissemination of PAPs and other relevant stakeholders during RAP process
- Assist UPMO and ESSD in monitoring the implementation of RAP during the process
- Assist the City Government in the enforcement of laws and ordinances regarding encroachment into the ROW of the Project in coordination with concerned government agencies.
- Receive complaints and grievances of PAPs and other stakeholders and act accordingly
- Maintain record of all public meetings, complaints and actions taken to address complaints and grievances

With the above serving as reference/guidelines, the institutional set-up/arrangements during construction and operation phases of the project are exhibited in Figures 8.46 and 8.47.

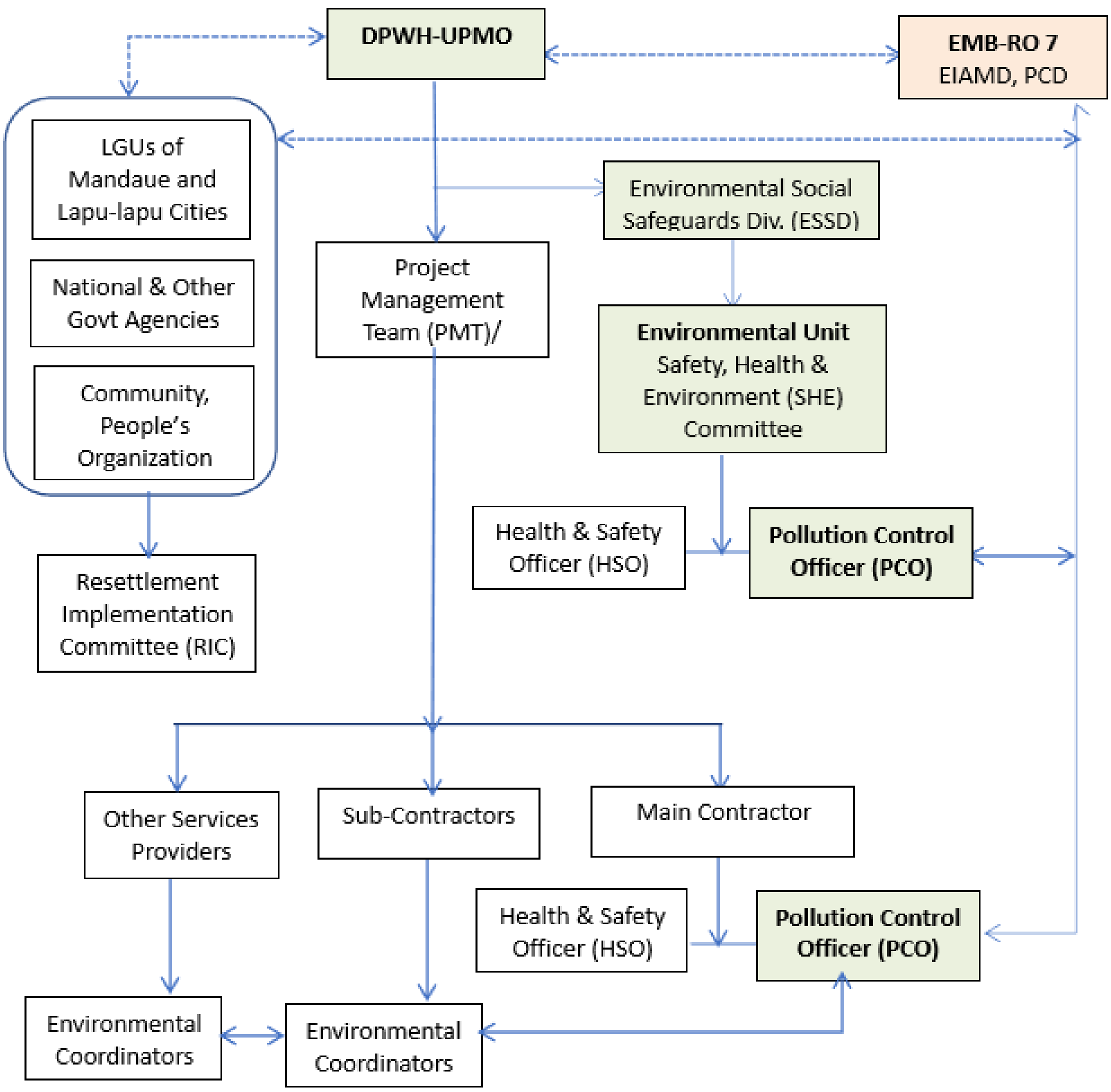
During construction and operation stages of the New Mactan Bridge and Coastal Road project, the DPWH-UPMO being the designated project proponent has the primary responsibility in ensuring compliance to the ECC provisions and its Environmental Impact Management Plan. In both stages, it will be the ESSD and its Environmental Unit that will be directly in-charge to handle the management and technical works necessary to comply with the environmental requirements of the project. It will also coordinate and provide the necessary information and assistance to the other parties in fulfilling their respective monitoring responsibilities, such as the EMB, LGUs, other government agencies, people's organization and the stakeholders. The ESSD is also a member of the RIC, thus, it also has the primary responsibility for the RAPs implementation.

During the construction stage, the main project contractor will have its own environmental unit and PCO to ensure compliance to the Construction Environmental Management Plan. The sub-contractors, will have at least an environmental coordinator to monitor their activities and environmental performance.

A Project Management Team or Project Management Office (PMO) will be establish on-site to directly manage the construction activities, including environmental compliance monitoring.

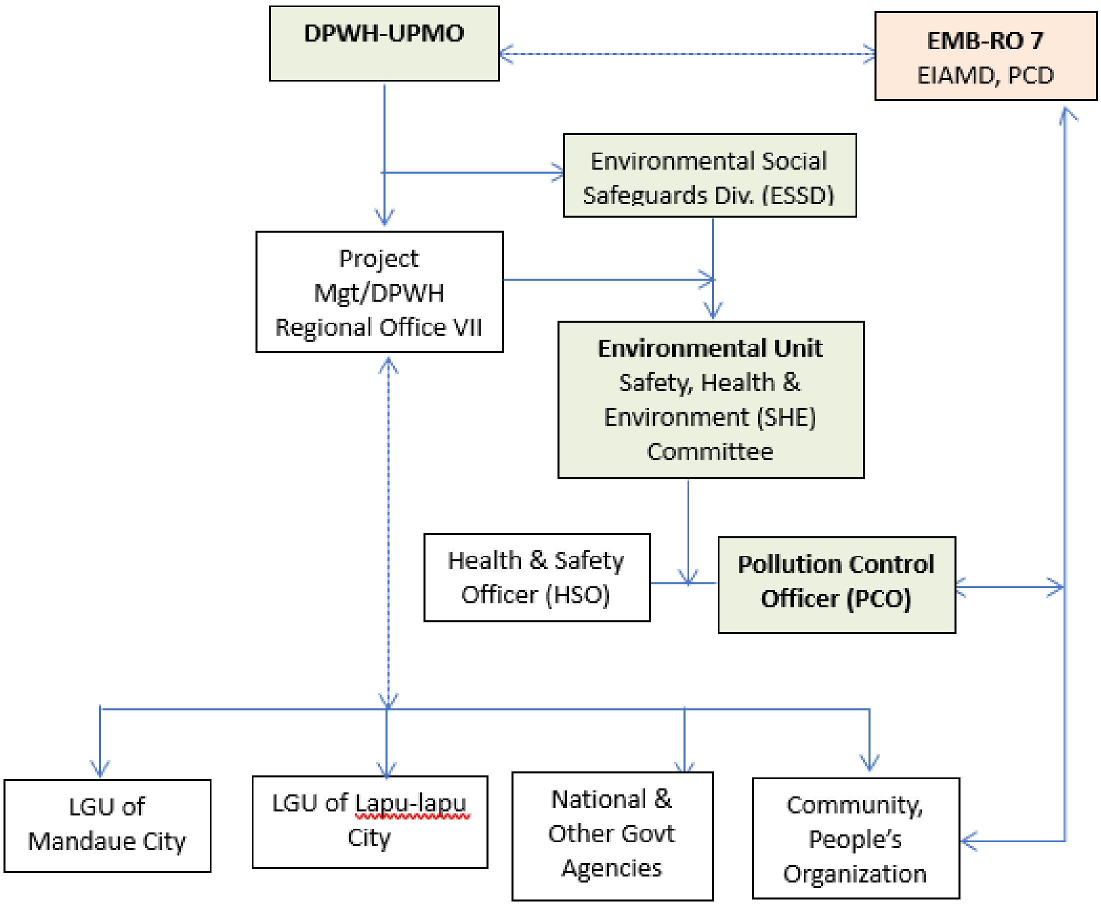
During the Operation stage of the project -as this is in the long-term, the DPWH Regional Office maybe designated by the DPWH-UPMO to monitor and comply with the environmental requirements. However, it will have an Environmental Unit/PCO solely designated for the New Mactan Bridge and Coastal Road -which, aside from complying documentary requirements for the facility's environmental performance, also include attending to and monitoring the bridge/coastal road infrastructure pollution source and control facilities with the end in view of ensuring their compliance with the air, noise and water quality standards and to handle other matters of environmental concerns.

The other parties such as the LGUs, other government agencies, people's organization and stakeholders will continuously monitor and vigilant on the facility's environmental performance during its operational life.



Source: JICA Study Team

Figure 8.10.1 Institutional Arrangement Schema during Construction Stage



Source: JICA Study Team

Figure 8.10.2 Institutional Arrangement Schema during Operation Stage

8.11 Stakeholder Meeting

8.11.1 Preparatory and Coordination Meetings

Prior to commencement of the survey, activities for information, education and communications on the project had already commenced. The project was identified as one of the priority projects in two previous JICA studies (i.e. the Roadmap Study and the MCUTMP). As a priority project proposed in these studies, the project was included in the presentation and discussions during the stakeholders meetings that took place in these two related studies. To officially set the scene for commencement of the subject preparatory survey, a coordination meeting was undertaken from January 23 to 24, 2019 with JICA representatives, DPWH, JICA Survey Team, representatives from the Cities of Mandaue and Lapu-Lapu, and the Metro Cebu Development and Coordinating Board (MCDCB). Some of such preparatory meetings are presented in Table 8.11.1.

Table 8.11.1 Overview of Preparatory and Coordination Meetings

Date and Time	Venue	Agenda	Number of Participants	
			by Affiliation	by Sex
January, 23, 2019	DPWH Region VII Strategy Room	・Coordination/kick-off meeting	DPWH Region VII: 4 JICA Philippines Office: 2 JICA Survey Team (ST): 7	Male: 10 Female: 3
January 24, 2019	DPWH Region VII Office	・Introduction to the Project ・Coordination/Kick-off meeting	DPWH Region VII: 3 Mandaue City: 1 Lapu-Lapu City: 2 MCDCB: 2 NEDA: 3 JICA: 1 JICA ST: 6	Male: 13 Female: 5
January 25, 2019	Coast Guard Cebu Main Office	・Introduction to the Project ・Coordination Meeting	Coast Guard: 1 JICA ST: 6	Male: 7 Female: 0
March 27, 2019	Mandaue City Planning Office	・Introduction to the Project ・Coordination Meeting with City's Zoning Board	Private: 5 DPWH Region VII: 2 Zoning Board Members: 10 JICA ST: 2	Male: 13 Female: 7
April 11, 2019	Lapu-Lapu City Engineering Office	・Introduction to the Project ・Coordination Meeting	DPWH Region VII: 5 LGU::3 JICA ST: 3	Male:5 Female: 6
April 13, 2019	Barangay Opao	・Introduction to the Project ・Coordination Meeting	Local: 14 Barangay Officials: 5 JICA ST: 5	Male: 14 Female: 10
April 16, 2019 (10am-11am)	Barangay Umapad	・Introduction to the Project ・Coordination Meeting	Barangay Officials: 7 JICA ST: 3	Male: 6 Female: 4
April 16, 2019 (11am-12:00pm)	Barangay Paknan	・Introduction to the Project ・Coordination Meeting	Barangay Officials: 10 JICA ST: 3	Male: 9 Female: 4
April 16, 2019 (1pm-2pm)	Barangay Pusok	・Introduction to the Project ・Coordination Meeting	Barangay Officials: 3 JICA ST: 3	Male: 2 Female: 4
April 16, 2019 (2pm-3pm)	Barangay Ibo	・Introduction to the Project ・Coordination Meeting	Barangay Officials: 2 JICA ST: 3	Male:2 Female: 3
April 17, 2019	Barangay Centro	・Introduction to the Project ・ Coordination Meeting	Barangay Officials: 10 JICA ST: 3	Male: 10 Female: 3
May 27, 2019	Regional Development Council-Economic Development Committee (RDC-EDC)	・Introductin to the project ・Coordination Meeting	Cebu Chamber of Commerce & Industry Mactan Chamber of Commerce & Industry Dept. of Trade and Industry Dept. of Agriculture Bureau of Fisheries and Aquatic Resources-Dept. Agri. Dept. of Tourism Dept. of Science and Technology Dept. of Environment and Natural Resources and line bureau Land Bank of the Philippines	N/A

Source: JICA Survey Team

Source: JICA Survey Team

Figure 8.11.1 Coordination Meeting with Government Officials (Kick-off Meeting)

The JICA Survey Team, aside from the public consultations/scoping required as part and parcel for the EIA study and the review and approval process for the project's ECC application requirement, conducted a series of small-group discussions and coordination meetings with the city and barangay officials as well as with individual stakeholders and companies. In these meetings, while seeking the cooperation of the local officials and coordinating with them for the EIA and RAP activities, the survey team presented and thereby disseminated information about the project and at the same time, collected comments and inputs from local officials and stakeholders including the companies located along the planned route alignment.

Source: JICA Survey Team

Figure 8.11.2 Coordination Meeting with Mandaue City Zoning Board

Figure 8.11.3 Coordination Meetings with Barangay Officials

8.11.2 Public Scoping/Stakeholder Meeting at Scoping Stage

There were three "public scopings", or stakeholder meetings carried out at the scoping stage of the survey, at: 1) City Hall Session in Mandaue City on March 6, 2019; 2) Mandani Bay Boardroom in Mandaue City on April 26, 2019; and 3) Session Hall in Lapu-Lapu City on April 12, 2019. The first public scoping in Mandaue City was mostly attended by barangay officials and representatives of private companies expected to be affected by the project. The second public scoping in Mandaue City was therefore carried out to supplement the first meeting with a focus on individual residents although most of the to-be- affected companies were also at present. Below shows a summary of the Public Scoping held in Mandaue and Lapu-Lapu Ciy.

Table 8.11.2 Overview of Public Scopings

Date	Venue	Agenda	Participants	
			by Affiliation	by Sex
March 6, 2019	Mandaue City Social Welfare Services	First Public Scoping (Mandaue City)	Total: 36	
			Private: 9 DPWH Region VII: 1 DENR 7: 1 DENR-EMB 7: 4 DENR- City Environment & Natural Resources Office (CENRO):1 LGU:10 JICA ST:10	Male: 30 Female: 6 (Female: 17%)
April 12, 2019	Lapu-Lapu City Sangguniang Panglungsod Session Hall	Public Scoping (Lapu-Lapu City)	Total: 41	
			Local People: 12 Private: 1 DPWH Region VII: 4 DENR 7: 1 DENR-EMB 7:3 LGU:14 JICA ST: 6	Male: 23 Female: 18 (Female: 43.9%)
April 26, 2019	Board Room, Mandani Bay	Second Public Scoping (Mandaue City)	Total: 118	
			Local People:53 Private: 34 DPWH Region VII: 7 DENR-EMB 7:3 DENR-CENRO:1 LGU:16 JICA ST: 3 Media: 1	Male: 69 Female: 49 (Female: 41.5%)

Source: JICA Survey Team

The program/agenda of the three public scopings was generally as follows:

- Project background/overview and rationale/objectives of the project: DPWH Region VII;
- Background of the EIA system, public participation in the review and approval process, and purpose/objective of the public scoping and public hearing: EMB Region VII;
- Description of the project, comparison of the project (i.e. alignment) alternatives, and environmental and social considerations including objectives of the EIA and RAP: JICA Survey Team; and
- Questions and answers session often referred to in the Philippines as the “open forum”: EMB Region VII

(1) Mandaue City

The first scoping meeting was held from 2 to 4 pm on March 6, 2019 at Mandaue City Social Welfare Services. People that attended this meeting were mostly owners of land and companies that use the land as tenants along the planned route of Mandaue Coastal Road. The main issues raised at the meeting are shown in Table 8.11.3. There was no notable objection from the participants regarding project implementation.

Table 8.11.3 Record of the First Public Scoping in Mandaue City

Program/Agenda	
Welcome Address and Presentation of Project Background	A representative from DPWH delivered the welcome address and explained the objectives and importance of the project stating that it is expected to contribute to addressing the increased traffic congestion in Metro Cebu and to its economic development.
Public Scoping Purpose	A representative from EMB Region VII explained the purpose/objectives of the public hearing. The need to address the positive and negative impacts of the project to the environment was also highlighted.
Project Design	A representative from the JICA Survey Team, presented the project background and project design, the study schedule, and route selection for both Mandaue Coastal Road and the 4th Cebu-Mactan Bridge.
EIA Studies	Another representative from the JICA Survey Team presented the preliminary scoping results, or the potential environmental effects, against different environmental parameters such as air, land, water and people during the construction and operation phases of the project. He also explained about the household survey.
Open Forum	Another representative from EMB Region VII facilitated and moderated the Open Forum. The main discussions at the open forum are described below.

No.	Comments, Questions and Suggestions	Answers	Reaction by Questioner
1	Question Is coastal road planned at grade? Will the access to structures such as factories be secured? Our lot has a docking facility. Can we have a meeting with the project proponent for the specification of the elevated structure at this area? (Individual owner of land that is affected/Male)	Viaduct is elevated and access to existing structures will be secured as much as possible. Yes, after the public scoping, we can visit companies and lot owners. (DPWH)	Understood.
2	Question Are the lots affected by the project expropriated? (Business entity that uses the land/Male)	No. Once the alignment is finalized, we utilize our legal team to check the mode of acquisition to be undertaken on this project. Properties that will be affected by the final alignment will be acquired using the fair market value by a third party in accordance with the new Right-of-Way Law. Structures that will be affected will be assessed based on the current market price. (DPWH)	Understood.
3.	Question Since it is an elevated structure and so with posts, how will the land acquisition be carried out? Only the lot occupied by the posts or all the area under the alignment? (Representative from San Miguel Shipping and Lighterage Corp/Male)	The usual procedure is acquiring the whole lot area under the length and width of the alignment. (DPWH)	Understood.
4.	Comment We have an ongoing construction that will be completed this year, December. There is a possibility it will be hit by the alignment. (Representative from San Miguel Shipping and Lighterage Corp/Male)	There will be several consultations and meetings by the consultants to the companies and lot owners after this meeting. And during that time, these stakeholders can give inputs and suggestions with regards to the design of the alignment. (DPWH)	Understood.
5	Comment On the coastal road, two significant areas for Mandaue will be affected, the closed dumpsite and the mangroves area. Does the JICA team know about the JICA study that had been carried out on the closed dumpsite? From then, we know that the garbage is 10 m deep. We have the file and we can share it with the study team. For the mangroves, we have a scientific study of assessment and we can share that also to avoid any destruction to mangroves. (Mandaue CENRO/Female)	The impacts on the environment are being minimized as much as possible and there will be close coordination with Mandaue LGU and DENR for this matter. We have a directive from DENR Central Office that allows DPWH to implement projects on mangrove areas as long as the mangroves are replaced and planted near the area. (DPWH/DENR EMB)	Understood
6	Request It is planned that a viaduct will be constructed between the	Understood. We will discuss with your technical team. The inputs made will be	-

	anchorage area and the oil tank. Since the oil tank is a facility that handles combustibles, safety measures are necessary in both the construction and operation phases. We would like you to discuss with our technical team. (Representative from Petron Corp/Male)	incorporated into the project. (DPWH/JICA Survey Team)	
7	Question When will the project end? (Individual owner of land that is affected/Male)	The project is still currently in the F/S stage. Construction stage is to commence on the 4th quarter of 2021. Negotiations are currently underway between both governments for the realization of the project. (DPWH)	Understood.
A representative from the JICA Survey Team presented in detail the affected lots for the proposed alignment. Any issues and concerns from the stakeholders' end can be discussed in detail through a meeting with the project proponent, he said. Project sites need to be visited before the alignment is finalized. A meeting can be arranged later on with the JICA Survey Team and DPWH together with those that will be affected by the alignment.			

Source: JICA Survey Team

Source: JICA Survey Team

Figure 8.11.4 First Public Scoping in Mandaue City

The second public scoping in Mandaue City was held from 8 to 11 am at the Mandani Bay Boardroom on April 26, 2019 as described below.

Table 8.11.4 Record of the Second Public Scoping in Mandaue City

Program/Agenda	
Welcome Address and Presentation of Project Background	A representative from DPWH delivered the welcome address and explained the objectives and importance of the project stating that it is expected to contribute to addressing the increased traffic congestion in Metro Cebu and to its economic development.
Project Design	A representative from the JICA Survey Team, presented the project background and project design, the study schedule, and the route selection for both Mandaue Coastal Road and the 4th Cebu-Mactan Bridge.
Public Scoping Purpose	A representative from EMB Region VII explained the purpose/objectives of the public hearing. The need to address the positive and negative impacts of the project to the environment was also highlighted.
EIA Studies	Another representative from the JICA Survey Team presented the preliminary scoping results, or the potential environmental effects, against different environmental parameters such as air, land, water and people during the construction and operation phases of the project. He also explained about the household/establishment survey.
Open Forum	Another representative from EMB Region VII facilitated and moderated the Open Forum. The main discussions at the open forum are described below.

No.	Comments, Questions and Suggestions	Answers	Reaction by Questioner
1	Question I am worried about the project as we are located in the mangrove area which is directly hit by the coastal road. It is also where we soak the brooms which are our only source of livelihood. If we would be affected by the project, where would our livelihood be relocated? Is our area going to be surveyed and informed by the barangay captain? There has been no surveyor yet in the area but there was already information from the barangay about the project. (Broom Maker from Paknaan/Female)	Surveys are now being conducted for the affected families and establishments. We request you to cooperate and fill out/answer the questionnaire forms properly so that the team can correctly estimate/determine the replacement cost provided that you are affected/interviewed. The purpose of the survey is also to relocate/resettle the PAPs where they will have better security compared to the mangrove area owned by the government. We reiterate the need for your cooperation by answering and providing the data needed in the surveys to help the team correctly carry out the assessments. (JICA Survey Team/DPWH)	Understood.
2	Comment Approximately 500 houses may be affected who mostly live near the mangrove area. (Local person from Paknaan/Male)	Same concern as before and is answered already. There is a compensation program adopted in the project. PAPs will be adequately compensated as long as they are qualified based on the laws, directives and orders by the national government. You will be paid of the current market value of the affected resources. (DENR-EMB/DPWH)	Understood.
3	Suggestion The area of interchange falls mainly within our property and my concern is if it is a viaduct, our remaining land will be trapped by the said project. I suggest for the interchange to be on-grade rather than an elevated road so that we could still make use of the remaining land. (Representative from Athecor Development Corp/Male)	The suggestion is noted. (DPWH)	-
4	Question During the planning stage, would it be possible for the team to include in the design of the project, the plans and operations of our shipyard to minimize the disturbance of the project in our area? (Representative from Cabahug Shipyard/Male)	Suggestion is very much welcome. There has been site visits to different companies. Also, the team will contact you and visit your area. Even during the implementation, there will still be more meetings to improve the project. (DPWH)	Understood.
5	Suggestion We have the same concern with the shipyard. We request the height of the viaduct to accommodate the height of the ships and barges that are needed to make use of our wharf. (Individual owner of land that is affected /Female)	The suggestion will be taken into consideration. (DPWH)	Understood.
6	Comment During the site visit on their location, one of the Japanese consultants mentioned of a 5.2 m vertical	The suggestion will be taken into consideration. (DPWH)	Understood.

	clearance of the viaduct. May we suggest for at least 7 m height? (Individual owner of land that is affected/Male)		
7	Question We have been living here for quite some time. Can we go back to the area after the construction of the project? (Local person from Paknaan/Female)	The decision will depend on Mandaue LGU if you can go back to the mangrove area after the construction and whether the affected lots within the mangrove areas will be acquired by the government. (DPWH)	Understood.
8	Suggestion I noticed in the project there is only one entry and exit or access point in Bai Hotel. I suggest in creating another access points along Zuelig Avenue to decongest the access point in Bai Hotel. (Representative from Mandani Bay Hotel/Male)	The original route was on Zuelig Road. But after coordinating with Mandaue City based on their revised CLUP, the aforementioned road will not be a truck corridor and will cater to the incoming opening of Mandani Bay which is one of their biggest stakeholders. We will meet with Mandaue City on that matter. (DPWH)	Understood.
9	Question Our office has been attending since the previous meetings. Can we have the copy of the final alignment or the plan of the project for their office to create a land status of the project? (CENRO/Male)	We are finalizing the alignment now. We can submit such relative documents once it has been finalized. (JICA Survey Team)	Understood.
10	Question Can we ask for the contact persons and the corresponding contact numbers for scheduling of consultation meetings? (Representative from Athecor Development Corp/Female)	Yes. (The contact persons and contact numbers were displayed on the screen.)	-
11	Question There was a mention to the cut-off date. I am planning to make shanties for my goat-raising. The construction will start at 2021, what will happen to my soon-to-be-born goats? (Farmer from Opao/Male)	Goats are not included in the RAP survey (*It is movable and hence not subject to compensation). In general, if the livelihood is affected by the project, DPWH would provide compensation. (JICA Survey Team)	Understood.
It was concluded by a summary of the comments by participant from DENR-EMB Region VII. The stakeholders were also informed that after a public scoping, there will be a public hearing.			

Source: JICA Survey Team

Source: JICA Survey Team

Figure 8.11.5 Second Public Scoping in Mandaue City

(2) Lapu-Lapu City

Stakeholder meeting at the scoping stage (i.e. public scoping) was held at the Sangguniang Panglungsod Session Hall on April 12, 2019 in Lapu-Lapu City. Main points explained at the meeting were as follows:

Table 8.11.5 Record of the Public Scoping in Lapu-Lapu City

Program/Agenda	
Welcome Address	A representative from the City Planning Office delivered the welcome address. A representative from EMB Region VII explained the purpose/objectives of the public hearing. The need to address the positive and negative impacts of the project to the environment was also highlighted.
Presentation of Project Background and Project Design	A representative from explained the objectives and importance of the project stating that it is expected to contribute to addressing the increased traffic congestion in Metro Cebu and to its economic development. A representative from the JICA Survey Team, presented the project background and project design, the study schedule and the route selection for both Mandaue Coastal Road and the 4th Cebu-Mactan Bridge.
EIA Studies	Another representative from the JICA Survey Team presented the preliminary scoping results, or the potential environmental effects, against different environmental parameters such as air, land, water and people during the construction and operation phases of the project. He also explained about the household/establishment survey and announced the cut-off date to be set on April 22, 2019 for both Barangay Pusok and Ibo in Lapu-Lapu City.
Open Forum	Another representative from EMB Region VII facilitated and moderated the Open Forum. The main discussions at the open forum are described below.

No.	Comments, Questions and Suggestions	Answers	Reaction by Questioner
1	Question The drawing shows area to be reclaimed, what is the purpose of the reclamation? (Barangay Official/Female)	Reclamation is not part of the project. It is carried out by Mandaue City government. (JICA Survey Team/DPWH)	Understood.
2	Question Are the people who received the invitations affected people of the project? What specific properties will be affected by the alignment? (Local person/Male)	The option one alignment leads to the Airport Road. The vicinity near Marina Mall along the Airport Road and other establishments will be directly affected by the bridge. On the other side of the Airport Road, the lot owned by General Milling Corporation (GMC) will also be acquired for the alignment. (DPWH)	Understood.
3	Question Is the curve road going through the GMC lot elevated or on the ground? Can I ask for a detailed design/description at this stage of the survey of the alignment as I will forward this to the management? (Representative from GMC/Male)	It is an elevated road and will slowly descend to connect to the existing road. We can share you a design but please note that this is a tentative design since it is still in its F/S stage. *There was an exchange of email addresses for the request to be done within the day. Site visit would then be arranged tentatively before the holy week starts. (DPWH/JICA Survey Team)	Understood.
4	Question Was an underground tunnel considered among the options of the 4th Cebu-Mactan Bridge since it would have less level of impact on the stakeholders? (Representative from GMC/Male)	Whether it is a road bridge or an underground tunnel, more or less the same stakeholders would be affected because of the location of the connection of the bridge/tunnel to the mainland. Furthermore, the cost and duration of construction would be doubled compared to the bridge. (DPWH/JICA Survey Team)	Understood.
5	Question The second bridge, Marcelo Fernan Bridge, has truck load limits that are not consistent. What is the capacity of the new bridge? Would it also have a higher load limit? (Representative from GMC/Male)	The load limits of the new bridge would have no restriction as long as it follows the governing laws on load limits that are consistent with the national road. (DPWH/JICA Survey Team)	Understood.
6	Question Is there a UMRT line on the bridge? (Representative from GMC/Male)	The bridge for which the F/S is being carried out is a road bridge only. (DPWH)	Understood.
7	Question Where is the exact location of the curved road?	Only the lot owned by GMC will be affected. The residential lots near Island Central Mall will	Understood.

	Will our houses be affected? Our houses are located near the highway on the side of Island Central Mall. (Local Person/Male)	not be affected. (DPWH)	
8	Question Is the curved road or ramp the entrance to the 4th bridge? (Local Person/Male)	If you are coming from the public market then this will be your direct access going to the bridge. (DPWH)	Understood.
9	Question Is there already a survey regarding the compensation to the affected properties or houses? (Local Person/Female)	Affected households/structures need to be identified first. There would be a comprehensive survey afterwards which includes questions with regards to livelihood, types of house, number of households and so on. The value of the replacement cost is the current market value. (DPWH)	Understood.

Source: JICA Survey Team

Source: JICA Survey Team

Figure 8.11.6 Public Scoping at Lapu-Lapu City

8.11.3 Public Hearing/Stakeholder Meeting at Draft Final Report Stage

Public Hearings were held in the morning on June 4, 2019 for Lapu-Lapu City (i.e. Lapu-Lapu City Session Hall) and in the afternoon of that day in Mandaue City (i.e. Barangay Paknaan Gymnasium) at the draft final report stage of the Survey. The Public Hearing comprised of two parts. The first part (Part I) was primarily to present the project background, design, results of the EIA and RAP studies including the compensation policy and entitlement matrix, and the open forum (i.e. Q&A session). The second part (Part II) was individual consultations with the PAPs and a FGD involving: PWDs; Women's Group; and senior citizens. Due to time constraints, however, Part II for Lapu-Lapu City was postponed to be held on a different occasion (i.e. June 11, 2019).

Table 8.11.6 Overview of Public Hearings

Date and Time	Venue	Agenda	Participants	
			by Affiliation	by Sex
June 4, 2019 1:30 - 4:30pm	Barangay Paknaan Gym	Public Hearing (Mandaue City)	Total: 184	
			Local People: 136 NGOs: 1 NCIP VI & VII: 1 DPWH Region VII:1 Private: 30 DENR-EMB 7: 3 LGU:4 JICA ST: 8	Male: 67 Female: 117
June 4, 2019 9:30am - 12:30pm	Lapu-Lapu City Sangguniang Panglungsod Session Hall	Public Hearing (Lapu-Lapu City)	Total: 79	
			Local People: 48 Private: 9 DPWH Region VII: 1 DENR-EMB VII: 3 DENR-CENRO: 1 RPMO–DPWH: 1 DPWH-ESSD: 1 LGU: 2 PEZA: 5 JICA ST: 5 Media 2: NGOs: 1	Male: 50 Female: 29

Source: JICA Survey Team

(1) Mandaue City

The results of the public hearing held in Mandaue City are presented in Table 8.11.7.

Table 8.11.7 Record of Public Hearing in Mandaue City

PART I	
Welcome Address	The participants were welcomed by Hon Malaquias Soco, the barangay captain of Barangay Paknaan and an introduction and acknowledgment of participants were made. A representative from EMB Region VII explained the purpose/objectives of the public hearing in which the need to address the positive and negative impacts of the project to the environment was highlighted.
Presentation of Project Background and Project Design	A representative from DPWH Region VII explained the objectives and importance of the project in addressing the increasing traffic congestion in Metro Cebu and the project's expected contribution to economic development. A representative from the JICA Survey Team, presented the project background and the project design, study schedule, the route selection for both Mandaue Coastal Road and 4th Cebu-Mactan Bridge.
EIA and RAP Studies	A representative from the local EIA/RAP survey team, presented the following: ・summary of the results of the public scoping and consultations previously undertaken; ・summary of the EIA results; and ・compensation policies/entitlement matrix of the RAP
Open Forum	Another representative from EMB Region VII facilitated and moderated the Open Forum.

No.	Comments, Questions and Suggestions	Answers	Reaction by Questioner
1	Question Has the project already started? There is already an ongoing reclamation within the mangrove area. Does DENR know of such activity that is affecting the mangroves? (Broom Maker/Female)	The project is still in the F/S stage and no physical activities have commenced. It is a different project. I recommend that such activity be documented to file a complaint to the barangay so that it will be soon coordinated with the City Environment and Natural Resources Office. (CENRO) The barangay already filed a complaint of the said activity to City CENRO. The area has 3 - 4 claimants as lot owners and each with documents. There are also ongoing negotiations with the informal settlers and developers in the area. We will be in coordination with Mandaue City's Planning to address this issue since the owner of the land is Mandaue City. (Barangay Paknaan Official)	Understood.
2	Comment The project is very good since it considers the welfare of the informal settlers. (Barangay Official/Male)		-
3	Question Why is there no public hearing or consultation of the reclamation project currently happening in the mangroves? We are also experiencing floods when it rains due to the said activity. How strong is the police power of DENR in implementing the law since you are from EMB? (President of Sectoral Group/Male)	Again, the mentioned project is not part of the public hearing currently happening and the agency concerned for the said matter is DENR-CENRO and not DENR-EMB. But since we are under the same umbrella of DENR, we will take note of this issue and relay this matter to CENRO. We can also ask the copy of the letter of complaint to give to the proper agency. There would be coordination with the LGUs to identify the true owner of the lot and development. (DENR-EMB)	Understood.
4	Question Is the Drainage Master Plan of Mandaue City considered by the proponents for this project? (President of Sectoral Group/Male)	We have heard of this master plan with Mandaue City's Planning Officer and they will ask funding from us for this Master Plan. (DPWH)	-
5	Suggestion Can we have our relocation site to be near our livelihood in the mangroves? The possible relocation sites presented by HUDO with their previous projects to the informal settlers were Danao City and in Opon of Mactan Island. (Local Person/Male)	We will be coordinating with other agencies such as NHA, DPWH and other LGUs to determine the qualified informal settlers, the relocation sites and the compensation that will be given. It will be a challenge by the LGU of Mandaue City since the city is already full. (DPWH)	Understood.
6	Comment With the Cansaga Bridge project, the cost determined by DPWH as compensation for us was not followed and we received less amount. (Local Person/Male)	There is a possibility that the payment before was based on zonal which means DPWH cannot pay beyond what is determined by the law. The New Right of Way Law which will be followed by this project offers the fair market value in acquiring	Understood.

		the land. (DPWH)	
7	Comment There is an ongoing project of DPWH in Tayud, Consolacion and the unfinished project causes more traffic congestion. (Senior Citizen/Male)	The said project is not included in this project. However, we will raise the concern to the appropriate proponents. (DPWH)	-
8	Question Are utilities such as water and electricity part of the compensation? Will there be an aid in transporting our belongings to the relocation site? (Senior Citizen/Male)	Such costs will be included as well as the transportation costs in the replacement costs which will be given to the affected stakeholders. (JICA Survey Team)	Understood.
9	Suggestion I would like to suggest affected households be given priority in employment for construction of the project. (Local Person/Male)	The suggestion was noted and be considered since it has been also the concerns of the previous consultations. (JICA Survey Team)	Understood.
10	Comment and Question The project is good and beneficial to us residents. Since this is a national project, does the president of the Philippines know about this project? (Local person/Male)	This project is between the agreement of the government of Japan and the government of the Philippines. (JICA Survey Team)	Understood.
11	Question Based on the survey in our area, we were around 25 and now the list is down to 11 households. How would we know if we are included in the 11 affected households? (Local Person/Female)	In the next part of the program (i.e. Part II), we will discuss in more details of the affected households of the new alignment. (JICA Survey Team)	Understood.

Source: JICA Survey Team

(2) Lapu-Lapu City

The results of the public hearing held in Lapu-Lapu City are presented in Table 8.11.8.

Table 8.11.8 Record of Public Hearing in Lapu-Lapu City

PART I	
Welcome Address	A representative from the City Planning Office delivered the welcome address. A representative from EMB Region VII explained the purpose/objectives of the public hearing. The need to address the positive and negative impacts of the project to the environment was also highlighted.
Presentation of Project Background and Project Design	A representative from DPWH explained the objectives and importance of the project stating that it is expected to contribute to addressing the increased traffic congestion in Metro Cebu and to its economic development. A representative from the JICA Survey Team, presented the project background and project design, the study schedule and route selection for both Mandaue Coastal Road and the 4th Cebu-Mactan Bridge.
EIA and RAP Studies	A representative from the local EIA/RAP survey team, presented the following: ・summary of the results of the public scoping and consultations previously undertaken; ・summary of the EIA results; and ・compensation policies/entitlement matrix in the RAP
Open Forum	Another representative from EMB Region VII facilitated and moderated the Open Forum. The main discussions at the open forum are described below.

Comments, Questions and Suggestions	**Answers**
Question I own a business in Barangay Pusok located directly under the skywalk before going to the airport road. I would like to confirm whether my commercial building will be affected. (Business entity in the area/Female)	The establishment will not be affected. (JICA Survey Team)
Question Hundreds of workers will be displaced because of the project. What are the mitigations and concrete plans for the affected workers? (Sectoral Organization President/Male)	The matter is being considered in the study. As by the Labor Code of the Philippines, there would be a separation payment for the labor loss caused by the project. The matter is also still being considered by DPWH UPMO. (DPWH)

Comment The project is very beneficial to the residents of Lapu-Lapu City. (Sectoral Organization President/Male)	-
Question Ours house and lot, located at the back of the vacant lot owned by General Milling Corporation, would it be affected by the project? (Local Person/Male)	Only the vacant lot would be affected and no households in Lapu-Lapu City would be demolished. The project is trying to minimize its effects to structures especially households. A more detailed survey will be done on the vicinity of the affected areas in the next stage which is the Detailed Engineering Design. (Lapu-Lapu City CPDO/DPWH)
Question With the presentations given, Option 1 has more details. Is it safe to say that the final alignment is Option 1? Were Options 2 and 3 considered for a feasibility study? Were there meetings like these for Options 2 and 3? (Representative from Island Central Mall/Male)	Option 1 is being considered as the most feasible option. In each option, several factors such as constructability, project cost, natural environmental impact and social environmental impact were taken into account but especially its accessibility to the airport road. The three options presented were based on the previous JICA study for a Mactan Bridge near Cansaga Bay. The selection of the first option was done during a meeting with Lapu-Lapu City's Planning and Engineer's Office, JICA Survey Team, DPWH Planning and other technical group members of the survey. Only Option 1 has a feasibility study which is currently happening. (JICA Survey Team/DPWH)
Question Can we pass a position paper for this project? (Representative from Island Central Mall/Male)	In fact, companies affected had been sending position papers to the team. Furthermore, comments, suggestions and recommendations made in the meetings are being noted and can be considered as position papers. The structure of Island Central Mall will not be affected. The factory, Muramoto Audio Visual Phils Inc., opposite to their area will be affected based on the plan. (JICA Survey Team/DPWH)
Comment and Question Businesses located near bridges and flyovers will have negative economic impact. How high is the bridge? We also have a restaurant near the Cebu Yacht Club, will it be affected? (Representative from Island Central Mall/Male)	The height of the bridge will be enough for the customers on cars to access the mall vicinity. As practiced by other countries and in Ayala Road Access, there will be no negative economic impact on the businesses located near bridges/flyovers once the construction is done. However, there would be disturbances caused during the construction period. The Marina Seaview Restaurant and the nearby port facility will not be affected. (JICA Survey Team/DPWH)
Comment and Question We share same sentiments with Island Central Mall with regards to the effects of the project to the businesses. We appreciate the Survey Team and the government of the project since it is highly beneficial to the stakeholders. On the other hand, 33% of our total mall area will be demolished. What is the traffic scheme of the loop? Will it not generate more traffic in the mall hub of Lapu-Lapu City? (Representative from Marina Mall/Male)	The comment was noted. (DENR EMB)
Comment and Question What will be our compensation for establishments affected during the 5-7 years of construction of the project? What will happen to our tenants with a 5-20 years contract? Lastly, we prefer the alignment in Option 2 and 3 as they move away the traffic from our establishments. (Representative from Marina Mall/Male)	The matter is being considered in the study. (DPWH)
Question When will the announcement be made as to what option would be finalized and be used in the project? (Representative from Ubix Corp/Female)	Option 1 is already finalized and is the most recommended option for the 4th Cebu-Mactan Bridge. (DPWH)
Part II was not carried out on this day due to time constraints.	

Source: JICA Survey Team

8.11.4 Focus Group Discussions for Sectoral Groups

Two rounds of focus group discussions were held for the project during the survey for PWDs, women, senior citizens and fisheries in both Mandaue City and Lapu-Lapu City as they are considered to potentially have a specific stake and opinion on the project as they may be affected by the project differently from other people. The first round has been completed on May 21and May 23, 2019. The second round of FGDs was carried out on June 4, 2019 for Mandaue City and on June 11, 2019 for Lapu-Lapu City. The following shows an overview of the discussions.

Table 8.11.9 Overview of the Focus Group Discussions

Date and Time	Venue	Agenda	Participants	
			by Affiliation	by Sex
May 21, 2019	Mandaue City Social Welfare Service Conference Room	First FGD (Mandaue City)	Total: 60	
			Local People: 49 DPWH Region VII: 2 LGU:3 JICA ST: 6	Male: 16 Female: 44 (Female: 73.3%)
May 23, 2019	Lapu-Lapu City Tourism Bldg	First FGD (Lapu-Lapu City)	Total: 70	
			Local People: 59 DPWH Region VII: 2 LGU:2 JICA ST: 7	Male: 30 Female: 40 (Female: 57.1%)
June 4, 2019	Barangay Paknaan Gym	Second FGD (Mandaue City)	Total: 8	
			Local People: 4 DPWH Region VII: 2 JICA ST: 2	Male: 3 Female: 5 (Female: 62.5%)
June 11, 2019	Lapu-Lapu City ABC Building	Second FGD (Lapu-Lapu City)	Total: 35	
			Local People: 29 DPWH Region VII: 1 LGU:1 JICA ST: 4	Male: 23 Female: 12 (Female: 34.3%)

Source: JICA Survey Team

For the socially vulnerable including PWDs, women and senior citizens, special considerations were taken as follows:

i) Direct prior notification

Local staffs explained the objectives of the stakeholder meetings and focus group discussions to the leaders of the women association, the disable association as well as the senior citizen association, and handed over to them the invitation letters with asking them to attend the meetings.

ii) Convenient venue

The venues are chosen with the criteria of accessibility and usability for the social vulnerable.

For Mandaue City, the first round of FGDs was held at the City Social Welfare Office Building, in which the mentioned associations have ever held the meetings. The second round of FGDs was held at the Barangay Paknaan Gymnasium adjoined to the office of Barangay Paknaan and the Social Welfare Office, where many of PAPs live around. For Lapu-Lapu City, the first round of FGDs was held at the City Tourism Office Building adjoined to the Lapu-Lapu City Hall, where it is located at the center of the town, and citizens including the mentioned associations have ever held meetings. The second round of FGDs was held at the ABC Building where public hearing meetings are often held and the decent space is able to be prepared.

iii) Meeting facilitation for the equal opportunity to express views

In the FGDs, the explanation of the project objectives and exchange of opinions were done in local language (i.e. Visayas) by local staff. While exchange of opinion session, local staffs provided the equal opportunity for all attendances to express their views.

(1) Mandaue City

The first round of FGDs was held in Mandaue for PWDs, women, senior citizens and fisheries on May 21, 2019 at the City Social Welfare Office Building in Mandaue City. The table below shows the comments and suggestions made by the groups.

Table 8.11.10 Comments and Suggestions from PWDs in Mandaue City during First FGD

Topics	Comments, Opinions and Suggestions
General Information	• PWD organizations are active and operative in all Barangays of Mandaue. • Most of the offices are also located inside their respective Barangay halls. • They collect monthly dues mostly PhP 20. • Members are I.D holders (issued by City's Office of the Differently-Abled Persons Affairs (ODAPA) to be used/presented in availing discounts same with senior citizens. • Members are entitled to claim PhP 5,000/year financial assistance from the City Government and PhP 5,000 Mortuary assistance. • Qualified members are, but not limited to, the following: PWD inborn, polio, injured, stroked, psycho social, discriminated, visually impaired, deaf, mute and others. • Dialysis patient and cancer survivors are considered for I.D purposes only (no more financial assistance unlike before) to avail discounts as PWD. • They are in need of donations in form of supplies like wheelchairs, canes, scratches and others.
Perceived Impacts of the Project	(Negative Impact) • changes in traffic conditions during construction • noise and air pollution in the residents near the project site • resettlement of informal settlers
	(Positive Impact) • decongestion of traffic
Opinions and Requests	• consideration of a PWD-friendly bridge • sidewalks where wheelchairs can pass in case of emergency • sidewalks for joggers, walkers and so on just as the first and second Cebu-Mactan Bridges

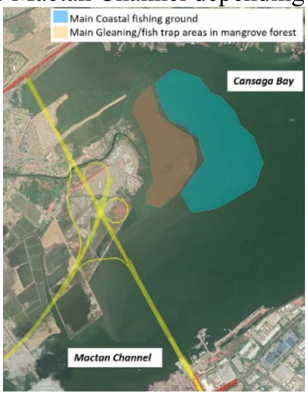
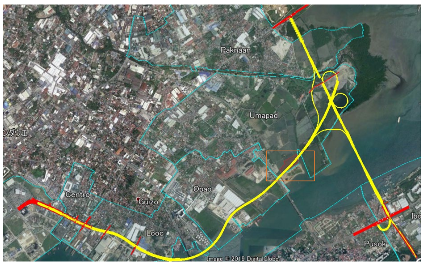
Source: JICA Survey Team

Table 8.11.11 Comments and Suggestions from Women's Group in Mandaue City during First FGD

Topics	Comments, Opinions and Suggestions
General Information	• Women and senior citizens organizations are active and operative in all barangays within Mandaue City. • Most of the offices are also located inside their respective Barangay halls. • They collect dues mostly PhP 150/month. • Members are I.D holders (issued by City's Office of the Senior Citizens Affairs (OSCA)) to be used/presented in availing discounts same with senior citizens. • Members are entitled to claim PhP 8,000/year financial assistance from the City Government and Mortuary assistance. • Qualified members are any women in Mandaue (for women groups) and any person at least 60 years of age and above for Senior Citizens. • They are in need of donations in forms such as wheelchairs, canes, pain relievers liniment/haplas and others.
Perceived Impacts of the Project	(Negative Impact) • mud flow during construction especially during typhoon or high tide • changes in traffic conditions during construction • noise and air pollution in the residents near the project site • resettlement of informal settlers
	(Positive Impact) • decongestion of traffic
Opinions and Requests	• employment priority for Mandauehanons, if qualified • commencement of the project to be as soon as possible • sidewalks where wheelchairs can pass in case of emergency • sidewalks for joggers, walkers and so on just as the first and second Cebu-Mactan Bridges

Source: JICA Survey Team

Table 8.11.12 Comments and Suggestions from Fisheries in Mandaue City during First FGD

Topics	Comments, Opinions and Suggestions
General Information	• Most of the fisherfolks and gleaners in Mandaue City are part time. • Not all are registered. • There are fisher folks organizations in the project area (Umapad Fisher folks Organization). • There is an existing organization called Bantay Digit or sea guard and most of them are fishermen. (Mandaue Bantay Dagat). • There are existing Illegal fishing ordinances that are in accordance with the national law. • Fishing gears used are hook and line and gillnet, others are gleaning and push net or sudsod and some gleaners use iron bar or kabilla to collect shellfishes. • They can do fishing even if not registered as long as they do not employ illegal methods of fishing. • They have other sources of income other than fishing such as laborers, mason, carpentry, construction works, store vending and others. • The major fishing ground is the sea area and the tidal flat next to Cansaga Bay, while they can do sometimes fishing in the Mactan Channel depending on the currents of water.  • They need to secure a permit from the LGU where they intend to catch fish, except Lapu-Lapu coastal area as it is considered their shared fishing grounds within the channel. • They share the same fishing grounds (i.e. Mactan Channel) with Lapu-Lapu fishermen. • Their total catch (includes anything like fish, crab, shrimp and others) per day and per fisherman will average into a Minimum of 5 kg and maximum of 10 kg with a value of PhP 1000 to 2000 more or less and PhP 300 for the expenses. • They sell the catch to their neighbors only and not in the public markets or restaurants. • Fish types are bangus/milk fish, tilapia/cat fish, shrimps, crabs, seaweeds and others. • They use pump boats and ordinary Bangka/boat with bugsay (motorized and non-motorized). Fishpond Operations • According to a sea guard, only one aquaculture farm/fish pond (i.e. Batiller Fish Pond) is operating within the coastal area.   • Some fish ponds are converted to warehouses, reclaimed for other development and some are sold to private entities. • According the City Agriculture Office (CAO), the area is no longer suitable for aquaculture operation due to contaminations/seepage from the closed garbage dumpsite and from other sources (e.g. industries). • Bangus/milk fish, tilapia/cat fish, shrimps, crabs, seaweeds and others are grown. • An affected stakeholder from Barangay Opao (veterinary doctor and former City Veterinary) who owns a fishpond within Opao shore (after VM Cabahug Shipyard property) and is still

	planning to revive his operation through modern method/technology not the conventional way.
Perceived Impacts of the Project	(Negative Impact) • During the construction, there may be changes/limitation in: fishing grounds; fish catch; and access to certain fishing grounds. • In addition, the following concerns were raised although they are not directly related to the project) • Dynamited/blasted fishing (very rare these days because of bantay dagat/seaguard) • Chemical/cyanide fishing • Liba-liba (use of small fishnets) • Illegal fishers that come from other nearby towns and provinces • Compressor fishing (not illegal fishing but considered as health hazard and recommended by the City Fishery Aquatic Resource Management Council (CFARMC) to be prohibited through an ordinance to be enacted by the LGU law making body). • Fewer employment in the fisheries sector
	(Positive Impact) • Development of the City for the benefit of the public
Opinions and Requests	• Any development is welcome as long as the fishermen will not be displaced

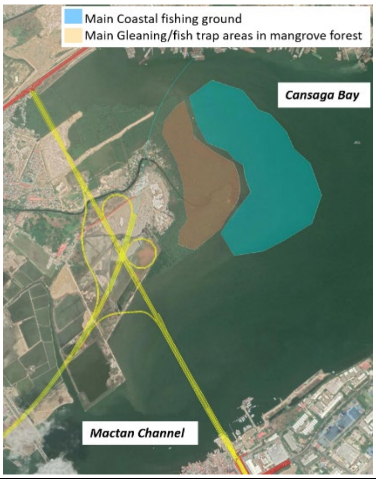
Source: JICA Survey Team

Source: JICA Survey Team

Figure 8.11.7 First Round of FGDs for PWDs, Women, Senior Citizen and Fishermen in Mandaue City

The second round of discussions was held in Mandaue City for PWDs, women, senior citizens and fisheries on June 4, 2019 at the Barangay Paknaan Gymnasium in Mandaue City. The table below shows the comments and suggestions made by the groups.

Table 8.11.13 Comments and Suggestions from the Second FGDs in Mandaue City

Topics	Women, Senior Citizens PWDs and Fisheries Sectors
Matters raised during the 2nd FDG meeting	(Discussion relative to the 1st FDG) • Consideration of the comments and suggestions raised during the Focus Group Discussion held last May 21, 2019 in Mandaue City's Social Welfare Services Session Hall were presented to the sectoral groups. • Survey Team explained that, during construction, accessibility to the major fishing ground (i.e. Cansaga Bay) will be secured by making an access channel between bridge piers. • A representative from the Senior Citizen's clarified that for Mandaue City's concern on fishing, aside from the usual fishing by boat, they use fish traps within the mangroves area (as shown as an area in orange in the map below) to catch crabs, fish and shrimps. • It was clarified that the location of the fish traps would not be affected by the project by showing the map. However, it may cause some disturbances during construction. 
	(Negative Impacts) • Fishing ground disturbance • Loss of income (Positive Impact) • Public purpose to decongest traffic
Opinions, Responses and Request	• They recommended that the team would hire contractors with new and well-maintained machines to minimize the noise created so as not to disrupt the fishes, and the Survey team accepted the recommendation. • As for their suggestion of a sidewalk or a pedestrian lane on the new Mactan Bridge, it was not considered in this project due to safety reasons. (Responses) • However, if there would be a high demand of pedestrian lanes on the bridge during the next stages, then it would be considered.

Source: JICA Survey Team

(2) Lapu-Lapu City

The first round of FGD was held at the City Tourism Office Building in Lapu-Lapu City on May 23, 2019 for PWDs, women, senior citizens and fisheries. The comments and suggestions made by the groups are presented in the table below.

Table 8.11.14 Comments and Suggestions from Women's Senior and PWD groups in Lapu-Lapu City during First FGD

Topics	Comments, Opinions and Suggestions
General Information	• Women and Senior Citizens organizations are active and operative in all Barangays of Lapu-Lapu. • Most of the offices are also located inside their respective Barangay halls. • They collect monthly dues mostly 150 pesos. • Members are I.D holders (issued by City OSCA) to be used/presented in availing discounts same with senior citizens. • Members are entitled to claim 8000 pesos yearly financial assistance from the City Government and Mortuary assistance. • Qualified members are any women in Mandaue (for women groups) and any person at least 60 years of age and above. • They are in need of donations in form of supplies like wheelchairs, canes, pain reliever liniment/haplas and others.
Perceived Impacts of the Project	(Negative Impact) • During the construction there will be changes in traffic conditions • Noise and air pollution for the residents near the project area • Resettlement for the informal settlers
	(Positive Impact) • Public purpose to decongest traffic
Opinions and Requests	• Next meeting to be held at a more PWD-friendly venue • Commencement of the project to be as soon as possible • Sidewalks where wheelchairs can pass in case of emergency • Sidewalks for joggers, walkers and so on just as the first and second Cebu-Mactan Bridges

Source: JICA Survey Team

Table 8.11.15 Comments and Suggestions from Fisheries in Lapu-Lapu during First FGD

Topics	Comments, Opinions and Suggestions
General Information	• There are full time and part time fishermen including gleaners. • Not all are registered. • No existing organizations Pusok fishermen (Mactan channel Lapu-Lapu side). • Existing Bantay dagat/ sea guard organization (Mactan channel Lapu-Lapu side). • Existing Illegal fishing ordinances in accordance with the national law. • Fishing gears used are hook and line and gillnet, others are gleaning and push net or sudsod and some gleaners use iron bar or kabilla to collect shellfishes. • They can do fishing even if not registered as long as they will not employ illegal methods of fishing. • They have other sources of income other than fishing like labourers, mason, carpentry, construction works, store vending and others. • Their main fishing ground is located near the marine sanctuary at the north east side of the Mactan Island. They sometimes use the areas within the Mactan channel and Cansaga bay, depending on the currents of water.  • They need to secure a permit from the LGU where they intend to catch fish, except Mandaue Coastal area as it is considered as their shared fishing grounds within the channel.

	• Their total catch (includes anything like fish, crab, shrimp and others) per day and per fisherman will average into a Minimum of 5 kilos and maximum of 10 kilos valued at PhP 1,000 to 2,000 more or less and PhP 300 for the expenses. • They will sell it to their neighbor-customers not in the public markets or restaurants. • Bangus/ milk fish, tilapia/cat fish, shrimps, crabs, seaweeds and others. • They use pump boats and ordinary Bangka/boat with bugsay (motorized and non-motorized). Fishpond Operators • According to a fisherman, there is no existing fishpond operation within the project and its adjacent areas.
Perceived Impacts of the Project	(Negative Impact) • During the construction of the 2nd Mactan Bridge, the accessibility to the fishing ground on the north east side of the Mactan Island was limited. There are concerns among the fisher forks that there may be the same limitations. ->Survey Team explained that, during construction, accessibility to the major fishing ground (i.e. north east part of Mactan Island) will be secured by making an access channel between bridge piers. • Noise disturbance from construction machines are expected. (Positive Impact) • Development of the City for the benefit of the public.
Opinions and Requests	• Any development is welcome as long as the fishermen will not be displaced • Access should be secured to move to the major fishing ground, the north east part of the Mactan Island, during construction (i.e. no blockage of the Channel)

Source: JICA Survey Team

Figure 8.11.8 First Round of FGDs for PWDs, Women, Senior Citizens and Fishermen in Lapu-Lapu City

The second round of FGDs was held in Lapu-Lapu City for PWDs, women, senior citizens and fisheries on June 11, 2019 at the ABC Building in Lapu-Lapu City. The table below shows the comments and suggestions made by the groups.

Table 8.11.16 Comments and Suggestions from the Second FGDs in Lapu-Lapu City

Topics	Women, Senior Citizens, PWDs and Fisheries Sectors
Matters raised during the 2nd FDG meeting	(Questions/Comments) • A fisherman asked about what the status would be for those fishermen who will suffer loss of income as a result of the project during the construction. • Local residents are concerned about the gleaners at nighttime and other groups in the area, if they will still be allowed to enter their fishing ground during the construction. • They hope local residents will be given the priority in terms of employment during the construction.
Responses and Discussion/ Opinions	• JICA Survey Team explained that there will be a replacement cost if fishermen cannot anymore do fishing activities in the area because of the project. Livelihood is one of the options and possible employment of the said project, for there must be a replacement of what will be lost from you. They will coordinate with JICA and assure that the latter would always see to it that the plan must be implemented, as it is very strict in terms of fulfillment/compliance. • JICA Survey Team mentioned that they would inform the management or their security guards about the fishing activity in the area within a specified time, so that fishermen will not be prohibited from entering the fishing ground. • JICA Survey Team explained that local residents will be given priority as what other company did as long as they are qualified. • JICA Survey Team further informed them that, the team will be giving notices through publication in the newspapers, leaflets and tarpaulins to be posted in public places. Together with the Survey Team's contact numbers for them to coordinate or for their suggestions and complaints.

Source: JICA Survey Team

9. LAND ACQUISITION AND INVOLUNTARY RESETTLEMENT

9.1 Objectives of the Resettlement Action Plan

The overall goal of the resettlement action plan (RAP) is to ensure that the views and voices of the project-affected persons (PAPs), both individuals and organizations, are adequately heard and that they are compensated and provided necessary support and assistances that enable them to enjoy a standard of living that is equivalent or higher than that prior to the project. It has been prepared based on relevant laws, regulations and policies existing in the Philippines as well as good international practices such as the policies adopted by JICA and the World Bank, and reflects pertinent social, economic and geophysical circumstances and constraints at the project site. It serves as a guiding document for DPWH (Unified Project Management Office Roads Management Cluster I/UPMO-RMC I and Region VII) as well as for all stakeholders involved in the project including Local Government Units (LGUs), National Housing Authority (NHA) and other relevant government bodies in the Philippines as well as PAPs, project-affected companies, Non-Government Organization (NGOs), Internal Monitoring Agents (IMAs), construction companies and the consultants for land acquisition and associated activities (e.g. public consultation, consensus building and provision of compensation and social support) to better attain the abovementioned goal. The objectives of the RAP can be summarized as follows:

- To identify the PAPs and understand the expected adverse impacts on their living by recording all of their properties, assets and opportunities that are lost or affected by the project
- To identify and document entitlements of the PAPs and to propose a viable policy and package for compensation and support adequately reflecting their rights, views and circumstances
- To identify potential resettlement sites and formulate a menu for resettlement options
- To better ensure that adequate level and means of participation and meaningful dialogue are maintained between the PAPs and DPWH, LGUs, NHA and other relevant bodies
- To better ensure that the PAPs are given a fair, easily accessible, and less time- and cost-consuming venue to raise and address their concerns and complaints to the project's decision-makers throughout the process of RAP implementation
- To better ensure implementation of the RAP by highlighting the organizations responsible for carrying it out, estimating, and thereby help securing, the budget needed for its implementation and by offering the steps and timetable for RAP implementation
- To reduce the risk of social unrest and opposition against the project and thereby better ensure smooth implementation of the project

9.2 Necessity of Land Acquisition and Involuntary Settlement

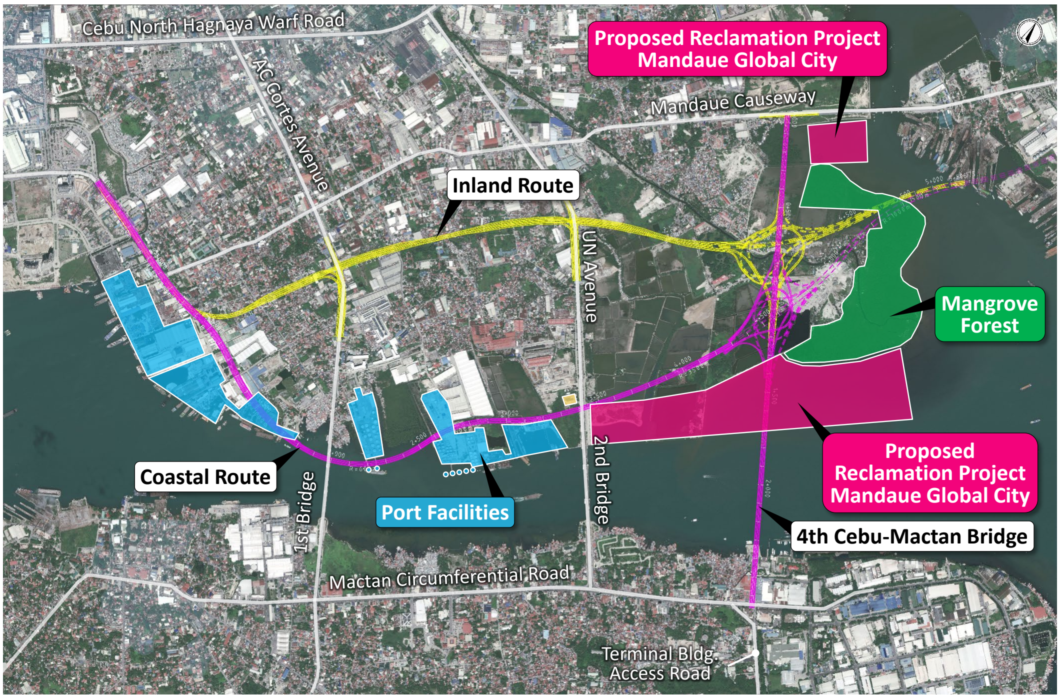
9.2.1 Necessity and Scope of Land Acquisition and Resettlement

The survey revealed that a total number of 86 plots that belong to private individuals, companies and public (i.e. Mandaue City and the Philippine Economic Zone Area (PEZA)) will be affected. 69 households (i.e. 243 people) are living on this land all of which may be subject to relocation under the project. There is no individual household expected to be affected in Lapu-Lapu City and all affected households are located in Mandaue City. More details are provided in Section 9.4

9.2.2 Alternatives considered at Earlier Stage

For the Mandaue Coastal Road, the following two routes were identified as the possible route options:

- Coastal Route; and
- Inland Route



Source: JICA Survey Team

Figure 9.2.1 Alternative Route Options for Mandaue Coastal Road

The Coastal Route is modified from the alignment recommended by MCUTMP in order to avoid the port facilities, proposed reclamation project, mangrove forest and tidal flat. This route can provide interconnectivity to the 1st and 4th Cebu-Mactan Bridges. Due to the steep vertical gradient of the 2nd Cebu-Mactan Bridge, however, it cannot be connected to the 2nd Bridge. Although this route can avoid highly populated residential area, resettlement of approximately 80 houses was expected.

The Inland Route, on the other hand, has higher functionality of road than Coastal Route with interconnectivity to all Cebu-Mactan Bridges but passes through the residential area in Mandaue City and would require relocation of approximately 400 houses. Primarily due to this large scale of involuntary resettlement, the inland route option was dismissed and the coastal route option was adopted to be the more preferable option.

9.2.3 Width of ROW referring to the Laws and Regulations Concerned

With regards to the ROW, it is stated under Executive Order 113 (1955) and Executive Order 621 (1980) that:

- National Roads shall have an Right-of-Way (ROW) width of at least 20 m in rural areas which may be reduced to 15 m in highly urbanized areas
- ROW shall be at least 60 m in unpatented public land
- ROW shall be at least 120 m through natural forested areas of aesthetic or scientific value

Table 9.2.1 and Table 9.2.2 below summarize the widths of the ROW for the 4th Cebu-Mactan Bridge and Mandaue Coastal Road, respectively.

Table 9.2.1 ROW Width of 4th Cebu-Mactan Bridge

Station	Length (m)	ROW Width (m)	Remarks
0+000 - 0+050	50	40.0	Embankment
0+050 - 0+400	350	25.5	4-lane viaduct
0+400 - 1+650	1,250	Varies (Interchange)	Mandaue Interchange
1+650 - 1+930	280	30.5	6-lane viaduct
1+930 - 2+125	195	30.5 – 35.5	2-lane + 2-lane + 2-lane viaduct
2+125 - 2+295	170	35.5	ditto
2+295 - 2+500	205	35.5 – 40.25	ditto + 1-lane viaduct
2+500 - 2+640	140	40.25	ditto + service road
2+640 - 2+730	90	Varies (Interchange)	Lapu-Lapu Interchange
2+730 - 2+960	230	20.0 – 30.0	2-lane viaduct + service road
2+960 - 3+100	140	30.0	ditto
3+100 - 3+230	130	22.0	4-lane road

Source: JICA Survey Team

Table 9.2.2 ROW Width of Mandaue Coastal Road

Station	Length (m)	ROW Width (m)	Remarks
0+000 - 0+300	300	47.0	6-lane viaduct + service road
0+300 - 0+360	60	37.5 – 47.0	ditto
0+360 - 0+620	260	37.5	ditto
0+620 - 1+660	1,040	30.5	6-lane viaduct
1+660 - 1+920	260	Varies (Interchange)	1st Cebu-Mactan Bridge Interchange
1+920 - 3+940	2,020	25.5	4-lane viaduct
3+940 - 4+890	950	Varies (Interchange)	Mandaue Interchange

Source: JICA Survey Team

9.3 Policy and Legal Framework on Land Acquisition and Resettlement

9.3.1 Policies, Laws, Regulations and Guidelines Governing the RAP

The RAP must be prepared based on, and hence is inevitably closely linked with, relevant policies, laws, regulations, guidelines and other binding documents and commitments in and of the Philippines. This chapter explains about such documents and describes their content. In general, the RAP has been prepared with reference to:

- relevant laws, regulations, guidelines and so on of the Government of the Republic of the Philippines (GOP)
- JICA Guidelines for Environmental and Social Considerations (April 2010)
- World Bank Operational Policies, OP 4.01 (January 1999) and Involuntary Resettlement Policy, OP 4.12 (December 2001)

9.3.2 Legal Framework on Land Acquisition and Resettlement in the Philippines

(1) Overview

Table 9.3.1 below provides an overview of the principle laws and regulations governing issues concerned with land acquisition and involuntary resettlement in the Philippines. Regulations that are particularly pertinent to the project and require further explanations are presented in the sections that follow.

Table 9.3.1 Legal Framework concerning Land Acquisition and Resettlement in the Philippines

Item	Law and Regulations	Major Stipulations
Resettlement, Land Acquisition, Land Use	The Philippine Constitution of 1987	• Private property shall not be taken for public use without just compensation. (Article III, Bill of Rights, Section 9) • Urban or rural poor dwellers shall not be evicted nor their dwelling demolished, except in accordance with law and in a just and humane manner. No resettlement of urban or rural dwellers shall be undertaken without adequate consultation with them and the communities where they are to be relocated. (Article XIII, Urban Land Reform and Hosing, Section 10)
	Republic Act No. 10752 (An Act to Facilitate the Acquisition of Right-of-Way, Site or Location for National Government Infrastructure Projects and other purposes of 2016)	• This law, enacted in March 7, 2016, repeals Republic Act (RA) No. 8974 (An Act to Facilitate the Acquisition of Right-of-Way, Site or Location for National Government Infrastructure Projects and other purposes). Both laws (RA 8974 and RA 10752) are based on the premise that private property shall not be taken for public use without just compensation (Article III, Section 9 of the 1987 Constitution). RA 10752 was enacted to further strengthen the said constitutional provision and ensure that property owners and project-affected properties in areas where national government infrastructure projects would be given just compensation. Implementing Rules and Regulations (IRR) of RA 10752 is promulgated in May 25, 2016 to carry out the provisions of the said Act. • Main provisions in RA 10752 sought to expedite the implementation of infrastructure projects while ensuring that just and equitable compensation be provided to the PAPs. The pertinent revisions in RA 10752 include: (1) expansion in scope of national government projects; (2) refining the modes of acquisition; (3) compensation based on the current market value of the land and replacement cost of structures and improvements[1]; (4) changes in guidelines for expropriation proceedings; (5) payment terms; and (6) appropriation.

[1] According to Sec. 3 (f) of RA7279, "Improvements" refers to all types of buildings and residential units, walls, fences, structures or constructions of all kinds of a fixed character or which are adhered to the soil but shall not include trees, plants and growing fruits, and other fixtures that are mere superimpositions on the land, and the value of improvements shall not be less than fifty percent (50%) of the assessed value of the property. However,

Item	Law and Regulations	Major Stipulations
	Republic Act No.7160 (Local Government Code of 1991)	• The power of eminent domain by the local government unit may not be exercised unless a valid and definite offer has been previously made to the owner, and such offer was not accepted. • It allows LGUs to adopt the provisions in the ROW acquisitions, LGUs can possess land immediately after court application for land acquisition by pre-supporting 15% of the fair land price calculated based on tax payment. The remaining amount is determined by the court based on market price at the time of land acquisition.
	Commonwealth Act 141 (Public Land Act) and Presidential Decree 635	• CA 141 prescribes a 20 m strip of land reserved by the government for public use, with damages being paid for improvements only. • PD 635 amended Section 112 of CA 141 increasing the width of the reserved strip from 20 m to 60 m.
	Executive Order No. 1035, Series of 1985	• It provides the procedures and guidelines for the expeditious acquisition by the government of private real properties or rights thereon for infrastructure and other government development projects.
	Executive Order No. 113 (1955) and 621 (1980)	• It states that: national roads shall have a ROW width of at least 20 m in rural areas which may be reduced to 15 m in highly urbanized areas; ROW shall be at least 60 m in unpatented public land; and ROW shall be at least 120 m through natural forested areas of aesthetic or scientific value.
	Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy (LARRIPP), 2007	• The LARRIPP indicates that social impacts of infrastructure projects should be avoided, minimized and/or mitigated. PAPs should be provided with sufficient compensation to ensure that their standard of living prior to the project is maintained or improved. Project stakeholders should also be consulted regarding the project's design, implementation and operation.
	DPWH Right-of-Way Acquisition Manual (DRAM)	• The DRAM was developed in compliance with Section 18 of the Implementing Rules and Regulations (IRR) of RA 10752, which prescribes that, to provide clear, specific, and operational guidelines for the efficient acquisition of ROW for its infrastructure projects, each implementing agency (IA) shall prepare and implement its own "Manual of Procedures for ROW Acquisition." The DRAM covers the entire ROW acquisition process for DPWH.
	Republic Act (Comprehensive Agrarian Reform Law) No. 6657 (1988)	• Section 28 of the Act provides that landowner shall retain his shares of any standing crop un-harvested at the time the Department of Agrarian Reform shall take possession of the land under Section 16 of this Act, and shall be given a reasonable time to harvest.
Compensation on Agricultural Land	Republic Act No. 6389 (Agricultural Land Reform Code of 1971)	• Agricultural lessees are entitled to receive disturbance compensation equivalent to five times the average gross harvests on his/her landholding during the last five preceding calendar years.
	Executive Order No. 1035	• The EO calls for financial assistance to displaced tenants, indigenous peoples, and settlers equivalent to the average gross harvest for the last 3 years and not less than PhP 15,000 per ha; disturbance compensation to agricultural lessees equivalent to five times the average gross harvest during the last five years; compensation for improvements on land acquired under CA 141; and stipulates that government has the power to expropriate in case agreement is not reached.
Housing	Republic Act No.7279 (Urban Development and Housing Act: UDHA of 1992)	• The mandate of this Act is to uplift the conditions of the underprivileged and homeless citizens in urban areas and in resettlement areas by making available to them decent housing at affordable cost, basic services, and employment opportunities. • It defines equitable land tenure system, defines compensation measures for leasehold rights and ensures compensation payment to small property owners. • Eviction and demolition may be allowed: (a) for government infrastructure projects with available funding; (b) for persons within danger areas such as esteros and railroad tracks; and (c) for cases with a court order for eviction and demolition. • Socialized housing or resettlement areas shall be provided by the local government unit or NHA in cooperation with the private developers and concerned agencies with the basic services and facilities. • NHA, with respect to lands belonging to the national government, and the

improvements with less than 50% of the assessed value of the property will also be considered improvements under this project and hence be subject to compensation in case they are affected. Further, a more familiar word of "assets" will be used in this report as the same meaning as "improvements" defined here.

Item	Law and Regulations	Major Stipulations
		LGUs with respect to other lands within their respective localities, shall coordinate with each other to formulate and make available various alternative schemes for the disposition of lands to the beneficiaries of the socialized housing program.
	Republic Act No. 9679 (Home Development Mutual Fund Law of 2009)	• The Pag-IBIG Fund is a mutual provident savings system which is primarily intended for shelter financing among its members. Section 10 of the law states that the Fund shall be private in character, owned wholly by the members, administered in trust and applied exclusively for their benefit. Section 6 of the Act provides that membership in the Fund shall be mandatory upon all employees covered by the Social Security System (SSS) and the Government Service Insurance System (GSIS), and their respective employers.
	Executive Order No. 272, Series of 2004	• EO 272 created the Social Housing Finance Corporation (SHFC) and assigned SHFC as the lead government agency for undertaking socialized housing programs that will cater to the formal and informal sectors in the low-income bracket and shall take charge of developing and administering social housing program schemes, particularly the Community Mortgage Program (CMP) and the Abot-Kaya Pabahay Fund (AKPF) Program (amortization support program and development financing program).
	NHA Memorandum Circular No. 2427 Series of 2012	• According to the Memorandum Circular, NHA will; (i) provide technical assistance to LGUs in preparing project plans and formulating policies and guidelines in implementing resettlement projects; and (ii) contribute funds (in the form of grants) for the development of resettlement sites. The LGUs on the other hand shall (i) contribute land for the project; and (ii) be the lead project implementer with overall responsibility for the operation and management of the resettlement project including preparation of overall project plans, site development and housing plans, beneficiary selection, relocation of families and estate management.
	HLURB Memorandum Circular No. 13, Series of 2017	• The Housing and Land Use Regulatory Board (HLURB) Memo sets the price ceiling for Economic Housing at above PhP450,000 to PhP1,700,000 while a Medium-Cost Housing is above PhP1,700,000 to PhP4,000,000.
Employment	Republic Act No. 6685 (December 1988)	• National and local public works projects funded by either the national government or local government, including foreign-assisted projects, must hire at least 50% of the unskilled and 30% of the skilled labor requirements from bona fide and actual residents in the province, city and municipality who are ready, willing and able, as determined by the governor, city mayor, or municipal mayor concerned.
Gender and Human Rights	The Philippine Constitution of 1987	• Article II recognizes the role that women play in the construction of the state, and claim the guarantee of gender equality based on the law.
	Republic Act 9710 and Implementing Rules and Regulations (series of 2010) known as the "Magna Carta of Women"	• The rights of women are defined as follows: gender equality in front of the law; protection from any violence; participation and representation; equal education opportunities and eradication of discrimination; scholarships and training; equal rights with marriage and family relations; comprehensive health services and information/education; and nondiscrimination in employment
	Executive Order No.153 (2002)	• It aims at curbing professional squatter activity and enhancing national momentum towards eradicating syndicates.
	National Commission on Indigenous Peoples (NCIP) Administrative Order No. 1, Series of 2006	• It stipulates the procedures for establishing Free, Prior and Informed Consent (FPIC) with affected communities
	Department Order No. 130, Series of 2016 (Guidelines for the Implementation of the Provisions of RA6685 and RA9710 or the Magna Carta of Women)	• It stipulates the implementing rules of RA6685 and RA9710 regarding hiring 50% of unskilled labor and 30% of skilled labor from the locality and hiring women in the project.
	A Tool Kit for Making Road Infrastructure Projects Gender Responsive	• It serves as a guideline showing the procedures that aim to carry out activities that contribute to gender mainstreaming at all stages of road improvement projects.
Historical and Cultural Heritage	Republic Decree No. 4365	• It stipulates the authority of the National History Commission on restoration and maintenance of historical heritage.
	Republic Decree No. 4346	• It stipulates the responsibility for promoting the preservation and maintenance of cultural heritage in the National Museum.
Indigenous People	Indigenous Peoples	• It prescribes the conditions, requirements, and safeguards required for

Item	Law and Regulations	Major Stipulations
	'Rights Act/Republic Act 837 (1997)	the plan, programs, and projects to be implemented that affect IP. This includes the provision that the acquisition of the site for the project and the transfer from the territory inherited from the ancestors require the agreement from the affected IP.

Source: JICA Survey Team

(2) The Philippine Constitution

The overall objective of this RAP is anchored on the Bill of Rights of the Constitution of the Republic of the Philippines. Article III Section 9 of the Constitution states that private property shall not be taken for public use without "just compensation". Article XIII Section 10 states that urban or rural poor dwellers shall not be evicted nor their dwelling demolished except in accordance with the law and in a just and humane manner. No resettlement of urban or rural dwellers shall be undertaken without adequate consultation with them and the communities where they are to be relocated.

(3) Republic Act No. 10752

Republic Act 10752 took effect on April 3, 2016 and its Implementing Rules and Regulations (IRR) became effective on August 7, 2016 repealing the RA 8974. RA 10752 aims to make negotiated sale more attractive than expropriation, since the process reduces negotiation time and provides realistic prices. The new law provides clear and simple ROW acquisition guideline which benefits both the property owners/PAPs and the implementing agencies (IAs). Section 4 of the Act explicitly states that the modes of acquiring real property are: (i) donation; (ii) negotiated sale; (iii) expropriation; or (iv) any other mode of acquisition as provided by law. Property valuation is market-based and undertaken using government financial institutions (GFIs) or independent property appraisers (IPAs) accredited by the Bangko Sentral ng Pilipinas (BSP) which helps achieve objective property valuation. The assumption by the IA of the capital gains tax also provides an additional incentive to the lot owners to negotiate with government. Negotiated sale is the preferred mode of ROW acquisition (after voluntary land donation) and should be explored before resorting to expropriation. RA 10752 aims to make negotiated sale more attractive than expropriation, since the process reduces negotiation time and provides realistic prices.

Under RA 10752, the IA shall immediately make the first offer to the property owner as compensation price, the sum of (i) the current market value of the land, (ii) the replacement cost of structures and improvements, and (iii) the current market value of crops and trees. DPWH may use the GFI/IPA appraisal reports, as duly validated, as one of bases of DPWH's price offer for negotiated sale. DPWH is encouraged to develop its in-house personnel capable of validating appraisal reports.

In the event that the owner contests the Department's offered value for compensation for land, the PAF or the DPWH may take the matter to court. Upon filing of the complaint or at any time thereafter, and after due notice to the defendant, DPWH shall immediately deposit to the court in favor of the owner: a) 100 % of the value of the property based on the Bureau of Internal Revenue (BIR) current relevant zonal valuation; b) the replacement cost at market value of improvements and structures, validated by the GFI/IPA accredited by the BSP; and c) the current market value of crops and trees located within the property as determined by the GFI/IPA.

It is also stipulated that the IA shall pay, upon the execution of a deed of sale, the property owner:

- Fifty percent (50%) of the negotiated price of the affected land, exclusive of taxes remitted to the LGU concerned; and
- Seventy percent (70%) of the negotiated price of the affected structures, improvements, crops and trees, exclusive of unpaid taxes remitted to the LGU concerned

The IA shall, at the times stated hereunder, pay the property owner the remaining fifty percent (50%) of the negotiated price of the affected land, and thirty percent (30%) of the affected structures, improvements, crops and trees, exclusive of unpaid taxes remitted to the LGU concerned provided that the land is already completely cleared of structures, improvements, crops and trees:

- At the time of the transfer of title in the name of the Republic of the Philippines, in cases where the land is wholly affected; or
- At the time of the annotation of a deed of sale on the title, in cases where the land is partially affected

Negotiated sale between DPWH and the PAF will be based on the following standards to determine the market value in accordance with Section 7 of the Law:

- The classification and use for which the property is suited;
- The development costs for improving the land;
- The value declared by the owners;
- The current selling price of similar lands in the vicinity;
- The reasonable disturbance compensation for the removal and/or demolition of certain improvements on the land and for the value for improvements thereon;
- The size, shape and location, tax declaration and zonal valuation of the land;
- The price of the land as manifested in the ocular findings, oral as well as documentary evidence presented; and
- Such facts and events as to enable the affected property owners to have sufficient funds to acquire similarly-situated lands of approximate areas as those required from them by the government, and thereby rehabilitate themselves as early as possible.

Section 10 of the law states that the government shall provide adequate appropriations to acquire the required ROW in advance of project implementation. These appropriations shall cover the funds needed to cover the following expenses for activities directly related to ROW acquisition for the project:

- Cost of parcellary surveys and appraisal of properties affected by the projects;
- Compensation for the project-affected land, structures and improvements, crops and trees;
- Cost of development and implementation of resettlement projects covered by RA 10752 including planning, social preparation, and other activities under the resettlement action plan; and
- Related expenses of the DPWH, including capital gains tax in the case of negotiated sale under Section 5 of RA 10752, documentary stamp tax, transfer tax and registration fees for the transfer of titles, and other relevant administrative expenses for ROW management.

(4) Common Wealth Act No. 141 (Public Land Act) and Presidential Decree No. 635

Section 44 of the law states that any person that meets the following conditions is entitled to being issued a free patent for a land not to exceed 24ha:

- Any natural-born citizen of the Philippines who is not the owner of more than 24ha and who since July 4, 1926 or prior thereto, has continuously occupied and cultivated, his predecessors-in-interest, a tract or tracts of agricultural public lands subject to disposition; or

- Who shall have paid the real estate tax thereon while same has not been occupied by any person

Section 112 of the law states that said land shall further be subject to a ROW not exceeding sixty (60) meters[2] in width for public highways, railroads, irrigation ditches, aqueducts, telegraph and telephone lines and similar works as the Government or any public or quasi-public service or enterprise, including mining or forest concessionaires, may reasonably require for carrying on their business, with damages for the improvements only. CA 141 was amended by PD No. 635, which increased the ROW strip reserved for public use to a width not exceeding 60 meters.

If the government decides to exercise its right to use the ROW strip reserved for public use within the land acquired under CA 141, the owner is required to execute a quit claim. The implementing organization shall then take possession of the property affected by the ROW without any compensation to the owner for the land, but shall pay the owner the cost of the damages for the improvements within that land equivalent to their replacement cost as determined in accordance with Section 6.6 of the Implementing Rules and Regulations (IRR) of RA 10752. If the owner refuses or is unable to issue a quit claim, the concerned government officials responsible for the implementation of projects are authorized to immediately take possession of the portion of property subject of the lien, as the need arises and upon due notice to the owner. This is without prejudice to the Implementing Office resorting to appropriate proceedings to acquire immediate possession of the property.

In other words, even if the title or free patent describes the whole area as owned by the patentee or title holders, by operation of the law, a strip of twenty or sixty meters, as the case maybe, of that area described is not absolutely owned by him, because it is reserved by the government for public use. Hence, if the government should exercise its right to use the area reserved by it for public use, the owner shall be required to execute a Quit Claim over such area reserved and actually taken by the government for public use. This mode can be availed of not only in cases where the lot acquired under the Public Land Act is still covered by Free Patents but even after the issuance of Certificate of Title or Transfer Certificates of Title because of a series of transactions involving transfer of ownership from one person to another. No payment shall be made for land acquired under the quit claim mode except for damages to improvements, and, if eligible, assistance with income restoration.

Holders of free or homesteads patents and Certificates of Land Ownership Award (CLOA) under CA 141, covers the following:

- Follow the other modes of acquisition enumerated in the IRR of RA 10752, if the landowners is not the original patent holder and any previous acquisition of said land is not through a gratuitous title;
- Cash compensation for loss of land at 100% current market value and improvements at replacement cost; or
- Follow the provisions under CA No. 141 regarding acquisition of ROW on patents land, if the landowners are the original patent holder or the acquisition of the land from the original patent holder is through a [gratuitous title] except for improvements at replacement cost

(5) Executive Order No. 1035

Specifically, the order stipulates the following:

[2] This 60m width stated in CA141 is considered to be actually 20m based on the description in Section 8 of the IRR of RA10752.

- The provision of financial assistance to displaced tenants, indigenous peoples, and settlers equivalent to the average annual gross harvest for the last three years and not less than PhP 15,000 per ha;
- Disturbance compensation to agricultural lessee's equivalent to five times the average gross harvest during the last five years;
- Compensation for improvements on land acquired under Commonwealth Act 141; and
- Government has the power to expropriate in case agreement is not reached

(6) DWPH Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy (LARRIPP/2007)

LARRIPP (2007) spells out the legal framework and donors' policies that governs when infrastructure projects implemented by DPWH cause the involuntary taking of land, structures, crops and other assets resulting in some cases in the displacement and resettlement of affected persons. It enumerates the entitlements and benefits that project-affected families and persons should rightfully receive under the law based on the project's adverse impacts on their assets, livelihood, and lives.

The first Land Acquisition, Resettlement and Rehabilitation (LARR) Policy was formulated in 1999 specifically for the National Road Improvement and Management Program (NRIMP) Phase 1, World Bank assisted project. Thereafter, the LARR Policy of 1999 was adopted, with some modifications in pursuance to prevailing laws and policies, by other financing institutions such as the Asian Development Bank (ADB) and JICA in their projects. A second edition of the LARR Policy was formulated in 2004 for projects under the Sixth Road Project. To some extent the ADB LARR Policy was applied to Japan Bank for International Cooperation (JBIC now JICA) funded projects.

To ensure uniformity of standards in the Resettlement Planning, a revised LARR Policy, 3rd edition, was formulated. This third edition of the policy now contains the Department's Indigenous People's Policy, based on the Indigenous Peoples' Right Act (IPRA) and NCIP Administrative Order No. 1, series of 2006 or the Free and Prior Informed Consent Guidelines of 2006. The 3rd edition, now called the Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy or LARRIPP shall provide guidance to those preparing RAPs and safeguards instrument for Indigenous Peoples (IPs) affected by infrastructure projects implemented by DPWH, whether foreign or locally funded, which was based on Republic Act (RA) 8794.

Even with the development of the above-mentioned policy on LARR still greatly hindered the implementation of infrastructure projects to the disadvantages of the general public. To address this issue, Republic Act (RA) 10752 – "An Act to Facilitating the Acquisition of Right-of-Way, Site or Location for National Government Infrastructure Projects," or "Right-of-Way Act,"-was approved on March 7, 2016, and became effective on April 3, 2016. RA 10752 repealed the previous ROW Act (RA 8794). This RA 10752 aims to fast track and simplify negotiated sale as the preferred mode of ROW acquisition by making the price offer and terms of negotiation more attractive and just for the owners than the current rules.

LARRIPP (2007) includes: (a) the principles and objectives of the resettlement policy; (b) the legal framework; (c) the eligibility, compensation and entitlements; (d) the indigenous people's policy framework; (e) the implementation procedures that ensure complaints are processed; (e) the public support and participation; and (f) the provision of internal and external monitoring of the implementation of RAP and safeguard instrument for indigenous people.

9.3.3 JICA's Policy on Land Acquisition and Resettlement

The key principles of JICA policies on involuntary resettlement are summarized below.

- 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 (JICA Guidelines Appendix 1.7.1).
- 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 (JICA Guidelines Appendix 1.7.2).
- Prior compensation, at full replacement cost, must be provided as much as possible (JICA Guidelines Appendix 1.7.2).
- 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 (JICA Guidelines Appendix 1.7.2).
- Appropriate participation by affected people and their communities must be promoted in the planning, implementation, and monitoring of resettlement action plans (JICA Guidelines Appendix 1.7.3).
- Appropriate and accessible grievance mechanisms must be established for the affected people and their communities (JICA Guidelines Appendix 1.7.3).
- For projects that will result in large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public (JICA Guideline Appendix 1.7.4).
- 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 (JICA Guidelines Appendix 1.7.4).
- When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people (JICA Guidelines Appendix 1.7.4).
- 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).
- 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 do not 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).
- Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based (WB OP4.12 Para.11).
- Provide support for the transition period (between displacement and livelihood restoration (WB OP4.12 Para.6).
- 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 OP4.12 Para.8).

- For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, abbreviated resettlement plan is to be prepared (WB OP4.12 Para.25).

9.3.4 Gap Analysis between Philippine Legal Framework and JICA Guidelines

A gap analyses was carried out by comparing the laws and regulations in the Philippines and the JICA Guidelines. Results of the analyses and proposed measures to fill the gaps are shown in Table 9.3.2. While some relatively large gaps were identified as shown below, by adopting these countermeasures, the gaps are expected to be filled:

- absence of a law in the Philippines that necessitates payment of compensation against lost livelihood per se including loss attributed to impact on business activities;
- absence of a law in the Philippines that necessitates providing full compensation and other kinds of support to the PAPs prior to displacement;
- absence of a law in the Philippines that gives preference to land-based resettlement strategies for displaced persons whose livelihoods are land-based; and
- absence of a law in the Philippines that necessitates providing sufficient level of assistance to the PAPs during their relocation and restoration of livelihood

Table 9.3.2 Gaps between the Philippine Legislation and JICA Guidelines on Resettlement

No.	JICA Guidelines	Legislation of Philippines	Major Gap	Policy Adopted in this Project
1	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.	• Free and private properties shall not be taken without legal procedures (Law Article No.3) • NEDA Policy requires studying three alternative alignments in consideration of the environmental and social impacts of the project.	While there is no specific law in the Philippines, there is no notable gap.	The project will compare and analyze different project alternatives taking into account the economic, environmental and social impats with priority given to the option that minimizes the scale of involuntary resettlement.
2	When population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.	• Private properties shall not be taken for public purpose without appropriate compensation (Article II (9) of Law (1987)). • Government must hold a series of discussions with the PAPs (RA7279).	While there is no specific law in the Philippines, there is no notable gap.	The impact on the PAPs will be analyzed in view of the land, structure, crops, trees and so on that are to be affected by the project based on which efforts to minimize such impacts would be made and an appropriate level of compensation would be considered and described in the RAP for implementation.
3	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. 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.	• Monetary compensation will be made to people that legally own the land and structures affected by the project (RA10752, Article 5). • The government will, in coordination with HUDCC and NHA, discuss with LGUs about identifying the resettlement site and developing them (RA10752 No.9) • Government shall provide adequate appropriations that will allow Implementing Agencies to acquire ROW for national government projects. These appropriations include: cost of development and implementation of resettlement projects… including planning, social preparation. Where necessary, this may include land development and housing	There is no law in the Philippines that necessitate payment of compensation against lost income and livelihood. LARRIPP covers compensation against lost livelihood including loss attributed to impact on business activities. However, there is limited practice, if any, within DPWH where compensation against business loss has been provided at a scale beyond the income rehabilitation assistance not to	Compensation policy and package will be formulated based on the census, lost-asset inventory, and socio-economic surveys and will take into account the project impact on livelihood including that caused by project impact on business activities based on their socio-economic status, the laws and regulations in the Philippines and JICA Guidelines. Impact on business activities will be avoided as much as possible as described in more detail under 9.5.5.

No.	JICA Guidelines	Legislation of Philippines	Major Gap	Policy Adopted in this Project
		construction, provision of basic services and community facilities, livelihood restoration and improvement (RA10752 Section 15). • Among other types of entitlements that may be afforded to the PAFs/PAPs as compensation for lost livelihood is income loss and rehabilitation assistance (LARRIPP 2007*) • For illegal residents, LGUs and NHA will collaborate to provide low-cost housings or a resettlement site to the PAPs (RA7279). • In negotiating the level of compensation, project proponents must pay to the owner: 1) market price of land; 2) restoration cost for structure and other assets; and 3) present value of the crops and trees (RA 10752 NO.5, No.6).	exceed PhP 15,000 for severely affected structures.	
4	Compensation must be based on the full replacement cost as much as possible.	In negotiating the level of compensation, project proponents must pay to the owner: 1) current market price of land; 2) replacement cost for structure and other assets; and 3) current market value of the crops and trees (RA 10752 No.5, No.6).	There is no notable gap.	Compensation will be provided to the PAPs based on the full replacement cost measured based on the current market value.
5	Compensation and other kinds of assistance must be provided prior to displacement.	Under R.A. 10752, PAPs will be paid only 50% of the negotiated price of the affected land and 70% of the negotiated price of the affected structures, improvements, crops and trees upon the execution of a deed of sale. The balance of payment are paid as stated below provided that the land is already completely cleared of structures, improvements, crops and trees (1) At the time of the transfer of title in the name of the Republic of the Philippines, in cases where the land is wholly affected; or (2) At the time of the annotation of a deed of sale on the title, in cases where the land is partially affected.	Compensation and other support to the PAPs are not provided fully prior to displacement.	All compensation and support will be provided to the PAPs prior to displacement.
6	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public.	• National Economic and Development Authority (NEDA) ICC Policy* requires the project proponent to acquire the ROW and to prepare and submit a resettlement action plan. • DPWH ROW Manual states that the RAP will be disclosed at the D/D stage.	NEDA ICC does not require making the RAP available to the public. DPWH ROW Manual requires the RAP to be disclosed at the D/D stage.	RAP will be prepared and be made available on DPWH's webpage under this project.
7	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	No people will be relocated in the absence of an appropriate dialogue between the people and the community that accepts the people (Act No. 8.10). A series of discussion is required by all government bodies and organizations. All government organization that intend to carry	There is no notable gap.	PAPs will be invited to attend the stakeholder meetings. In addition, a series of discussion such as public consultations and focus group discussions (FGDs) will be made with the PAPs or with their representatives (e.g. Barangay Captain and Councilor) throughout the study.

No.	JICA Guidelines	Legislation of Philippines	Major Gap	Policy Adopted in this Project
	advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.	out a road construction project must discuss with the relevant local government bodies, widely explain to the public about the project's objective and the expected benefits to alleviate their concern (EO1035 No.3).		
8	When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.	• All information on the project must be made public in a language and form easily understandable to the people (DENR Administrative Order No. 96-37 Article 2). • Government body that promotes projects that involve land acquisition must hold discussions with the stakeholders (EO 1035 Article 3)). • Public Consultation Meetings (PCMs) must be held in each barangay that will be traversed by the project. Venues for PCMs must be neutral grounds such as barangay halls, day care centers, public schools and the like (DPWH ROW Acquisition Manual* Section 2.4 and 2.5)	While the laws in the Philippines do not clearly mention affected people (*instead they use the word "beneficiaries"), there appears to be no notable gap in essence.	Stakeholder meetings and public consultations will be held in a language widely used in the local area with visual aids.
9	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.	• No. 23 of RA 7279 states that the beneficiaries of the project must, in coordination with the Presidential Commission for the Urban Poor (PCUP) and relevant government bodies, participate in the decision-making process concerned with protecting and promoting legal collective interest. • Public Consultation Meetings (PCMs) must be held in each barangay that will be traversed by the project. Venues for PCMs must be neutral grounds such as barangay halls, day care centers, public schools and the like (DPWH ROW Acquisition Manual* Section 2.4 and 2.5). • With regards to monitoring, Chapter VIII of LARRIPP 2007* stipulates the objective, scope, monitoring mechanism, stages and frequency of monitoring, schedule of implementation, reporting and monitoring indicators.	There is no notable gap.	Discussions with the PAPs will take place from an early stage of RAP preparation at the scoping stage throughout the survey. Their livelihood will be monitored continuously into the implementation stage of the project.
10	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.	• RA9285 (Alternative Dispute Resolution (ADR) Act of 2004) recommends that disputes be resolved through an alternative dispute resolution (ADR). • A grievance redress procedure is described in Chapter VI of the LARRIPP*.	There is no notable gap.	A grievance redress mechanism (i.e. resettlement implementation committee/RIC) will be formed based on LARRIPP prior to implementation of the RAP and finalized in consultation with DPWH and other relevant government bodies.
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	• LGUs must prepare an inventory of informal settler families (ISFs) (RA7279). • According to Article 4 of the rules for registers of welfare housing; - Under each LGU, the city/town will be responsible for registering socially-vulnerable	There is no notable gap.	Affected people will be identified at an early stage of the study as part of the RAP survey, which consists of census, lost-asset inventory and socio-economic surveys. A cut-off date will be set at the commencement day of the census survey and announced at

No.	JICA Guidelines	Legislation of Philippines	Major Gap	Policy Adopted in this Project
	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 OP 4.12Para. 6)	and homeless people; and - Registration will take place at the barangay level in the barangay registration committee with the barangay captain taking responsibility • DRAM* stipulates the procedures of preparing a RAP, which mentions carrying out census and socio-economic surveys as well as tagging of affected structures. • DRAM* stipulates that PAPs shall be determined based on the cut-off date.		the first stakeholder meeting and/or through other appropriate means.
12	Eligibility of benefits include, 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. 6)	Compensation of structures and improvements: Among the non-regular residents of the public land, those eligible for relocation based on RA 10752 Section 5 (b) are those: - having Filipino nationality; - do not own real estate in urban and rural areas; - not a member of a professional squatter or squatter syndicate - do not occupy the government's existing ROW. According to RA Implementation Rule 10 of 10752, informal settlers of private land is: - those that do not meet the above four requirements but have proof of ownership of the structure (such as a disclaimer certificate issued by the owner or a local government) and have the right to compensation. Relocation: Eligible Residents (RA 7279) who are informal settlers are: - having Filipino nationality; - be a homeless citizen below the poverty level; - do not own real estate in urban and rural areas; and - not a member of a professional squatter or squatter syndicate. According to RA7279 paragraph 29, NHA shall carry out resettlement of the inhabitants who live in the dangerous area (lagoon, railway, dump, riverbed, shoreline, shoreline, waterway and footpath, public place such as road, park or playground).	Many informal settlers that do not meet the requirements may occupy the site of the government but unless they: (a) meet the requirements set forth in RA10752 and RA7279; or (b) have a certificate that shows the consent of the owner, they cannot receive compensation for their structure.	Based on the findings of socio-economic survey, an entitlement matrix will be prepared for both formal and informal settlers. Not only those informal settlers that meet the conditions set forth in RA10752 and RA7279 but those who do not meet the requirements will also be entitled to compensation and relocation unless they have been found to be coming back to the original site of dwelling for unlawful reasons. The project proponent (i.e. DPWH) and relevant agencies (e.g. LGUs and NHA) will jointly examine the qualifications for compensation and resettlement of the affected people.
13	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based (WB OP 4.12Para. 11)	• According to the DPWH Manual SEMS (2016)*, affected people who lose their means of livelihood participate in a livelihood restoration program to ensure the quality of life before relocation and the means of livelihood. • Section 18 of EO 1035 stipulates that the amount of financial assistance to be given to tenants/farmers of agricultural lands shall be	There is no legal rule that prioritize land-based resettlement strategies.	Preference would be given to the extent possible, subject to availability of land and other circumstances, to land-based resettlement strategies for displaced persons whose livelihoods are land-based. FGDs will be held based on the socio-economic survey to ensure that there is no negative change when compared with the affected people's income before relocation (land-based

No.	JICA Guidelines	Legislation of Philippines	Major Gap	Policy Adopted in this Project
		equivalent to the value of the gross harvest for one year on the principal and secondary crops of the area acquired, based on the average annual gross harvest for the last three preceding crop years provided that in no case shall the financial assistance be less than P15,000 per hectare. • Section 7 of RA 6389 stipulates that the agricultural lessee shall be entitled to disturbance compensation equivalent to five times the average of the gross harvests on his landholding during the last five preceding calendar years. • LARRIPP states that: lessees of agricultural land severely affected (i.e., >20% of the land or when the land is no longer economically viable) by the project are entitled to receiving a disturbance compensation equivalent to five times the average gross harvest during the last five years; and • agricultural tenants/settlers/occupants severely affected by the project are entitled to receiving financial assistance equivalent to the average gross harvest for the last three years and not less than PhP15,000 per ha, in addition to the cash payment/compensation for their crops actually damaged by the project.		livelihoods etc.).
14	Displaced persons are provided assistance during relocation and restoration of livelihood (WB OP 4.12Para. 6)	• Paragraph 28 of RA 7279 stipulates that if relocation is not completed in 45 days, the LGU shall provide financial support to the affected family equal to the minimum daily wage of 60 days. • The Implementing Rules and Regulations to Ensure the Observance of Proper and Humane Relocation and Resettlement Procedures mandated by the Urban Development and Housing Act of 1992 provides guidelines for officials responsible for dismantling to "Ensure that the dismantling of structure shall be executed as carefully as possible for the maximum recovery of materials which could be reused by families to rebuild their structures in the resettlement project" and "Encourage and motivate families to voluntarily and peacefully dismantle their structures and whenever requested by the families, assign manpower to assist families in the dismantling" during relocation. More support is provided to the dislocated PAPs after their relocation.	Support and considerations are given to the displaced persons during the relocation period.	Support for the transition period will be offered to the dislocated PAPs under this project.

No.	JICA Guidelines	Legislation of Philippines	Major Gap	Policy Adopted in this Project
15	Particular attention is paid to the needs of vulnerable groups among those displaced, especially those below the poverty line, the landless, the elderly, women and children, indigenous peoples, or ethnic minorities (WB OP 4.12 Para. 6).	RA 7279 requires the provision of relocation sites for non-regular residents below the poverty line and without land. Other relevant laws in the Philippines to address the needs of the socially vulnerable include: RA 8972 (Solo Parents' Welfare Act); RA 8425 (Social Reform and Poverty Alleviation Act); RA 9710 (Magna Carta Of Women Act); RA 8371 (Indigenous People's Rights Act); RA 7277 (Magna Carta for Persons with Disability); and RA 9994 (Expanded Senior. Citizens Act)	There is no notable gap.	Socially-vulnerable groups of people will be identified during the RAP survey and necessary support will be provided.

*internal regulations
Source: JICA Survey Team

9.4 Scope of Land Acquisition and Resettlement

9.4.1 Overview of the Survey

A survey for RAP preparation, consisting of a: census survey; lost-asset inventory survey; and socio-economic survey, was carried out from April 24 to May 14, 2019[3]. The main purpose of the surveys was to identify the number of people directly affected by the project and their socio-economic characteristics as well as the type, number and size of the land, structures, trees and other assets that are to be affected by the project.

The survey was carried out by interviewing the PAPs using carefully designed questionnaires and by delineating the project-affected area and recording by visual observation in the presence of the PAPs what would fall within the area and by calculation based on the GIS data given by LGUs. The site survey was carried out by the *Housing* and Urban Development Office (HUDO) of Mandaue City with technical assistance from JICA Survey Team. Census and socio-economic survey was carried out in Mandaue City only as no individual household is expected to be affected in Lapu-Lapu City.

The results of this survey is expected to be reviewed and updated as found necessary during the detailed design (D/D) stage of the project especially in case there is a change in the alignment and/or a reasonably long period of time (e.g. three years) is expected between the time of completion of this survey and the time of project implementation.

9.4.2 Cut-Off-Date of Eligibility

The cut-off-date (COD) of eligibility was set to identify the PAPs, or the people rightfully entitled to be receiving compensation and other forms of support provided that they are adversely affected by the project. It was set on the commencement day of the census survey in accordance with the DPWH ROW Acquisition Manual (2017) and announced publicly through different means. The ways in which the COD was announced to the PAPs and project-affected companies includes: stakeholder meeting (i.e. public scoping held on April 12, 2019 in Lapu-Lapu City), public consultations (i.e. barangay council meetings held on April 8, 16 and 17 at respective Barangays in Mandaue City) and leaflets (in both Mandaue and Lapu-Lapu City). In addition, surveyors notified the PAPs directly of the COD during the RAP survey. In July, a project notification written in both English and Visayan was put up in each barangay hall as well as in the two city halls in the period between July 10 and 16, 2019. The notifications included information on the CODs as well as satellite imagery showing the project boundaries (cf. a sample of the notification put up in the barangay halls are shown in Figure 9.4.1 and Figure 9.4.2 below). These notifications are expected to be put up to, and throughout, project implementation. By establishing eligibility based on the COD, the risk of seeing an influx of ineligible non-residents moving into the project site can be expected to be reduced. The COD for the affected barangay is shown in Table 9.4.1.

[3] Supplementary survey was conducted in July, 2019 to confirm the PAFs' preference between being compensated in cash or being allowed to move into a resettlement site.

Notification of the 4th Cebu-Mactan Bridge and Mandaue Coastal Road Construction Project

July 10, 2019

1. **Paghulagway sa Proyekto**
a) Ngalan sa Proyekto:
4th Cebu-Mactan Bridge and Mandaue Coastal Road Construction Project

b) Tumong sa Proyekto:
Aron makatampo sa pagpalambo sa socio- economic sa Metro Cebu, pinaagi sa pagpataas sa kapasidad sa transportasyon, pagpalambo sa kahusayan sa trapiko ug makapalu-ag sa kahu-ot sa trapiko.

c) Mga Nag -Unang Bahin sa Proyekto:
a. pagtukod ug pagsugod sa operasyon sa 4th Cebu Mactan Bridge (gitas on sa dalan: 3.2 km; 4 ka lane)
b. pagpalambo sa Mandaue Coastal Road (gitas-on sa dalan: 4.9 km/ upat/unom ka lanes)

d) Lokasyon sa Project
Ang 4th Cebu Mactan Bridge ug Mandaue Coastal Road molabay sa mga syudad ug mga barangay nga gipakita niining maong mapa.
a. Mandaue City (North Reclamation Area/NRA, Centro, Looc, Opao, Umapad ug Paknaan) ug
b. Lapu-Lapu City (Ibo ug Pusok)

Location of the Project

e) Skedyul sa Proyekto
Detailed Design- gi bana-bana 15 ka bulan sugod tuig 2021
Pagtukod: Gi bana- bana 42 ka bulan sugod tuig 2023

2. **Nanag-iya sa Proyekto ug Contact Person**
Ang nanag iya niining proyekto mao ang DPWH

<DPWH Head Office>
Address: Bonifacio Drive, Port Area, Manila 1018

< DPWH Region VII Office>
Address: South Road Properties, Cebu City 6000

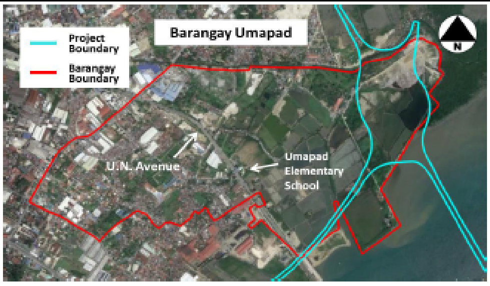
Mga komentaryo kabahin sa proyekto mamahimong isuwat ug ipadala sa mosunod;

Name: Engr. Nonato Paylado
Position: Chief of Planning and Design Division, DPWH Region VII Office
Tel: (032)-411-6772 / (032)-411-6721
Email: dpwh7pdd @yahoo.com

3. **Cut Off nga Petsa**
Ang cut off na petsa natakda ug gipahibalo sa DPWH ug sa mga LGUs aron sa pag-ila ug paglahi sa mga tawong apektado sa proyekto gikan sa mga tawong dili apektado nga mo puyo unya sa lokasyon sa proyekto human na napahibalo ang cut off date. Kini natakda dungan usab sa pagsugod sa atong gipasi-ugdahan nga survey, diin gi ila ug gi tala ang tanang apektadong tawo, straktura ug uban pang mga pagpalambo na gihimo diha sa lokasyon sa proyekto. Ang mga tawo nga mi puyo sa lokasyon sa proyekto human na sa cut off date dili na kwalipikado nga maka dawat ug bayad isip danyos o suporta.

Cut-off Dates per Barangay

Barangay	Cut-off Date	Barangay	Cut-off Date
NRA, Mandaue City	April 26, 2019	Umapad, Mandaue City	April 23, 2019
Centro, Mandaue City	April 24, 2019	Paknaan, Mandaue City	April 26, 2019
Looc, Mandaue City	May 2, 2019	Ibo, Lapu-Lapu City	April 22, 2019
Opao, Mandaue City	April 16, 2019	Pusok, Lapu-Lapu City	April 22, 2019



Source: JICA Survey Team

Figure 9.4.1 Notification of the Project and Cut-off Date (Cebuano/sample)

Notification of the 4th Cebu-Mactan Bridge and Mandaue Coastal Road Construction Project

July 10, 2019

1. **Description of the Project**
a) Name of the Project:
4th Cebu-Mactan Bridge and Mandaue Coastal Road Construction Project

b) Objective of the Project:
To contribute to the socio-economic development of Metro Cebu by increasing the transport capacity, improving traffic efficiency and easing traffic congestion

c) Main Components of the Project:
a. construction and eventual operations of the 4th Cebu-Mactan Bridge (total road length: 3.2 km; four-lane); and
b. development of Mandaue Coastal Road (total road length: 4.9 km; four/six-lane)

d) Location of the Project
The 4th Cebu-Mactan Bridge and Mandaue Coastal Road will pass the following cities and barangays/areas as shown in the location map below.
a. Mandaue City (North Reclamation Area/NRA, Centro, Looc, Opao, Umapad and Paknaan); and
b. Lapu-Lapu City (Ibo and Pusok)

Location of the Project

e) Schedule of the Project
Detailed Design: approximately 15 months from 2021
Construction: approximately 42 months from 2023

2. **Project Proponent and Contact Person**
The project proponent is the Department of Public Works and Highways (DPWH)

<DPWH Head Office>
Address: Bonifacio Drive, Port Area, Manila 1018

< DPWH Region VII Office>
Address: South Road Properties, Cebu City 6000

Comments about the project can be written and sent to the following person.

Name: Mr. Nonato Paylado
Position: Chief of Planning and Design Division, DPWH Region VII Office
Tel: (032)-411-6772 / (032)-411-6721
Email: dpwh7pdd @yahoo.com

3. **Cut-off Date**
Cut-off date has been set and announced by DPWH and the LGUs in order to identify and differentiate project-affected persons from non-eligible people who may come into the project area (i.e. project boundary as shown in the map below) after the cut-off date. It has been set on the commencement day of the census survey as shown below through which all people, structures and improvements in the project site had been identified and recorded. People that move into and occupy the project area after the cut-off date will not be eligible to receive any compensation or support.

Cut-off Dates per Barangay

Barangay	Cut-off Date	Barangay	Cut-off Date
NRA, Mandaue City	April 26, 2019	Umapad, Mandaue City	April 23, 2019
Centro, Mandaue City	April 24, 2019	Paknaan, Mandaue City	April 26, 2019
Looc, Mandaue City	May 2, 2019	Ibo, Lapu-Lapu City	April 22, 2019
Opao, Mandaue City	April 16, 2019	Pusok, Lapu-Lapu City	April 22, 2019

Source: JICA Survey Team

Figure 9.4.2 Notification of the Project and Cut-off Date (English/sample)

Table 9.4.1 Cut-off Dates per Barangay for Eligibility

Barangay	Cut-off Date	Barangay	Cut-off Date
North Reclamation Area (NRA), Mandaue City	April 26, 2019	Umapad, Mandaue City	April 23, 2019
Centro, Mandaue City	April 24, 2019	Paknaan, Mandaue City	April 26, 2019
Looc, Mandaue City	May 2, 2019	Ibo, Lapu-Lapu City	April 22, 2019
Opao, Mandaue City	April 16, 2019	Pusok, Lapu-Lapu City	April 22, 2019

Source : JICA Survey Team

In addition, DPWH is committed to patrolling the project-affected area upon completion of the F/S by the assistance of the LGUs. A ground verification will made with support from the LGUs wherein they will issue pertinent documents which will show the affected property owners and an LGU certification which will prove that the individuals claiming compensation are situated within the boundary of the project. Furthermore, a pre-acquisition survey will determine the affected assets and ownership of the aforementioned assets together with photographic documentations of the affected project area.

9.4.3 Results of Census and Lost-asset Inventory Survey

1) Project-affected Persons and Companies

The survey revealed that there were 42 land owners, 33 non-residential structure[4] and asset (e.g. fences) owners that belong to mainly private companies and government bodies, eight tenants and 243 persons that belong to 69 households affected by the project. A bulk of the people, companies and government bodies affected are located in Mandaue City including all affected households while 10 land owners and 10 asset owners are located in Lapu-Lapu City (refer to Table 9.4.2). Excluding any duplication among the land owners and structure and asset owners, the total number of affected persons and entities, considering each company to be one entity, is 322 in total as shown in Table 9.4.3. All individuals that have their dwelling affected are informal settlers, or people that are living in the project-affected area without legal rights. All land owners and non-residential structure and asset owners, on the other hand, have permits to operate in the area hence can be considered formal owners and businesses. All of the 69 households (i.e. informal settlers) are all expected to be relocated. It is too early, given the limited information available at the F/S stage, on the other hand, to estimate with reasonable accuracy the number of formal entities that need to be relocated and hence this needs to be made apparent during the D/D stage.

Table 9.4.2 Number of Project-affected Entities by Type of Ownership and Location

Location/ Entities	Mandaue City						Lapu-Lapu City		TOTAL
	NRA/ CSSEAZ[5]	Centro	Looc	Opao	Umapad	Paknaan	Pusok	Ibo	
Households	-	-	5 (23)*[1]	11 (59)*[1]	12 (33)*[1]	41 (128)*[1]	-	-	**69 (243)*[1]**
Land Owners	9 (8)*[2]	1	9 (8)*[2]	11	4	1 (0)*[2]	7 (5)*[2]	5 (4)*[2]	**47 (42)*[2]**
Asset Owners*[3]	5	7	8	2	1	-	9	1	**33**
Tenants	-	-	-	-	-	-	-	8	**8**

*[1] Number in brackets are that of PAPs.
*[2] Number in brackets are that when excluding duplicates.
*[3] excluding households
Source : JICA Survey Team

[4] While improvements include structures according to the definition in RA7279, structures, referring to buildings and other physical, relatively large objects are described separately from improvements in this report to give the readers better understanding of the assets that are affected.

[5] City Special South Economic Administrative Zone

Table 9.4.3 Number of Project-affected Entities by Category

Affected Entities		Number	Remarks
Individuals	ISFs	243	69 HHs
	Land and Asset Owners	21	20 land owners and one aquaculture farmer
Private Companies		46	incl. eight tenants
Public Entities		12	
TOTAL		**322**	

Source: JICA Survey Team

The road and bridge alignment will pass through a number of relatively large companies' compound and affect some buildings. Table 9.4.4 exhibits the profile of the affected companies. It should be noted that some companies have not responded to the survey questionnaires and hence the table is not a complete list of all affected companies.

Table 9.4.4 Profile of the Project-affected Companies

Name of Companies	Type of Business	Main or Branch Office	Year Estab lished	Years in Operation	Monthly Net Income (PhP)	No. of Work ers	Revenue (PhP)
San Miguel Foods Incorporation	Warehouse, Maufacturing, Dry Goods & Feeds	Main	2016	Not yet operating	10,100,000-20,000,000 (expected)	221	No response (NR)
FMC-Dupont	Manufacturing	Main	1978	41	8,000,000	120	2,618,289,000
Tin Guan Trading Corp	Trading	Branch	NR	NR	NR	NR	NR
Petron Corp	Fuel, Terminal Depot	NR	NR	NR	5,100,000-10,000,000	NR	NR
Arctura Corp	Fuel, Terminal Depot	NR	2005	14	4,000,000	40	NR
Athecor Development Corp	Real Estate Devt	NR	NR	NR	NR	6	NR
General Milling Corp	Manufacturing, Leasing	NR	1961	58	NR	NR	NR
PJ's Videoke & BBQ	BBQ/Renting Space	NR	1999	20	30,000	2	NR
Muramoto Audio-Visuals Phils., Inc - Factory 1*	Manufacturing	Branch	1991	28	18,995,430	1,043	5,574,388,620
San Miguel Shipping & Lighterage Corp*	Warehousing, Transport/ Trucking	Main	1974	45	NR	312	NR
Petronas Marketing Group	LPG Distribution	NR	1997	22	NR	26	NR
BBQ House	Others (BBQ)	NR	NR	NR	NR	NR	NR
Miljun Bakeshop/ Key & Remote Duplicate	Bakeshop/ Renting space	NR	NR	NR	NR	NR	NR
Josh Internet Café	Internet Café/ Renting space	NR	NR	NR	NR	NR	NR

*Supplementary information was collected from their respective websites for these companies.
Source : JICA Survey Team

2) Land to be Acquired by the Project

86 plots of land (i.e. 28 plots of pubic land and 58 plots of private land) with a total land area of 549,190 m2 are expected to be acquired for the project. The plots and land size acquired are shown in the following table by barangays.

Table 9.4.5 Number of Plots and Land Size to be Acquired

Barangay		Land Area (No. of Plots)	
		Public	**Private**
Mandaue City			
	NRA	2,340 m2 (2)	1,590 m2 (11)
	Centro	9,720 m2 (5)	-
	Looc	1,390 m2 (2)	43,990 m2 (17)
	Opao	-	45,310 m2 (13)
	Umapad	-	373,160 m2 (8)
	Paknaan	11,200 m2 (2)	-
Lapu-Lapu City			-
	Pusok	9,980 m2 (3)	22,870 m2 (6)
	Ibo	23,190 m2 (14)	4,450 m2 (3)
Sub-total		**57,820 m2 (28)**	**491,370 m2 (58)**
TOTAL			**549,190 m2 (86)**

*total area of the plot is shown in case 20% or more of the land area is affected
Source : JICA Survey Team

3) Project-affected Structures

A total number of 115 structures are expected to be affected by the project. A large proportion of them belong to private entities including all houses that belong to informal settlers. A summary of the project affected structures is shown in the table below.

Table 9.4.6 Project-affected Structures by Category and Severity

Category of Structures		Severely Affected	Marginally Affected	Remarks
Private	ISFs' Houses	69	-	
	Other Structures	35	3	factory, warehouse, guard house etc.
Public		4	4	
TOTAL		**108**	**7**	

Source : JICA Survey Team

(1) Structures owned by Individual Households

<u>Type of Structure</u>

The project-affected households' affected housing/dwelling structures are predominantly shanties and wooden structures. In fact, this type of structures comprise of approximately 70% of the total number of structures affected. The type of materials used in the project affected structures in Barangay Looc, Opao, Umapad and Paknaan, Mandaue City are summarized in Table 9.4.7.

Table 9.4.7 Type of Materials used in Project-affected Structures

Type of Structure Materials (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Shanty/Light-Nipa/Cogon/Bamboo	1	1	10	12	**24**	**34.78**
Predominantly Wooden	1	6	2	16	**25**	**36.23**
Semi-Permanent (Concrete and Wood)	3	4	0	8	**15**	**21.74**
Permanent (Concreter)	0	0	0	4	**4**	**5.80**
Others	0	0	0	0	**0**	**0**
No Response	0	0	0	1	**1**	**1.45**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source : JICA Survey Team

Number of Storeys

The number of storeys of the buildings affected by the project in Barangays Looc, Opao, Umapad and Paknaan, Mandaue City are summarized in Table 9.4.8.

Table 9.4.8 Number of Storeys of Project-affected Buildings

Number of Storeys (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
1-storey/flat	3	9	10	27	**49**	**71.01**
2-storeys	2	2	0	13	**17**	**24.64**
3-storeys	0	0	0	1	**1**	**1.45**
4-storeys	0	0	0	0	**0**	**0**
More Storeys	0	0	0	0	**0**	**0**
No Response	0	0	2	0	**2**	**2.90**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source : JICA Survey Team

Type of Roofing

The type of roofing of the project-affected Structures in Barangays Looc, Opao, Umapad and Paknaan, Mandaue City are summarized inTable 9.4.9.

Table 9.4.9 Materials used for Roofing of Project-affected Structures

Roof Type (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Tiles	0	0	0	0	**0**	**0**
Galvanized Iron (GI) Sheets	5	11	2	38	**56**	**81.16**
Nipa	0	0	0	0	**0**	**0**
Cogon Grass	0	0	0	0	**0**	**0**
Others	0	0	10	2	**12**	**17.39**
No Response	0	0	0	1	**1**	**1.45**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source : JICA Survey Team

Type of Wall

The materials used for walls of the project-affected structures are concrete, wood, bamboo, combination of concrete/wood and other used tarpaulin. The type of walling materials of the PAFs is summarized in Table 9.4.10.

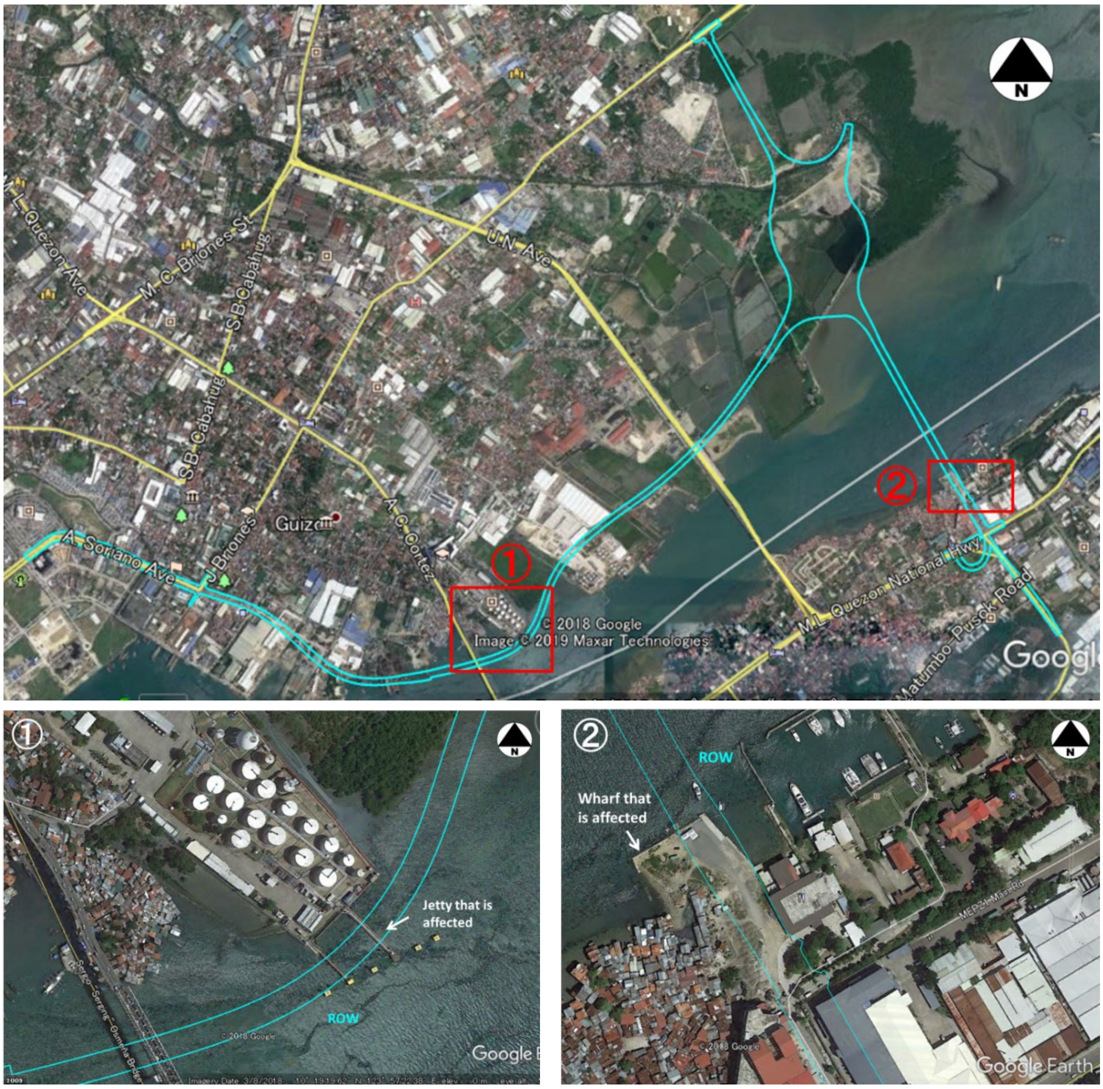
Table 9.4.10 Type of Wall used in Project-affected Structures

Wall Type (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Concrete	0	1	0	7	**8**	**11.59**
Wood	5	10	7	30	**52**	**75.36**
Bamboo	0	0	1	3	**4**	**5.80**
Grass	0	0	0	0	**0**	**0**
Others	0	0	4	1	**5**	**7.25**
No Response	0	0	0	0	**0**	**0**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source : JICA Survey Team

(2) Structures owned Publicly and Privately

38 private structures and eight public structures are considered to be affected by the project as presented in Table 9.4.6 above. This includes a jetty that belongs to a private company (i.e. Petron) and is used to transport oils from the ships to the oil tanks. In addition, a wharf that is located in Lapu-Lapu City is considered to be partially affected by the project and hence planned to be compensated (i.e. extended). The location of these structures are shown below.



Source : JICA Survey Team

Figure 9.4.3 Location of Project-affected Jetty and Wharf

4) Project-affected Assets

(1) Assets owned by Individual Households

Assets owned by the individual households affected by the project in Barangays Looc, Opao, Umapad and Paknaan, Mandaue City are summarized in Table 9.4.11.

Table 9.4.11 Project-affected Assets owned by Households

Other Assets (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Fence	1	5	0	6	**12**	**38.71**
Pathway	0	4	0	1	**5**	**16.13**
Waiting Shed	0	0	0	0	**0**	**0.00**
Pigpen	0	0	0	2	**2**	**6.45**
Poultry	0	1	0	2	**3**	**9.68**
Storage Shed	0	0	0	0	**0**	**0.00**
Garage	0	0	0	0	**0**	**0.00**
Sari-sari store	0	1	0	2	**3**	**9.68**
Dog House	0	0	0	2	**2**	**6.45**
Compost	0	0	0	0	**0**	**0.00**
Materials Recovery Facility	0	1	0	1	**2**	**6.45**
Outside Comfort Room (i.e. toilet)	0	1	0	0	**1**	**3.23**
Others	0	0	0	1	**1**	**3.23**
TOTAL	**1**	**13**	**0**	**17**	**31**	**100.00**

Source : JICA Survey Team

(2) Other Assets owned Publicly and Privately

A number of assets such as fences and concrete floor are also expected to be affected by the project. Public utilities such as power poles are also found to be located within the ROW and hence are expected to be affected. In addition, there is one aquaculture farm in Umapad that is in operation whose land size is approximately 2.35 ha (23,500 m2) as shown in the figure below.

Source : JICA Survey Team

Figure 9.4.4 Location of Project-affected Aquaculture Farm

5) Project-affected Trees

(1) Trees owned by Individual Households

The type of trees and cultivated crops of the project-affected households in Looc, Opao, Umapad and Paknaan, Mandaue City are summarized in Table 9.4.12.

Table 9.4.12 Project-affected Tree Species owned by Individual Households

Tree Species	Number of Trees by Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Gmelina	0	0	0	1	**1**	**1.41**
Mahogany	0	0	0	0	**0**	**0.00**
Acacia	0	0	0	0	**0**	**0.00**
Talisay	0	4	1	5	**10**	**14.08**
Mango	0	0	0	4	**4**	**5.63**
Nangka	0	0	0	3	**3**	**4.23**
Caimito	0	0	0	0	**0**	**0.00**
Coconut	0	2	0	5	**7**	**9.86**
Banana	0	0	0	13	**13**	**18.31**
Papaya	0	2	0	10	**12**	**16.90**
Camanchiles	0	0	0	0	**0**	**0.00**
Boongon	0	0	0	0	**0**	**0.00**
Tomato	0	0	0	0	**0**	**0.00**
Leafy Legumes	0	3	0	2	**5**	**7.04**
Bil-at	0	1	0	0	**1**	**1.41**
Malunggay	0	2	2	2	**6**	**8.45**
San Francisco	0	1	0	0	**1**	**1.41**
Agbate	0	1	0	0	**1**	**1.41**
Tangad	0	1	0	0	**1**	**1.41**
Guava	0	0	0	0	**0**	**0.00**
Mangroves	0	0	2	0	**2**	**2.82**
Tambis	0	0	0	2	**2**	**2.82**
Others	0	0	0	2	**2**	**2.82**
TOTAL	**0**	**17**	**5**	**49**	**71**	**100.00**

Source : JICA Survey Team

Source : JICA Survey Team

Figure 9.4.5 Trees and Crops located in the Project-affected Area

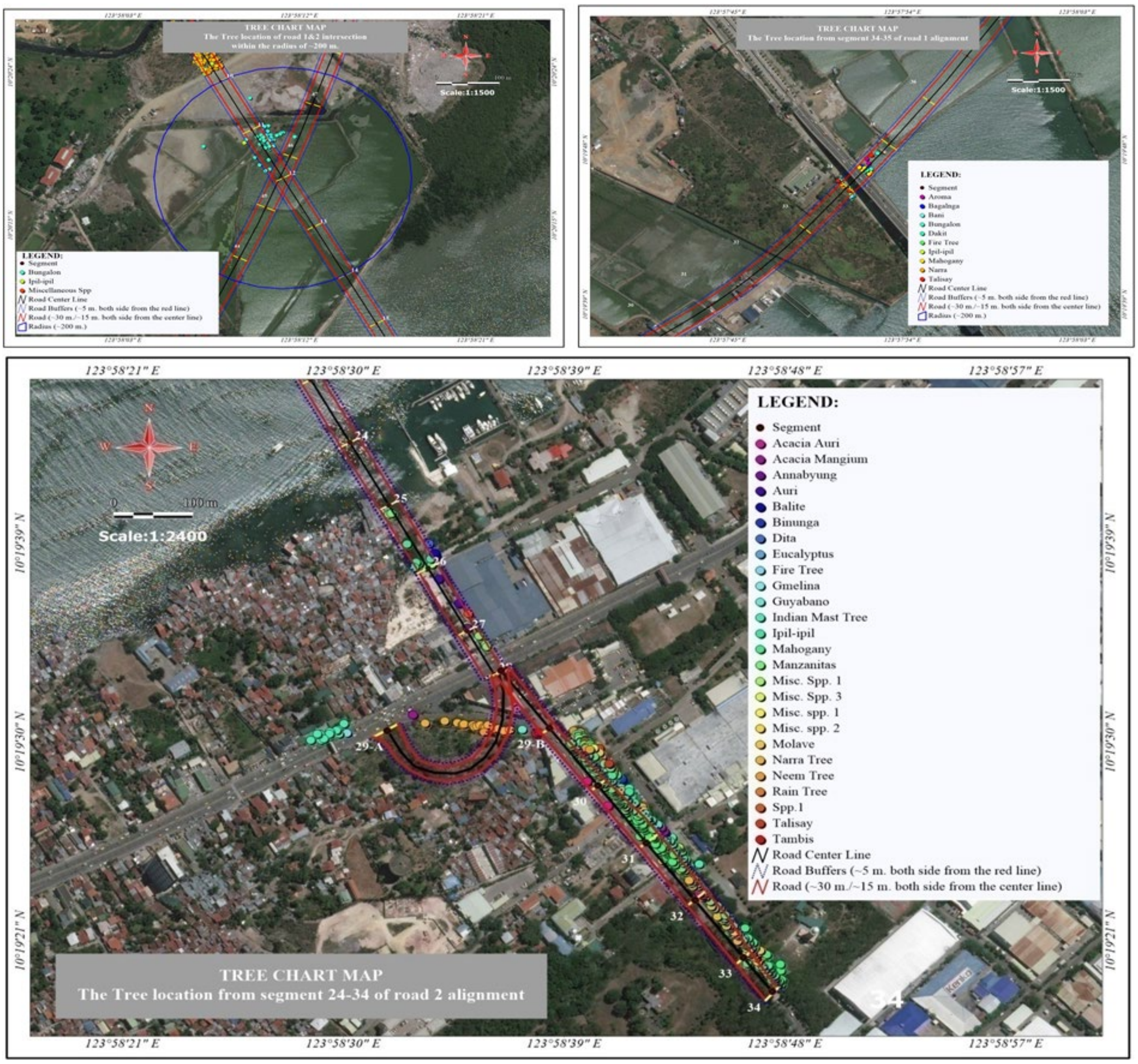
(2) Other Trees owned Publicly and Privately

An inventory survey was conducted along the route alignment. As a result, a total number of 1,494 trees of various species were found to be affected by the project. 70 of such trees are privately-owned, while the rest are located within the government property ande hence considered publicly-owned. Among the publicly-owned trees, 1,195 are found to be grown along the existing road such as the airport access road.

Table 9.4.13 Other Project-affected Tree Species owned Publicly and Privately

Location and Tree Species	Number of Trees	
	Public	Private
Mandaue City		
Anabiong	1	
Antipolo	3	
Auri	9	
Bagalnga	3	
Balite	13	
Bani	1	
Binunga	2	
Caimito	5	
Eucalyptus camadulensis	31	
Eucalyptus deglupta	9	
Fire Tree	9	
Gmelina	1	3
Guava		1
Indian Mast Tree	2	9
Ipi-ipil		4
Ipil-ipil	75	
Kapok	2	
Kulis	1	
Mahogany	37	1
Manga	7	
Manzanitas	5	
Misc. Spp 1	1	
Misc. Spp 2	2	
Molave	144	1
Narra	71	
Neem Tree	32	31
Noni	1	
Raintree	8	
Talisay	20	
Taloto	1	
Lapu-Lapu City		-
Anabiong	4	
Auri	5	
Balite		4
Binunga	9	
Dita		1
Eucalyptus spp.		1
Fire Tree	1	
Gmelina	21	
Guyabano	1	
Indian Mast Tree	42	
Ipil-ipil	11	9
Mahogany	674	
Mangium	10	
Manzanitas	6	5
Misc. Spp1	3	
Misc. Spp2	1	
Misc. Spp3	5	
Molave	27	
Narra	84	
Neem Tree	12	
Rain Tree	2	
Spp1	1	
Talisay	7	
Tambis	2	
TOTAL	**1,424**	**70**

Source : JICA Survey Team



Source : JICA Survey Team

Figure 9.4.6 Distribution of Project-affected Publicly and Privately Owned Trees

9.4.4 Results of Socio-economic Survey

(1) Household Composition

Household Size

Among the 69 total PAFs, 37 of them have a size of household that range from one to four members. 24 PAFs have a household size of five to seven members while two PAFs have a household size of 8-10 members. The PAFs' household sizes in the affected barangays are shown in Table 9.4.14.

Table 9.4.14 Size of Project-affected Households

Household Size (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
1-4	2	2	8	25	**37**	**53.62**
5-7	3	8	3	10	**24**	**34.78**
8-10	0	1	0	1	**2**	**2.90**
11-15	0	0	0	0	**0**	**0**
No Response	0	0	1	5	**6**	**8.70**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source: JICA Survey Team

Number of Children

The number of children of the project-affected households in Barangays Looc, Opao, Umapad and Paknaan, Mandaue City is summarized in Table 9.4.15.

Table 9.4.15 Number of Children in the Project-affected Households

Number of Children (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
None	1	0	4	6	**11**	**15.94**
1	2	2	4	12	**20**	**28.99**
2	0	0	0	6	**6**	**8.70**
3	0	4	0	6	**10**	**15.50**
4	1	4	0	2	**7**	**10.14**
5	1	1	2	1	**5**	**7.25**
6	0	0	0	0	**0**	**0**
7	0	0	0	0	**0**	**0**
8	0	0	0	0	**0**	**0**
9	0	0	0	1	**1**	**1.45**
10	0	0	0	0	**0**	**0**
No Response	0	0	2	7	**9**	**13.04**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source : JICA Survey Team

(2) Marital Status

Among the 69 PAFs in total, 41 or 60.89% are married while 20 or 28.99% are single. One or 1.45% is a widower and the rest of the PAFs did not answer. The project-affected households by marital status in Barangay Looc, Opao, Umapad and Paknaan, Mandaue City respectively are summarized in Table 9.4.16.

Table 9.4.16 Project-affected Household Heads by Marital Status

Marital Status (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Single	3	2	6	9	**20**	**28.99**
Married	2	9	4	26	**41**	**60.89**
Widower	0	0	0	1	**1**	**1.45**
No Response	0	0	2	5	**7**	**10.14**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source : JICA Survey Team

(3) Gender

Among the 69 total PAFs, a majority (69.57%) of the household heads are male while 17.69% are female. The project-affected households' gender in Barangay Looc, Opao, Umapad and Paknaan, Mandaue City respectively are summarized in Table 9.4.17.

Table 9.4.17 Project-affected Household Heads by Gender

Gender (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Male	4	10	7	27	**48**	**69.57**
Female	1	1	3	7	**12**	**17.39**
No Response	0	0	2	7	**9**	**8.70**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100.00**

Source : JICA Survey Team

(4) Age Structure

Age distribution of the project-affected household heads is summarized in Table 9.4.18. 56.62% or 39 household heads belong to an age group of 30 to 60 years old. Approximatley 17.39% or 12 household heads are 18-30 years old while 10.14% of the PAFs' household heads were over 60 years old.

Table 9.4.18 Project-affected Household Head by Age Structure

Age (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
<18	0	0	0	0	**0**	**0.00**
18-30	0	3	2	7	**12**	**17.39**
30-60	4	8	5	22	**39**	**56.52**
>60	1	0	2	4	**7**	**10.14**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100.00**

Source : JICA Survey Team

(5) Educational Attainment

Out of the 69 PAFs, 17 or 24.64% are high school graduates, 14 or 20.29% are high school undergraduate, 11 or 15.94% are elementary undergraduates, nine or 13.04% are college graduate, six are elementary graduate, three are college undergraduate, and two PAFs were vocational graduate or had no educational attainment. The educational attainments of the PAFs' household heads in the barangays are shown in Table 9.4.19.

Table 9.4.19 Project-affected Household Head by Educational Attainment

Educational Attainment (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
None	0	1	1	0	**2**	**2.90**
Elementary Undergraduate	1	1	3	6	**11**	**15.94**
Elementary Graduate	0	1	4	1	**6**	**8.70**
High School Undergraduate	1	5	3	5	**14**	**20.29**
High School Graduate	1	3	1	12	**17**	**24.64**
Vocational Undergraduate	0	0	0	0	**0**	**0**
Vocational Graduate	1	0	0	1	**2**	**2.90**
College Undergraduate	0	0	0	3	**3**	**4.35**
College Graduate	1	0	0	8	**9**	**13.04**
Post Graduate	0	0	0	0	**0**	**0**
No Response	0	0	0	5	**5**	**7.25**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source: JICA Survey Team

(6) Linguistic Characteristics

Out of the 69 total project-affected households, 45 belong to the Binisaya ethno-linguistic, while 18 of the interviewed speaks Cebuano. Table 9.4.20 shows the distribution of PAFs' linguistic characteristics.

Table 9.4.20 Distribution of Project-affected Household Heads by Linguistic Characteristics

Ethno-Linguistic Affiliation (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Binisaya	4	9	8	24	**45**	**65.22**
Cebuano	1	2	3	12	**18**	**26.09**
Boholano	0	0	0	0	**0**	**0**
Hiligaynon/Ilonggo	0	0	0	0	**0**	**0**
Tagalog	0	0	0	0	**0**	**0**
Waray-waray	0	0	0	0	**0**	**0**
Ilocano	0	0	0	0	**0**	**0**
Others	0	0	0	0	**0**	**0**
No Response	0	0	1	5	**6**	**8.70**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source: JICA Survey Team

(7) Ethnicity

Out of the 69 total project-affected households, 36 or 52.17% of them, belong to the Bisaya Group, while 33 of them did not respond. The high rate of non-response is presumably because they considered them not to be affiliated with any of the ethnic (i.e. indigenous) groups included in the questionnaire from which respondents were to select and hence decided not to answer. Table 9.4.21 shows the distribution of PAFs' ethnic group affiliation in the barangays. The result confirms that there is no indigenous group of people included in the project-affected households.

Table 9.4.21 Distribution of Project-affected Households by Ethnicity

Ethnic Affiliations (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Igorot	0	0	0	0	**0**	**0**
Mangayn	0	0	0	0	**0**	**0**
Tausug/Maranao	0	0	0	0	**0**	**0**
Manobo	0	0	0	0	**0**	**0**
Subanon	0	0	0	0	**0**	**0**
Aeta	0	0	0	0	**0**	**0**
Badjao	0	0	0	0	**0**	**0**
Others (Bisaya)	4	4	8	20	**36**	**52.17**
No Response	1	7	4	21	**33**	**47.83**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source: JICA Survey Team

(8) Access to Basic Social Services

<u>Source of Drinking Water</u>

A total number of 31 or 44.93% of the PAFs has a water source from piped water provided by the Metropolitan Cebu Water District (MCWD) and five or 7.25% of them from the piped water (other source). 14 households or 20.29% use dug well, nine or 13.04% buy bottled water and one household or 1.45% rely on a spring. None of them collects rainwater or use cart with small tank/drum. Three households use other sources. The source of water supply of the PAFs in Barangays Looc, Opao, Umapad, and Paknaan are summarized in Table 9.4.22.

Table 9.4.22 Source of Drinking Water of the Project-affected Households

Source of Drinking Water (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Piped Water (MCWD)	5	4	10	12	**31**	**44.93**
Piped Water (Other Source)	0	0	0	5	**5**	**7.25**
Dug Well	0	0	1	13	**14**	**20.29**
Spring	0	1	0	0	**1**	**1.45**
Rainwater Collection	0	0	0	0	**0**	**0**
Bottled Water	0	4	0	5	**9**	**13.04**
Cart with small tank/drum	0	0	0	0	**0**	**0**
Others	0	2	**0**	1	**3**	**4.35**
No Response	0	0	1	**5**	**6**	**8.70**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source: JICA Survey Team

Sanitation Facilities

A total number of 26 or 37.68% of the PAFs utilized flush/pour flush to septic tank type of toilet. Three or 4.35% of them used flush/pour flush to pit latrine. Those who utilized pit latrine had a total number of six or 8.70%. Four or 5.80% use composting toilet, 12 or 17.39% use the public/common toilet while nine or 13.04% has no facilities and the remaining three or 4.35% use other types of toilet facility. Table 9.4.23 shows the type of sanitation facilities of the PAFs in the project affected area.

Table 9.4.23 Sanitation Facilities of the Project-affected Households

Sanitation Facilities (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Flush/Pour Flush to Septic Tank	5	1	0	20	**26**	**37.68**
Flush/Pour Flush to Pit Latrine	0	3	0	0	**3**	**4.35**
Ventilated Improved Pit Latrine	0	0	0	0	**0**	**0**
Pit Latrine	0	6	0	0	**6**	**8.70**
Composting Toilet	0	0	0	4	**4**	**5.80**
Bucket	0	0	0	0	**0**	**0**
Public/Common Toilet	0	1	3	8	**12**	**17.39**
No facilities or elsewhere	0	0	7	2	**9**	**13.04**
Others	0	0	1	2	**3**	**4.35**
No Response	0	0	1	5	**6**	**8.70**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source: JICA Survey Team

Electricity

Among the 69 PAFs, seven or 10.14% of the PAFs affected use kerosene, 14 or 20.29% have access to electricity, and 37 or 53.62% PAFs utilize other lighting facilities such as solar. Table 9.4.24 summarizes the PAFs lighting facilities of barangays Looc, Opao, Umapad and Paknaan in Mandaue City.

Table 9.4.24 Lighting Facilities used by the Project-affected Households

Lighting Facilities (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Kerosene	0	0	4	3	**7**	**10.14**
Coleman	0	0	0	0	**0**	**0**
Oil	0	0	0	0	**0**	**0**
VECO	5	0	0	9	**14**	**20.29**
Own Generator	0	0	0	0	**0**	**0**
Others	0	11	7	19	**37**	**53.62**
No Response	0	0	1	10	**11**	**15.94**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source: JICA Survey Team

Cooking Facilities

The sources of cooking fuels utilized by the PAFs are wood, LPG, kerosene, electricity and butane. 21 PAFs utilize wood, followed by 18 of them that utilize LPG. 13 households use butane and seven rely on charcoal. Three households use electricity and two PAFs utilize other cooking facilities. Table 9.4.25 shows the PAFs cooking facilities in Barangays Looc, Opao, Umapad, and Paknaan, Mandaue City.

Table 9.4.25 Cooking Facilities used by the Project-affected Households

Cooking Facilities (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Wood	0	2	7	12	**21**	**30.43**
Charcoal	0	0	0	0	**0**	**0**
LPG	0	5	0	13	**18**	**26.09**
Kerosene	0	1	0	1	**2**	**2.90**
Electricity	0	0	3	0	**3**	**4.35**
Butane	5	2	1	5	**13**	**18.84**
Others	0	0	0	2	**2**	**2.90**
No Response	0	1	1	8	**10**	**14.49**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source: JICA Survey Team

(9) Primary Source of Income

Out of the 69 total PAFs, household heads' main source of income in the barangays are presented in Table 9.4.26. The occupation with the largest group of respondents were unskilled labor (i.e. 23.19%) followed by skilled labor (i.e. 11.59%) and government employee (10.14%).

Table 9.4.26 Main Occupation of Project-affected Household Heads

Occupation (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
None	0	1	1	0	**2**	**2.90**
Farmer/Crop	0	0	0	0	**0**	**0**
Farmer/Livestock	0	0	0	0	**0**	**0**
Cottage Industry (Broom making, Mat weaving, etc.)	0	0	0	0	**0**	**0**
Hired Farm Worker	0	1	0	0	**1**	**1.45**
Aquaculture	0	0	0	0	**0**	**0**
Fisherman	0	0	0	0	**0**	**0**
Driver/Habal-Habal,Trike	0	1	0	2	**3**	**4.35**
Driver/Taxi, Rent-A-Car, etc	0	0	0	3	**3**	**4.35**
Waste Picker (Landfill)	0	0	5	1	**6**	**8.70**
Waste Recycler	0	0	3	0	**3**	**4.35**
Skilled Labor	0	5	0	3	**8**	**11.59**
Unskilled Labor	2	1	2	11	**16**	**23.19**
Government Employee	2	0	0	5	**7**	**10.14**
Private Firm	0	2	0	3	**5**	**7.25**
Business Operator	0	0	0	2	**2**	**2.90**
Housekeeper	0	0	0	0	**0**	**0**
Hunter/Gatherer	0	0	0	0	**0**	**0**
Gleaning	0	0	0	0	**0**	**0**
OFW	0	0	0	0	**0**	**0**
Student	0	0	0	0	**0**	**0**
Others	0	0	0	3	**3**	**4.35**
No Response	1	0	1	8	**10**	**14.49**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source: JICA Survey Team

(10) Secondary Source of Income

The secondary source of income for the 69 PAFs living in Looc, Opao, Umapad, Paknaan are summarized in the table below.

Table 9.4.27 Secondary Occupation of Project-affected Household Head

Occupation (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
None		4		1	**5**	**7.25**
Farmer/Crop					**0**	**0**
Farmer/Livestock			1		**1**	**1.45**
Cottage Industry (Broom making, Mat weaving, etc.)					**0**	**0**
Hired Farm Worker					**0**	**0**
Aquaculture					**0**	**0**
Fisherman					**0**	**0**
Driver/Habal-Habal,Trike		1			**1**	**1.45**
Waste Picker (Landfill)			2		**2**	**2.90**
Waste Recycler					**0**	**0**
Skilled Labor		1			**1**	**1.45**
Unskilled Labor		1		1	**2**	**2.90**
Government Employee					**0**	**0**
Private Firm		1		1	**2**	**2.90**
Business Operator					**0**	**0**
Housekeeper					**0**	**0**
Hunter/Gatherer					**0**	**0**
Gleaning					**0**	**0**
OFW						
Student					**0**	**0**
Others			1	1	**2**	**2.90**
No Response	5	3	8	37	**53**	**76.81**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source: JICA Survey Team

(11) Household Income

A total number of 21 or 30.43% of PAFs have a monthly income range of PhP 1,001-5,000 while 13 or 18.84% is on the range of PhP 5,001-10,000. 12 or 17.37% of the PAFs have an income range of PhP 10,001-15,000, and four or 5.80% have a monthly income range of less than PhP 1,000. Three or 4.35% enjoy PhP 30,001-50,000 and two households have an income range of PhP 15,001-20,000. As explained later, 38 households fall under the poverty threshold of PhP 10,481 per month set by NEDA. The monthly household income range of the PAFs in Barangay Looc, Opao, Umapad, and Paknaan, Mandaue City is summarized in Table 9.4.28.

Table 9.4.28 Monthly Household Income Range of the Project-affected Households

Monthly Household Income Range (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Below 1,000	0	0	1	3	**4**	**5.80**
1,001-5,000	2	3	7	9	**21**	**30.43**
5,001-10,000	1	0	2	10	**13**	**18.84**
10,001-15,000	2	3	0	7	**12**	**17.37**
15,001-20,000	0	1	0	1	**2**	**2.90**
20,001-30,000	0	2	0	0	**2**	**2.90**
30,001-50,000	0	1	0	2	**3**	**4.35**
Above 50,000	0	0	0	0	**0**	**0**
No Response	0	1	2	9	**12**	**17.37**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source : JICA Survey Team

(12) Household Expenditures

Respondents of the households explained that their monthly expenses were mainly on food and utilities. Except for Brangay Opao, households' food expenses comprise approximately 87-91 percent of the total monthly expenditures. The total monthly expenses range from PhP 4,433 in Barangay Umapad to PhP 15,938 in Barangay Opao. The following table shows the average monthly household expenditures of the PAFs in Barangay Looc, Opao, Umapad, and Paknaan.

Table 9.4.29 Average Monthly Household Expenditures Range of the Project-affected Households

Monthly Household Expenditures	Barangay				TOTAL/ AVERAGE
	Looc	Opao	Umapad	Paknaan	
Number of PAHs	5	11	12	41	**69**
Ave. HH Size	4.6	5.4	3.0	3.55	**4.14**
Ave. Monthly Expenditures (PhP) on:					
-Food	7,325 (4)[x]	9,000 (9)	4,040 (5)	5,481 (13)	**6,461.50**
-Utilities	450 (2)	998.75 (8)	193 (3)	357 (7)	**499.69**
-Education	350 (2)	1,615 (4)	200 (1)	350 (4)	**628.75**
-Medical Care	NR	2,100 (2)	NR	0	
-Taxes	NR	900 (1)	NR	0	
-Allowances	NR	NR	NR	100 (1)	
-Transportation	NR	1,325(4)	NR	NR	
TOTAL MONTHLY EXPENDITURES	**8,125**	**15,938.75**	**4,433**	**6,288**	

* Number in brackets are that of households that responded to this specific item
Source : JICA Survey Team

(13) Type of Land

The type of land which the project-affected households are in occupancy in Barangay Looc, Opao, Umapad and Paknaan, Mandaue City are, according to the respondents, as summarized in Table 9.4.30.

Table 9.4.30 Type of Land occupied by the Project-affected Households

Type of Land (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Private (A&D*)	0	11	0	0	**11**	**15.94**
Government-National	0	0	0	0	**0**	**0**
Government-Local	5	0	8	0	**13**	**18.84**
Forestland (Mangroves)	0	0	4	41	**45**	**65.22**
Others	0	0	0	0	**0**	**0**
No Response	0	0	0	0	**0**	**0**
TOTAL	**5**	**11**	**12**	**41**	69	100

*alienable and disposable land (i.e. type of land that can be titled by private persons or companies)
Source : JICA Survey Team

(14) Land Use Status

The land use of the project-affected households in Barangay Looc, Opao, Umapad and Paknaan, Mandaue City are summarized in Table 9.4.31. While many people, more than 75% of the respondents, answered that it is an agricultural land, in fact, none of the PAHs are engaged in farming and there are very few crops found to be grown in the area.

Table 9.4.31 Land Use Status of the Project-affected Households

Land Use (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Agricultural	0	0	12	41	**53**	**76.81**
Residential	5	9	0	0	**14**	**20.29**
Commercial	0	1	0	0	**1**	**1.45**
Industrial	0	1	0	0	**1**	**1.45**
Institutional	0	0	0	0	**0**	**0**
Others	0	0	0	0	**0**	**0**
No Response	0	0	0	0	**0**	**0**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source : JICA Survey Team

(15) Title over Land

The claimed rights of the PAPs over the land where they are in occupation in Barangays Looc, Opao, Umapad and Paknaan, Mandaue City are summarized in Table 9.4.32. One person claimed to be having ownership over the land. However, no evidence could be provided at the time of the survey that suggests the respondents' ownership nor does the official data provided by Mandaue City show the respondent's possession. While the majority of the occupants are said to be staying in the area without consent from the land owner, approximately 15% of them claim to have such consent. However, none of them have been paying any fee to the land owners.

Table 9.4.32 Claimed Land Title of the Project-affected Households

Tenureship (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Owner	0	0	0	1	**1**	**1.45**
Tenant	0	0	0	14	**14**	**20.29**
Free Occupation with Permit*[1]	0	10	0	0	**10**	**14.49**
Free Occupation without Permit*[2]	5	1	12	26	**44**	**63.77**
No Response	0	0	0	0	**0**	**0**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

*[1] occupying the land with permission from the land owner
*[2] occupying the land without permission from the land owner
Source : JICA Survey Team

(16) Proof of Title

The proof of ownership over the land that is to be acquired for the project in Barangay Looc, Opao, Umapad and Paknaan, Mandaue City are summarized in Table 9.4.33. While three respondents claimed during the survey to have evidence to prove their ownership, none of them were able to show any evidence or even provide information on what kind of documents or other proofs they possessed.

Table 9.4.33 Project-affected Households' Proof of Ownership over Land

Tenure (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Land Title	0	0	0	0	**0**	**0**
Deed of Sale	0	0	0	0	**0**	**0**
Tax Declaration	0	0	0	0	**0**	**0**
Contract	0	0	0	0	**0**	**0**
None	5	11	11	39	**66**	**95.65**
Others	0	0	1	2	**3**	**4.35**
No Response	0	0	0	0	**0**	**0**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source : JICA Survey Team

(17) Duration of Occupancy

The length of period the PAPs have been in occupancy in the area in Barangay Looc, Opao, Umapad and Paknaan, Mandaue City are summarized in Table 9.4.34. It has been found from the survey that approximately 35% of the PAPs have moved into the area recently (i.e. between 2015 and 2018) and approximately half of them have moved in the last 10 years.

Table 9.4.34 Duration of Occupancy of Project-affected Households

Year moved into Project-affected Area (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
1950's and earlier	0	0	0	0	**0**	**0**
1951-1959	0	0	0	0	**0**	**0**
1960-1969	0	2	0	1	**3**	**4.35**
1970-1979	0	0	0	0	**0**	**0**
1980-1989	0	3	0	4	**7**	**10.14**
1990-1999	3	4	3	1	**11**	**15.94**
2000-2004	1	0	2	3	**6**	**8.70**
2005-2009	0	0	2	2	**4**	**5.80**
2010-2014	0	2	2	4	**8**	**11.59**
2015-2018	1	0	2	21	**24**	**34.78**
2019	0	0	0	0	**0**	**0**
No Response	0	0	1	5	**6**	**8.70**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source: JICA Survey Team

(18) Perception of the PAPs

Project Awareness

Among the 69 household heads, 60 or 86.96% of them are aware of the project while only two or 2.90% PAFs have no knowledge about the project. The project awareness of project affected household heads is summarized in Table 9.4.35.

Table 9.4.35 Project Awareness of the PAPs

Project Awareness	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Yes	5	11	11	33	**60**	**86.96**
No	0	0	0	2	**2**	**2.90**
No Response	0	0	1	6	**7**	**10.14**
TOTAL	**5**	**11**	**12**	**41**	**69**	

Source : JICA Survey Team

Source of Information on the Project

The source of information collected on the project in the Barangays Looc, Opao, Umapad and Paknaan, Mandaue City are summarized in Table 9.4.36. It has been revealed from the survey that most of the PAPs have heard about the project from either the government officials (i.e. 33.33%) or from neighbors and friends (i.e. 31.88%).

Table 9.4.36 Source of Information on the Project

Source of Information (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Government Officials	4	4	2	13	**23**	**33.33**
Flyers Handed Out	0	0	0	0	**0**	**0**
Neighbors/Friends	1	3	5	13	**22**	**31.88**
Posters in the Barangay Hall	0	0	0	0	**0**	**0**
Relatives	0	0	0	0	**0**	**0**
Radio	0	0	1	1	**2**	**2.90**
TV	0	0	2	5	**7**	**10.14**
NGOs	0	0	0	0	**0**	**0**
Newspaper	0	0	0	0	**0**	**0**
Public Meetings/Consultations	0	3	1	0	**4**	**5.80**
Enumerators/During Survey	0	1	0	3	**1**	**1.45**
Others	0	0	0	0	**0**	**0**
No Response	0	0	1	6	**7**	**10.14**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source : JICA Survey Team

Attitude towards the Project

Out of the 69 households affected, 58 or 84.06% of them are in favor of the project while one household or 1.45% was not in favor of the project as the respondent was afraid of losing the land and having livelihood being affected[6]. The PAFs stand on the project affected household heads is summarized in Table 9.4.37.

Table 9.4.37 PAPs' Attitude towards the Project

Attitude towards the Project (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Favorable	5	9	11	33	**58**	**84.06**
Unfavorable	0	0	0	1	**1**	**1.45**
Not Decided	0	1	0	0	**1**	**1.45**
No Comment	0	1	0	1	**2**	**2.90**
No Response	0	0	1	6	**7**	**10.15**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100**

Source : JICA Survey Team

Preference of PAFs for Livelihood Restoration Programs

Preferences of the PAFs for livelihood restoration programs in Barangay Looc, Opao, Umapad and Paknaan, Mandaue City are summarized in Table 9.4.38.

Table 9.4.38 PAFs' Preference for Livelihood Restoration Programs

Preference of PAPs for Livelihood Restoration Programs (Number and Percentage Share)	Barangay				TOTAL	%
	Looc	Opao	Umapad	Paknaan		
Compensation	2	2	5	18	**27**	**39.12**
Vocational Training	0	0	0	0	**0**	**0.00**
Employment	0	3	1	3	**7**	**10.14**
Granting of Credit	0	0	0	0	**0**	**0.00**
Relocation	0	4	4	4	**12**	**17.39**
Others	0	0	0	0	**0**	**0.00**
No Response	3	2	2	16	**23**	**23.33**
TOTAL	**5**	**11**	**12**	**41**	**69**	**100.00**

Source : JICA Survey Team

Preference of PAFs for Compensation and Relocation

An additional survey was conducted in July, 2019 to confirm the PAFs' preference between being compensated in cash or being allowed to move into a resettlement site for replacement of loss of housing/abode. Among those that responded, 79% were in favor of the option of resettlement housing. Those that chose this option all preferred row houses and lot package as opposed to the low-rise buildings (LRBs). Their preference for the location of the housing package was within five km radius from their existing residence. The table below shows the result of the questionnaire.

[6] The respondent said he would be in favor of the project if there was a resettlement site provided.

Table 9.4.39 PAFs Preference for Compensation/Replacement of Loss

Description	Looc	Opao	Umapad	Paknaan	TOTAL
Public Consultations/Meetings Attended on:					
-March 6		4			**4**
-April 12		10	1		**11**
-June 4		8	2	1	**11**
-None	3		1	25	**29**
Choice of Compensation/Replacement type to transfer residence					
Cash Compensation	1	2	2	4	**9**
Resettlement Housing	4	9	1	20	**34**
Choice of Type of Resettlement/Housing:					
Row House/House and Lot	4	9	1	20	**34**
Low-Cost LRBs					
Amenable to either options Row House or LRBs					
Maximum Acceptable Distance of the Resettlement Site:					
Row House/House and Lot:					
-Within 5km	3	1	1	20	**25**
-5-10 km	1	6			**7**
-10-15 km					
-15-30 km					
-Above 30 km					
Low-Cost LRBs/Medium Rise Building					
-Within 5km		2			**2**
-5-10 km					
-10-15 km					
-15-30 km					
-Above 30 km					
Ranges of Monthly Amortization Fee acceptable or willing to Pay (PhP)					
-Below 500	4	9	1	13	**27**
-500-1000				7	**7**
-1001-5000					
-5001-10,000					
-Above 10,000					
-Undecided				7	**7**

Source : JICA Survey Team

(19) Households belonging to Vulnerable Groups

The vulnerable groups have been defined in this survey to be the following groups of people: poor people whose combined income falls within the poverty threshold set by NEDA except for professional squatters and members of the squatting syndicates[7]; female-headed households; elderly people; and persons with disabilities (PWD).

The Philippine Statistics Authority (PSA) reported that the poverty threshold per family per month rose by 10.9% in the Philippines to PhP 10,481 in 2018 from PhP 9,453 in 2015. The PSA explained that this is the level of income needed to meet both basic food and nonfood needs of a family of five in one month[8]. Based on the results of the survey, the number of households that fall under these categories are as follows. The number of households that belong to at least one of these groups is 44.

Table 9.4.40 Number of Project-affected Households considered Vulnerable

Type of Vulnerability	Number of PAFs
Poor	38
Female-headed	12
Elderly	7
PWDs	0
Poor, Female-headed, Elderly or PWDs	44

Source: JICA Survey Team

[7] Not only those informal settlers that meet the conditions set forth in RA10752 and RA7279 but those who do not meet the requirements will also be entitled to compensation and relocation in this project unless they have been found to be coming back to the original site of dwelling for unlawful reasons. The project proponent or DPWH and LGUs will jointly examine the resettlement qualifications of the affected people.
[8] https://businessmirror.com.ph/2019/04/11/poverty-rate-down-to-21-on-higher-income-neda/

9.5 Compensation Policy, Package and Procedures

9.5.1 Eligibility for Compensation and Other Entitlements

The project's compensation policy and package were developed in consultation with DPWH and other concerned government bodies such as Mandaue City and Lapu-Lapu City reflecting also the views of other stakeholders, PAPs and project-affected companies in particular, that had been collected through different means of consultations. It is grounded on pertinent laws and regulations governing the issue in the Philippines and is in accordance with the JICA Guidelines for Environmental and Social Considerations (2010) described in 9.3.3above.

All qualified affected people, which are judged based on the conditions described below in this chapter, are eligible for compensation, either in cash or in-kind, and for rehabilitation/resettlement assistance irrespective of tenure status, social or economic standing, or any such factors. All PAPs will be entitled to compensation for their lost assets (i.e. land and/or non-land assets) at replacement cost, and to restoration of incomes and businesses. They will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels.

9.5.2 Principle of Replacement Cost

As explained in 9.5.1, all compensation for land and non-land assets owned by the PAPs will be made based on the replacement cost of the assets, which is the amount calculated before displacement which is needed to replace the affected asset without depreciation and without deduction for taxes and/or costs of transaction. More specifically, it can be described as follows:

- For agricultural land, it is the pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes;
- For land in urban areas, it is the pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services located in the vicinity of the affected land or in other areas with no less favorable conditions than the affected land, plus the cost of any registration and transfer taxes;
- For houses and other structures, it is the market cost of the materials to build a replacement structure with an area and quality similar or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labor and contractors' fees, plus the cost of any registration and transfer taxes;
- For annual crops, it is equivalent to the current market value of the crops at the time of compensation;
- For perennial crops, it is equivalent to the current market value given the type and age at the time of compensation; and
- For timber trees, it is equivalent to the current market value of each type, age and relevant productive value at the time of compensation based on the diameter at breast height of each tree

1) Cut-off Date of Eligibility

COD of eligibility pertains to the date up to which people would be considered eligible for receiving compensation and other forms of assistance for their losses or damages caused by the project, or in other words, those who would be regarded as a PAP. People are considered entitled to such support only if they were found to be occupying, living or using, in one way or another, the project-affected area at the time of declaration of the COD, which was set on the day when the census survey commenced. The COD was declared on different dates reflecting the days when the survey commenced in each barangay. People that had at the time of the COD their land, house, building, facility, structure, crops, valuable trees or other assets in the project-affected area or those that had been carrying out business or other income-earning activity in the area in a way that the project disturbs its operation would be considered affected by the project and hence be entitled to compensation and support. It has been agreed with DPWH that while business entities are allowed to continue with their businesses activities including accepting new tenants, installation of additional assets must be made at their own risk as such newly developed assets will not be subject to compensation.

2) Legal and Socio-economic Status of the PAPs

The legal, customary and socio-economic status and rights of the PAPs is another aspect that needs to be adequately reflected to the entitlement package. Below shows a classification of the PAPs by their status vis-à-vis losses and damages caused by the project. It reflects their rights and entitlements recognized in the laws and regulations in the Philippines as well as in JICA Guidelines.

(1) Land Owners and Land Users

Owners of the land and users of the land, including those that do not possess any formal title over the land they occupy or use, are one group of the PAPs. They can be classified into the following groups.

- PAPs with Original Certificate of Title (OCT), Transfer Certificate of Title (TCT), emancipation patents (EP), or Certificates of Land Ownership Award (CLOA) granted under the Comprehensive Agrarian Reform Act;
- PAPs who are not original patent holders of lands granted through CA 141 (i.e. those who have bought the patent for land previously granted through CA 141 and where any previous acquisition is not through gratuitous title (e.g. donation or succession);
- PAPs with: a) Tax Declaration showing 30 or more years of continuous possession; b) DENR certification showing that land is alienable and disposable; and c) other documents that show proof of ownership for the untitled land;
- PAPs who were formerly ISFs but now hold a title over land as a result of the government social housing program;
- PAPs who were formerly ISFs and the government social housing program beneficiaries whose titles are still under the name of the organization;
- PAPs whose properties are mortgaged;
- PAPs who are original patent holders of lands granted through CA 141 which has not been subject to previous government exercise of its lien; and
- PAPs without OCT, TCT, EP or CLOA including holders of free or homestead patents

(2) Structure Owners and Users

Owners of the structures and users of them such as tenants consists another group of PAPs, which can be classified as follows.

- PAPs that own the structures affected by the project including absentee owners;
- PAPs that do not own but rent based on payment as tenants the structures affected by the project; and
- Rent-free occupants that may include co-owners, sharers or caretakers of the structures affected by the project

(3) Business Entities and Employees

A few medium to large-scale business entities' business activities are expected to be affected by the project both in Mandaue City and Lapu-Lapu City. Such organizations consist of the third group of PAPs, which are classified in the following manner. Classification of the size of business entities followed the definition provided by Small and Medium Enterprise Development (SMED) Council Resolution No. 01 Series of 2003 dated 16 January 2003 as shown in Table 9.5.1 .

- PAPs who own project-affected fixed micro businesses (e.g. sari sari stores, food stalls, repair shops) that may or may not have permits to be doing their businesses in the area from concerned LGUs;
- PAPs who own project-affected small, medium or large business including building owners that rent the land or building; and
- PAPs who are employed in the displaced buildings and lose their job as a result of the damage caused by the project

Table 9.5.1 Classification of Business Entities by Size

Type of Business Entities	Size of Assets
Micro	Up to Php 3,000,000
Small	Php 3,000,001 to Php 15,000,000
Medium	Php 15,000,001 to Php 100,000,000
Large	Above Php 100,000,000

Source: JICA Survey Team based on Small and Medium Enterprise Development (SMED) Council Resolution No. 01 Series of 2003 dated 16 January 2003

(4) Farmers

People engaged in farming in the Philippines can be classified into the following groups. It should be noted, however, that the survey results suggest that there are few, if any, people that are engaged in farming for their living in the project-affected area and hence this clause may not be applicable.

- PAPs that own land or are lessees directly involved in farming;
- Displaced tenants and settlers on agricultural land; and
- PAPs growing crops, trees and perennials informally without official permissions to engage in such activities

(5) Other Assets' Owners

People that own fences, gates and other assets of value, or in other words "Assets" that are affected by the project, belong to this category.

(6) Government Bodies

There are some government buildings and facilities that are affected by the project such as the tourist information center, police station, and power poles. The government bodies the own such public buildings and assets are classified separately from other groups given that the arrangements for removing such establishments are considered to be based on inter-governmental dialogue and exchanges with different set of impacts from privately-owned assets.

(7) Vulnerable Groups

Such PAPs that are particularly vulnerable to the impacts caused by the project are hereby categorized separately in light of the relative severity of impact expected to be caused by the project on their livings. This group of people includes the following:

- Poor people whose combined income falls within the poverty threshold set by NEDA except for professional squatters and members of the squatting syndicates9;
- Female-headed households;
- Elderly people; and
- Persons with disability

The following benefits will be provided to such persons:

- Inconvenience compensation of PhP 10,000 per household;
- Rehabilitation assistance in the form of skills training and other development activities;
- For PAPs that need special assistance and/or medical care, respective LGUs to provide support before and during resettlement; and
- Participation in the Livelihood Restoration Program

3) Type of Loss incurred by the Project

PAPs are expected to be affected by the project in different ways. It is necessary that the compensation policy be formulated taking into account the different type of such losses. This section presents the category of losses expected and hence that need to be taken into account in the project.

- Loss of land (agricultural, residential, commercial or institutional);
- Loss of structures (agricultural, residential, commercial or institutional);
- Loss of improvements (or assets);
- Loss of crops, trees and perennials;

[9] Not only those informal settlers that meet the conditions set forth in RA10752 and RA7279 but those who do not meet the requirements will also be entitled to compensation and relocation in this project unless they have been found to be coming back to the original site of dwelling for unlawful reasons. The project proponent or DPWH and LGUs will jointly examine the resettlement qualifications of the affected people.

- Loss of income earning activities/businesses;
- Loss of public structures and utilities; and
- Other losses not expected at the present time

4) Impact on Livelihood

Another factor that requires consideration that is related to the type of loss explained above are whether the PAPs' livelihoods are affected or not. In case they are, measures to restore or improve their livelihood, compared to pre-project level, is required under JICA Guidelines. Under this project, the following three groups of people and entities are considered to fall under this category provided that they are affected. The PAPs that fall under this category will be entitled to participation in the livelihood restoration program described in 9.5.3.

- Business entities and employees;
- Displaced persons; and
- Vulnerable groups

5) Severity of Project Impacts

The compensation policy will also take into consideration different level of impact, or "severity" in accordance with LARRIPP (2007). The severity of impact is defined as shown below.

- Severely Affected - PAPs who stand to lose 20% or more of their assets, or less than 20% of their assets are lost and the remaining land/structure is no longer viable for continued use as intended
- Marginally Affected - PAPs who stand to lose less than 20% of their assets and the remaining land/structure is still viable for continued use as intended

LARRIPP states that severely affected property, land or structures, will be entitled to payment of the entire property at replacement cost (i.e. the cost of the materials and labor of the whole structure at current market price in the locality where the structure is located). Salvage value will not be deducted in the computation of replacement cost. If the property is only marginally affected, the PAPs would be entitled to payment on the affected portions of the structure only at replacement cost and at current market price in the locality where the structure is located. There will be no salvage value deducted.

9.5.3 Livelihood Restoration Program

The objective of the livelihood restoration program (LRP) is to assist the PAPs whose livelihoods are directly adversely affected by the project for restoring their income generating capacity to at least pre-project levels. For vulnerable PAPs, the LRP is also aimed at improving their living standards. The livelihood restoration measures are to be planned to take into account each individual situation. Sufficient time for planning and substantial interaction with the PAPs is deemed essential requisites to developing a robust plan that will ensure both immediate and long-term self-sufficiency. As such, while this plan outlines the necessary livelihood restoration measures, further consultations are recommended to be carried out in further studies with the PAPs to plan specific livelihood restoration and improvement measures. Preference over the type of trainings willing to be taken will be confirmed with the PAPs in advance. As explained in 2) and 4), the following groups of people are considered to have their livelihood hindered as a result of the project and hence be eligible to participating in the program.

- Business entities and employees;
- Displaced persons; and
- Vulnerable groups

1) Livelihood Restoration of Business Entities and Employees

The following measures will be taken with an aim to restore and improve the livelihood of business entities and their employees affected by the project.

Table 9.5.2 Livelihood Restoration Measures for Business Entities and Employees

Affected Entities	Assistance
PAPs who own affected fixed micro businesses (e.g. small shops)	· Assistance in securing government soft loans that offer lower transaction costs and interest rates, and long-term and flexible payment schedule
PAPs who own affected small, medium or large businesses	· Assistance in securing government soft loans that offer lower transaction costs and interest rates, and long-term and flexible payment schedule
PAPs who are employed in displaced establishments and lose job due to the project	· Priority in employment during construction and operation stage of the project · Rehabilitation assistance in the form of skills training and other development activities

Source: JICA Survey Team

2) Livelihood Restoration of Displaced Persons and Vulnerable Groups

The LRP for individuals including displaced employees is designed based on the existing relevant programs at the national, regional, provincial and LGU levels. While DPWH carries the ultimate responsibility for the program, LGUs are expected to play an equally, if not more, important role in ensuring that the PAPs' livelihoods are restored and/or improved in a long run and that the LRP is in line with the existing programs and institutions. The program should start prior to implementation stage of the project and may extend as far as the end of its completion yet not less than one year after commencement of construction. In order to ensure social inclusion, development outcomes should pay a special attention to integrating the different needs and concerns of women and men, people with disability, and the elderly as agents and beneficiaries of the programs and services.

(1) Vocational Training

Vocational training will be provided to the PAPs by the Technical Education and Skills Development Authority (TESDA). TESDA is the government agency tasked to manage and supervise technical education and skills development in the Philippines. Training activities will be delivered through the following three modes.

<u>Training Centers operated by TESDA</u>

TESDA provides certificates of completion after each training course. The certificates of the completion are presented to would-be employers who will provide permanent employment and a regular stream of income. Trainings cost an average of PhP 10,000/course but may be as high as PhP 15,000. TESDA, in collaboration with the LGUs, industries that provide funds, implement the Training for Work Scholarship Program (TWSP) where successful scholars are chosen to undergo trainings based on industry requirements. The scholars, before being chosen, undergo a rigid selection process. PAFs and/or vulnerable groups may avail of this program after they pass the tests or assessments.

Vocational trainings, those provided by TESDA in particular, should ensure women's enrollment in non-traditional skills training (e.g. welding, carpentry and plumbing) as it offers higher income compared to being engaged in traditional livelihood activities (Sec. 13, RA 9710). TESDA should ensure the full implementation of the gender sensitive technical vocational education and training (TVET) curriculum in all training courses regardless of the mode of delivery of these trainings. Similarly, the Department of Trade and Industry (DTI) may provide necessary trainings for skills development and capacity and institutional buildings.

Private Institutions

Vouchers are allocated by TESDA at least three to four times a year to accredited training centers. The number of vouchers is based on demand and is usually determined through surveys on the training courses needed in each barangay.

Community-based Organizations

Community-based Training for Enterprise Development Program is primarily addressed to the poor and marginal groups who cannot access formal training provisions. They may have low skills, limited management abilities, and have few economic options. They may have no access to capital and hence unqualified for formal credit programs. The program goes further than just skills trainings. It is purposefully designed to help form livelihood enterprises that will be implemented by the trainees immediately after the training. Likewise, it is designed to assist partner agencies such as LGUs, NGOs, people organizations and other agencies and organizations tasked to help the poor people engage in productive activities to help themselves and their communities.

(2) Mainstream Employment Information and Referral

Mainstream employment opportunities will be explored and interventions carried out to assist the PAPs in being employed. A labor market assessment will be carried out in areas where groups of project-affected households are relocated so that implementers of the LRP better understand the dynamic market conditions (e.g. available jobs, volume of human resource demand, skills required, and job hiring seasons and cycles) and the potential employment and entrepreneurship opportunities that could be offered to the PAPs. Labor market assessment should consider gender needs of women and men, as gender segregation characterizes employment in the country (cf. Women's Empowerment, Development and Gender Equality/WEDGE Plan). By Looking into the type of employment women and men are traditionally engaged in, a gender responsive employment plan could be devised by the project implementers so that chances of women getting better, higher income jobs could be heightened. The result of the assessment will help define specific interventions to improve the chances of PAPs' employment.

(3) Project Employment Opportunities

In addition to the requirements set forth by DO No. 130, Series of 2016, voices were heard during consultations with the PAPs and FGDs requesting for employment opportunities in the project. It is also considered just to give priority to qualified PAPs to be engaging in the project. It is therefore recommended that the PAPs are given an opportunity to be working for the project to the extent practical.

(4) Financial Management and Entrepreneurial Training

Resettlement process is complex particularly as they relate to valuation, compensation and assistance packages. Limited exposure to the cash economy and low levels of financial literacy, in light of future payment of compensation funds, highlights the need to provide PAPs with access to financial advice. Financial advice will help them improve their capabilities on money management including financial planning, investments, trainings, employment and business development. The nature of financial advice varies and will have to be undertaken at different stages to coincide with the various financial activities during the RAP implementation (i.e. provision of compensation, release of livelihood support, livelihood implementation and so on).

(5) Additional Support for Vulnerable Persons

Details of the LRP will be identified and implemented by the LGUs in cooperation with HUDCC, SHFC, NHA and DPWH in light of the need to provide additional support to vulnerable groups depicted above. Depending on the number of such persons, DPWH may engage a qualified civil society organization (CSO) or a non-governmental organization (NGO) to assist in the undertakings.

9.5.4 Resettlement Site Development Plan

(1) PAPs Qualified for Relocating into Resettlement Sites

All qualified informal settlers that are affected by the project are eligible to be relocated into relocation sites. The eligibility of the PAPs is determined in accordance with RA 7279 (Urban Development and Housing Act of 1992). Those project-affected ISFs that do not meet the following criteria will be compensated in cash for their affected assets such as structures at replacement cost as described in Table 9.5.8. Relocation of PAPs will ensure their security of tenure that they will not be evicted nor their dwellings be demolished without just or acceptable reason and ample consultation with the affected people in accordance with the compensation policy adopted in the project (refer to Chapter 5). The qualifications for the PAPs to avail of the Socialized Housing Program under the provisions of the RA 7279 are as follows:

- Must be a Filipino citizen;
- Must be an underprivileged and homeless citizen, as defined in Section 3 of RA 7279[10];
- Must not own any real property whether in the urban or rural areas; and
- Must not be a professional squatter or a member of squatting syndicates[11]

The government's socialized housing programs and projects cover houses and lots or home lots only to be undertaken by the government or private sector for the underprivileged and homeless citizens, which shall include sites and services development with long-term financing, liberalized terms of interest payments, and such other benefits that are in accordance with the provisions of RA 7279. In addition, it shall include housing packages with selling prices within the lowest interest rates under the Unified Home Lending Program, public rental housing, or any equivalent housing program of the government, the private sector or NGOs. For those that do not meet the above conditions may choose a public rental option that will be provided at an affordable rate or avail of additional financial assistance worth of 60 days of the prevailing minimum wage.

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[10] Under defined in Section 3 of RA 7279, "underprivileged and homeless citizens" refers to the beneficiaries of RA 7279 and to individuals or families residing in urban and urbanizable areas whose income or combined household income falls within the poverty threshold as defined by the National Economic and Development Authority and who do not own housing facilities. This shall include those who live in makeshift dwelling units and do not enjoy security of tenure.

[11] Not only those informal settlers that meet the conditions set forth in RA10752 and RA7279 but those who do not meet the requirements will also be entitled to compensation and relocation in this project unless they have been found to be coming back to the original site of dwelling for unlawful reasons. The project proponent or DPWH and LGUs will jointly examine the resettlement qualifications of the affected people.

(2) Types of Housings within Resettlement Sites

There are two types of housings that can be expected in resettlement sites developed for the PAHs namely, row house and low-rise building. Low-rise building has as many as five floors. The lot/unit sizes and land requirement are shown in the following table.

Table 9.5.3 Types of Housings within Resettlement Sites

Housing Type	Lot/Unit Sizes (m2)	Land Title Holder after Repayment
Row House	lot size: approx. 40m2 unit size: 22.0-28.4m2	Owner of Row House
LRB	lot size: approx 24.0m2 unit size: approx 24.0m2	House Owners' Association

Source: JICA Survey Team

Among the two housing types, the row house, given that a larger land area is required is, in general, more feasible in areas where the cost of land is not so high (e.g. in Consolacion and other areas outside of the highly-urbanized city). In areas within Mandaue City (e.g. near the project site), however, where land for socialized housing is scarce, LRBs become more viable.

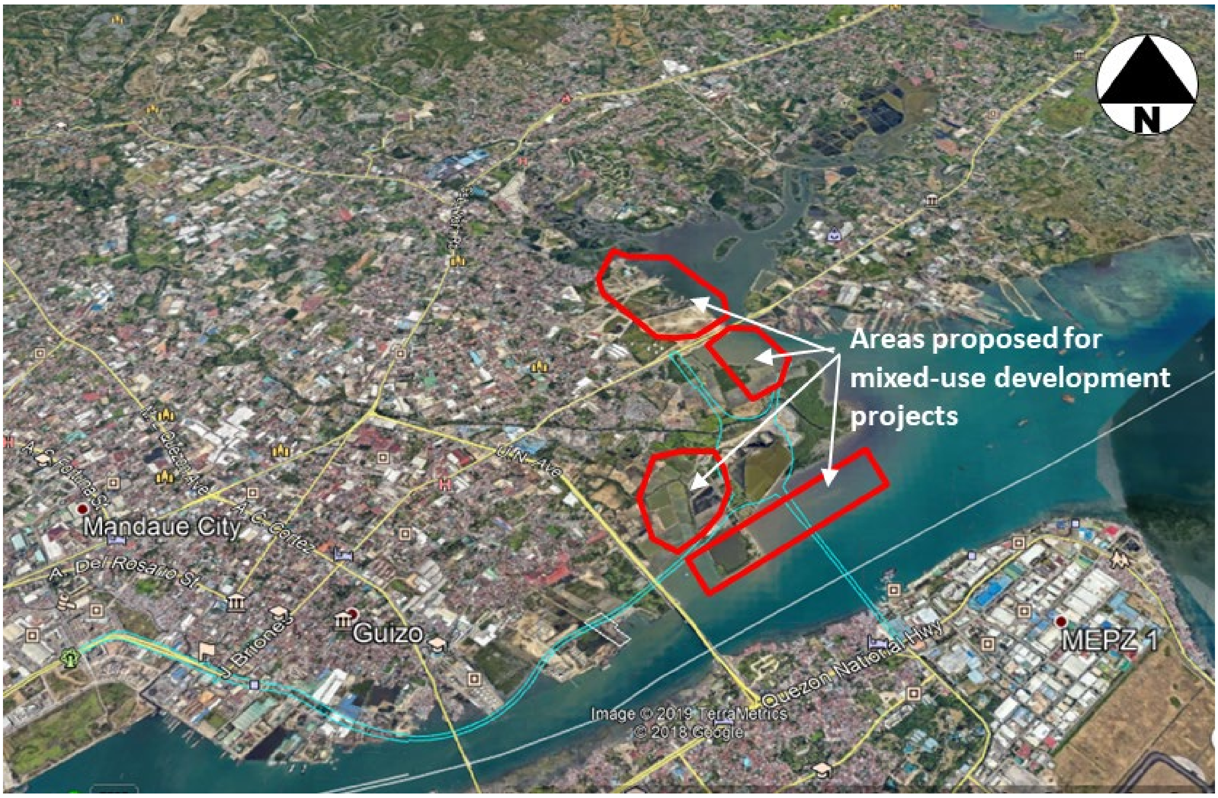
Source:
https://cdo-realestate.com/listing/socialized-condominium-unit/

Figure 9.5.1 Example of a Four-Storey LRB

Source:
http://www.boholchronicle.com.ph/2016/03/20/478-units-in-five-towns/

Figure 9.5.2 Example of Row Houses

There are a few mixed-use development proposals in the areas around Barangay Umapad, Paknaan, and Labogon (within the vicinity of the project site) as shown in the figure below. These proposals include commercial and residential LRB projects which will be subject to compliance with Section 18 of RA 7279 that requires the owners/developers to provide a socialized housing.



Source: JICA Survey Team

Figure 9.5.3 Location of PAHs Possible Resettlement Sites

(3) Infrastructure

It has been confirmed at the joint meeting held on July 23, 2019 in the presence of representatives from DPWH (central office and Region VII), NHA and Mandaue City (City Planning and Development Office (CPDO) and HUDO) that the following basic services stipulated in Section 21 of RA7279 will be provided by Mandaue City or NHA in cooperation with private developers and concerned agencies:

- Potable water;
- Power and electricity and an adequate power distribution system;
- Sewerage facilities and an efficient and adequate solid waste disposal system; and
- Access to primary roads and transportation facilities

In the above mentioned meeting, it was confirmed that the following services may also be developed in cooperation with relevant government agencies provided that they are not accessible to the residents:

- Schools in cooperation with the Department of Education;
- Health centers in cooperation with the Department of Health;
- Livelihood and community center by Mandaue City in cooperation with private partners; and
- Sport facilities

(4) Timeline for Site Development

It has been confirmed that the time required for site development may be as much as three and a half years. The general steps and time identified are as follows:

Table 9.5.4 Estimated Timeline for Site Development

No.	Activities	Organization Responsible	Time Required
1	Purchase of land and transfer of title	Land owner, LGUs (Mandaue City and Municipality of Consolacion) and DPWH	0.5 years
2	Design of Buildings	NHA	1.0 month
3	Permit from HLURB	NHA, LGUs and DPWH	1.0 year
4	Permit from NHA and Others	NHA, DENR, LGUs and DPWH	1.0 year
5	Site and Housing Development	Construction Company, NHA, LGUs and DPWH	1.0 year

*Permits include that for subdivision lots, building permits and ECC.
Source: JICA Survey Team

(5) Status of Resettlement Sites for Project-affected Persons

In accordance with RA7279, ISFs are eligible to moving into socialized housings, or in other words resettlement sites, in the Philippines. As explained in (18), close to 80% of the PAHs preferred this option as opposed to the option of being compensated in cash. On the other hand, there is limited land available for developing resettlement sites for the ISFs in the highly urbanized city of Mandaue. This chapter describes the resettlement sites planned to be developed for the project-affected informal settlers. Given that there is no PAPs in Lapu-Lapu City that requires relocation, discussion on this section is limited to Mandaue City.

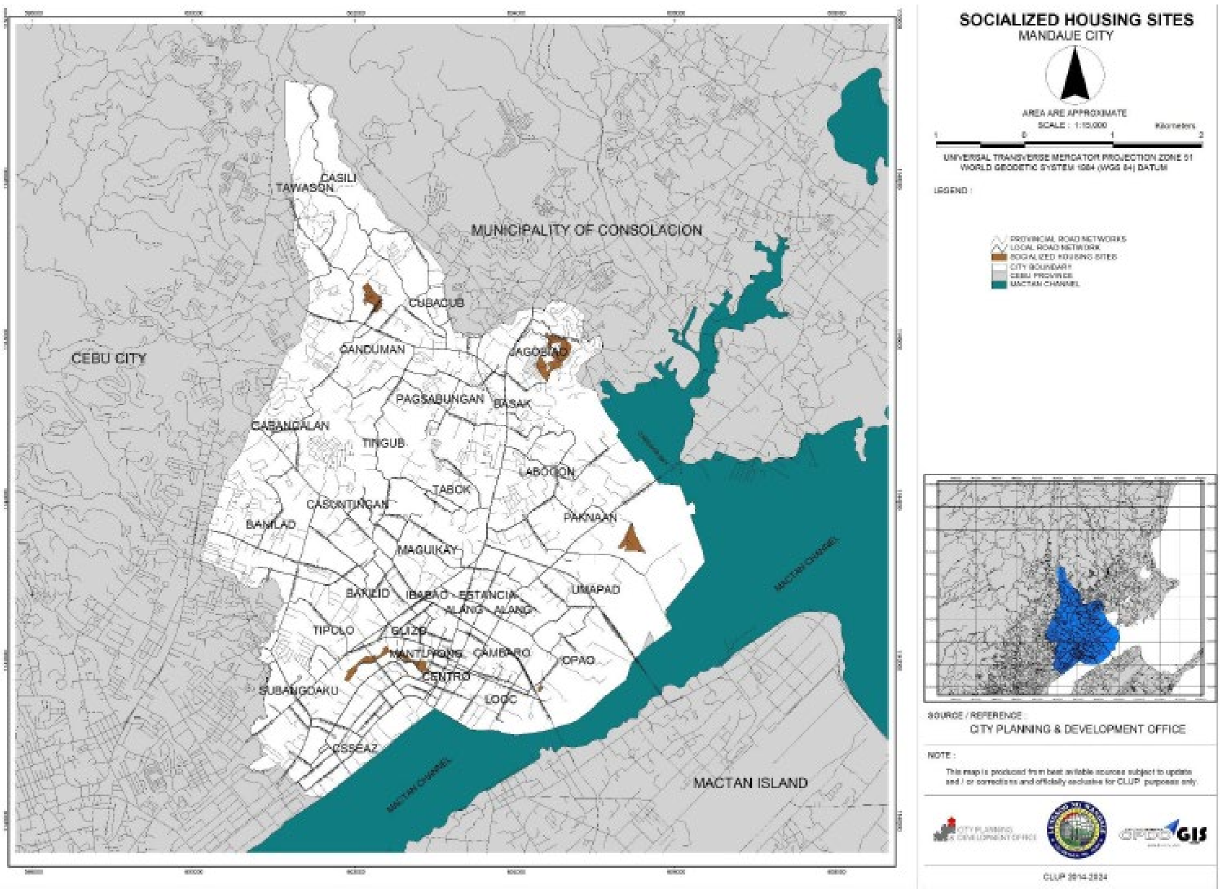
<u>Existing Resettlement Sites</u>

The Comprehensive Land Use Plan (CLUP) 2014-2024 of Mandaue City indicates that “there were 60 homeowners association with 7,800 households occupying lots which are either government or privately-owned… these are informal settlers,” as of 2012 with 3,632 living along riverbanks and natural waterways, which are described as the “danger zones”, or hazardous places where people are not allowed to be living. In 2015, the number of such informal settlers increased to 15,235 households. In response, Mandaue City government has developed 11 resettlement sites that are able to provide housing units to 4,783 families. Description of the 11 sites is shown in the following table followed by their location. One of these resettlement areas with an area of 6.5 ha (i.e. No.10 in the above table), is located just within the vicinity of the project site (i.e. 4th Cebu-Mactan Bridge alignment) in Barangay Paknaan.

Table 9.5.5 Resettlement Sites in Mandaue City

No.	Barangay	Homeowners Association*	Land Ownership	No. of Families/ Housing Units	Administration
1	Canduman	Canduman Haven	Joint Venture with NHA and the government	631	HUDO
2	Canduman	Kobe Canduman	Kobe Canduman	317	HUDO
3	Canduman	Sunflower	Co-ownership between government and private	100	HUDO
4	Subangdaku	Malibu, Matimco	Government	311	HUDO
5	Tipolo	Lower Tipolo	Government	237	HUDO
6	Tipolo	Sitio Maharlika	Government	215	HUDO
7	Guizo	Sta. Cruz Village	Government	317	HUDO
8	Guizo	Sta. Cruz II	Government	94	HUDO
9	Mantuyong	Mantuyong Urban Poor	Government	462	HUDO
10	Paknaan	6.5 Has. Resettlement Site	Private lot	1,200	HUDO
11	Jagobiao	JUPO/Sacred Heart Ville	Government	899	Project Inter-agency Committee
TOTAL				4,783	

*Organization that is formed by the PAPs to avail of the government housing program.
Source: Mandaue City CLUP 2014-2024



Source: Mandaue City CLUP 2014-2024

Figure 9.5.4 Location of Resettlement Sites in Mandaue City

<u>Availability of Existing Resettlement Sites</u>

The Mandaue City Local Shelter Plan (2018-2026) has identified 8,760 displaced households needing relocation, which includes families living in the danger areas and doubled-up households (i.e. housings where two or more different households live). The Mandaue City government targets to provide housing units to these families between 2018 and 2026. The first to be accommodated will be the families living in these danger areas in Barangays Alangalang, Banilad, Looc, Maguikay, Mantuyong, Opao, Paknaan, Subangdau, Tabok, Tingub, Tipolo and Umapad, which account for a total of 3,767 households. These barangays happened to cover all barangays where people would be affected by the project. However, except for those 11 resettlement sites that have already been developed in 2012 by the city government and is fully occupied, there is no additional resettlement site being identified or developed at present.

(6) Candidate Resettlement Sites for the Project

Despite the land constraint, two candidate sites have emerged as a result of discussions made with relevant bodies primarily Mandaue City. One is located in Mandaue City (i.e. Labogon, Mandaue City) and the other in the adjacent municipality of Consolacion (i.e. Pulog, Consolacion). A comparison of the two potential sites is presented below.

Table 9.5.6 Comparison of Candidate Resettlement Sites

Category	Labogon, Mandaue	Pulog, Consolacion	Remarks
Land Classification	commercial land	agricultural land	Agricultural land requires conversion while commercial land does not. Both are private land as of July, 2019
Land (buildable) Area	3,600 (1,600) m2	18,000 (14,400) m2	
Topography	flat	rolling	
Distance from Original Dwelling	approx 1.0-3.5 km	approx 8-11 km	
Existing Infrastructure	electricity, water supply and concrete road	electricity, gravel and concrete road	
Infrastructure to be Developed	sewage and waste disposal system	water supply, road, sewage and waste disposal system	
Transportation	public transportation	none (only accessible by bikes or "habal-habal")	
Social Infrastructure	school, health facilities, and community center nearby	no school, health facilities, and community center nearby	
Cost for Site Development	low	high	
Housing Type	LRBs	Row Houses	
Amortization Fee/Month	approx PhP600-1,000	approx PhP500	
Issues to be Addressed	· approx 20 ISFs reside in the area · selling price is higher than appraised price	· land conversion required · infrastructure development required · accessibility not ideal · belongs to Consolacion	

Source: JICA Survey Team

<u>Candidate Resettlement Site in Labogon, Mandaue</u>

The candidate site in Labogon is located approximately 1.0 to 3.5 km from the original location of PAPs' dwellings as the crow flies. The subject plot of land is privately-owned but the land owner is willing to sell the land. Given that DPWH is willing to provide the funding for purchasing the land, this option can be considered worth exploring in the D/D stage. The advantages of this site include the proximity to the PAPs' current place of living, favorable accessibility and the fact that social infrastructure and services already exist near the site. However, there are some ISFs occupying the area whose number is fewer than 20 households, according to HUDO, and the land owner's offering price (i.e. PhP 10,000/m2) is higher than the price valued by the Land appraisal Committee (i.e. PhP 3,645). A location map is presented below along with pictures of the site.

Source: JICA Survey Team

Figure 9.5.5 Location of the Candidate Resettlement Site in Labogon, Mandaue

Source: JICA Survey Team

Figure 9.5.6 Candidate Resettlement Site in Labogon, Mandaue

Candidate Resettlement Site in Pulog, Consolacion

Mandaue City is now one of the most densely populated areas in the Philippines outside of the National Capital Region. Given that there is limited space in the city that can develop a resettlement site coupled with its obligation stated under the law to provide decent housings to the ISFs, Mandaue City has proposed developing a resettlement site in a plot of land put forward by the land owner and located in the nearby city of Consolacion.

It is located approximately 8.5 km from the project site and approximately eight to 10 km away from the original location of PAPs' dwellings as the crow flies. While the subject plot of land is privately-owned, the land owner is willing to sell the land for PhP 2,000/m2, which is, in the view of Mandaue City, a reasonable rate (cf. zonal value in the area is PhP 450/m2). The land is approximately 18,000 m2 in size, which is considered more than sufficient to accommodate a maximum number of 69 households that may need to be dislocated into a resettlement site. A location map is presented below along with pictures taken at the site.

While its advantages include abundant land size which allows row houses to be developed, the following conditions need is found needed to be met in order for the site to be fully functional for the project.

- It is under the jurisdiction of the Municipality of Consolacion. While initial consent has been obtained from the municipality to use the land as a resettlement site for the ISFs affected by the project, further coordination is expected necessary involving the barangay captains and the local community;
- The land is currently categorized to be agricultural land. In order for the land to be used as resettlement site for the ISFs, it needs to be recategorized to residential land; and
- While electricity is provided in the area water is not suppled to date nor is paved road developed to reach the site. Coupled with the fact that the site is generally rolling which requires slope protection works and installment of a guard rail, cost for development is expected to be greater than the option of Labogon.

Source: JICA Survey Team

Figure 9.5.7 Location of the Candidate Resettlement Site in Pulog, Consolacion

Source: JICA Survey Team

Figure 9.5.8 Candidate Resettlement Site in Pulog, Consolacion

(7) Financial Arrangements

Costs were discussed and estimated at the joint meeting above mentioned and arrangements were agreed to be made in the following way. While details will be determined through discussions in the D/D stage, DPWH has agreed to provide necessary funding for all items, if that is necessary.

Table 9.5.7 Estimated Unit Cost for Resettlement Site Development

Category	Cost Estimation (PhP)	Organization Responsible
Purchase of Land	900 - 7,000/m2*	Mandaue City and DPWH
Land and Infrastructure Development	81,200 - 137,000/unit	Mandaue City and DPWH
Housing Development	406,200 - 550,000/unit	NHA and DPWH

*twice the zonal value in two candidate sites (i.e. Lagobon and Pulog)
Source: JICA Survey Team

9.5.5 Entitlement Matrix

Table 9.5.8, referred to as the entitlement matrix, depicts the compensation and assistances that need to be provided under the project to the PAPs depending on their eligibilities described above. It is designed to enhance or at least restore the livelihoods of all PAPs in real terms relative to pre-project levels and to improve the living standards of the displaced poor and other people that are considered vulnerable. It should be noted that all compensation and support will be provided to the PAPs prior to resettlement. It is aimed under this entitlement matrix that impact on the business activities be avoided by providing full compensation prior to dislocation and allowing the business entities to continue with their businesses at the original location for a period that is sufficient to build, relocate and resume the business in the new site using the compensation.

Table 9.5.8 Entitlement Matrix

Type of Loss	Entitled Person	Compensation/Entitlements	Responsible Organization
Land (Classified as Agricultural, Residential, Commercial, or Institutional)	PAPs with Original Certificate of Title (OCT), Transfer Certificate of Title (TCT), emancipation patents (EP), or Certificates of Land Ownership Award (CLOA) granted under Comprehensive Agrarian Reform Act PAPs who are not original patent holders of lands granted through CA 141 (i.e. those who have bought the patent for land previously granted through CA 141 and where any previous acquisition is not through gratuitous title (e.g. donation or succession) For untitled land, PAPs with a) Tax Declaration showing 30 or more years of continuous possession; b) DENR certification showing that land is alienable and disposable; or c) other documents that show proof of ownership PAPs who were formerly ISFs but now hold title of land as a result of social government housing program	[Severely Affected[12]] Cash compensation for the loss of entire land based on the current market value free of taxes including capital gain tax (CGT), documentary stamps tax (DST), transfer tax and registration fees AND Transaction costs (e.g. administrative charges and registration or title fees) *Payment of Real Property Tax (RPT) is a condition to be entitled. PAPs can request DPWH to: support the PAPs in preparing documents necessary to complete tax payment; and pay RPT in arrears to LGUs, which will be deducted from the amount of compensation except when the arrears are higher than the total amount of compensation. [Marginally Affected] Cash compensation for the affected portion of the land based on the current market value free of taxes including CGT, DST, transfer tax and registration fees. *Payment of RPT is a condition to be entitled. PAPs can request DPWH to: support the PAPs in preparing documents necessary to complete tax payment; and pay RPT in arrears to LGUs, which will be deducted from the amount of compensation except when the arrears are higher than the total amount of compensation.	DPWH-UPMO (RMC I)
	PAPs who were formerly ISFs and government social housing program beneficiaries whose titles are still under the name of the organization	Same as PAPs with OCT with less any amount still owing to the title	
	PAPs whose properties are mortgaged	Same as PAPs with OCT with less any amount still owing to the title or the mortgage bank or other financial institutions	
	PAPs who are original patent holders of lands granted through CA 141 which has not been subject to previous government exercise of its lien	No compensation for land up to 20 m width if patent was granted prior to 1975 or up to 60 m width for patents granted thereafter. For area in excess of government lien, same as PAPs with OCT	
Structures (Residential, Commercial, Industrial/ Institutional)	PAPs that own affected structures including absentee owners	[Severely Affected] Cash compensation for entire structure at replacement cost including transaction costs without deduction for depreciation or salvaged materials AND In case affected structures are used as dwelling, permission to stay for one month or a longer time between delivery of compensation and other assistance, and demolition of the dwelling AND In case PAPs are ISFs and affected structures are used as dwelling, option of living in a resettlement site. [Marginally Affected] Cash compensation for affected portion of structure at replacement cost	
	Tenants of structures	Three months or longer prior notice to the tenants before evacuation *Not applicable to lease contracts that will expire at the time of taking	DPWH-UPMO (RMC I)
Improvements/ Assets	PAPs that own affected improvements/assets	Cash compensation for affected improvements/assets at replacement cost AND Transportation assistance if improvements/assets need to be transferred and requires cost	
Crops, Trees and Perennials	PAPs that own land directly involved in farming	Cash compensation for affected crops at replacement cost	DPWH-UPMO (RMC I) with

[12] Refer to 5) for the definition of severely and marginally affected land and structures.

Type of Loss	Entitled Person	Compensation/Entitlements	Responsible Organization
	PAPs that are lessees directly involved in farming	Disturbance compensation equivalent to five times the average of gross harvest over the last five years	support from MAO and DENR
	Displaced tenants and settlers on agricultural land	Financial assistance equivalent to the average gross harvest over the last three years and not less than PhP15,000/ha	
	PAPs growing crops, trees and perennials informally	Permission to harvest crops prior to commencement of construction AND Cash compensation for affected crops at replacement cost	
Income Earning/Business Activities	PAPs who own affected fixed micro businesses (e.g. small shops)	In case affected business entities move to new locations and continue with their business there, permission to continue with the business activities at the original location for a period that is sufficient to build, relocate and resume the business in the new site at a production level no less favorable than pre-project level AND Cash compensation for relocation costs and transaction costs (e.g. payment of taxes due to the government) AND Assistance in securing government soft loans that offer lower transaction costs and interest rates, and long-term and flexible payment schedule OR Income rehabilitation assistance AND Assistance in securing government soft loans that offer lower transaction costs and interest rates, and long-term and flexible payment schedule	DPWH-UPMO (RMC I) with support from concerned government agencies
	PAPs who own affected small, medium or large businesses	In case affected business entities move to new locations and continue with their business there, permission to continue with the business activities at the original location for a period that is sufficient to build, relocate and resume the business in the new site at a production level no less favorable than pre-project level AND Cash compensation for relocation costs and transaction costs (e.g. payment of taxes due to the government) AND Assistance in securing government soft loans that offer lower transaction costs and interest rates, and long-term and flexible payment schedule	DPWH-UPMO (RMC I) with support from concerned government agencies
	PAPs who are employed in displaced establishments and lose job for reasons reasonably attributable to the damages caused by the project	Compensation equivalent to one month pay or at least one-half a month pay for every year of service, whichever is higher AND One month or longer prior notice to the establishments AND Priority in employment during construction and operation stage of the project AND Rehabilitation assistance in the form of skills training and other development activities	
Government Structure and Utilities	Government agencies that own affected structures	Compensation to the government agencies based on mutual agreement between DPWH and the government agencies	
Vulnerable Groups	PAPs that are classified as any of the following groups: poor (whose combined income falls within the poverty threshold set by NEDA); female-headed households; elderly people, and persons with disability	[Severely Affected] Compensation allowance of PhP10,000 per family AND Rehabilitation assistance in the form of skills training and other development activities AND Participation in the Livelihood Restoration Program AND For PAPs that need special assistance and/or medical care, respective LGUs to provide support before and during resettlement	DPWH-UPMO (RMC I) with support from NHA and LGUs

Source: JICA Survey Team

9.6 Grievance Redress Mechanism

9.6.1 Objectives and Advantages of Developing a Grievance Redress Mechanism

It is important that the PAPs are provided with a mechanism through which they can lodge their complaints, if any, towards the project on matters related to land acquisition and resettlement. In fact, this can be considered an instrument that helps both the PAPs and DPWH. It allows the PAPs, on the one hand, to lodge their complaints directly to the decision makers in a way that is much easier and less stressful and costly than through the judicial procedures. On the other hand, it allows DPWH to acknowledge any problem and source of frustrations of the PAPs at an early stage so that measures can be taken to relieve the tension while they are still manageable. By directing the complaints to themselves, DPWH can also have full control over the issue. A properly designed grievance redress mechanism will better ensure realizing a sound implementation of the project, which would be in the interest of both parties.

Such mechanism shall be swiftly established, practical, and easily accessible to the PAPs so that they can lodge their opinion, complaint or concern without stress and with trust. DPWH should make sure that the PAPs know and understand the mechanism including the members involved, procedure, and time and cost needed. A special attention should be paid to any vulnerable people such as those that are illiterate, in which case, DPWH may wish to explain in a different way (e.g. verbally instead of by paper). A person responsible for receiving and processing the grievances should also be assigned within DPWH and/or the RIC and the name and contact information of the person should be shared with all PAPs. It is also important that DPWH ensures that the grievances are properly treated and discussed and the conclusion delivered back to the complainants in a timely manner.

9.6.2 Procedures of Grievance Redress

LARRIPP (2007) mentioned above provides a framework for redressing concerns, complaints and grievances related to land acquisition, compensation and other matters related to the project that may arise as a result of the projects implemented by DPWH. This framework of grievance redress mechanism has been modified in consultation with DPWH (ESSD and Region VII), Mandaue City and Lapu-Lapu City so that it is realistic, feasible and effective under the circumstances surrounding the project. Grievances related to any aspect of the project will be dealt through dialogue and negotiations with an aim to more quickly and amicably address the issues in a less costly manner compared to that dealt as a legal case.

Under this arrangement, the RIC, a coordinating and consultative body organized to assist DPWH in the validation and implementation of the RAP, established by UPMO (RMC I) through a Memorandum of Understanding (MOU) with concerned parties during the D/D, will play a key role. One of their responsibilities is to receive and record the voices, complaints opinions and suggestions provided by the PAPs, except complaints and grievances that specifically pertain to the valuation of affected assets since such will be decided upon by the proper courts, and to address them as the first stage of the decision-making body (cf. until the RIC is formed, complaints can be directly addressed to DPWH Region VII). If the response to the complaint is deemed inadequate in the view of the PAPs, they may elevate their grievance to the ROW Task Force that consists of higher level officials of DPWH Central Office before resorting the case finally to the court. Under this project, grievances from the PAPs would be handled in the following manner.

- Grievance shall be filed by the PAP with the RIC who will act within 15 days upon receipt, except complaints and grievances that specifically pertain to the valuation of affected assets, since such will be decided upon by the proper courts
- If no understanding or amicable solution can be reached, or if the PAP does not receive a

response from the RIC within 15 days of registry of the complaint, he or she can appeal to the ROW Task Force, which should act on the complaint or grievance within 15 days from the day of its filing

- If the PAP is not satisfied with the decision made by the ROW Task Force, he/she, as a last resort, can submit the complaint to any court of law

PAPs shall be exempted from all administrative and legal fees incurred pursuant to the grievance redress procedures as is guaranteed under LARRIPP (2007). All complaints received in writing (or written when received verbally) from the PAPs will be documented and shall be acted upon immediately according to the procedures detailed above. Table 9.6.1 delineates the steps in the filing of complaints, the various agencies involved in the redress of grievances, and the timelines for resolving complaints.

Table 9.6.1 Steps in Filing Grievances and Grievance Redress Structure

Stage	Grievance Procedure	Responsible Agency
Receipt	Grievances may be filed either orally or in writing with the RIC. At the barangay level, PAPs could file their complaint with their Barangay Captain, a member of the RIC. Grievances may also be filed through DPWH Region VII. If unsatisfied with the outcome, PAPs may file their complaint with the ROW Task Force. Courts of law are the last resort for PAPs not in agreement with the decision of the RIC or the ROW Task Force.	Barangay, UPMO (RMC I) and DPWH Region VII
Documentation	A grievance form will be used to document complaints to ensure all relevant details are obtained. The identity of the complainant (i.e. name, address, and contact details), means of reporting complaint, the date grievance was sent and received, and the nature of the complaint needs to be captured in the form. Use of the local language (i.e. Cebuano) is allowed, and in cases where the complainant lacks literacy skills to fill out the form, grievances could be submitted orally and recorded by an officer of the receiving office.	Barangay, UPMO (RMC I) and DPWH Region VII *Complaints are documented through the grievance form drafted by UPMO (RMC I).
Fact-Finding	RIC shall verify the identity of the complainant and the nature of complaint, and compile supporting evidence. The RIC shall make recommendations for resolution to the appropriate bodies for consideration in the redress of grievance or complaints. If the complainant wishes to appeal the RIC's decision, the grievance is escalated to the ROW Task Force for resolution.	RIC Members: City Mayor or Representative, UPMO (RMC I) or DPWH Region VII, City Government Officers, Barangay Captains of each affected barangay, Representative of PAPs for each affected barangay, Representative of relevant NGOs operating within the city, and Representatives of assisting government agencies such as NHA, DOLE, DSWD and DTI
Feedback	The RIC will be given 15 days upon receipt of complaint to resolve cases, except for complaints on the valuation of affected assets. The ROW Task Force will also have 15 days to resolve cases from receipt of complaint. The aggrieved party will be informed of the outcome through DPWH Region VII.	RIC, UPMO (RMC I), ROW Task Force and DPWH Region VII
Appeal	If the complainant wishes to appeal the RIC's decision, the grievance is escalated to the ROW Task Force for resolution. If the aggrieved party does not accept the decision of the ROW Task Force, the grievance could be filed with the appropriate court of law. In property valuation complaints where DPWH has decided to initiate expropriation proceedings, RA 8974 requires PAPs to be paid one hundred percent (100%) of the value of the property based on the current zonal valuation of the BIR. The amount will be deposited into an escrow account while the court determines the just compensation to be paid to PAPs. After the court decision becomes final and executor, DPWH	RIC, DPWH ROW Task Force, and Courts

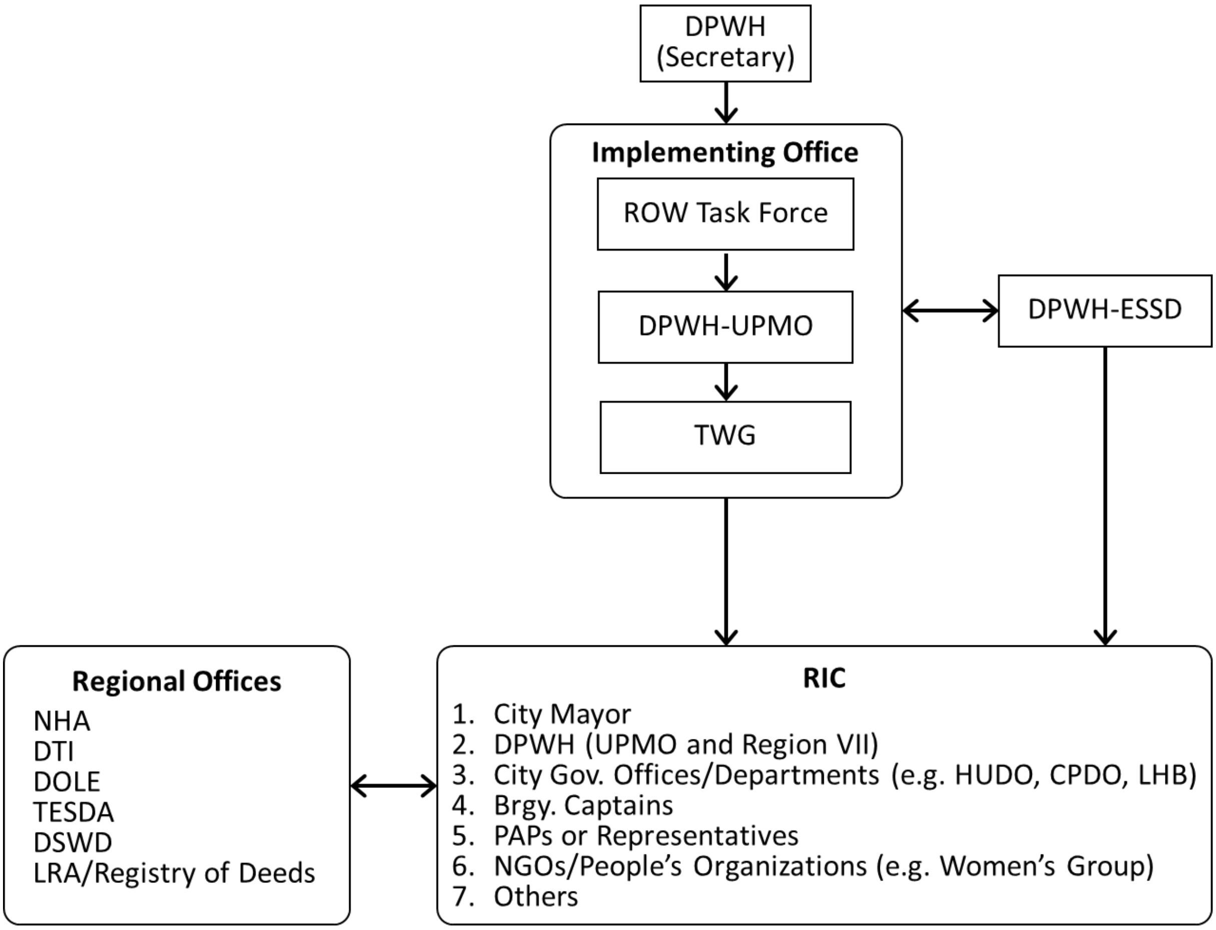
	will pay PAPs the difference between the amounts paid and the just compensation determined by the court.	

Source: JICA Survey Team

9.7 Institutional Framework

9.7.1 Organizational Framework for RAP Implementation

A number of entities/organizations will be actively involved in implementing this RAP. Among them, DPWH, the project proponent, carries overall responsibility for the project. The managerial and supervisory body of DPWH is its UPMO (RMC I). Under the UPMO (RMC I) lies the ROW Task Force and the Technical Working Group (TWG) that are mandated to implement the RAP. At the local level, a RIC will be set up in both Mandaue City and Lapu-Lapu City to assist DPWH in implementing the RAP in close coordination with relevant national government agencies such as NHA, DTI, Department of Labor and Employment (DOLE), TESDA and the Department of Social Welfare and Development (DSWD). The following organizational chart depicts the institutional framework for implementing the RAP and the key responsibilities of the agencies concerned.



Source: JICA Survey Team

Figure 9.7.1 Organizational Chart of RAP Implementation

9.7.2 Organizations related to Implementation of the RAP

(1) Organizations within DPWH

The offices within DPWH that are responsible for implementing the activities related to land acquisition and resettlement for the project are presented in Table 9.7.1 along with their major functions.

Table 9.7.1 Key Functions of Offices within DPWH for RAP Implementation

Offices within DPWH	Description of Functions
Unified Project Management Office (UPMO-RMC I)	UPMO (RMC I) as the implementing office of the project will, with regards to RAP implementation: • Update, validate and approve the RAP including a budget plan with assistance from ESSD and in accordance with guidance from JICA; • Make necessary arrangements with concerned parties on RAP implementation; • Set up the RIC by entering into an MOU with concerned local parties; • Conduct census, lost-asset inventory, socioeconomic and replacement cost surveys as necessary; • Prepare and validate the list of PAPs and affected assets; • Conduct assessments and provide compensations; • Facilitate consultation meetings and information dissemination on the RAP with other relevant stakeholders throughout the RAP process; and • Monitor the implementation of RAP during RAP implementation Field Office for the project will be created in the project site under UPMO (RMC I) with the following functions: • Assist UPMO (RMC I) in managing and supervising project construction in the project site; • Assist UPMO (RMC I) in securing the ROW by implementing resettlement activities; • Assist UPMO (RMC I) in conducting census, lost-asset inventory, socioeconomic and replacement cost surveys as necessary; • Assist UPMO (RMC I) in preparing and validating the list of PAFs and affected assets; and • Assist UPMO (RMC I) in assessing and providing compensations
UPMO (RMC I)-ROW Task Force	• Organize ROW Team for the UPMO (RMC I) that will handle the ROW acquisition of its projects, to be headed by the Project Manager assigned for the project; • Monitor the status of ROW acquisition and recommend appropriate actions to projects when faced difficulties; • Execute and recommend appropriate resolutions pertaining to payment of compensation to the PAPs which are beyond the authority of the Project Directors; and • Review the validation of supporting documents undertaken by its TWG and recommend payments after the evaluation based on the propriety of the claims
ROW TWG	• Ensure that all relevant papers and documents in support of the ROW claim are carefully screened and verified as to their authenticity and genuineness in order to forestall fraud, pursuant to the provisions of the Simplified Guidelines for Validation and Evaluation of Infrastructure ROW claims; and • Ensure that the computation of land valuations and disturbance compensation for structures and other assets are based on RA 10752 and its IRR and other applicable laws, policies and department orders
Environmental and Social Safeguards Division (ESSD) of Planning Service	ESSD, formerly called ESSO (Environmental and Social Service Office), provides technical guidance and support in the implementation of RAP and will be responsible for the following: • Assist UPMO (RMC I) in preparing, reviewing, updating and approving the RAP including a RAP budget plan; • Assist UPMO (RMC I) in facilitating consultation meetings and information dissemination of PAPs and other relevant stakeholders during RAP process; • Assist UPMO (RMC I) in monitoring the implementation of RAP; and • Assist UPMO (RMC I) in resolving concerns and issues encountered during the implementation of RAP.
DPWH Region VII	As the regional office of the implementing agency, DPWH Region VII will: • Assist UPMO (RMC I) in managing and supervising construction in the project site; • Assist UPMO (RMC I) in securing ROW including resettlement activities; • Assist UPMO (RMC I) in conducting census, lost-asset inventory, and socioeconomic and replacement cost surveys as necessary; • Assist UPMO (RMC I) in preparing and validating list of PAFs and affected assets; and • Assist UPMO (RMC I) in assessing and providing compensation to PAPs

Source: JICA Survey Team

(2) Local and National Governments

The local and national governments concerned with implementation of resettlement for the project are presented in Table 9.7.2 along with their major functions.

Table 9.7.2 Key Functions of Concerned Local and National Governments for RAP Implementation

Concerned Governments	Functions Related to Resettlement
Local Government Units (LGU) of Mandaue and Lapu-Lapu City	LGUs (i.e. Mandaue and Lapu-Lapu City) are key local actors in the implementation of resettlement, mandated by the Urban and Housing Development Act (RA7729). They will coordinate with NHA and other concerned government agencies in: • Providing resettlement sites; • Providing basic services such as potable water, power and sewerage, in coordination with concerned government agencies and private sector; • Providing other basic facilities such as health, education, communication, security, recreation, relief and welfare, in coordination with concerned government agencies and private sector; • Providing livelihood programs in coordination with concerned government agencies and private sector; • Providing the above basic services, basic facilities and livelihood programs made through entering into MOA with concerned parties; and • Within the city government of Mandaue, HUDO, and for Lapu-Lapu City, CPDO, will be responsible for following resettlement activities: - Administering and maintaining existing and new resettlement sites of the city; - Administering applications, screening and awarding of social housing program of the city; and - Administering resettlement assistance including transfer of relocating persons
Local Housing Board (LHB) of Mandaue and Lapu-Lapu City	LHB of Mandaue and Lapu-Lapu Cities is a local special body for housing devoted to address shelter concerns of LGUs with a legal basis and authority by the Executive Order 708 (2008), reorganized by the Local Executive Order (No. 039-13) in August 2013 and is responsible for the following key matters: • Formulating a comprehensive city shelter plan of LGUs concerned including the following local housing projects such as resettlement projects, CMP, regular low-cost housing projects, medium rise housing and rental housing projects and core shelter housing assistance projects; • Administering housing and land development plans, socialized housing programs and coordination with other government agencies; and • Demolishing and evicting informal settlers' structures in coordination with the PCUP.
Resettlement Implementation Committee (RIC)	RIC is a local coordinating and consultative body organized for the implementation of RAP and set up by UPMO (RMC I) by entering into an MOA with concerned parties prior to the commencement of the detail design. RIC is composed of and functions as follows. Composition: • City Mayor or representative; • DPWH (UPMO-RMC I and Region VII); • City Government Officers; • Barangay Captain of each affected barangay; • Representative of PAPs of each affected barangay; • Representative of relevant NGOs and/or People's Organizations operating within the jurisdiction of the city; and • Representatives of assisting regional government offices such as NHA, DOLE, TESDA, DSWD, Department of Trade and Industry (DTI) and others, if necessary Functions: • Assist UPMO (RMC I) in preparing and validating the list of PAFs and affected assets; • Assist UPMO (RMC I) in provision of compensation; • Assist UPMO (RMC I) and ESSD in the conduct of consultation meetings and information dissemination of PAPs and other relevant stakeholders during RAP process; • Assist DPWH in providing compensation to the PAPs; • Assist the City Government in the enforcement of laws and ordinances regarding encroachment into the ROW of the Project in coordination with concerned government agencies; • Receive complaints and grievances of PAPs and other stakeholders and act accordingly; and • Maintain record of all public meetings, complaints and actions taken to address complaints and grievances

Concerned Governments	Functions Related to Resettlement
National Housing Authority (NHA) Region VII	NHA Region VII is a key national agency on housing in Mandaue and Lapu-Lapu City and mandated to provide the following service related to resettlement. • Provide relocation sites and adequate utilities and services for informal settlers in coordination with concerned LGUs and other government agencies
Department of Social Welfare and Development (DSWD) Region VII	DSWD Region VII is a key agency on social welfare and development in Mandaue and Lapu-Lapu City and is mandated to provide the following services related to resettlement. • Provide social protection services and programs for the poor, vulnerable, disadvantaged, women and children • Provide livelihood assistance and training programs
Technical Education and Skills Development Authority (TESDA) Region VII	TESDA Region VII is a key national agency on technical education and skills development in Mandaue and Lapu-Lapu City with a mandate to provide the following service related to resettlement. • Provide diversified and quality technical and skills development training programs including some programs targeted for National Certification of TESDA
Department of Labor and Employment (DOLE) Region VII	DOLE Region VII is a key national agency on employment development and promotion in Mandaue and Lapu-Lapu City with a mandate to provide the following service related to resettlement. • Provide job placement services program; and • Provide livelihood training program
Department of Trade and Industry (DTI) Region VII	DTI Region VII is a key agency on industrial and trade development and promotion in Mandaue and Lapu-Lapu City mandated to provide the following service related to resettlement. • Provide small and medium business and enterprise training program; and • Provide sustainable livelihood training program
Land Registration Authority/ Registry of Deeds (LRA/ROD), LGU (City Assessor's Office & City Treasurers Office), Bureau of Internal Revenue[13]	The role of the following organizations in Disposition of Resettlement/Housing lots/units by transfer of ownership in fee simple (Issuance of Land Titles to qualified PAPs) are respectively: • BIR: issuance of Certificate Authorizing Registration (CAR) or BIR clearance; • City Treasurers Office: Payment of Transfer Tax and issuance of Tax Clearance; • LRA/ROD: Issuance of new land title; and • City Treasurer's Office: Issuance of New Tax Declaration

Source: JICA Survey Team

[13] The process of securing land titles is dependent on the agency that will undertake the Resettlement Housing Program. For example, if it is NHA that undertakes the project (e.g. directly under its housing program or by using the funds of DPWH), NHA will be responsible for the titling of the lots. However, when NHA purchases the land from private land owners, the entire lot title will be transferred and the lot will be registered first under the name of NHA. It will then be NHA to undertake the process to transfer/register the title from NHA to the PAPs. The process of titling/land registration is standardized and involves the cited parties (i.e. LRA/ROD, BIR, City Treasurers and Assessors' Office).

9.7.3 Organizational Responsibilities on Implementation of RAP

Table 9.7.3 provides summary of responsibilities of organizations concerned with the implementation of RAP of the Project.

Table 9.7.3 Summary of Organizational Responsibilities

	Responsibilities	Responsible Agencies	Assisting Agencies	Coordinating Agencies
Pre-Relocation Stage [Stage A]	[A-1] Preparation, review, update and approval of RAP including a RAP budget plan	UPMO (RMC I)	ESSD	-
	[A-2] Arrangement with Concerned Parties on RAP Implementation	UPMO (RMC I)	-	City government and concerned local parties
	[A-3] Setting up of Resettlement Implementation Committee through entering into MOAs with concerned parties	UPMO (RMC I)	-	City government and concerned local parties
	[A-4] Conduct of tagging, census, socioeconomic survey and replacement cost survey	UPMO (RMC I)	ROW-Task Force TWG	RIC
	[A-5] Preparation and validation of the list of PAPs and affected assets including confirmation of documents and land registration in case PAPs were newly found to be possessing title over their properties.	UPMO (RMC I)	ROW-Task Force TWG/RIC, Registry of Deeds/Land Registration Authority, BIR and other relevant bodies	City government and concerned local parties
	[A-6] Assessment and provision of compensations	UPMO (RMC I)	ROW-Task Force TWG/RIC	City government and concerned local parties
	[A-7] Receiving and acting on complaints and grievances of PAPs	RIC	-	-
	[A-8] Development of resettlement sites	City Government /NHA Region VII	Private Sector NGOs	-
	[A-9] Provision of utilities and facilities at and access to resettlement sites	City Government / NHA Region VII	DPWH	-
	[A-10] Provision of livelihood assistance measures (skills trainings/capacity building trainings/institutional building trainings)	City Government	NHA, DSWD, DOLE, TESDA, DTI, Others if necessary	
	[A-11] Preparation of demolition and eviction of relocatees in the project site	City Government (City Housing Board), HUDO	-	
	[A-12] Facilitation of consultation meetings and information dissemination of PAPs and other relevant stakeholders on information of relocation procedures and assistance measures during pre-relocation stage	UPMO (RMC I)	ESSD/RIC	-
	[A-13] Periodic monitoring of the implementation of RAP (internal/external monitoring) during pre-relocation stage	UPMO (RMC I)	ESSD/RIC	-

Source: JICA Survey Team

Table 9.7.4 Summary of Organizational Responsibilities (Continuity)

	Responsibilities	Responsible Agencies	Assisting Agencies	Coordinating Agencies
Actual Relocation Stage [Stage B]	[B-1] Facilitation of consultation meetings and information dissemination of PAPs and other relevant stakeholders on settlement of relocation procedures and assistance measures during actual relocation stage	UPMO (RMC I)	ESSD / RIC	-
	[B-2] Provision of livelihood assistance measures (skills trainings/capacity building trainings/institutional building trainings)	City Government	NHA Region VII, DSWD, DOLE, TESDA, DTI, Others if necessary	UPMO
	[B-3] Preparation and implementation of demolition of structures and transfer of relocatees	City Government (City Housing Board),HUDO	-	PCUP
	[B-4] Receiving and acting on complaints and grievances of PAPs	RIC/ROW Task Force	-	-
	[B-5] Enforcement of laws and ordinances regarding encroachment into the right-of-way areas of the Project, in coordinating with concerned government agencies	City Government	RIC	-
	[B-6] Periodic monitoring of the implementation of RAP (internal / external monitoring) during actual relocation stage	IMA (ESSD)/EMA	ESSD / RIC	
Post-Relocation Stage [Stage C]	[C-1] Provision of livelihood assistance measures (skills trainings/capacity building trainings/institutional building trainings)	City Government	NHA DSWD DOLE TESDA DTI, Others if necessary	UPMO
	[C-2] Facilitation of consultation meetings and information dissemination of PAPs and other relevant stakeholders on settlement of relocation procedures and assistance measures during actual relocation stage.	UPMO (RMC I)	ESSD/RIC	-
	[C-3] Receiving and acting on complaints and grievances of PAPs	RIC/ROW Task Force	-	UPMO/ESSD
	[C-4] Administration and maintenance of resettlement sites, including periodic monitoring on conditions of relocatees and sites	City Government/ NHA-	DPWH, DepEd Private Sector	-
	[C-5] Enforcement of laws and ordinances regarding encroachment into the right-of-way areas of the Project, in coordinating with concerned government agencies.	City Government	RIC	-
	[C-6] Periodic monitoring of the implementation of RAP (internal/external monitoring) during post-relocation stage	UPMO (RMC I)	ESSD/RIC	-
	[C-7] Disposition of resettlement/housing lots/units by transfer of ownership in fee simple (Issuance of Land Titles to qualified PAPs)	City Govt, NHA	City Assessors Office, City Treasurer's Office, BIR, Registry of Deeds	UPMO

Source: JICA Survey Team

9.8 Monitoring and Evaluation

9.8.1 Purpose of Monitoring RAP Activities

The primary purpose of monitoring the RAP is to: ensure that resettlement is carried out in accordance with the RAP; to check the progress made in the associated activities; and to identify any issues or problems that may arise during the course of RAP implementation at an early stage so that measures can be taken to address the problem without delay. Activities subject to monitoring include: land acquisition; payment of compensation for lost assets; resettlement of the people affected by the project; and release of funds. It is required under JICA Guidelines that the PAPs' livelihoods are at least restored, if not improved, compared to pre-project levels. It is part of the goal of monitoring to confirm whether this condition has indeed been met.

9.8.2 Internal and External Monitoring

DPWH undertakes monitoring on RAP implementation through internal monitoring, which is conducted by ESSD as well as through external monitoring, which is carried out by either a qualified individual or a consulting firm to ensure neutrality in its monitoring.

(1) Internal Monitoring

The evaluation and in-house monitoring of RAP implementation will be conducted by ESSD and will serve as the internal monitoring agent (IMA) supported by the consultants. The tasks assigned to the IMA are to:

- Regularly supervise and monitor the implementation of RAP in coordination with the RIC. The findings will be documented in a quarterly report that is to be submitted to UPMO (RMC I);
- Verify that the re-inventory baseline information of all PAPs has been carried out and that the valuation of assets lost or damaged, the provision of compensation and other entitlements, and relocation have been carried out in accordance with LARRIPP and RAP;
- Ensure that RAP is implemented as designed and planned;
- Verify that the funds for RAP implementation are provided by UPMO (RMC I) in a timely manner and in the amount sufficient for the purpose; and
- Record all grievances and their resolution and ensure that complaints are dealt with promptly.

(2) External Monitoring and Evaluation

UPMO (RMC I) will commission an external monitoring agent (EMA) to undertake independent monitoring and evaluation. According to the "Good Practice Note: Third-Party Monitoring" (2018) of the WB, "The goal of using third parties to assess the status and performance of a project, its compliance status, or emerging issues through a specialized party is to provide an unbiased perspective on the issue and status, and to make recommendations for improvement, where relevant". EMA needs to have certain level of monitoring expertise and experiences required by DPWH to be qualified to meet the requirements for participating in the bidding and selection process of DPWH. As explained earlier, it is often either a qualified individual or consultancy firm that is selected to undertake external monitoring activities and the evaluation work. Prior to the engagement of the EMA, DPWH will prepare the Terms of Reference (TOR) for the EMA. External monitoring and evaluation will entail random observations/visits and consultations with the PAPs at their current pre-project residence and their relocation site. The tasks of the EMA are to:

- Verify the results of internal monitoring;

- Verify that the compensation process has been carried out in an open and transparent manner with sufficient communication and consultations with the PAPs;
- Review how the affected assets were evaluated and compensation amount determined;
- Assess the efficiency, effectiveness, impact and sustainability of activities associated with resettlement and RAP implementation;
- Assess if resettlement objectives have been met, specifically if livelihoods and living standards have been restored or improved;
- Review the way in which complaints and grievances had been handled; and
- Suggest modifications in the implementation procedures of RAP, if necessary, to better achieve the principles and objectives of the resettlement policy

The EMA shall also include in the monitoring the results of disclosing RAP to the PAPs during public consultations conducted for each project contract package.

9.8.3 Framework of Monitoring Activities

The monitoring activities and frequency are summarized in the table below:

Table 9.8.1 Monitoring Activities and Frequency

Monitoring Activity	Description	Schedule/ Frequency	Monitoring Agent Responsible
Preparation of Inception Report and Compliance Monitoring Report	To determine the scope of the monitoring activities to be carried out	One month after receipt of Notice to Proceed for the engagement of IMA/ EMA	IMA, EMA
Monitoring and Evaluation during RAP Implementation	Monitoring of RAP implementation activities	Monthly (for IMA) and Quarterly (for EMA) until end of RAP implementation	IMA, EMA
Interim Evaluation	Interim evaluation of the implementation of RAP to verify if the social and economic conditions of the PAPs have been restored after delivery of compensation and other assistance *If PAPs are found worse off in terms of standard of living and livelihood, DPWH in coordination with concerned institutions shall provide assistance such as livelihood and skills training.	Three months after completion of compensation payments to, and resettlement of, PAPs	EMA
Monitoring and Evaluation during Construction	To follow up if the social and economic conditions of the PAPs after project implementation have improved or are been restored *If PAPs are found worse off in terms of standard of living and livelihood, DPWH in coordination with concerned institutions shall provide assistance such as livelihood and skills training.	Every six months (for IMA) and every 12 months (for EMA) until one year after completion of construction	IMA, EMA
Final Evaluation	To confirm if social and economic conditions of the PAPs after project implementation have improved or are at least been restored	One and two years after completion of the project	IMA, EMA

Source: JICA Survey Team

9.8.4 Monitoring Activities

(1) Considerations for Internal Monitoring

Internal monitoring should be carried out with the points of considerations shown in the following table in accordance with LARRIPP. A form for internal monitoring (draft) is shown in Appendix 3.

Table 9.8.2 Points of Considerations for Internal Monitoring

Category	Points to Consider
Budget and Timeframe	• Have all land acquisition and resettlement staff been appointed and mobilized for the field and office work on schedule? • Have capacity building and trainings been completed on schedule? • Are resettlement implementation activities being achieved against the agreed implementation plan? • Are funds for resettlement being allocated to resettlement agencies on time? • Have resettlement offices received the scheduled funds? • Have funds been disbursed according to the RAP? • Has the social preparation phase taken place as scheduled? • Has all land been acquired and occupied in time for project implementation?
Delivery of Compensation and Entitlements	• Have all PAPs received entitlements according to numbers and categories of loss set out in the entitlement matrix? • Have all PAPs received payments for affected land and structures on time? • Have all PAPs received the agreed transport costs, relocation costs, income substitution support and any resettlement allowances, according to schedule? • Have all replacement land plots or contracts been provided? Was the land developed as specified? • How many PAPs resorted to expropriation? • How many PAPs received land titles? • How many PAPs received housing as per relocation options in the RAP? • Does house quality meet the standards agreed? • Have relocation sites been selected and developed as per agreed standards? • Are the PAPs occupying the new houses? • Are assistance measures being implemented as planned for host communities? • Is restoration proceeding for social infrastructure and services? • Are the PAPs able to access schools, health services, cultural sites and activities at the level of accessibility prior to resettlement? • Are income and livelihood restoration activities being implemented as set out in the income restoration plan? For example, have utilizing replacement land, commencement of production, numbers of PAPs trained and provided with jobs, micro-credit disbursed, number of income generating activities been assisted? • Have affected businesses received entitlements including transfer and payments for net losses resulting from lost business and stoppage of production?
Public Participation and Consultation	• Have consultations taken place as scheduled including meetings, groups, and community activities? Have appropriate resettlement leaflets been prepared and distributed? • How many PAFs know their entitlements? How many know if they have been received? • Have any PAFs used the grievance redress procedures? What were the outcomes? • Have conflicts been resolved? • Was the social preparation phase implemented?
Benefit Monitoring	• What changes have occurred in patterns of occupation, production and resources use compared to the pre-project situation? • What changes have occurred in income and expenditure patterns compared to pre-project situation? What have been the changes in cost of living compared to pre-project situation? Have PAFs' incomes kept pace with these changes? • What changes have taken place in key social and cultural parameters relating to living standards? • What changes have occurred to vulnerable groups?

Source: JICA Survey Team

(2) Considerations for External Monitoring

External monitoring should be carried out with the points of considerations shown in the following table in accordance with LARRIPP. A form for external monitoring (draft) is shown in Appendix 3.

Table 9.8.3 Points of Considerations for External Monitoring

Category	Points to Consider
Basic Information on Project-affected Households	• Location • Composition and structures, ages, education and skill levels • Gender of household head • Ethnic group • Access to health, education, utilities and other social services • Housing type • Land use and other resource ownership patterns • Occupation and employment patterns • Income sources and levels • Agricultural production data (for rural households) • Participation in neighborhood or community groups • Access to cultural sites and events • Value of all assets forming entitlements and resettlement entitlements
Restoration of Living Standards	• Were house compensation payments made free of depreciation, fees or transfer costs to the PAP? • Have PAPs adopted the housing options developed? • Have PAPs achieved replacement of key social cultural elements?
Restoration of Livelihoods	• Were compensation payments free of deduction for depreciation, fees or transfer costs to the PAP? • Were compensation payments sufficient to replace lost assets? • Did transfer and relocation payments cover these costs? • Did income substitution allow for re-establishment of enterprises and production? • Have enterprises affected received sufficient assistance to re-establish themselves? • Have vulnerable groups been provided income-earning opportunities? • Are these effective and sustainable? • Do the jobs provided restore pre-project income levels and living standards?
Levels of PAP Satisfaction	• How much do PAPs know about resettlement procedures and entitlements? Do PAPs know their entitlements? • Do they know if these have been met? • How do PAPs assess the extent to which their own living standards and livelihoods been restored? • How much do PAPs know about grievance redress and conflict resolution procedures? How satisfied are those who have used the said mechanisms?
Effectiveness of Resettlement Planning	• Were the PAPs and their assets correctly enumerated? • Was the time frame and budget sufficient to meet the objectives? • Were entitlements too generous? • Were vulnerable groups identified and assisted? • How did resettlement implementers deal with unforeseen problems?
Other Impacts	• Were there unintended environmental impacts? • Were there unintended impacts on employment or incomes?

Source: JICA Survey Team

9.8.5 Schedule of Monitoring

Schedule for implementation of the RAP and the required monitoring has been developed as shown in Table 9.9.1. Internal and external monitoring systems should be set up after the ROW has been finalized and all PAPs identified and yet no later than when the process for land acquisition has commenced. They should be carried out periodically until one year after project completion. The schedule should be reviewed and updated during the D/D stage of the study in view of the project's implementing schedule.

9.8.6 Reporting

The monitoring reports of the IMA prepared by ESSD and that of the EMA prepared by an external agent are reported to ESSD and are accountable to UPMO (RMC I). The UPMO (RMC I), which receives monitoring reports through ESSD, reviews and thereafter submits the monitoring reports of the IMA and EMA to JICA quarterly.

9.9 Schedule for Implementation

Major steps and considerations in preparing the schedule for carrying out the RAP are described below. The overall schedule is presented in Table 9.9.1.

(1) Review and Update of RAP

During the D/D stage, the RAP prepared by the JICA Survey Team will be reviewed and updated, which may include conducting an additional set of survey for census, lost-asset inventory, and socio-economic (i.e. household income) surveys in the project-affected area depending on whether if additional people and assets have been found to be affected due to changes to the project design (e.g. alignment). In such cases, a new cut-off date will be set in the respective areas for those newly identified PAPs.

*Parcellary surveys and RAP preparation shall be undertaken at least one year ahead of the scheduled construction works, according to the DPWH ROW Acquisition Manual.

(2) Arrangements for Implementation of RAP

Posterior to the official arrangement of the implementation of the project made by DPWH, the arrangement with concerned parties on the implementation of RAP and the RIC will be set up by DPWH during or after the D/D stage and yet no later than commencement of provision of compensation and other assistance.

(3) Compensation and Other Assistance

Compensation should be duly paid before relocation, in accordance with JICA Guidelines and other assistance such as those support aimed at restoring PAPs' livelihood be provided from pre-relocation stage up to the end of the construction.

(4) Relocation of PAPs

Relocation of all PAPs including the demolition of affected structures and the preparation of resettlement sites should be completed before commencement of construction of each contract package. It should be noted that for relocation of large companies, the time necessary for its relocation may take years.

(5) Information Dissemination and Consultation

All information on resettlement activities, such as required documents and its procedures, schedules and other necessary information for compensation, relocation, resettlement and other assistance will be provided to all PAPs and its concerned parties through consultative meetings and media (e.g. newspapers, radio and TV) from pre-relocation stage up to the end of construction.

(6) Grievances Redress

Grievances related to any aspect of the project will be handled through the RIC from pre-relocation stage up to the end of construction.

(7) Monitoring of RAP Implementation

Internal and external monitoring will be conducted upon commencement of construction, throughout the construction stage and until two years after completion of the project.

Table 9.9.1 Implementation Schedule of RAP

Activities	Responsible Agency
Review and Update of RAP	
RAP Survey (parcellary, census, lost-asset inventory and socio-economic surveys)	JICA DT/DPWH-UPMO
Public Consultations	JICA DT/DPWH-UPMO
Finalization of RAP	JICA DT/DPWH-UPMO
Validation of RAP	DPWH-UPMO
Formation of Implementing Body of RAP	
MOA between DPWH and relevant government organizations such as NHA	DPWH-UPMO
Formation of RIC, URTF and TWG	DPWH-UPMO
Formation of Grievance Redress Mechanism	DPWH-UPMO
Land Acquisition	
Verification of PAPs and Affected Properties	DPWH-UPMO
Deed of Donation	DPWH-UPMO
Verification of PAPs' Eligibility	DPWH-UPMO
Issuance of Letter of Offer	DPWH-UPMO
Deed of Absolute Sale	DPWH-UPMO
Relocation of Utilities	DPWH-UPMO
Processing Transfer of Title to the Republic of the Philippines	DPWH-UPMO
Payment for Land	DPWH-UPMO
Payment for Improvements	DPWH-UPMO
Provision of Other Assistance (e.g. livelihood restoration program)	DPWH-UPMO
Notification for Demolition of Structures	DPWH-UPMO
Clearance of Land/ROW by PAPs	PAPs
Demolition of Remaining Structures	DPWH-UPMO
Resettlement of PAPs	
Preparation of Relocation Sites (e.g. bidding, selection of developer, construction)	NHA/LGUs/DPWH
Provision of Rental Subsidy to PAPs (if housing development has not been completed)	DPWH-UPMO
Relocation	RIC/DPWH-UPMO
Consultation	
consultation with PAPs	
consultation with projet-affected companies	
Monitoring	
Internal Monitoring	DPWH-ESSD
Selection of External Monitoring Agent (EMA)	DPWH-UPMO
External Monitoring	EMA/DPWH-UPMO
Project Implementation	
Detail Design	JICA DT/DPWH-UPMO
Tendering	DPWH-UPMO/JICA DT
Obtainment of Permit to Enter (PTE)	DPWH-UPMO
Notice of Award to the Contractor	DPWH-UPMO
Notice to Proceed (by phases)	DPWH-UPMO
Construction	Contractor/DPWH-UPMO

9.10 Cost and Budget

9.10.1 Compensation Cost for Land

The cost for acquiring the land was estimated based on the effective zonal values provided by the City Assessor's Office in both Mandaue and Lapu-Lapu City. It should be noted, however, that the zonal value tends to be lower than the market value of the land, which should be the basis of calculation of the compensation cost. With reference to the DRAM that states that "DPWH may estimate this [land market value], using BIR ZV x factor not exceeding 2" for Simple Road Widening, a factor of 2.0 has been adopted in the study[14]. The following tables show the estimated cost for acquiring the land for the project by barangay based on the said adjusted zonal values. Table 9.10.1 and Table 9.10.2 respectively show the cost excluding and including capital gain tax, documentary stamp tax, transfer tax and notarial and operational expenses. The total cost including those taxes comes down to approximately PhP 10,471,708,050.

Table 9.10.1 Cost for Acquiring Land based on Adjusted Zonal Value excluding Taxes

Location	Land Area			Zonal Value*		Land Classification	Cost excluding Taxes
	Public	Private	Total	Original	Adjusted (original*2.0)		
Mandaue City							
NRA	2,340 m2	1,590 m2	3,930m2	25,000	50,000	commercial	196,500,000
Centro	9,720 m2	-	9,720 m2	25,000	50,000	commercial	486,000,000
Looc	1,390 m2	43,990 m2	45,380m2	7,625	15,250	industrial	692,045,000
Opao	-	45,310 m2	45,310 m2	12,000	24,000	industrial	1,087,440,000
Umapad	-	373,160 m2	373,160 m2	7,375	14,750	industrial	5,504,110,000
Paknaan	11,200 m2	-	11,200 m2	9,500	19,000	industrial	212,800,000
Lapu-Lapu City							
Pusok	9,980 m2	22,870 m2	32,850m2	12,000	24,000	commercial	788,400,000
Ibo	23,190 m2	4,450 m2	27,640m2	12,000	24,000	commercial	663,360,000
Sub-total							**9,630,655,000**

*based on the zonal value dated 2018 except for Brangay Pusok and Ibo where the stated market values written in the tax declaration form dated 2018 provided by the Assessors' Office of Lapu-Lapu City were adopted

Source: JICA Survey Team

Table 9.10.2 Cost for Acquiring Land based on Adjusted Zonal Value including Taxes

Cost excluding Taxes	Taxes and Fees			Notarial and Operational Expenses	TOTAL COST
	CGT	DST	Transfer Tax		
9,630,655,000	614,722,660	144,459,825	72,229,913	9,640,655	**10,471,708,053**

Source: JICA Survey Team

9.10.2 Compensation Cost for Structures

(1) Replacement Cost Survey

A replacement cost was estimated for project-affected structures by: (a) identifying the prevailing types of buildings in both Mandaue and Lapu-Lapu City through a field investigation, particularly in the project-affected area; and (b) by determining the unit cost by referencing with similar studies such as the "Feasibility Study on the Mandaue-Consolacion-Liloan Bypass Road Project (2018)". All structures in the project-affected area were identified, counted and measured through aerial photographs using the geographic information system (GIS) and verified on site.

[14] It is worth noting that with the newly adopted zonal value in Mandaue City has been found to be equivalent to the market value in some cases (cf. UN Avenue Underpass Project).

(2) Unit Cost for Construction of the Structures by Types

The prevailing building types in the project-affected area was surveyed and identified through analyses on the results of field investigations on their compositions and materials. The building types were identified and classifieds as a result. Based on the building materials (i.e. types) and estimated unit cost for materials and labor, the per square meter cost for constructing each of the identified building types was estimated as presented in Table 9.10.3.

Table 9.10.3 Building Types and Unit Cost for Construction of Structures

Building Types		Unit Cost (PhP/m2)
REINFORCED CONCRETE		
Type 1A	Fully furnished, structural element shall be of steel, iron, reinforced concrete or masonry construction. Walls, ceiling, & concrete permanent partitions with paint	17,484
Type 1B	All structural elements are reinforced concrete. Walls are plastered concrete hollow blocks (CHB) without paint	12,510
Type 1C	Some structural elements are reinforced concrete. CHB wall without plastered and without paint. Ordinary GI roofing	11,220
2. SEMI CONCRETE		
Type 2A	Concrete columns, beams and walls with plaster, with paint -but wooden floor joist, flooring and roof framing and GI roofing	9,930
Type 2B	Concrete columns, beams and walls with plaster, no paint -but wooden floor joist, CHB walls and GI roofing	9,020
Type 2C-	Concrete columns, beams and walls without plaster, no paint, ordinary GI roofing and floor finish	8,090
3. WOODEN MATERIALS		
Type 3A-	Wooden structural framing, flooring and walls, roof framing with paint double walling and ceiling	7,470
Type 3B-	Wooden structural framing, flooring and walls, roof framing with paint double walling, no ceiling	6,900
Type 3C-	Wooden structural framing, flooring and walls, roof framing without paint single walling, no ceiling	5,200
Type 3D-	Shanty, Barong barong type	2,940
Type 3E-	Nipa and bamboo slats	4,070
4. TEMPORARY STRUCTURES (Shade with ordinary GI roofing)		2,636

*unit cost based on interview with a construction company operating in the local area
Source: JICA Survey Team

(3) Compensation Cost for Project-affected Household Structures

With a total floor area of 1,531.92 m2, the total compensation cost for PAFs' affected household structures was estimated to be approximately PhP 9,088,660.

Table 9.10.4 Compensation Cost for Project-affected Household Structures

Building Types / Barangays	Shanty	Predo Wooden	Semi-Permanent	Permanent	TOTAL
Looc (m2)	9.05	47.68	34.70		**91.43**
Opao (m2)	27.46	164.09	98.80		**290.35**
Umapad (m2)	151.59	31.50	-		**183.09**
Paknaan (m2)	160.32	434.98	228.00	143.75	**967.05**
Total Area (m2)	348.42	678.25	361.50	143.75	**1,531.92**
Unit Cost (PhP)	2,940.00	5,200.00	8,090.00	11,220.00	
Total Cost (PhP)	**1,024,354.80**	**3,526,900.00**	**2,924,535.00**	**1,612,875.00**	**9,088,664.80**

Source: JICA Survey Team

(4) Compensation Cost for Project-affected Private and Public Structures

Survey suggests that a total floor area of 18,148 m2 would be affected by the project. When the building types shown in Table 9.10.5 are applied, the necessary cost for compensating for the affected buildings and structures including facilities is estimated to come down to approximately PhP1,623,670,960. Adding the cost for extending a jetty in Looc and the wharf in Lapu-Lapu City, the amount becomes PhP 1,776,270,960 in total.

Table 9.10.5 Compensation Cost for Project-affected Private and Public Structures

Barangay	Area Compensated (m2)	Cost for Compensation (PhP)
NRA	923	10,744,992
Centro	368	3,918,690
Looc	8,408	61,323,484
Opao	1,060	8,670,280
Umapad	0	0
Paknaan	0	0
Pusok	5,251	1,501,632,720
Ibo	2,138	37,380,792
TOTAL	**18,148**	**1,623,670,958**

Source: JICA Survey Team

Table 9.10.6 Compensation Cost for Jetty and Wharf

Type of Assets	Area Affected	Unit Cost (PhP)	Total Cost (PhP)	Remarks
Jetty	1,600 m2	54,500	87,200,000	
Wharf	1,200 m2	54,500	65,400,000	
TOTAL			**152,600,000**	

Source: JICA Survey Team

9.10.3 Compensation Cost for Project-affected Trees

The estimated amount of cost for compensating the trees owned by individual households and other private and public entities is PhP 99,510 in total as described in more detail below.

(1) Trees owned by Individual Households

A total number of 54 trees of various species were found within the project-affected households' dwellings. It has been found through the site inspection and interview surveys with the PAPs that these trees were not grown for commercial production purposes but for backyard gardening and own-consumptions only (cf. some crops have been found but were all grown in pots which are easily movable and hence have not been considered affected).

The trees are generally small (i.e. diameter of less than 5 cm) and not fully grown. The compensation cost for PAHs trees was therefore not based on the DAO No. 2000-63 Forest Charges (which was used as basis for computation for trees inventoried), which is applicable to larger trees, but rather on per standing tree basis (generally informal agreement between the tree owner and the buyer). The total cost for this is estimated to be PhP 3,600.

Table 9.10.7 Compensation Cost for Project-affected Household Trees

Types of Trees	Barangay				Total	Unit Cost	Total Cost (PhP)
	Looc	Opao	Umapad	Paknaan			
Gmelina	-	-	-	1	1	100	100
Talisay	-	4	1	5	10	100	1,000
Mango	-	-	-	4	4	200	800
Nangka	-	-	-	3	3	200	600
Coconut	-	2	-	5	7	100	700
Tambis	-	-	-	2	2	200	400
TOTAL	**-**	**6**	**1**	**20**	**27**		**3,600**

Source: JICA Survey Team

(2) Other Trees owned Publicly and Privately

Value of the trees that are not owned by the households affected have been calculated based on the DAO No. 2000-63 Forest Charges. As a result, the compensation cost has been estimated to be PhP 95,910.

Table 9.10.8 Other Project-affected Trees owned Publicly and Privately

Location and Tree Species	Public Trees		Private Trees		Est. Unit Price per Volume	Est. Cost (PhP)	
	Number	Volume (m3)	Number	Volume (m3)		Public	Private
Mandaue City							
Anabiong	1	0.04			700	30	
Antipolo	3	0.34			950	320	
Auri	9	0.38			700	270	
Bagalnga	3	0.09			950	90	
Balite	13	0.54			700	380	
Bani	1	0.01			700	10	
Binunga	2	0.01			700	10	
Caimito	5	0.1			700	70	
Eucalyptus camadulensis	31	2.6			700	1,820	
Eucalyptus deglupta	9	0.86			700	600	
Fire Tree	9	0.45			700	320	
Gmelina	1	0.17	3	1.69	950	160	1,600
Guava			1	0.01	700		10
Indian Mast Tree	2	0.08	9	0.08	700	60	60
Ipil-ipil	75	1.85	4	0.04	700	1,290	30
Kapok	2	0.45			700	320	
Kulis	1	0.77			700	540	
Mahogany	37	12.21	1	0.04	950	11,600	40
Manga	7	0.26			700	180	
Manzanitas	5	0.05			700	40	
Misc. Spp 1	1	0.01			700	10	
Misc. Spp 2	2	0.45			700	320	
Molave	144	2.38	1	0.01	3,000	7,140	30
Narra	71	2.75			3,000	8,250	
Neem Tree	32	2.22	31	2.38	950	2,110	2,260
Noni	1	0			700	0	
Raintree	8	0.94			700	660	
Talisay	20	1.57			950	1,490	
Taloto	1	0.09			700	60	
Sub-total	**496**		**50**			**38,150**	**4,030**
Lapu-Lapu City							
Anabiong	4	0.21			700	150	
Auri	5	0.81			700	570	
Balite			4	1.27	700		890
Binunga	9	0.19			700	130	
Dita			1	3.6	700		2,520
Eucalyptus spp.			1	0.01	700		10
Fire Tree	1	0.05			700	40	
Gmelina	21	3.41			950	3,240	
Guyabano	1	0.01			700	10	
Indian Mast Tree	42	3.64			700	2,550	
Ipil-ipil	11	0.37	9	0.25	700	260	180
Mahogany	674	25.05			950	23,800	
Mangium	10	2			700	1,400	
Manzanitas	6	0.04	5	0.02	700	30	10
Misc. Spp1	3	0.07			700	50	
Misc. Spp2	1	0.09			700	60	
Misc. Spp3	5	0.14			700	100	
Molave	27	1.33			3,000	3,990	
Narra	84	4.23			3,000	12,690	
Neem Tree	12	0.85			700	600	
Rain Tree	2	0.14			700	100	
Spp1	1	0.01			700	10	
Talisay	7	0.32			950	300	
Tambis	2	0.06			700	40	
Sub-total	**928**		**20**			**50,120**	**3,610**
TOTAL	**1,424**		**70**			**88,270**	**7,640**
						Total Cost (PhP)	**95,910**

Source : JICA Survey Team

9.10.4 Compensation Cost for Assets

Compensation cost for relocating the aquaculture farm in Umapad is estimated to be PhP 8,114,550 as shown in Table 9.10.9. There are also concrete and fences that are affected whose compensation costs are calculated as shown in Table 9.10.10 which comes down to an aggregate amount of PhP 41,236,140. Combining the two, the total amount of compensation cost for assets are PhP 49,350,690.

Table 9.10.9 Compensation Cost for Aquaculture Farm

Type of Assets	Area Affected	Unit Cost (PhP)	Total Cost (PhP)
Aquaculture Farm	2.35 ha	3,453,000	8,114,550

*based on interview with agriculturist in the local area
Source: JICA Survey Team

Table 9.10.10 Compensation Cost for Concrete and Fences

Barangay	Compensation Cost for Concrete	Compensation Cost for Fences
NRA	646,800	1,290,810
Centro	3,145,120	2,343,370
Looc	15,741,220	5,993,650
Opao	3,804,680	686,240
Umapad	-	-
Paknaan	-	-
Pusok	4,507,800	2,616,650
Ibo	459,800	-
Sub-total	28,305,420	12,930,720
TOTAL		**41,236,140**

Source: JICA Survey Team

9.10.5 Cost for Development of Resettlement Site

Cost for development of resettlement sites has been estimated based on the two candidate sites using their respective BIR zonal value multiplied by two for land as well as the cost for land and housing development offered by NHA as shown in the table below. Provided that 69 households are to be resettled, and DPWH covers the cost, the compensation cost comes down to PhP 53,752,800 for Labogon and PhP 66,162,800 for Pulog. The higher value (i.e. PhP 66,162,800) will be adopted in this report as the necessary cost.

Table 9.10.11 Estimated Cost for Resettlement Site Development in Labogon, Mandaue

Category	Unit Cost (PhP)	Number	Total (PhP)	Remarks
Land Purchase	900/m2	18,080 m2	16,272,000	
Land Development	137,000/lot	69 lots	9,453,000	lot size: 4m * 10m
Housing Development	406,200/unit	69 units	28,027,800	unit size: 22.0-28.4m2
TOTAL			**53,752,800**	

*The above cost includes the cost for infrastructure within the resettlement site but not that outside of it which is to be provided by the LGUs.
Source: Interview with the Regional Office VII of the National Housing Authority

Table 9.10.12 Estimated Cost for Resettlement Site Development in Pulog, Consolacion

Category	Unit Cost (PhP)	Number	Total (PhP)	Remarks
Land Purchase	7,000/m2	3,230 m2	22,610,000	
Land Development	81,200/lot	69 lots	5,602,800	lot size: 4m * 10m
Housing Development	550,000/unit	69 units	37,950,000	unit size: 22.0-28.4m2
TOTAL			**66,162,800**	

*The above cost includes the cost for infrastructure within the resettlement site but not that outside of it which is to be provided by the LGUs.
Source: Interview with the Regional Office VII of the National Housing Authority

9.10.6 Cost for Resettlement and Assistance to Vulnerable Groups

Cost for resettlement and additional assistance to be provided to vulnerable groups are estimated to be PhP 1,820,000.

Table 9.10.13 Cost for Resettlement and Assistance for Vulnerable Groups

Particulars	Unit Price	Number of PAPs	Total (PhP)
Rehabilitation Assistance	PhP 15,000	69	1,035,000
Inconvenience Compensation	PhP 10,000	44	440,000
Transportation Assistance	PhP 5,000	69	345,000
TOTAL			**1,820,000**

Source: JICA Survey Team

9.10.7 Cost for Monitoring

A lump sum cost of PhP 25,000,000 is expected to cover the cost for both internal and external monitoring.

9.10.8 Budget for Resettlement

(1) Funds for RAP Implementation

DPWH as the project proponent and UPMO (RMC I) as the implementing office of the project are responsible for securing and providing necessary funds for implementing the RAP as part of the project cost. The resettlement cost of the project shall be a component of the counterpart funds provided by DPWH called the ROW funds and include compensation for affected structures and acquisition of land.

(2) Preparation of RAP Budget Plan

Consistent with the provisions in the LARRIPP of DPWH, ESSD shall assist UPMO (RMC I) in preparing, reviewing, updating and approving the RAP budget plan of the project. The UPMO (RMC I) shall, thereafter, submit the RAP budget plan to the Central Office of DPWH for approval following a due diligence review conducted by ESSD.

(3) Procedures for Flow of Funds

DPWH, specifically the implementing office of UPMO (RMC I), shall be responsible for securing and providing the funds needed for carrying out the RAP. Disbursement of the funds for implementing the RAP shall be requested to, and obtained from, the Central Office of DPWH and implemented and monitored by UPMO (RMC I) through the field office.

9.10.9 Total Cost for RAP Implementation

The total cost for implementation of land acquisition and resettlement is estimated to be approximately PhP 14,259,425,770, which covers the costs for compensating affected structures/assets and land/property, that for developing the resettlement site, the cost for implementing the livelihood restoration program, resettlement and assistance for vulnerable groups, and the cost for monitoring.

Table 9.10.14 Total Cost for Implementation of the RAP

No.	Items	Amount (PhP)	Remarks
1	Compensation Cost for Land	10,471,708,050	
2	Compensation Cost for HH Structures	9,088,660	
3	Compensation Cost for Other Structures	1,776,270,960	
4	Compensation Cost for Trees	99,510	
5	Compensation Cost for Assets	49,350,690	
6	Cost for Development of Resettlement Site	66,162,800	
7	Cost for Implementing LRP	-	
8	Cost for Resettlement and Assistance to Vulnerable Groups	1,820,000	
9	Cost for Monitoring	25,000,000	
Sub-total		**12,399,500,670**	
10	Administrative Cost and Contingency	1,859,925,101	15%
TOTAL		**14,259,425,771**	

Source: JICA Survey Team

9.11 Public Consultation

Public consultation for the PAPs and companies on the RAP was carried out in different forms so that it best suits the purpose within the limited timeframe. Relatively large meetings were mostly undertaken on the same day and in the same venue as the stakeholder meeting held for the EIA (i.e. Public Hearing/Stakeholder Meeting at the Scoping Stage) in a closed session exclusively for the PAPs after the open session broke up. Explanations were given to the PAPs on the project (e.g. road and bridge design and alignment and schedule for implementation) and their views and opinions were collected. The presentations made by the JICA Survey Team were in English, with supplementary explanations in Cebuano when necessary, while those given by other people (e.g. DPWH, EMB, LGUs and local consultants) were in Cebuano. The purpose of the discussion was to better ensure that the PAPs understood about the project and how they would be affected by it as well as to, from the project proponents' point of view, understand the PAPs' views, opinions and difficulties they would face as a result of the project so that they could be eased and ameliorated. The meetings held in the survey can be classified into the following groups:

- Preparatory and Coordination Meetings;
- Public Scoping/Stakeholder Meeting at the Scoping Stage;
- Public Hearing/Stakeholder Meeting at the DFR stage;
- Group Consultations with Project-affected Persons and Companies;
- Individual Consultations with Project-affected Companies; and
- Focus Group Discussions (FGDs)

The Preparatory and Coordination Meetings, the Public Scoping/Stakeholder Meeting at the Scoping Stage, the Public Hearing/Stakeholder Meeting at the DFR stage, and the Focus Group Discussions (FGDs) are summarized in the Chapter 8 Environmental Impact Assessment. The Group Consultations with Project-affected Persons and Companies and the Individual Consultations with Project-affected Companies are summarized below.

9.11.1 Group Consultations with Project-affected Households and Entities

A series of group consultations were held with both the individual households and other entities affected by the project as summarized in the table below. A record of the discussions made is described in the following sections.

Table 9.11.1 Overview of Group Consultations with Project-affected Households and Entities

Date	Venue	Agenda	Participants	
			by Affiliation	by Sex
June 4, 2019	Barangay Paknaan Gym	First Consultation with PAHs (Mandaue City)	Local People: 21 DPWH-ESSD: 1 DPWH Region VII: 2 JICA ST: 4	Male: 9 Female: 19
June 6, 2019	Mandaue City Mayor's Office Conference Room	First Consultation with Project-affected Entities (Mandaue City)	Private: 16 DPWH Region VII: 4 LGU: 2 JICA ST: 6	Male: 20 Female: 8
June 11, 2019	Lapu-Lapu City Tourism Building	First Consultation with Project-affected Entities (Lapu-Lapu City)	Private: 10 DPWH Region VII: 3 LGU:1 PEZA: 3 JICA ST: 4	Male: 12 Female: 9
July 11, 2019	Mandaue City Social Welfare Services Conference Room	Second Consultation with Project-affected Entities (Mandaue City)	Local People: 4 Private: 20 DPWH-UPMO (RMC I): 1 DPWH-ESSD: 1 DPWH Region VII: 4 LGU: 3 JICA ST: 8	Male: 29 Female: 12
July 11, 2019	Lapu-Lapu City ABC Building	Second Consultation with Project-affected Entities (Lapu-Lapu City)	Private: 12 DPWH-UPMO (RMC I): 1 DPWH-ESSD: 1 DPWH Region VII: 5 LGU:1 PEZA: 5 JICA ST: 7	Male: 19 Female: 13
July 24, 2019	Paknaan Barangay Multi-Purpose Hall	Second Consultation with PAHs (Mandaue City)	Local People: 49 DPWH Region VII: 7 JICA ST: 5	Male: 29 Female: 32

Source: JICA Survey Team

1) Consultation with Project-affected Households

The first consultation held with the project-affected households on June 4, 2019 in Mandaue City is presented in Table 9.11.2.

Table 9.11.2 First Consultation with PAHs in Mandaue City

PART II of Public Hearing			
Preliminaries	The names of the affected households were shown to inform the attendees who are affected and not.		
No.	**Comments, Questions and Suggestions**	**Answers**	**Reaction by Questioner**
1	Question The list of PAPs shown here does not include some households that responded to the survey. Can they also avail of the compensation? (Local Person/Male)	This list is based on the new alignment. The respondents to the survey include those affected by the previous alignment and those in setbacks/easements. In the D/D stage this list may be updated as this is still at the F/S stage. (JICA Survey Team)	Understood.
2	Question Is it possible for us, PAPs, to identify the lots where we can relocate (in the absence of government relocation sites) in which case will the purchase be shouldered by the government, and will the lots including the housing units and other utilities be free (no payment or amortization)? (Local Person/Male)	The PAPs' payment will be dependent on the housing program that will be availed for the project. This has to be discussed with DPWH, the City Government (i.e. HUDO) and NHA. Livelihood assistance will also be provided, if hindered. (JICA Survey Team)	Understood
3	Question The PAPs and those in the surrounding areas use the mangrove swamps for soaking the raw materials for their broom-making. With the project, will they be prevented from accessing these areas? Will the mangrove swamps be backfilled? This could be a large loss to the people in the area. (Local Person/Male)	The project will not close the area nor fill-up the mangrove swamps. Those areas that will be affected are only those areas with the bridge columns or piers. Any type of loss of livelihood will be sufficiently compensated and replacement will be provided. The compensation policy is to maintain the same, if not improve, the status of the PAPs from their situation prior to the project. (JICA Survey Team)	Understood
5	Question Will transportation cost to the relocation site or in any other areas that the PAPs will go to (e.g. going back to their hometown) be provided? (Local Person/Male)	Yes, this is part of the compensation policy. We have the UDHA RA 7279 and RA 10752 Right of Way. The important qualification to be entitled to compensation is to be a Filipino, no other property in the rural or urban, must not be professional squatters, not previously granted with compensation by the government and within the right of way/affected area. *The provisions of the RA7279 were also discussed as well as the criteria to qualify for compensation. (DPWH-ESSD)	Understood
6	Question Can those PAPs previously granted with compensation without relocation still be compensated/qualified for the next compensation of this project (*cited example was the Php10,000 previously given but no relocation)? This is the very reason why the PAPs return to the area after receiving money. (Local Person/Female)	By the enumerated conditions under the law, they are not entitled if they are already compensated (except entitlement of the relocation) but DPWH will coordinate with HUDO for the assessment of their concerns. (DPWH-ESSD)	Understood

Source: JICA Survey Team

The second consultation held on July 24, 2019 with the project-affected households in Mandaue City is presented in Table 9.11.3.

Table 9.11.3 Second Consultation with PAHs in Mandaue City

Program/Agenda	
Welcome Address	Representative from Barangay Paknaan, welcomed the participants to the public consultation of the informal setters.
Brief Background of the Project	Representative from the Planning and Design Division of DPWH Region VII explained the objectives and importance of the project stating that it is expected to contribute to addressing the increased traffic congestion in Metro Cebu and to its economic development. He also added the objectives of the current public consultation.
Resettlement Action Plan for ISF	Representative from the Legal Division of DPWH Region VII presented the compensation policy and package for the resettlement action plan of the project which includes: ・ Cut-Off Date; ・ Entitlement Matrix; ・ Cash Compensation and Resettlement Site; and ・ Livelihood Restoration Program Representative from the local consultant team on environment and social considerations presented the grievance redress mechanism and the steps for RAP Implementation.

No.	Comments, Questions and Suggestions	Answers	Reaction by Questioner
1	Question Will our house be included? I was not part of the survey in Barangay Opao. Instead, the extension of our house where a lady is renting was surveyed. Is it possible that only the extension will be included and not our house? (ISF Barangay Opao/Female)	This is still in the feasibility study stage and it will be in the Detailed Design Engineering stage where the Parcillary Survey is carried out. This will be the final guide on who will be included in the affected households and the final measurements of the area affected. The stakeholders present now are initially identified as affected stakeholders and not yet final. (Legal Division, DPWH) There are cut-off dates posted on each barangay wherein these determine which structures constructed before these dates are included in the compensation. If your structure was made before the cut-off date then it will be included in the compensation. (Planning Division, DPWH)	Understood.
2	Question If our house will be included and I was not surveyed yet, may I be surveyed also so that I could be included in the list? The one on the survey maybe was my mother who was deceased and now I will be managing it and hope to be surveyed. (ISF Barangay Opao/Female)	Yes, you will be surveyed so that even in the feasibility study stage, you will be included in the list already. (Planning Division, DPWH) Basis of payment is the tax declaration, and instances such as deceased owner, we have extrajudicial settlement and the heirs will be the one who will be paid and signs the Agreement to Demolish Improvement. (Legal Division, DPWH)	Understood.
3	Question A majority of us do not have tax declarations. What are we going to do to show ownership of our houses? (Participants)	If no tax declaration can be presented, then the affected households can secure an Affidavit of Ownership from any lawyer and a Certificate from the barangay that you are an informal settler. Aside from those, secure also any two Valid IDs, and your taxpayer identification number (TIN). If no TIN yet, you can use our notice of taking to present to BIR so you can avail your TIN card as soon as possible. (Legal Division, DPWH)	Understood.
4	Suggestion There is a 6.5 hectare of housing in Paknaan, which is near the reclamation. Can we be relocated there? Consolacion is far and Labogon is expensive. (Participants)	The team was not informed of this relocation area. We will coordinate with Mandaue City with regards to this matter since it is the responsibility of the LGU to provide the relocation area. *JICA Survey Team contacted Mandaue City. According to Mandaue CPDO, the area is allotted for the resettlement of households located in the danger zones or calamity-prone areas as required by DENR. (Planning Division, DPWH) Currently, Mandaue City has back logs on their resettlement activities around 8,000 plus houses. Maybe that is why the Paknaan housing was not mentioned since it is reserved for other resettlers. (Legal Division, DPWH)	Understood.

5	Question Where is the favored relocation site of the participants? Labogon, Mandaue or Pulog, Consolacion? (Planning Division, DPWH)	Between Labogon and Consolacion, we would prefer Labogon but not in favor of the Low-Rise Building type and is expensive also. (Participants)	-
6	Comment Most of us are poor. Our income cannot afford the monthly payment of PhP 600-1,000. We can only afford at most PhP 200 per month. (ISF Barangay Paknaan/Female)	We will coordinate with NHA and Mandaue City for this to see if we could negotiate with the price. (Planning Division, DPWH)	Understood.
7	Question Is it possible to only avail the compensation and not the resettlement site anymore? (ISF Barangay Opao/Female)	Yes, you can choose to take the cash compensation option. In addition, you will be compensated for the structures affected regardless of whether you want resettlement or not. (Planning Division, DPWH)	Understood.
8	Question Were only those surveyed be affected by the project? Or all of us in the mangroves area will be included? (ISF Brgy Paknaan/Female)	The final list will be identified in the Detailed Engineering Design. (Planning Division, DPWH)	Understood.
9	Question: We were surveyed but are no longer on the list. Are we not affected anymore? (ISF Brgy Looc/Female)	Due to the change in alignment, there were households not anymore included in the affected households list. From 300 plus households, down to 69 households. (JICA Survey Team)	Understood.

Source: JICA Survey Team

2) Consultation with Project-affected Entities

(1) Mandaue City

The first consultation was held in Mandaue City for the project-affected entities as shown in Table 9.11.4.

Table 9.11.4 First Consultation with Project-affected Entities in Mandaue City

Program/Agenda	
Welcome Address	The participants were welcomed by representative from the Planning and Design Division of DPWH Region VII. Introduction was given and participants were acknowledged.
Presentation of Project Alignment	Representative from JICA Survey Team presented the alignment of the Mandaue Coastal and explained which company and what structures or buildings are affected or are being avoided by the alignment.
RAP Studies	Representative from JICA Survey Team discussed the compensation policies/entitlement matrix for the Resettlement Action Plan of the project.
Open Forum	Representative from the Planning and Design Division of DPWH Region VII facilitated and moderated the Open Forum the content of which is described below.

No.	Comments, Questions and Suggestions	Answers	Reaction by Questioner
1	Comment Our docking facility which caters to almost 20 meters high shipments would be affected by the alignment. (Tin Guan Trading Corp Representative/Male)	The docking point of the said establishment may be extended towards the coastal area so as not to hinder the operations. (JICA Survey Team)	Understood.
2	Question When is the period of completion of the project? Will the construction of the Mandaue Coastal Road and the 4th Mactan Bridge be done simultaneously or in phases? (EC Ouano Development Corp Representative)	The physical construction is planned to start by the end of 2012 and may end by 2025 if schedule is followed. The phases of construction depend on the process of land acquisition. (JICA Survey Team)	Understood.
3	Question: What is the height of the viaduct? We have trucks as high as 10 m traversing within their compound. Are there arterial roads connecting to the viaduct where we could access? (Representative from San Miguel Shipping and Lighterage Corp)	The height of the viaduct will be based on the establishment's requirements as much as possible. No arterial roads will be connected to the viaduct and the only access from Mandaue City will be the access point near Bai Hotel. (JICA Survey Team)	Understood.
5	Question and Comment Is the alignment final and fixed? Dupont is making a food grade product and is practicing high-standards of food handling safety. A portion of the food storage will pass over the alignment. I am very grateful for accommodating our concerns with the previous alignment which resulted to the final alignment presented. (Representative from FMC-Dupont/Female)	As mitigations for the said matter, a fence will be placed on the area for protection. *A sample fencing made in other similar structures was shown on the screen. (JICA Survey Team)	Understood.
6	Comment Access roads within the San Miguel Corp are very small and are the heart of the facility since movement of products is vital. If the alignment will be placed within the access roads of the establishment, it will hinder the operations of the establishment. (Representative from San Miguel Foods Corp/Female)	There will be coordination of the optimum location of the poles in Detailed Engineering Design stage with the companies to determine the most feasible location of the poles. During construction however, it will create disturbances within the establishment's facilities and will affect their mobility. Construction Safety Measures will be taken before construction of the viaduct starts to assure the establishment's processes will not be hindered. (JICA Survey Team)	Understood.
7	Suggestion In our shipyard, we suggest for a longer span between the poles that passes through our winch house. (Representative from VM Cabahug Shipyard/Male)	The input will be taken into consideration as not to hinder the operation of the shipyard. (JICA Survey Team)	Understood.
Representative from the Legal Division of DPWH Region VII stated that the land below the viaduct that is acquired by the government is planned to be accessible to the public. Compensation will be based on the new Right of Way law where disturbances caused by the project as well as possibly business losses will be taken into consideration. Enough compensation will be made to support operations of the companies. There will be series of meetings with regards to compensation between the project proponent and the companies. A schedule of site visits is made to determine the affected structures within the affected companies.			

Source: JICA Survey Team

The second consultation was held in Mandaue City for the project-affected entities as shown in Table 9.11.5.

Table 9.11.5 Second Consultation with Project-affected Entities in Mandaue City

Program/Agenda	
Welcome Address	The participants were welcomed by representative from the Planning and Design Division of DPWH Region VII. The representatives from DPWH Central Office (UPMO-RMC I and ESSD) in Manila were recognized as well. Introduction and acknowledgment of participants were made.
Presentation of Project Alignment	Representative from the JICA Survey Team presented the alignment of the Mandaue Coastal and the 4th Mactan bridge.
RAP Studies	Representative from JICA Survey Team explained the compensation policies/entitlement matrix for the Resettlement Action Plan of the project.
Open Forum	Representative from the Planning and Design Division of DPWH Region VII facilitated the open forum the content of which is described below.

No.	Comments, Questions and Suggestions	Answers	Reaction by Questioner
1	Question I was able to join a meeting before with JICA and that the viaduct that I saw then was all in the coastal areas. Why did the alignment change towards the inland area? How is the viaduct in the first and second bridge? (Lot owner affected/Male)	The viaduct will pass under the first bridge due to the limits set by the Civil Aviation Authority of the Philippines of the airport and over the Second Bridge. Additionally, Arctura will not be able to dock their shipments as well as the VM Cabahug Shipyard will be closed if the previous alignment be followed. The project also wanted to minimize the negative impacts as much as possible to the establishments. (JICA Survey Team)	Understood.
2	Question How high is the viaduct from the sea level? Our business is on trading craps of iron with foreign barges with maximum height of around 60-68 feet. *He showed a video to the study team of an example of a shipment of scraps. (Representative from Tin Guan Trading Corp/Male)	The height is roughly to be 10 meters. *A discussion was made between the study team and the participant with regards to the video presented. (JICA Survey Team)	Understood.
3	Question How will the companies under the viaduct be compensated especially on the area under the viaduct? (Representative from Arctura Corp/Male)	We will ask government financing institutions such as the Land Bank and Development Bank of the Philippines to evaluate and determine the value of the land. The area of land under the viaduct will be bought by DPWH as a right of way. For security reasons also, it will be a right of way under DPWH. (DPWH UPMO-RMC I/JICA Survey Team)	Understood.
4	Question The viaduct passes through our establishment. Will we be able to use the land under the viaduct and what will happen to the land in the future? If the land area affected is acquired by DPWH, our company will stop its operations since the viaduct passes through our servicing roads. If it would be fenced, our property will be halved and immobilize our business. (Representative from San Miguel Shipping and Lighterage Corp/Male)	Like in the 2nd bridge there would be fencing made in the right of way land underneath it. Discussions and right of way passage for the vehicles will be made between DPWH and the affected establishments. A Memorandum of Agreement can be made to address this matter. (DPWH UPMO-RMC I)	Understood.
5	Question If the land underneath the structure will be fenced off and our lot is in the interchange, will we be paid also of the space between the interchange? (Representative from Athecor Development Corp/Male)	According to our discussion in Manila with JICA Survey Team, the area in the interchange will be made into a wetland park. We have similar case in their other projects, we created access roads for the land owners to access their land affected by the project. In general, everything will be acquired by the project including the spaces in the interchange. But it is possible that the land in the	Understood.

		interchange will not be acquired and that only the land traversed by the interchange will be acquired. Another possibility also is that under the law, if it is only a nominal property or a small part, an ease of agreement may be made. The land property will not be bought but the usage of the land will be bought. The land will still be in your ownership but in the title of the land there will be an easement agreement. For the computation of the real property tax, this will not be included anymore also. The land will still be owned by the companies but the right to use is by the government. More detailed description of this will be made in the Detailed Design Engineering Stage. (DPWH UPMO-RMC I/JICA Survey Team/DPWH ESSD)	
6	Comment There should be more discussion to be done with the properties and there should be also an agreement on the usage of the land. Our property will also be halved and the project will hinder the operations in the facility. Not only for Arctura but also with other companies affected. We want to make use of the land underneath the overhead structure. The overhead structure passes through the parking area of the trucks. If that area will be relocated, it will difficult to find another area. (Representative from Arctura/Male)	With the land acquisition, the land will be owned by the government. The government can study on how to provide access to the other side underneath the structure. DPWH will be continuing to coordinate with the affected establishments in the Detailed Design Engineering stage on the said matter. And we will secure the right of way and will become a property of the government. The company can ask permission to use the area after the implementation of the project. (DPWH/DPWH UPMO-RMC I)	Understood.
7	Question During the final design, will the companies be contacted? The height of the viaduct is also a matter of concern for us. (Representative from San Miguel Shipping and Lighterage Corp/Male)	As for the height, there have been public consultations to accommodate the inputs from companies or establishments. (JICA Survey Team)	-
8	Comment and Question We had already passed our position paper and that our inputs already have been considered. The usage of the land under the viaduct is of the same concern with other companies. From this discussion, I understood that there would be two possible options for this matter. First is when the government will acquire the land and will allow usage for the affected companies and the second one, the companies will still own the land but an agreement of easement will be made. As same with Arctura and San Miguel Shipping were our nature of business is affected, will they be considered as severely affected and can request for a total compensation including disturbance fee? Are these considered in the feasibility stage? (Representative from Petron Corp/Male)	DPWH will take note of the business loss affected by the project. But as much as possible, we want to avoid business losses in the project. As for an example that with Petron, there will be compensation for one of the tanks. It may not be in the right of way but to maintain the 50 m buffer, one of the tanks will be affected. (DPWH/JICA Survey Team)	Understood.
9	A participant from VM Cabahug Shipyard shared that the first alignment changed because of the operation of the shipyard. He added that there should be no fencing of the land under the viaduct so as not to hinder our operations also.	It was noted.	Understood.

Source: JICA Survey Team

(2) Lapu-Lapu City

The first consultation with project-affected entities were carried out in Lapu-Lapu City as shown in the table below.

Table 9.11.6 First Consultation with Project-affected Entities in Lapu-Lapu City

Program/Agenda	
Welcome Address	The participants were welcomed by representative from the Planning and Design Division of DPWH Region VII which included an introduction and acknowledgment of the participants.
Presentation of Project Alignment	Representative from the JICA Survey Team presented the alignment of the Mandaue Coastal in which he explained which company and what structures or buildings are expected to be affected or are being avoided by the alignment.
RAP	Representative from the JICA Survey Team explained about the compensation policies/entitlement matrix for the Resettlement Action Plan of the project.

No.	Comments, Questions and Suggestions	Answers	Reaction by Questioner
1	Question and Comment Is the alignment the final plan? We are not in favor of our building being demolished. It will not only affect one building but the two buildings we own. (Representative from Marina Mall/Female)	It is still the feasibility stage and in preparation for the Detailed Engineering Design stage. In that stage, the final alignment and the final affected stakeholders will be determined. Only one of your buildings is expected to be affected. (JICA Survey Team)	Understood.
2	Comment We oppose to the demolition of our building. We prepared a counter proposal where our building will not be demolished. We opt more for Option 2 and option 3 for the final alignment because it has fewer establishments affected. (Representative from Marina Mall/Male)	In fact, more people will be affected by Option 2 and 3. Further, the existing national road in Option 3 is narrow and road widening is needed thus affecting more establishments. (JICA Survey Team)	-
3	Comment Traffic bypassing our business establishments is not ideal for our malls, we will lose income. (Representative from Marina Mall/Female)	The team is trying to minimize the effect of the project to the main building of Marina Mall. The bypass road will cater to the traffic going to the airport road. This is expected to ease the traffic congestion in the area helping the customers who want to go to Marina Mall to do so more easily. (JICA Survey Team)	-
4	Comment Our building A or the building in the triangular lot has leases that are income generating for the years to come. (Representative from Marina Mall/Female)	DPWH will be compensating for the land and the structure affected. The possible compensation for business loses is still in coordination with DPWH UPMO (RMC I) and central office. The best alignment with least possible impact to the communities being considered by the team. More establishments affected means more land acquisition will be made. Furthermore, this would mean more cost by the government. That is why public consultations are made to create lesser impacts to the affected establishments. The purpose of the 4th bridge is to address traffic congestion in the Airport Road Access. If the bridge falls before Marina Mall, it defeats its purpose of addressing the traffic towards the airport road. (DPWH)	-
5	Suggestion We commissioned our in-house architect to create a counter-proposal of the project where Marina Mall's Building A will not be affected. May we request for a time to present our proposal? (Representative from Marina Mall/Female)	Suggestions are welcome. A separate meeting for technical matters will be made for each establishment affected. All comments and inputs made are all also being noted. *Meeting was held just after the subject group consultation in which Marina Mall's proposal was presented. However, it was explained here by JICA Survey Team that it was difficult to accept it given that a large number of buildings were expected to be affected. The architect understood. (DPWH)	Understood.
6	Question How soon can the compensation be given to us? (Representative from Marina Mall/Female).	In general, there would be a Notice of Taking given to the affected owners. Afterwards, the affected owners are given 30 days to submit the requirements needed. Lastly, the processing of compensation usually takes 2-3 months for	Understood.

		structures. At that period, no demolition of structures will happen; demolitions would start when 70% of the property's value is already given to the owners. A tax receipt of the real property tax will be asked for the structure dated of the current year. Then an additional 30% will be given. For the land, it takes usually longer due to issues of the land. If the titles are clear and no conflict of ownership, then the process usually takes around the same time with the structures. For structures, only the value of the entire structure will be needed. DPWH's engineers will be coordinating with the engineers and architects of the affected establishment with regards to the design of the building to determine the actual cost or replacement cost with the fair market value. (DPWH)	
7	Comment and Suggestion We have one tenant that was not given barangay clearance from the LGU due to the cut-off date. The tenant did not push through with the contract and thus become a business loss for them. May we have the cut-off date be lifted as of the moment so that we can accept tenants before the construction starts? (Representative from Marina Mall/Female)	The matter will be brought up on their meeting on Thursday, June 13, 2019 with DPWH UPMO (RMC I). There was a cut-off date last April 22, 2019. And our office already made a letter for the city planning of Lapu-Lapu city in response to this concern. We will consult with DPWH UPMO (RMC I) and JICA on this matter taking into account the planned time of construction and acquisition. (DPWH)	Understood.
8	Comment We already had business loss with the three year contract lease since the tenant backed out. (Representative from Marina Mall/Female)	This may be included in the compensation as disturbance loss. If the primary reason for the non-continuance of the contract was the preparation of the 4th bridge then it may be taken into consideration. (DPWH)	-
9	Suggestion We request that PEZA be included in the meetings with establishments under their properties. It is only now that we knew that the barangay is putting on-hold on clearances under PEZA-proclaimed area. (Representative from PEZA/Female)	There may have been a level of confusion between JICA, DPWH and barangay level authorities, since the purpose is not to withhold the business clearance but to limit the length of contracts since contracts from malls usually last long. We will coordinate closely with the companies to continue improving the alignment and minimizing its negative impact on the community. (DPWH)	Understood.
10	Question How big is the 20% of the total area? Especially in Marina Mall where building A is considered as 20% of the total area owned by Marina Mall. (Representative from Marina Mall/Male)	It would depend on the tax declaration of the buildings. If it is two different tax declarations, they will consider 20% of one tax declaration, and 20% of the second one. If it is one only one tax declaration then they will consider 20% of the entire total area. Compensations will be made one for the structures and another for the land affected. (DPWH)	Understood.
11	Question What will happen to the businesses affected in the period of 5-7 years of constructions? Our main customers are from PEZA and during construction, PEZA customers may not come anymore because of traffic. (Representative from Marina Mall/Female)	Even during the construction stage, there will be accessibility towards the businesses and that no total closure of the properties affected will happen. The affected businesses will not experience the 5-7 years since there is phasing of the construction. Part of the design stage is the traffic management plan with the LGU. (DPWH/JCIA Survey Team)	-
12	Question Since this is still the feasibility stage, is option 1 not final? (Representative from Marina Mall/Female)	All inputs will be considered. However Option1 is considered the most feasible. Having said that, there is still time to study all the comments to be considered in the Detailed Engineering Design stage. (JICA Survey Team)	-

13	Question What is the timeline of the project? (Representative from Marina Mall/Male)	The Detailed Engineering Design may start early next year. Agreement between governments of Japan and Philippines is planned to be signed at the end of this year. Construction may commence at the end of 2021. (JICA Survey Team)	Understood.
14	Question and Comment How will the compensation be made to the tenants? Marina Mall is into leasing business and the tenants are bound to Marina Mall's tax declaration. (Representative from Marina Mall/Female)	For tenants especially with contracts, they will be compensated only for the time they will be affected by the project. And for establishments with individual tenants who also spent on the construction of their own stores, with individual tax declarations, then they will be considered as different entity and will be compensated. One requirement for payment of structures is the tax declaration. But since this is a unique case of establishments within an establishment with their own improvements but no tax declarations, this will be considered and will be raised in the UPMO (RMC I) meeting. (DPWH)	Understood.

Source: JICA Survey Team

The second consultation with project-affected entities was held in Lapu-Lapu City as shown in the table below.

Table 9.11.7 Second Consultation with Project-affected Entities in Lapu-Lapu City

Program/Agenda	
Welcome Address	The participants were welcomed by a representative from the Planning and Design Division of DPWH Region VII. The representatives from DPWH Central (UPMO-RMC I and ESSD) in Manila were recognized as well. Introduction and acknowledgment of participants were made.
Presentation of Project Alignment	Representative from the JICA Survey Team presented the alignment of the Mandaue Coastal and the 4th Mactan Bridge.
RAP	Representative from the JICA Survey Team presented the compensation policies/entitlement matrix for the Resettlement Action Plan of the project.
Open Forum	Representative from the Planning and Design Division of DPWH Region VII facilitated the open forum.

No.	Comments, Questions and Suggestions	Answers	Reaction by Questioner
1	Question Will our tenants be included in the compensation? We also have relatively new tenants. (Representative from Marina Mall/Female)	The tenants will be given a notice for a sufficient period to give them time to move. (JICA Survey Team)	Understood.
2	Question If the project is still in the Feasibility Study stage, nothing is final on the project? (Representative from Marina Mall/Female)	Even though it is in the Feasibility Study stage, there is already an inclination between the Philippine and Japanese government that directly after the F/S Stage, the Detailed design Engineering will commence then actual implementation. The timeline has been compressed and more or less the schedule to be adopted until the project implementation. The alignment is final. It was agreed by the joint coordinating committee last March 2019. The committee composed of NEDA, DPWH, JICA and other agencies. (DPWH/DPWH UPMO-RMC I)	Understood.
3	Question With the alignment, it will affect our business. Is there any way to spare our business? (Representative from Marina Mall/Female)	Last year this project is part of the Metro Cebu Urban Transport Master Plan and a top priority project where a series of information dissemination was made. Every aspect of the project be it environmental, social etc. are being considered in finalizing the alignment. (DPWH)	-

4	Question and Comment Why was our office informed late of the project if it started last December 2018? The Local Government of Lapu-Lapu City knows ahead of this project but not us. The alignment was finalized in March and a decision was made without the consultation of the public. Before the finalization of alignment, were the locators in PEZA or PEZA itself invited to these public consultations last year? (Representative from PEZA/Male) The problem was that the project kept coordinating with the LGU when PEZA is a not under their jurisdiction. Our locators are enjoying incentives not found in other establishments. At the first meeting, I raised the concern on the relocation of establishments in PEZA. Why was the public only consulted when the option 1 was already chosen as the final alignment? (Representative from PEZA/Female)	We followed certain processes where the LGU needs to be informed first. It was focused first on the barangays affected. The stakeholders were identified and invited to public consultations from early April through the LGU covering the barangays directly concerned. The team also had Focus Group Discussions with sectoral groups to cover a wide range of information dissemination. PEZA was invited to these public consultations. The first public consultation in Lapu-Lapu City was April 12, 2019. That was the time that the public was informed of the project. As far as DPWH is concerned, the coordination is with the LGU concerned as to who will be representing the stakeholders affected in the project. There was a miscommunication on our side. The alignment was not fixed in March. In fact, it has been modified in this survey through the consultations made with the companies affected. With the option 1 as the final alignment, the consultants have found out that the most feasible alignment is option 1 based on technical, environmental, social and cost. Aside from the three options presented, there were other options considered such as before the 1st bridge and somewhere near in Consolacion. (DPWH)	-
5	Question Did the team consider the traffic in the project area especially in the zone and barangay Pusok? There is an existing 6-lane road in ML Quezon Highway. Will reducing it to 4-lanes not cause more traffic congestion? (Representative from PEZA/Male)	This is a full scale F/S and had conducted a traffic count within the area. The current volume of the traffic flow has been studied as well as when the project is implemented and until the future. We had traffic demand forecast with consideration of all the development plans of the Lapu-Lapu City such as the reclamation area on the eastern side of the island. The forecast also included a 20-year traffic forecast with and without the project. Based on the estimated traffic volume, the design was proposed. The number of lanes is based on the directional traffic volume. The 6-lanes of the existing highway is enough to accommodate the future traffic demand. To address the traffic in the intersection, such grade separation was proposed. (DPWH/JICA Survey Team)	-
6	Question Can the project guarantee that there will be no more traffic in the area? (Representative from PEZA/Male)	Honestly speaking, there will always be traffic and increasing due to the increase also of population. (JICA Survey Team)	-
7	Question What is the change in time of travel from PEZA to the 2nd bridge? Such as if the travel time from a certain area to another is 45 minutes, if after the project how many minutes then will it take with the project (Representative from Marina Mall/Female)	We had calculated travel time from Mactan International Airport to Cebu Port. Such as during peak hours it has a travel time from 2.5 hours and reduced to 2.35 hours. Another setting at day time, with project the travel time is 1 hour and with project is 48 mins. There is a 30% reduction. The project's traffic survey considered all that developments and forecasted until 2039. And that the 30% reduction is already a big factor to ease up traffic congestion for an urban area such as Metro Cebu. This project is one of the components of the Master Plan that will over-all decongest traffic in Metro Cebu. (JICA Survey Team/DPWH)	Understood.
8	Comment and Suggestion We had a meeting with the consultants and project proponent with regards to their position on the project. And we requested for a review of the design especially on the loop part of the project	The inputs are being taken into consideration for possible revisions and that the details of the loop will be shared to the establishment affected. (DPWH)	Understood.

	that crosses our property. We also hired a third party to conduct a traffic study in Mactan and it contradicted the study by JICA. We want to know the traffic volume by JICA to share the studies we made. We are willing to rehire again to accommodate the study by JICA. (Representative from General Milling Corporation/Male)		
9	Question and Suggestion Will the project have a continuing communication with the affected stakeholders? We request that our locators be informed always throughout the project so that our concerns be properly addressed. (Representative from PEZA/Male)	We assure you that there will be a series of consultations even until the actual implementation stage. (DPWH)	Understood.
10	Question When will the project plans be available for the stakeholders? Will our parking lot be retained as well as the pedestrian lane? (Representative from Island Central Mall/Male)	There will be no ramp affecting the Island Central Mall. As explained in the previous consultations, the stakeholder will not be directly affected. A 5 m parking space and another for bicycle parking space. The pedestrian lane is also being provided. *The grade separation perspective of the Island Central Mall was shown. (JICA Survey Team)	-
11	Question We understood from previous consultations that there will be a lane from the national highway connecting to the bridge on their opposing side, and that only one lane will be available for both sides. Can we have both lanes on our side? (Representative from Island Central Mall/Male)	The idea is not practical and that there would be one lane each on both sides. The traffic flow will enter through Muramoto's side and will be coming back to the side of the mall. If both lanes are on one side, it will cause more traffic. (JICA Survey Team)	Understood.
12	Question How wide is the access road or the u-turn road beneath the bridge? (Representative from Island Central Mall/Male)	The same measurements will be followed and retained. (JICA Survey Team)	Understood.
13	Question Is the road access to the basement parking considered? (Representative from Island Central Mall/Male)	The basement parking was considered with the 5-m access road. However the connecting road behind Muramoto factory is bigger than 5-m since there were no changes on this part. (JICA Survey Team)	Understood.
14	Question How near is the post to our building? (Representative from Island Central Mall/Male)	The building is around 10 m away from the post. (JICA Survey Team)	Understood.
15	Comment and Question Our company has been enjoying the benefits from PEZA. Where would we be the relocation for our factory considering MEPZ 1 and MEPZ 2 is already full? (Representative from Muramoto Factory/Male) We were consulted of this matter yet and PEZA is practically full and cannot accommodate anymore relocators. (Representative from PEZA/Female)	We have had several meetings with the management of your company. From that meeting, we understand that they have an idea of possible land in mind and that they want to decide the relocation site by themselves. The managers may have not consulted PEZA yet of the matter. We assure you that there will be more coordination meetings with regards to the design of the project especially in the Detailed Design Engineering. We encourage stakeholders if you have your own initiatives such as these like Muramoto factory, then please do so continue. (JICA Survey Team/DPWH)	Understood.
16	Question With regards to the compensation, are our tenants affected included? We have three to four tenants ending their contracts as well this 2019 and will incur future business loss since we cannot renew their contract for this project. Whom can we approach and how much will we be compensated for this business loss? (Representative from Marina Mall)	The right of way activities are based on land and structures affected. Compensation for business loss will be taken into account based on the new right of way law. The actual implementation will not start unless all right of way land acquisition will be finished. All of these issues be ironed out during the Detailed Designed Engineering. The regional office will seek help from their central office of projects similar to these with business losses.	Understood.

Source: JICA Survey Team

9.11.2 Individual Consultations with Project-affected Companies

A number of individual consultations and site visits were carried out in the survey from an early stage of, and throughout the study with companies that are expected to be affected by the project. The aim was to have such companies have a good understanding of the project (e.g. road and bridge design and alignment, project schedule and expected impacts) and to collect their views, suggestions and restrictions so that they could be incorporated into the project. Their inputs were reflected into the alignment of the Mandaue Coastal Road and into the project design (e.g. height of the viaduct is under consideration). While voices of disagreement were heard from some companies at the beginning, consent was obtained towards the end of the consultation process to proceed with the project. A summary of them are shown in the table below.

Table 9.11.8 Overview of Individual Consultations with Project-affected Companies

Date	Lot Owner	Lot Tenant	Comments/Concerns	Answers/Responses
March 8, 2019	Genoveva Cabahug Area Fausto Lim Area	Informal Settlers Cabahug-Ouano Wharf	• Their main concern was the height of the posts. In area number 7, a docking facility will be constructed and the height would also affect the vessels. They suggested for lesser number of posts and higher alignment especially near the docking facility. • The distance between the posts and its diameter was also asked. • The stakeholders asked if they can retain their ownership of the land under the elevated road. • They also asked if the installation of barriers for privacy of the land owners was considered especially during the construction stage. • Lastly, they asked if the study considered the climate change with higher tides.	• The suggestions on height of viaduct, distance of posts, retainment of ownership of land and the privacy matters were noted and will be considered in the design of the viaduct. • The climate change with higher tides was considered also.
March 8, 2019	San Miguel Corporation	San Miguel Foods Inc.	• The stakeholders presented to the study team the facilities and the area to be affected. However, only their top management based in Manila can give the official and technical comments of the said project. Further arrangements for the meeting with their top management will still be made.	• It was noted.
March 12, 2019	Pointer Development Corporation Area	Emission Control Testing Center	• The owner of the land is Johnny L. Siao of Signal Properties Corporation. • The area affected which is only around 3,000 m2 would be more than half of the land area. • The land is being rented by an Emission Testing Center which still has a 7-9 year contract with the owner. • They opt for the movement of alignment towards the other side of the road where the land area is occupied by container trucks by EPL. • They also opt for relocation or land swapping for land areas in Mandaue City. They suggested for the area in FF Cruz if possible. They shared there were instances that even lands being bought with the present fair market value, the government has not paid them still. • The stakeholders expressed that the earlier the project be implemented the better to address traffic congestion in Metro Cebu. • They also gave a copy of the sketch plan of their land area for reference.	• DPWH assured them that with cases such as these, the government will buy the whole area. • The suggestion was noted and will be in coordination with the LGU affected.
April	Ernesto	DuPont-FMC	• The plant manager shared that the	• Their company profile and

Date	Lot Owner	Lot Tenant	Comments/Concerns	Answers/Responses
30, 2019	Ouano Management Corporation		company has been operating since 1978 and recently bought by DuPont in 2017. The first DuPont Plant in the Philippines. • The company is one of the highest taxpayers in Mandaue City with a $60 Million/year revenue. • The alignment of the coastal road passes through the admin building, grinding and modification area and the waste water treatment facility, which are all the heart of the operations of the company. What would be left would be the warehouses only. • They have 125 employees. Furthermore, 98% of their raw material (seaweed) is bought from the seaweed farmers all over the islands in the Philippines. • The stakeholder suggested moving the alignment to the next establishment which was mostly of a warehouse.	type of business were noted and considered for the changes in the alignment.
May 2, 2019	Philippine Economic Zone Area	Marina Mall	• The study team had preliminary meeting with the direct staffs of the establishment. • The stakeholders shared that one of their tenants who was acquiring a barangay clearance for their restaurant was denied because of the cut-off date. • They also added that in the second floor of their rectangular establishment is an going construction of a 60-bedroom hotel. • A meeting with the top managers and developers was arranged on May 9, 2019.	• The inputs were noted and a scheduled meeting was arranged.
May 8, 2019	New Ventures Realty Corp	Petron Corp	• The stakeholders asked of the results/progress of the boring points near their area. It was responded that it was still on the process of conducting the survey. • They shared that the facility serves 70-80 Million liters of petroleum not only to Cebu but also to the neighboring islands. They added that they have 70-80% market share of the entire Region VII. • The alignment passes through Petron's receiving pipeline and traverses San Miguel's foreshore lease area. • They shared that their main concerns are in compliance of the National Fire Protection Association and international standards which requires clearances and distances to their facilities. • First concern is the location of roads/bridges should be at least 30 m. • Height Consideration of the viaduct above the pier access. • Other design consideration and safety regulations since the wharfs receive tanker fuels which are considered as hazardous and combustible. • They also mentioned of the 27 m air draft requirement of the two existing bridges for the vessels to pass through. • They have two vessels daily coming in and out of the wharf. They questioned of the constructability of the structure with regards to the regular operations of vessels in the Mactan channel. • They presented their suggested alignment to move more inland passing through an existing road, G.O. Martinez Road, beside UC which would avoid industries.	• The boring survey was still on the process of conducting it and no results yet. • The standards being observed by the facility is considered and slight changes in the alignment will occur. • The suggested alignment of Petron will incur more households to be affected by the project.

Date	Lot Owner	Lot Tenant	Comments/Concerns	Answers/Responses
			• They also added that once construction starts, they would have difficulties in their operations. • A position paper will be passed by the company as soon as possible.	
May 8, 2019	San Miguel Foods Inc.	San Miguel Foods Foreshore Lease San Miguel Foods Inc	• Their company has three facilities affected by the alignment namely: (1) Looc, Mandaue, (2) the San Miguel Shipping and Lighterage Corporation and (3) the Fore Shore Lease lot adjacent to Petron. • The fore shore lease lot area already has a planned development of San Miguel Hormel-Purefoods Plant. The new alignment passes through the proposed processing plant and port facility. • They recommended avoiding passing through the property since their operations on their proposed development will also be affected. They already started formally their development last year. • The lot area located in Barangy Looc, Mandaue is the San Miguel Foods, Inc. • They presented the alignment with the updated map along the company's area. There are already structures within the area such as access roads going to plant and towards the San Miguel Shipping and Lighterage Corporation.	• The comments and suggestions made by San Miguel is noted and be considered in the design of the coastal road.
May 8, 2019	Athecor Development Corp King, Haydee Cortes Lot Area Sanchez, Elma Lot Area	Fishponds	• The company has four lot areas affected by the interchange in the Mandaue Coastal Road and 4th Bridge. Some were of tax declaration and titled lots. • The area where the alignment falls before and after the Butuanon River is owned by the company. • The land occupied by the dumpsite is also owned by the stakeholders. They also donated a road ROW so that the city could use of the dumpsite. • They also showed their development plan in one of the lot areas where the interchange falls. • The stakeholders asked of the arrangement of lot acquisition. It was stated that it may either be replaced with a land of the same value or be bought with the current fair market value by the national agency. • They will send their lot plans and developments plan to the study team. • The height of the viaduct was being asked since it falls on their future development plans. • They proposed to move the interchange in Paknaan or towards north which is still under their ownership which has no development plans yet. • They showed their appreciations of the project since this will address the traffic congestion in Mandaue. • One of the owners shared that they had sightings of the Chinese Egret in the area. They added that these birds are from Olango Island Sanctuary and not really nesting in that area. • A position paper will be passed by the company as soon as possible.	• The development plans of the company were noted and be considered also. • The land acquisition may either be replaced with a land of the same value or be bought with the current fair market value by the national agency. • The height of the interchange may depend on the requirements of the affected company. • The proposal of moving the interchange in Paknaan towards north will affect the relocation site of Mandaue City and thus not recommended.
May 9, 2019	Philippine Economic Zone Area	Marina Mall	• The traffic scheme of the interchange in Lapu-Lapu area was asked. Going from the airport to mepza and vice versa, going	• The traffic flows were explained: such as to and from Paknaan and Airport, Bai

Date	Lot Owner	Lot Tenant	Comments/Concerns	Answers/Responses
			from airport to public market. They asked if from the viaduct, would there be any way to go down to their establishment. • A 3D perspective was made by an architect of the stakeholder for an easier view of the project on the affected area. • Their viaduct directly goes through their one whole building which means demolition of the said building. They suggested reconsidering the alignment so as not to affect their existing buildings along with their newly renovated sidewalk would be affected. • The stakeholders asked if their feasibility studies done with Options 2 and 3 alignment of the 4th Cebu-Mactan Bridge since the said alignments will not affect their establishments. They recommend Option 2 or the alignment before the airport expansion. • They asked if they would still be able to lease their areas they have before the construction of the said project. The company has a lot of empty space for the meantime before construction in 2021. Furthermore, they had on-going contracts that started way before December 2018. • They further asked, in the meantime, if they can at least continue the leasing for two years of the tenant who was denied of the barangay clearance. Since the said tenant already had paid for renovations and all preparations for the business. They added the future loss of income after the cut-off date for future tenants. • An on-going construction of the hotel was raised which was previously occupied as their administration office. They highlighted the credibility and good will of the Pelaez Group of Companies, owning these businesses, which may affect their reputation committing to long-term business. • Aside from the cost of the building, they asked if the future losses of income would be included in the compensation program. • They asked for assistance on the practical alignment that is neutrally beneficial to all. • A position paper will be passed by the company as soon as possible.	Hotel and ML Quezon Highway in Lapu-Lapu City; to and from Bai Hotel and Airport, Paknaan and ML Quezon in Lapu-Lapu City. • The only access towards there establishment is through the existing national highway. • No feasibility studies were made for Options 2 and 3 but only preliminary studies based on certain criteria such as economic, social, design, technical etc. Option 1 came out as the most feasible among the three. • As of the moment, it would be a risk to continue leasing when the construction will anytime start. The matter will be in coordination also with Lapu-Lapu City. • All the business loss incurred by the establishment that caused by the project and is under the law will be compensated. • The team will do as much as possible to create a neutrally beneficial to all projects.
May 9, 2019	VM Cabahug Shipyard		• The alignment passes through the shipyard's main slip way, the winch house and future development plans of a port facility which they acquired through fore shore lease with Mandaue City. • The height of the viaduct was of the main concern since they have large vessels docking in their shipyards. Aside from the height of the vessels, the low tide/high tide and the height mount should also be considered for the height of the viaduct. • During high tide, they would move their slipway further towards the inland to continue the operations therefore there should be clearance not only vertically but horizontally as well. • They presented their developments of another slipway adjacent to the main	• The inputs, suggestion of the height and the future developments of the company is being noted and considered.

Date	Lot Owner	Lot Tenant	Comments/Concerns	Answers/Responses
			slipway. • They recommended the alignment to move towards the vacant lots near their area.	
May 10, 2019	Arctura Corporation		• The alignment passes through the administration building and the most critical part of the company which is the loading bay of the fuels. • They added that the alignment would also pass the Ouano ancestral house and lot area adjacent to their company. • Their products are gasoline and diesel which are transported through trucks from the plant towards their partners. • They also added that during the loading of fuels which would last for almost 18 hours, it would emit fumes which would pose threat during the construction of the project also. • The height of the viaduct was asked to determine also of its effect in the company. • They recommend a coastal road nearer to the coastal away from their plant.	• The operations, the standard protocols, and height requirements of the company were noted and will be taken into account.
May 17, 2019	Philippine Economic Zone Area General Milling Corporation (GMC)	Muramoto Audio-Visuals Inc, Phils & Isalnd Central Mall Vacant Lot	• A clarification was made if there were interchanges proposed for Option 2 and 3 aside from Option 1. • GMC has plans in developing their 1.3-hectare property by next year. • The plan for the airport expansion was asked if it was considered in the study. • The representative from Muramoto Factory will be informing the management regarding the project. There will be a separate meeting/site visit for this factory.	• No interchanges were proposed in Options 2 and 3 since both will just directly land on the existing national highway which would be needed to expand if so. • The airport expansion was considered in the study. That is why Options 2 and 3 were not feasible due to this development.
May 28, 2019	Philippine Economic Zone Area	Muramoto Audio-Visuals Inc, Phils	• The affected portion of the building is almost half of the production area, the heart of the factory. • The company has started almost 30 years ago and their factory has been in PEZA since 1990. • Since they are a manufacturing company, they cannot operate if a certain part will be removed and transferred to another location. • No comments and inputs yet to the study from the representative since it was his first time knowing the project.	• The company profile is being noted and future meetings will be made with the top management.
July 3, 2019	General Milling Corporation		• Their affected lot is one of the few remaining properties in Lapu-Lapu City. They also had given up their lots for the first and second bridge. At first, they strongly opposed to the project stating that they will use all means to retain their land. • They had a Traffic Impact Assessment late last year in their lot area. The volume of the traffic peaks at 7 AM-9 M and in 4 PM-6 PM. They concluded that traffic is caused by the workers to and from Mactan and Cebu. The traffic from the airport is constant since the flight operations are at every hour. • They had submitted a major development plan to Lapu-Lapu City worth more than a billion pesos. • The land was leased last October 2018 to a group of investors. These investors also already had paid the lease for a year. • At the end, they requested for a redesign of the project especially of the ramp affecting	• The traffic survey conducted by the team stated that traffic will occur more in the project area and thus needing the project. • The team has been coordinating with Lapu-Lapu City and no major development was mentioned. • The comments and inputs are noted.

Date	Lot Owner	Lot Tenant	Comments/Concerns	Answers/Responses
			their land. They want to have a win-win situation where both the 4th bridge project and their development will continue.	
July 4, 2019	Philippine Economic Zone Authority	Muramoto Audio-Visuals Inc, Phils	• Muramoto was concerned that the cost estimate made by local people may not correctly estimate the quality of their buildings and facilities. • They stressed that they are not expecting any loss.	• JICA Survey Team explained that it is not in their interest to undervalue their assets and requested to provide data on the affected facilities, the production lines in particular, for better costing. • Muramoto side agreed.
July 26, 2019	Philippine Economic Zone Area	Marina Mall	• We support the project but would like to have our building avoided as much as possible. We hope that the other alignment options are adopted. Having said so, we understand that we have limited choice.	• We are trying to avoid as many structures affected as possible. But as a result, your building will necessarily be affected. Approaching the end of the F/S we would like to know if this set-up is acceptable. During the Detailed Engineering Design, more discussions will be made. • Compensation will be based on the structure affected and not the lot affected given that land belongs to PEZA. It will not be based on the usual 70%-30% payment but a one-time 100% payment prior to relocation. Once everything is finalized, our engineers will visit the site and estimate the materials affected based on the current fair market value. Included in the cost estimates is also the labor cost. The owner may also give inputs or blueprint to aid our engineers in cost estimation. The replacement cost will enable you to construct a similar structure in which you can do your business in a similar manner as now.
			• Is the value of our structure going to be estimated based on the tax declaration?	• We are aware that it will be undervalued if we estimate it based on the tax declaration. The answer is no. It will be based on the current market value. Tax declaration will be used only to identify the owner.
			• Is there a possibility that our compensation for the affected structure will be based on how much income we are earning from it?	• Under the new Right of Way Law, the replacement costs apply to only structures and not income. We cannot compensate for business loss unless the court orders us to. Under our proposed arrangement, however, the structure will not be demolished until there is a new structure in the relocation site hence there should be no income loss. You will also be given enough time to look for another plot of land and reconstruct the building.
			• As for now, we have no area to transfer	• We are informing you at this

Date	Lot Owner	Lot Tenant	Comments/Concerns	Answers/Responses
			since PEZA is already full. It will be troublesome to transfer since we also have tenants to consider. We also need to consider if the relocation area is feasible for a mall business. However, we understand that this is a national government project and with this meeting we know that we have to accept such terms.	F/S stage so that you can have maximum time possible to look for a suitable site and to transfer. The construction is expected to start from around 2023. And again, no demolition will take place unless structure is ready. We will do whatever we can with regards to securing a suitable land including talking to PEZA but please understand that we cannot impose it upon PEZA. As for the tenants, we may suggest for an amendment in the contract so that they can continue doing business in the new mall should they wish to. • If there are improvements introduced by tenants prior to the cut-off date, they will be included in the replacement costs and we can draft the contract where all the payments will be made to Marina Mall. You can also salvage materials from the old building to save construction costs.
			• When will the payment come in and when will estimation start?	• Payment will come in after the Detailed Engineering Design which is planned to be sometime around 2021. Cost estimation will start around 2021 or in the Detailed Engineering Design stage.
			• As middle management, we cannot decide but we will relay to the higher management. • Continued discussion in the D/D stage is also what we also want.	• Our goal for now is not get your definite answer now but to have your agreement to continue discussing in the Detailed Engineering Design Stage.
			• Can we propose the cost estimation? Since our bosses advised us in how to compute for such things.	• Yes, you can.
			• We have accepted one tenant after the cut-off date (i.e. April 22). Does this mean that they will no longer be compensated for their improvements/assets?	• We want you to continue with your business which we understand was one of the first requests made by your side. We also have talked with Lapu-Lapu City of this and I understand that you are now able to accept new tenants. However, all improvements made after the cut-off date will no longer be compensated.
			• We have an ongoing construction on the second floor the contract and building permit for which was signed and issued before the cut-off date. Will this contract be considered valid since it is before the cut-off date? It is a hotel development and the construction was to finish in November, 2019 but we stopped them for this project.	• With regards to the hotel development, we will discuss with higher officials since we have not gone through such a case. But personally, I think it may be accommodated. Are they aware that they have to stop their business when the project comes in in 2023?
			• We have been informing all our tenants about this project and developments that	• If you need DPWH to explain to the tenants, then we can.

Date	Lot Owner	Lot Tenant	Comments/Concerns	Answers/Responses
			have been made between us and your side. Some are frustrated and some are welcoming the project. The hotel is also aware and they think they can recover the cost. • It will be helpful if you could talk to the tenants with us as necessary. • During the construction, who can we contact? • As for the cost estimation, does it include the cost of the contractors? • Does the replacement cost include displacement of employees should there be closure of tenants as a result of the project? • Some tenants may not favor the relocation area and may not continue to operate anymore and there is a risk that some of them will sue us. We are not afraid to be sued but maybe the national government can back us up during court trials. • Yes, we have such clause in our contract. It is six months. • Just to confirm, can we accept tenants until 2023?	• There will be certain group of people who will contact the stakeholders but you can also contact us. • Yes, compensation includes the cost of the contractors. • There should be no displacement of employees since the old building will not be demolished until a new building is constructed and ready to be transferred. This means that there will be no business loss for the tenants' side either should they wish to relocate. Of course, it will be up to the tenants to continue or not. • The basic understanding is that the new site and building would be of more or less the same, if not higher, level of quality and hence attractiveness to the tenants. Some of the tenants may leave for this change in the location but the same number, if not more, of new tenants should be moving into your new mall. Do you not have a clause in your contract with the tenants stating the minimum notification period for tenants' exit which, if met, will not incur any penalty? DPWH will inform you in advance so that this notification period is met. This can be considered a force majure in the contract and hence even though they sue you, you should not lose the case. Again, we can help you explain to your tenants about the project, if necessary. • Yes, you can accept tenants but please make sure that they are aware of the demolition because of the project.

Source: JICA Survey Team

10. PROJECT IMPLEMENTATION PLAN

10.1 Scope of the Project

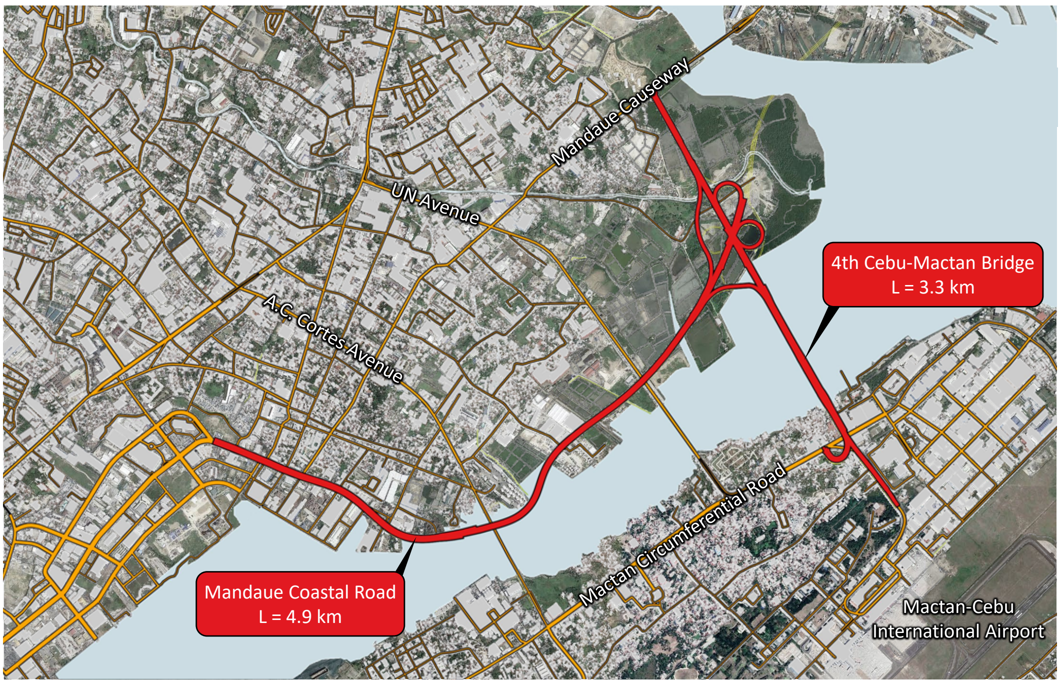
Based on the result of the Preliminary Design for the 4th Cebu-Mactan Bridge and Mandaue Coastal Road, the scope of the Project was determined as follows:

Construction of 4th Cebu-Mactan Bridge

- Total Road Length: 3.3 km
- Number of Lanes: four (4) lanes
- Design Speed: 60 km/h
- Structural Type: Elevated viaduct (L = 2,930 m + 455 m)
  - PC-I Girder: L = 315 m
  - PC Hollow Slab: L = 1,755 m
  - Steel Box Girder w/ Composite Slab: L = 790 m
  - Steel Box Girder w/ Orthotropic Steel Deck: L = 525 m

Construction of Mandaue Coastal Road

- Total Road Length: 4.9 km
- Number of Lanes: six (6) lanes / four (4) lanes
- Design Speed: 80 km/h
- Structural Type: Elevated viaduct (L = 4,751 m)
  - PC-I Girder: L = 3,050 m
  - PC Hollow Slab: L = 575 m
  - Steel Box Girder w/ Composite Slab: L = 1,126 m



Source: JICA Survey Team

Figure 10.1.1 Scope of the Project

Table 10.1.1 List of Bridges of 4th Cebu-Mactan Bridge

Name of bridge	Station	Total length (m)	Structure type	Span Number
North approach bridge Land section	0+040 – 1+322.5	1,282.5	PC-I girder PC Hollow Slab	8 spans 35 spans
North approach bridge Water section	1+322.5 – 1+815	492.5	PC Hollow Slab Steel box girder w/ composite slab	8 spans 3 spans
4th Cebu-Mactan Bridge Main Bridge	1+815 – 2+340	525	Steel box girder w/ orthotropic steel deck	4 spans
South approach bridge Land section	2+340 – 2+970 (to Airport)	630	PC Hollow Slab Steel box girder w/ composite slab	8 spans 8 spans
	2+340 – 2+795 (Loop Ramp)	455	PC Hollow Slab Steel box girder w/ composite slab	11 spans 3 spans
Total		3,560		87 spans

Note: The steel box girder type is selected as the optimum structural type for the main bridge, and the narrow steel box girder type with composite slab is selected for the approach bridge.

Source: JICA Survey Team

Table 10.1.2 List of Bridges of Mandaue Coastal Road

Name of bridge	Station	Total length (m)	Structure type	Span Number
Coastal road bridge	0+132.7 – 0+942.7	810	PC-I girder	21 spans
Coastal road bridge (Factory)	0+942.7 – 1+112.7	170	Steel box girder w/ composite slab	3 spans
Coastal road bridge	1+112.7 – 2+177.7	1,065	PC-I girder	28 spans
Coastal road bridge (Oil facility 1)	2+177.7 – 2+397.7	220	Steel box girder w/ composite slab	3 spans
Coastal road bridge	2+397.7 – 2+622.7	225	PC-I girder	6 spans
Coastal road bridge (Oil facility 2)	2+622.7 – 2+837.7	215	Steel box girder w/ composite slab	3 spans
Coastal road bridge	2+837.7 – 2+977.7	140	PC-I girder	4 spans
Coastal road bridge (Shipyard)	2+977.7 – 3+157.7	180	Steel box girder w/ composite slab	3 spans
Coastal road bridge	3+157.7 – 3+417.7	260	PC-I girder	7 spans
Coastal road bridge (2nd Cebu-Mactan Bridge overpass)	3+417.7 – 3+557.7	140	Steel box girder w/ composite slab	3 spans
Coastal road bridge	3+557.7 – 4+522.7	965	PC-I girder PC hollow slab	10 spans 21 spans
Coastal road bridge (4th Cebu-Mactan Bridge overpass)	4+522.7 – 4+723.7	201	Steel box girder w/ composite slab	5 spans
Coastal road bridge	4+723.7 – 4 +883.7	160	PC-I girder	6 spans
Total		4,751		123 spans

Source: JICA Survey Team

As described in Chapter 6, the procurement of contractor for the Project will be split into four (4) contract packages. Procurement method for each contract package is summarized in Table 10.1.3. As the result of cost estimation based on the preliminary design, the ratio of goods and services from Japan is 44% by the entire project cost and Special Terms for Economic Partnership (STEP) Loan condition can be applied to the Project.

Table 10.1.3 Expected Contract Packages

Package No.	Package name	Procurement method (ICB/LCB, with/without PQ)	Applicable Standard Bidding Documents
Package-1	Construction - Civil works 4th Cebu-Mactan Bridge	ICB without PQ	JICA's Standard Bidding Documents (Works)
Package-2	Construction - Civil works Mandaue Coastal Road (STA 0+000-STA 2+177.647)	ICB without PQ	JICA's Standard Bidding Documents (Works)
Package-3	Construction - Civil works Mandaue Coastal Road (STA 2+177.647-STA 3+557.647)	ICB without PQ	JICA's Standard Bidding Documents (Works)
Package-4	Construction - Civil works Mandaue Coastal Road (STA 3+557.647-STA 4+890.000)	ICB without PQ	JICA's Standard Bidding Documents (Works)

Source: JICA Survey Team

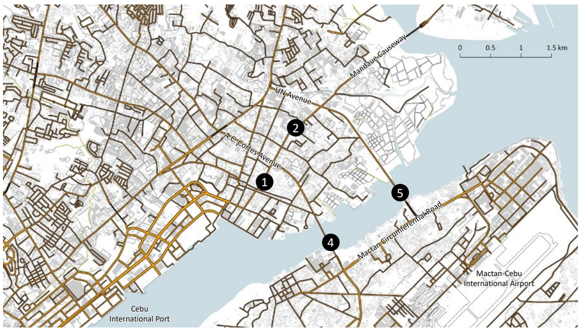
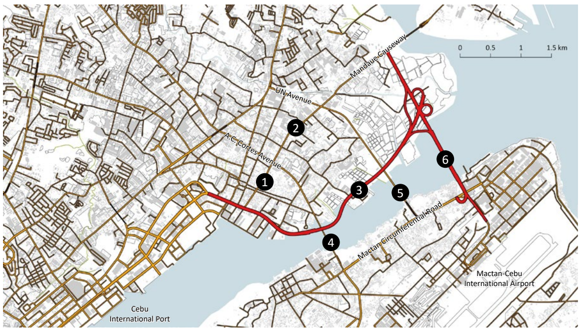
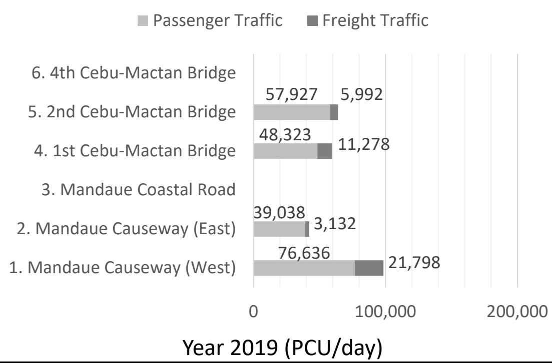
10.2 Expected Traffic Improvements

(1) Balancing Traffic Volume across Mactan Channel

Ex-post Evaluation for ODA Loan projects will be carried out about 2 year after completion of the project. Under this survey, it is assumed that the timing of the ex-post evaluation will be in 2030. Although several road improvement projects to be completed by 2030 have been proposed by MCUTMP, the beneficial impact by the Project was examined excluding the other project rather than 4th Cebu-Mactan Bridge and Mandaue Coastal Road.

Table 10.2.1 shows the comparison of traffic volume in 2019, 2028, 2030 and 2032 on major roads at the vicinity of the Project. From this table, it is obvious that 4th Cebu-Mactan Bridge will balance the traffic across Mactan Channel and Mandaue Coastal Road will decongest traffic of Mandaue Causeway.

Table 10.2.1 Comparison of Traffic Volume in 2019/2028/2029/2030/2032

<table>
<tr><th>Without Project</th><th>With Project</th></tr>
<tr><td></td><td></td></tr>
<tr><td>
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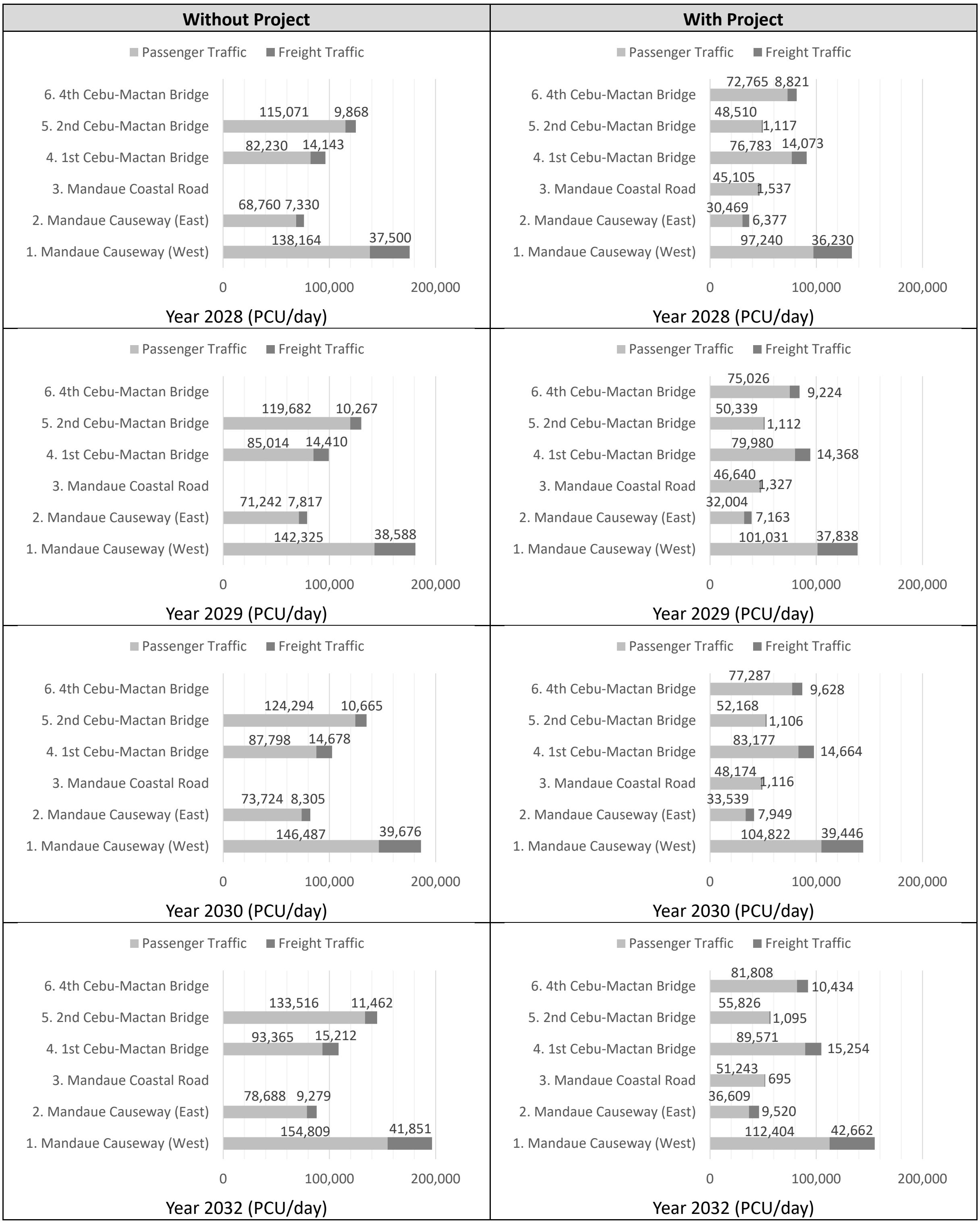


Source: JICA Survey Team

(2) Travel Time Saving

For the direction between Mactan-Cebu International Airport and Cebu Port Area, travel time savings during peak hour and daily average would be approximately 20 min.

Table 10.2.2 Travel between Mactan-Cebu International Airport and Cebu Port Area (Pier 6)

Year	Without Project (Distance 11.60 km)				With Project (Distance 11.13 km)			
	Peak Hours		Daily Average		Peak Hours		Daily Average	
	Travel Time (min)	Travel Speed (km/h)	Travel Time (min)	Travel Speed (km/h)	Travel Time (min)	Travel Speed (km/h)	Travel Time (min)	Travel Speed (km/h)
2019	106	6.6	31	22.3	* * *	* * *	* * *	* * *
2028	111	6.2	44	15.7	91	7.3	26	25.7
2029	112	6.2	44	15.0	92	7.5	27	25.2
2030	112	6.2	45	14.8	93	7.5	27	24.7
2032	113	6.1	47	14.7	96	7.0	28	23.8

Source: JICA Survey Team

Travel time saving between Mactan-Cebu International Airport and Cansaga Bay Bridge will be approximately 20 min in peak hours and 10 min in daily average.

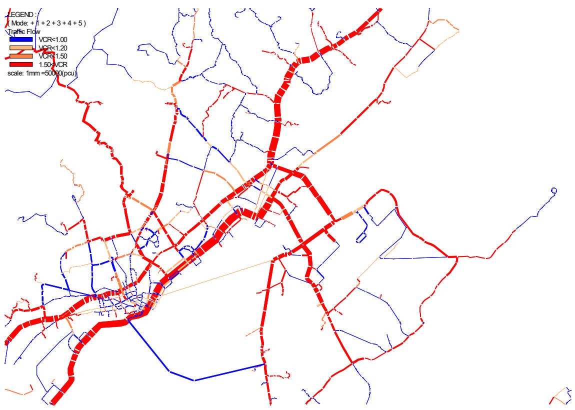
Table 10.2.3 Travel between Mactan-Cebu International Airport and Cansaga Bay Bridge

Year	Without Project (Distance 7.83 km)				With Project (Distance 6.41 km)			
	Peak Hour		Daily Average		Peak Hour		Daily Average	
	Travel Time (min)	Travel Speed (km/h)	Travel Time (min)	Travel Speed (km/h)	Travel Time (min)	Travel Speed (km/h)	Travel Time (min)	Travel Speed (km/h)
2019	49	9.5	17	28.2	* * *	* * *	* * *	* * *
2028	73	6.4	23	20.6	51	7.5	14	26.9
2029	74	6.3	23	20.2	53	7.3	15	26.5
2030	75	6.3	24	19.9	55	7.0	15	26.0
2032	77	6.1	25	19.1	58	6.6	15	25.2

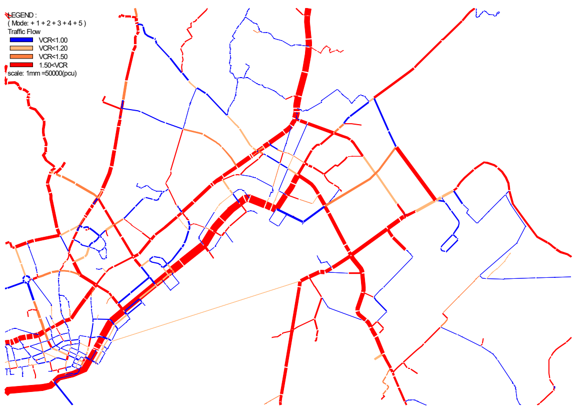
Source: JICA Survey Team

(3) Reduction of Congested Section (below 20 km/h)

Figure 10.1.1 shows the traffic situations in 2030 for both with and without project.



2030 Without Project

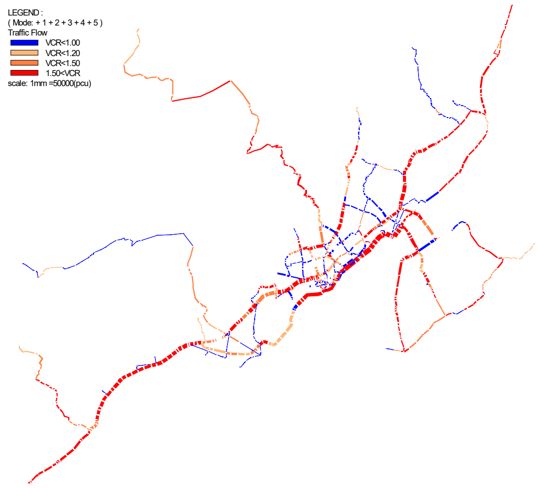


2030 With Project

Source: JICA Survey Team

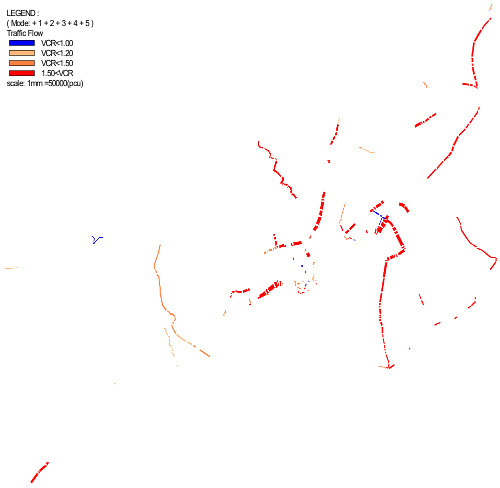
Figure 10.2.1 Comparison of Traffic Situations in 2030

Figure 10.2.2 shows the section where travel speed is below 20 km/h. After the construction of the Project Road, the congested section would be reduced at 2.5 km in peak hours and 8.2 km in daily average.



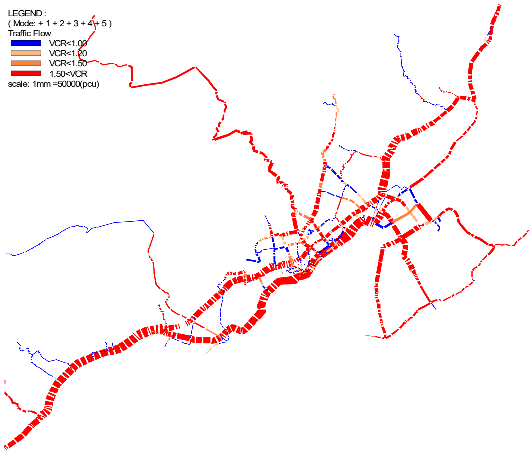
Section Length below 20 km/h: 380.3 km

2019 (Peak Hours)



Section Length below 20 km/h: 112.0 km

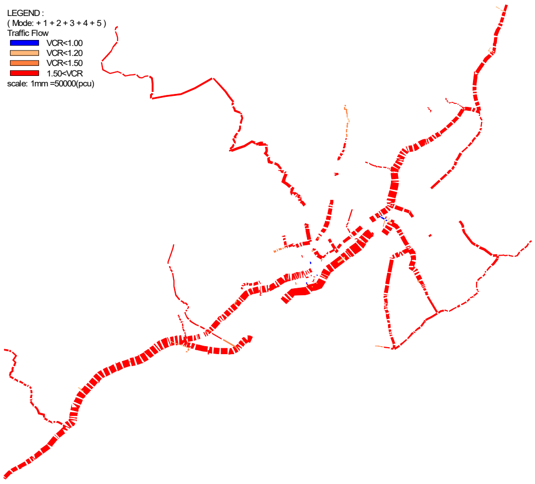
2019 (Daily Average)



Section Length below 20 km/h: 431.8 km

(Reduction of congested section 2.5 km)

2030 With Project (Peak Hours)



Section Length below 20 km/h: 268.8 km

(Reduction of congested section 8.2 km)

2030 With Project (Daily Average)

Source: JICA Survey Team

Figure 10.2.2 Comparison of Congested Sections in 2030

10.3 Implementation Schedule

The total duration of the Project is expected to be 105 months including 12 months of defects notification period. As shown in Figure 10.3.1, the civil works of the Project will be completed by June 2028.

	Start	End	Months	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
Procurement of Consultant	2020/01/01	2020/12/31	12										
Consulting Services	2021/01/01	2029/09/30	105										
Detailed Design	2021/01/01	2022/03/31	15										
Procurement of Contractor	2022/01/01	2023/04/30	16										
Civil Works (Package 1)	2023/05/01	2026/10/31	42										
Civil Works (Package 2)	2025/01/01	2027/12/31	36										
Civil Works (Package 3)	2025/01/01	2028/06/30	42										
Civil Works (Package 4)	2025/01/01	2027/12/31	36										
Defects Notification Period (Package 1)	2026/11/01	2027/10/31	12										
Defects Notification Period (Package 2)	2028/01/01	2028/12/31	12										
Defects Notification Period (Package 3)	2028/07/01	2029/06/30	12										
Defects Notification Period (Package 4)	2028/01/01	2028/12/31	12										

Source: JICA Survey Team

Figure 10.3.1 Expected Implementation Schedule of the Project

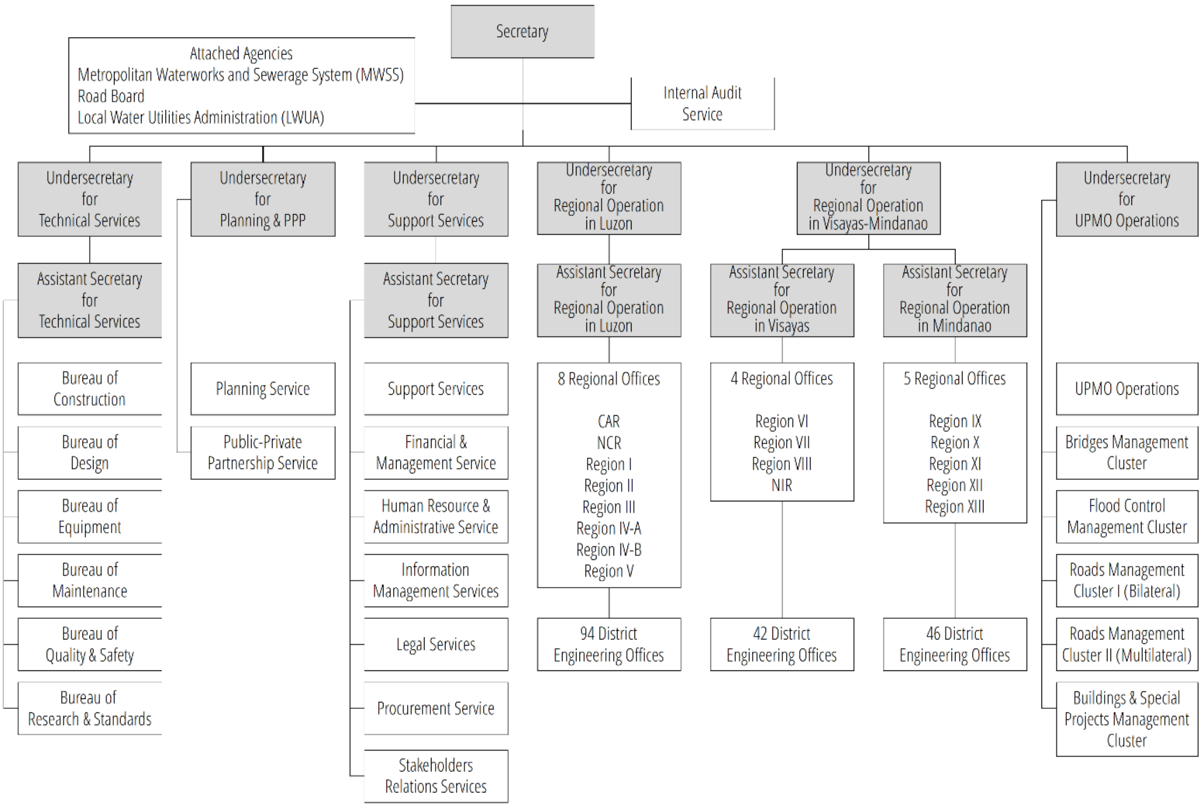
10.4 Implementation Framework

(1) Institutional Functions

The roads in the Philippines are mainly classified into two categories, namely National Roads under the jurisdiction of DPWH and the other City Roads and Barangay Roads under the jurisdiction of Local Government Units (LGUs). The Project Road will be registered as a National Road and thus DPWH is going to be the executing agency from the design, construction and maintenance stages.

DPWH functions as the engineering and construction arm of the Philippine Government tasked to continuously develop its technology for the purpose of ensuring the safety of all infrastructure facilities and securing for all public works and highways the highest efficiency and quality in construction. DPWH is currently responsible for the planning, design, construction and maintenance of infrastructure, especially the National Roads, flood control and water resources development system, and other public works in accordance with the national development objectives.

The organization structure of DPWH and the regional office is shown in Figure 10.4.1.

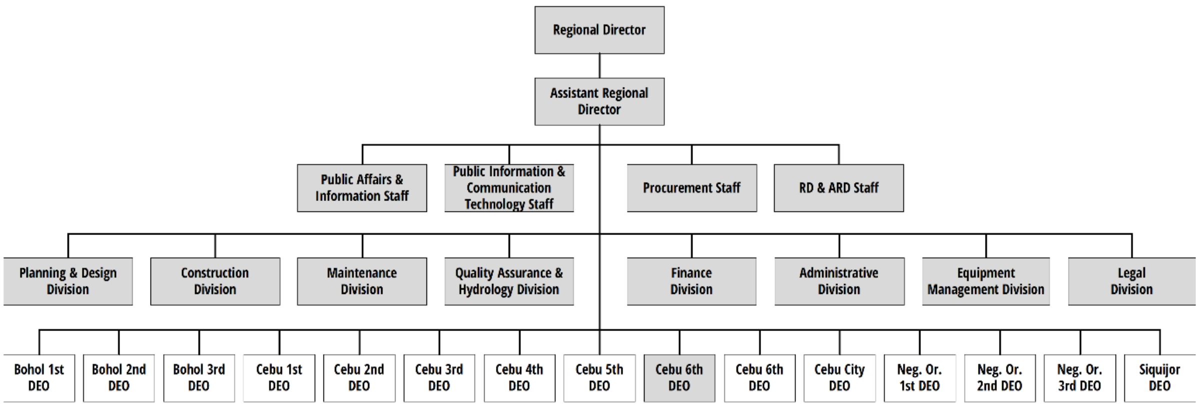


Source: DPWH Website

Figure 10.4.1 Organizational Structure of DPWH

Under Japanese ODA Loan projects, the Unified Project Management Office (UPMO) - Roads Management Cluster I (Bilateral), formerly known as Project Management Office for Philippine Japan Highway Loan (PMO-PJHL), has responsibility to manage project implementation. UPMO-RMC I has a lot of experience in roads and bridges construction projects for several decades. Therefore, DPWH has already set up the institutional framework as the executing agency for implementation of the Project.

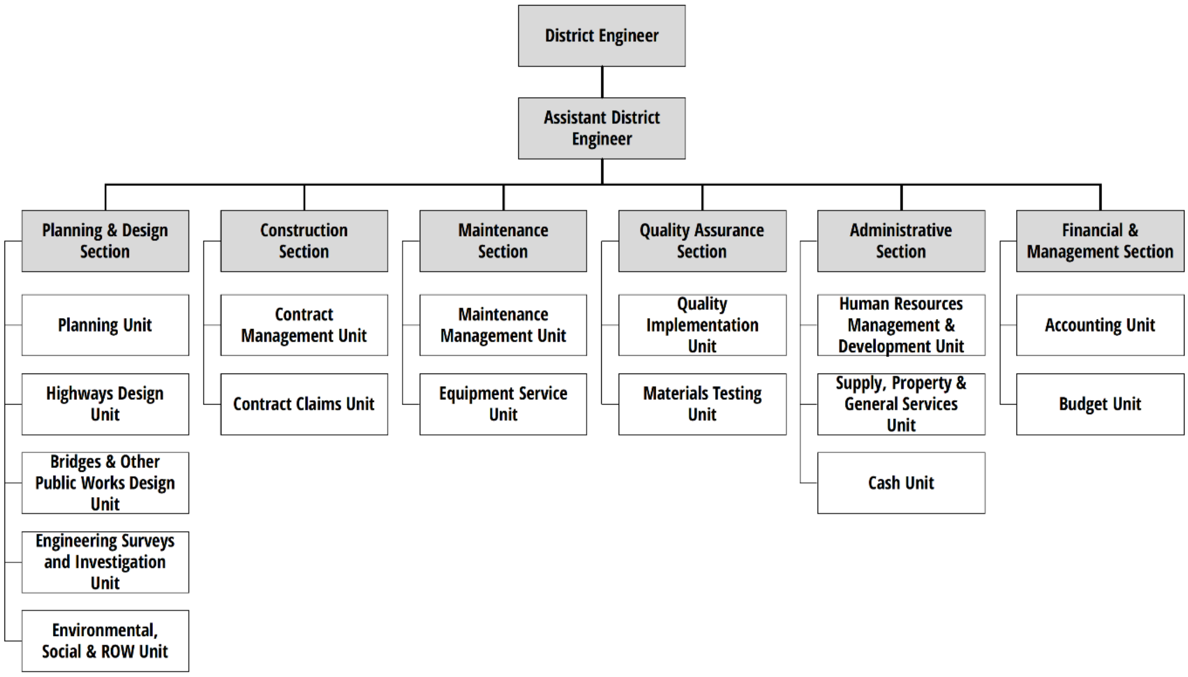
During the project implementation stage (from detailed engineering design stage until construction supervision stage), regional offices of DPWH (for the Cebu-Mactan Bridge and Coastal Road Construction Project, DPWH Region VII Office) will function as the coordinator in local level to support UPMO.



Source: DPWH Region VII Office

Figure 10.4.2 Organizational Structure of DPWH Regional Office

During the operation and maintenance stage, district engineering offices of DPWH (for 4th Cebu-Mactan Bridge and Mandaue Coastal Road, Cebu 6th District Engineering Office) has responsibility for physical inspection and maintenance works. Cebu 6th District Engineering Office has experience in maintenance of large-scale bridges such as Sergio Osmeña Bridge and Marcelo Fernan Bridge but their technical capability needs to be improved since the office is facing difficulty in repairing the defect on the bridge piers of Marcelo Fernan Bridge having Alkali-Silica Reaction.



Source: DPWH Region VII Office

Figure 10.4.3 Organizational Structure of DPWH Cebu 6th DEO

(2) Institutional Capacity

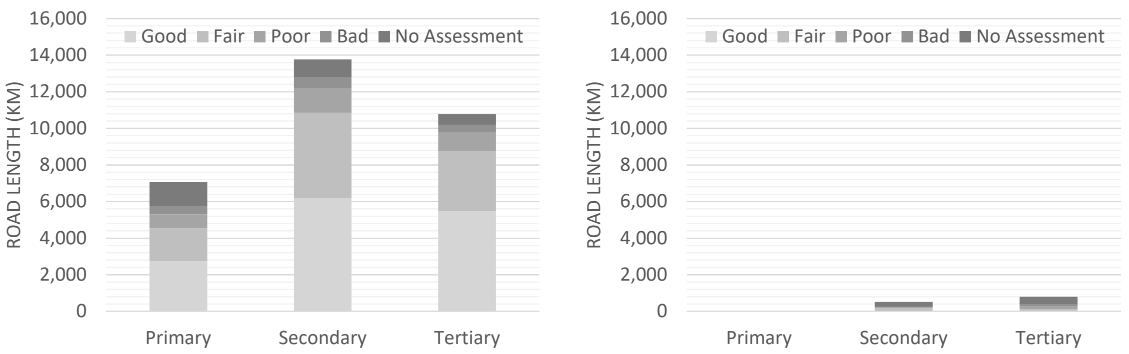
The technical level of DPWH seems high and Regional Offices have established an organizational structure to design roads and bridges on their own. At the DPWH Head Office, the Bureau of Design is responsible for design review and establishment of design standards while the Bureau of Construction is responsible for construction supervision and review of construction costs and Bureau of Maintenance is in charge of routine maintenance. Regional Offices (RO) are responsible for operation and maintenance of the roads and District Engineering Offices (DEO) are in charge of routine maintenance under supervision of RO.

According to DPWH Atlas 2018, the total road length of the National Roads operated by DPWH is 32,932 km. Road and bridge condition is inspected and monitored under the system of Road and Bridge Information Application (RBIA) and evaluated with the rating of good, fair, poor, bad. According to the Table 10.4.1, more than 70 % of roads are maintained in good or fair condition.

Table 10.4.1 National Road Length by Classification, Surface Type and Condition (Nationwide)

Surface Type		Condition Rating	Functional Classification						Grand Total	
			Primary		Secondary		Tertiary			
			km	%	km	%	km	%	km	%
Paved	Concrete	Good	1,058	3.2%	4,343	13.2%	4,315	13.1%	9,716	29.5%
		Fair	988	3.0%	3,752	11.4%	2,744	8.3%	7,484	22.7%
		Poor	351	1.1%	958	2.9%	768	2.3%	2,076	6.3%
		Bad	107	0.3%	371	1.1%	332	1.0%	810	2.5%
		No Assessment	417	1.3%	582	1.8%	437	1.3%	1,436	4.4%
		Concrete Total	2,921	8.9%	10,006	30.4%	8,596	26.1%	21,523	65.4%
	Asphalt	Good	1,681	5.1%	1,830	5.6%	1,151	3.5%	4,662	14.2%
		Fair	806	2.5%	929	2.8%	537	1.6%	2,272	6.9%
		Poor	418	1.3%	383	1.2%	247	0.8%	1,048	3.2%
		Bad	337	1.0%	201	0.6%	97	0.3%	635	1.9%
		No Assessment	904	2.7%	421	1.3%	158	0.5%	1,483	4.5%
		Asphalt Total	4,146	12.6%	3,764	11.4%	2,190	6.7%	10,100	30.7%
	Total Paved Length	Good	2,740	8.3%	6,173	18.7%	5,466	16.6%	14,379	43.7%
		Fair	1,794	5.5%	4,680	14.2%	3,281	10.0%	9,756	29.6%
		Poor	769	2.3%	1,341	4.1%	1,015	3.1%	3,124	9.5%
		Bad	444	1.4%	572	1.7%	429	1.3%	1,445	4.4%
		No Assessment	1,321	4.0%	1,004	3.1%	594	1.8%	2,919	8.9%
		Paved Total	7,067	21.5%	13,770	41.8%	10,786	32.8%	31,623	96.0%
Unpaved	Gravel	Good	-	0.0%	2	0.0%	22	0.1%	24	0.1%
		Fair	0	0.0%	171	0.5%	93	0.3%	264	0.8%
		Poor	-	0.0%	58	0.2%	176	0.5%	234	0.7%
		Bad	-	0.0%	3	0.0%	65	0.2%	69	0.2%
		No Assessment	1	0.0%	262	0.8%	411	1.3%	674	2.1%
		Gravel Total	1	0.0%	496	1.5%	767	2.3%	1,264	3.8%
	Earth	Fair	-	0.0%		0.0%	0	0.0%	0	0.0%
		Poor	-	0.0%	2	0.0%	1	0.0%	3	0.0%
		Bad	-	0.0%	7	0.0%	16	0.1%	23	0.1%
		No Assessment	-	0.0%	10	0.0%	9	0.0%	19	0.1%
		Earth Total	-	0.0%	19	0.1%	27	0.1%	45	0.1%
	Total Unpaved Length	Good	-	0.0%	2	0.0%	22	0.1%	24	0.1%
		Fair	0	0.0%	171	0.5%	93	0.3%	264	0.8%
		Poor	-	0.0%	60	0.2%	177	0.5%	237	0.7%
		Bad	-	0.0%	11	0.0%	81	0.3%	92	0.3%
		No Assessment	1	0.0%	272	0.8%	421	1.3%	693	2.1%
		Unpaved Total	1	0.0%	515	1.6%	794	2.4%	1,310	4.0%
Summary		Good	2,740	8.3%	6,175	18.8%	5,488	16.7%	14,402	43.7%
		Fair	1,794	5.5%	4,851	14.7%	3,374	10.3%	10,020	30.4%
		Poor	769	2.3%	1,401	4.3%	1,192	3.6%	3,361	10.2%
		Bad	444	1.4%	583	1.8%	511	1.6%	1,538	4.7%
		No Assessment	1,322	4.0%	1,275	3.9%	1,015	3.1%	3,612	11.0%
		Grand Total	7,068	21.5%	14,285	43.4%	11,580	35.2%	32,933	100.0%

Source: DPWH Atlas 2018



Paved Roads **Unpaved Roads**

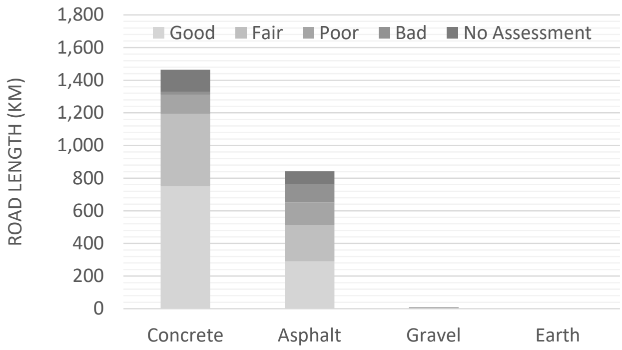
Source: DPWH Atlas 2018

Figure 10.4.4 Surface Condition of National Roads (Nationwide)

Table 10.4.2 National Road Length by Surface Type and Condition (Region VII)

Surface Type	Surface Condition (km)					Grand Total (km)
	Good	Fair	Poor	Bad	No Assessment	
Concrete	750.3	443.2	116.8	18.2	136.3	1,464.7
Asphalt	289.2	225.3	136.5	111.5	79.6	842.1
Gravel	-	0.2	5.3	0.1	1.6	7.2
Earth	-	-	-	0.5	0.9	1.4
Total	1,039.6	668.6	258.6	130.4	218.3	2,315.5

Source: DPWH Atlas 2018

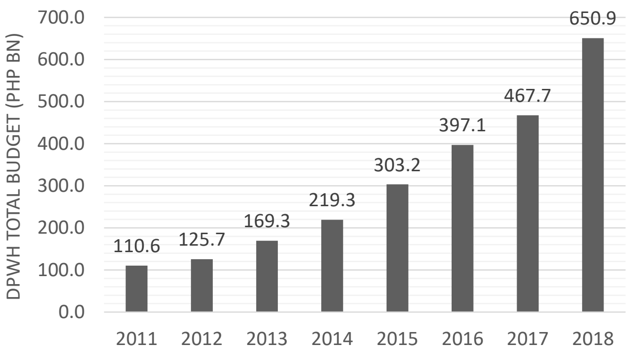


Source: DPWH Atlas 2018

Figure 10.4.5 Surface Condition of National Roads (Region VII)

(3) Finance and Budget

According to the latest DPWH's Strategic Infrastructure Programs and Policies (August 31st, 2018), the annual budget of DPWH has risen at an annual growth rate of approximately 30% and more funding has been allocated for infrastructure investments under the "Build Build Build" program of the Philippine Government. The Project implementation budget originates from the General Appropriations Act (GAA) and donor funds. Generally, the road development budget under GAA is requested by the Regional Offices to the Head Office of DPWH and thereafter allocated by Department of Budget and Management (DBM). The GAA operates on a single-year budget and the construction contract is also expected to be a one-year contract. Therefore, even for large-scale national road improvement projects, contractors are selected for different sections every year. It was noted that only registered national highways receive maintenance budgets therefore it is crucial that the Project Road is registered to ensure an adequate maintenance routine.



Source: DPWH Strategic Infrastructure Programs and Policies (2019)

Figure 10.4.6 Transition of Annual Budget for DPWH

10.5 Operation and Maintenance Plan

(1) Outline of Operation and Maintenance of Roads and Bridges

Road maintenance and operations covers various activities related to inspections, maintenance and repairs, which require a quick response and appropriate treatment to preserve functionality of the road. DPWH should be responsible for the following activities of road maintenance and operations:

- Inspections by maintenance patrol unit
- Road cleaning of road surface, etc.
- Vegetation control
- Repairs of traffic safety and management facilities
- Maintenance and repairs of pavement
- Maintenance and repairs of bridges
- Maintenance and repairs of other structures
- Disaster prevention and restoration
- Others

Road maintenance and operations programs should be made on annual, monthly and weekly basis, considering priority of the work, available resources, past work records, road inventories, road structure inventories, traffic volumes, meteorological data, etc.

<u>Maintenance of Pavement</u>

The objectives of pavement maintenance and repair are as follows:

- To sustain pavement durability and integrity
- To sustain driver's comfort and maintain traffic safety
- To avoid environmental deterioration

Inspection and maintenance activities are often conducted while open to public traffic. Therefore the following aspects should be considered while inspections and maintenance are undertaken:

- Identify surface condition changes in the early stages of deterioration
- Damages which need emergency repairs shall be repaired temporarily
- Surface conditions shall be monitored to predict future surface changes
- Maintenance schedules shall have long term plans
- Make effective use of surface condition information and construction records
- Enforcement of automobile laws and traffic safety education

Investigation for the pavement surface involves measurement and evaluation of the existing deficiencies of the pavement surface. It is the fundamental process for rational and systematic repair/maintenance of the pavement surface. The methods of attesting the pavement surface conditions are broken down into inspections and investigations. The major inspection items for pavement are rutting, cracking, skid resistance, faulting and local deformation and the major repair methods for asphalt pavement are overlay, patching or replacement of pavement.

<u>Maintenance of Bridges</u>

Experience shows that the need for maintenance and repairs to bridges is due to the following reasons:

- Deterioration commences immediately after completion of most civil works
- Live loads of vehicles and loading frequency will increase with time
- Structures may be constructed with unexpected defects which create inefficiencies and eventually affect the safety of the structure

In addition to the above, the reliability of technical products decreases with time. It is necessary to emphasize that a bridge is a technical product. The purpose of maintenance and repairs can be classified in two categories:

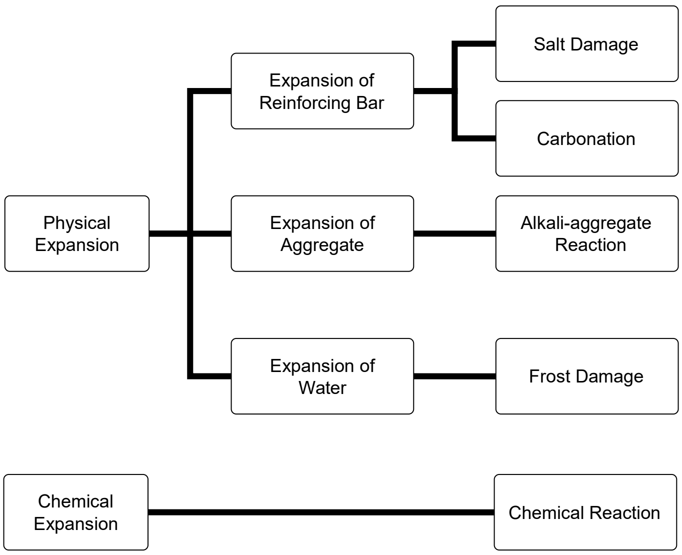
- To retain load bearing capacity and to sustain bridge durability
- To prevent failure of the bridge structure and to maintain traffic safety

It is necessary to keep design data, in particular the detailed engineering specifications, design calculations and drawings of bridges and viaducts since these are essential reference materials for planning and engineering maintenance.

Maintenance and repairs of bridges is closely related to inspection of bridges. In order to maintain bridges in good condition, the deck surface, superstructure and substructure of bridges should be inspected by routine, periodic and special inspections. When deficiencies are detected, maintenance and repairs must be carried out.

The major types of concrete deterioration are cracking, delamination, pop-outs, scaling, abrasion, spalling, efflorescence, honeycombs, or corner failure. Concrete structures are used frequently because their cost-effectiveness, strength and durability. In roadway bridges, concrete is used in many superstructures and substructures. However a concrete structure has disadvantages that offsets its high versatility as mentioned above. Deterioration of a concrete structure starts at the time of construction. Causes of concrete deterioration are listed below;

- Exposure: Carbonation caused by CO_2 in the air and salt damage caused by airborne salinity from the sea.
- Internal structure: Alkali aggregate reaction, salt damage caused by insufficient desalinization and resulting from shoddy workmanship
- Loading: Overloading and fatigue of the reinforced concrete slab
- Good knowledge of these deteriorations, suitable inspection at appropriate timing and suitable maintenance & repair will ensure that concrete structures keep their performance for a long period.

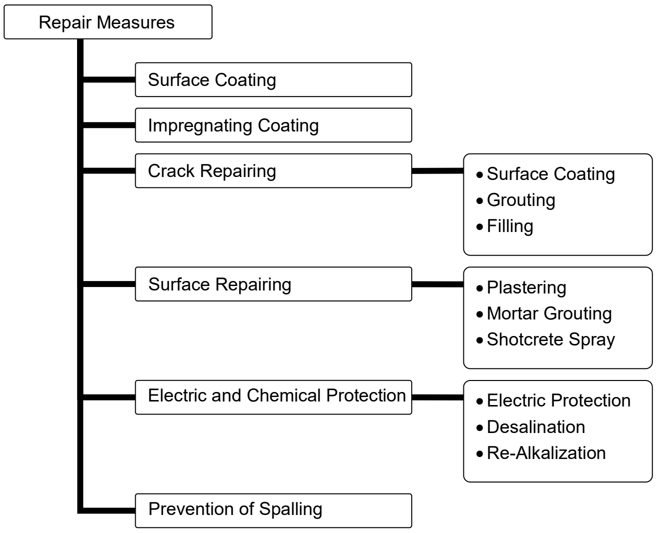


Source: JICA Survey Team

Figure 10.5.1 Classification of deterioration Mechanism

Objectives of concrete bridge repair are as follows:

- Restoration of deteriorating sections such as cracking or scaling, and prevention of reinforcing bar corrosion or deterioration around the cracks.
- Removing concrete that has suffered an attack of chloride ions (Cl-) or carbonation.
- Surface coating to prevent organic substance penetration.
- Rehabilitation for re-alkalization



Source: JICA Survey Team

Figure 10.5.2 Major Repairing Measures

(2) Current Situation of Operation and Maintenance for 1st and 2nd Cebu-Mactan Bridges

The Cebu 6th District Engineering Office under the DPWH Region VII Office is mandated to manage the operation and maintenance works of 1st and 2nd Cebu-Mactan Bridges and will do the same for the Project Road. After completion of the 4th Cebu-Mactan Bridge, the engineering office will need to increase on its operation and maintenance capacity to manage the three bridges across Mactan Channel.

DPWH Engineering Offices have carried out periodic inspection based on the Philippine Highway Maintenance Management Manual that was developed under JICA's Technical Cooperation Project. Advanced repair methods including reinforcing of slabs with carbon fiber was introduced. During the MCUTMP Study stage, it was observed that there was a lack of understanding for maintenance of steel bridges (e.g.: deterioration of critical components was overlooked, accumulation of sediment which leads to corrosion and, inadequate processing of surfaces before painting).

(3) Technical Cooperation Project Conducted by JICA

In accordance with the "*Philippine Development Plan (2011-2016)*" and "*Medium-term Program 2011-2016*" prepared by DPWH, Project on Improvement of Quality Management for Highway and Bridge Construction and Maintenance Phase I (2007-2010) and Phase II (2011-2014) were implemented in order to improve institutional capacity of operation and maintenance of roads and bridges. In this capacity building project, pilot projects for repairing roads and bridges were conducted at the selected regional offices and Region VII Office was included. 1st Cebu-Mactan Bridge (Sergio Osmeña Bridge) was selected one of the pilot project for repair/rehabilitation and the pier footings of the main bridge were repaired by recasting by underwater cure high flow grout or underwater epoxy grout including removal/breaking of concrete, installation of additional reinforcement bars, zinc-rich primer and epoxy anchorage grout.

The JICA-assisted Project on the Study of Improvement of the Bridges through Large Scale Earthquakes Disaster Mitigating Measures (Dec 2013) inspected the 1st Cebu-Mactan Bridge (Sergio Osmeña Bridge) and observed that its superstructure had seriously been deteriorated.

(4) Budget for Operation and Maintenance

As presented in annual budget transition for DPWH (based on GAA) shown in Figure 10.4.6, it has been increased approximately 30% annually since 2013. Operation and maintenance cost is covered by GAA and Motor Vehicle Users Charge (MVUC) and it includes the budget for routine and periodic maintenance. Table 10.5.1 shows annual budget for maintenance and Equivalent Maintenance Kilometer (EMK) unit price.

Table 10.5.1 Annual Budget for Operation and Maintenance for Road and Bridge

Year	Maintenance Budget (PHP million)	EMK Unit Price (PHP)	Source
2005	2,241	36,788	MVUC
2006	2,396	38,776	MVUC
2007	2,026	32,789	MVUC
2008	2,002	32,403	GAA
2009	2,500	42,825	GAA
2010	2,000	33,921	GAA
2011	4,000	68,131	GAA
2012	4,000	67,422	GAA
	1,500	24,769	MVUC
2013	4,000	67,387	GAA
	749	12,353	MVUC
2014	6,590	109,762	GAA
2015	6,700	110,502	GAA

Source: TCP Phase III Planning Report

Table 10.5.2 shows the performance of budget allocation for both carriageway maintenance and roadside maintenance to each district engineering offices in Region VII. Cebu 6th District Engineering Office has received approximately PHP 39.2 million per annum in recent five (5) years.

Table 10.5.2 Budget Allocation for Carriageway and Roadside Maintenance

Unit: PHP million

	2015	2016	2017	2018	2019
Bohol 1st	* * *	* * *	50.3	58.9	48.9
Bohol 2nd	* * *	* * *	45.8	52.2	43.0
Bohol 3rd	* * *	* * *	50.8	58.6	49.8
Cebu 1st	* * *	* * *	24.5	28.7	25.5
Cebu 2nd	* * *	* * *	44.4	52.0	42.8
Cebu 3rd	* * *	* * *	52.4	60.9	48.6
Cebu 4th	* * *	* * *	75.1	89.4	71.4
Cebu 5th	* * *	* * *	25.2	30.6	26.6
Cebu 6th	**29.3**	**33.3**	**40.6**	**52.1**	**40.6**
Siquijor	* * *	* * *	29.4	34.4	29.7
Cebu City	* * *	* * *	53.2	61.5	53.9
Negros Oriental 1st	* * *	* * *	0.0	49.7	37.2
Negros Oriental 2nd	* * *	* * *	0.0	38.3	33.7
Negros Oriental 3rd	* * *	* * *	0.0	64.6	52.9

Source: DPWH Region VII Office

(5) Operation and Maintenance Cost for the Project

<u>Cost Estimation for Operation and Maintenance Cost</u>

In order to maintain the project road in good condition, the following maintenance activities should be carried out during the operation and maintenance stage:

- Inspection of the road: weekly
- Partial resurfacing of pavement: every year
- Full resurfacing of pavement: every 10 years
- Full resurfacing of bridge pavement: every 15 years
- Replacement of bridge expansion joints: every 15 years
- Replacement of waterproofing layer on bridge decks: every 30 years
- Repainting of steel bridge coating: every 30 years

The operation and maintenance cost for the Project was roughly estimated as shown in Table 10.5.3.

Table 10.5.3 Required Budget for Operation and Maintenance of the Project Road

	Estimation of Required Cost	Estimated Cost
Routine Maintenance	0.1% of Construction Cost	CONFIDENTIAL
Periodic Maintenance (every 5 years)	1.0% of Construction Cost	
Periodic Maintenance (every 15 years)	2.0% of Construction Cost	

<u>Financial Feasibility for Operation and Maintenance Cost</u>

Comparing the required budget for operation and maintenance of the Project and the actual performance of budget allocation to the district engineering office, there is a shortage of budget. However, the maintenance budget for whole nation is increasing and there would be a possibility to increase the allocation. For more details, is should be re-examined during the Detailed Engineering Design Stage.

<u>Recommendation for Future Operation and Maintenance of the Project</u>

Damages of bridge pavement and slab have been reported in the Philippines and DPWH is facing some difficulty on maintenance of large scale bridge such as the 2nd Cebu-Mactan Bridge. There would not be much experience in the Philippines on applying pavement on the orthotropic deck, technology transfer on operation and maintenance of steel girder bridge should be incorporated in the project implementation.

11. CONCLUSION AND RECOMMENDATIONS

11.1 Conclusion

The following are the conclusion of the Survey:

- The component of the Project is comprised of the construction of 4th Cebu-Mactan Bridge (L = 3.3 km) and Mandaue Coastal Road (L = 4.9 km);
- The 4th Cebu-Mactan Bridge will start from Mandaue Causeway at approximately 80 m west side of the abutment of Cansaga Bay Bridge. The main bridge of the 4th Cebu-Mactan Bridge will be a steel box girder bridge with orthotropic deck with its main span of 215 m over the navigable waterway of Mactan Channel. The bridge will be directly connected with Airport Terminal Access Road and Mactan Circumferential Road by the separate interchange ramps;
- Mandaue Coastal Road will start from Mandaue Causeway at the corner of Mantawe Avenue in front of Bai Hotel. The alignment of the Coastal Road avoids the establishments in the industrial area in Barangays Centro and Looc as much as possible but some establishments along Mandaue Causeway need to be relocated. The Coastal Road will pass under the 1st Cebu-Mactan Bridge and pass over the 2nd and 4th Cebu-Mactan Bridges. This road will be extended into Consolacion and Liloan in future (not included in the scope of the Project under Japanese ODA Loan);
- The Mandaue Coastal Road will be connected with 1st Cebu-Mactan Bridge (Sergio Osmeña Bridge) via grade separated interchange but the construction of this interchange requires reconstruction of the 1st Cebu-Mactan Bridge. Therefore, construction of this interchange will not be included in the scope of works of the Project and it will be constructed in future;
- The Mandaue Coastal Road will not be connected with the 2nd Cebu-Mactan Bridge (Marcelo Fernan Bridge) because the bridge type of the 2nd bridge is extradosed bridge at the main span supported by cables and the vertical gradient of the approach bridge is steep at 5.5%;
- Interconnection between Mandaue Coastal Road and 4th Cebu-Mactan Bridge will be via a grade separated interchange (Mandaue Interchange). The designed type of the interchange is cloverleaf type because this type is the simplest interchange configuration and has advantage for phased construction where the half of the interchange will be constructed under the Project and the remaining half portion will be constructed in future when the Coastal Road will be extended to Consolacion.
- Because of the limited available space for ROW in highly urbanized area in Mandaue and Lapu-Lapu Cities, elevated viaduct type was applied to the most of the section of both 4th Cebu-Mactan Bridge and Mandaue Coastal Road. The Applied superstructure types are i) PC-I girder bridge, ii) PC hollow slab bridge, iii) steel box girder with composite slab bridge and iv) steel box girder with orthotropic steel deck depending on the requirement of span length and the site condition;
- Navigational clearance of Mactan Channel is 143 m in horizontal direction and 22.86 m in vertical direction above high water level (2.21 m MSL) in accordance with the instruction from

Philippine Coast Guard;

- Aviation limit of Mactan-Cebu International Airport is 45 m above its runway elevation (6 m MSL) since the project site is located within the range of 4 km radius from the airport;
- The design traffic volume with its projection year in 2039 is 60,000 PCU/day and 24,000-104,000 PCU/day for 4th Cebu-Mactan Bridge and Mandaue Coastal Road respectively. The section from the beginning point to the interchange with 1st Cebu-Mactan Bridge (Sergio Osmeña Bridge) of Mandaue Coastal Road has the highest traffic demand at 104,000 PCU/day and the traffic volume of the section from the interchange with 1st Cebu-Mactan Bridge to the interchange with 4th Cebu-Mactan Bridge of Mandaue Coastal Road will be 24,000 PCU/day. With this situation, the former section of Mandaue Coastal Road was designed with 6-lane (3-lane for each direction) and the latter section of Mandaue Coastal Road and 4th Cebu-Mactan Bridge were designed with 4-lane. However, the main bridge of the 4th Cebu-Mactan Bridge was designed with 6-lane due to the short distance (approximately 580 m) between two merging and diverging noses of Mandaue Interchange and Lapu-Lapu Interchange;
- Several mitigation measures for environmental considerations are proposed in the Project, for example, installation of 2 m height noise barrier on top of bridge railing and installation of bird-car collision prevention poles. During construction stage, use of silt fences and lower noise and vibration construction method will be adopted. In addition to such mitigation measures, development of a wetland park at the inside of the Mandaue Interchange is also proposed for betterment of the ecosystem at Cansaga Bay;
- The total area of project-affected land is calculated as 354,800 m^2 and number of the project-affected households and companies are 69 and 23 respectively. The total number of project-affected persons is 243;
- CONFIDENTIAL
- The estimated land acquisition cost including all compensations is PhP 14.26 billion (or JPY 30.09 billion);
- The economic internal rate of return (EIRR) of the Project was calculated as 10.9% based on the inflation rate of 3.5% per annum and Gross Domestic Product (GDP) per capta in 2014 and 2019. As the result of the sensitivity analysis, the EIRR of Project will be still over 10% in cases that the project cost will be increased 10% or the project benefit will be decreased at 10%. Therefore, the Project would have a certain viability for implementation; and
- A major challenge facing the project from a social environmental point of view is the lack of land that is readily available for the affected people and companies, a situation that has significant implications for the overall implementation schedule of the project. The project is expected to entail dislocation of some relatively large companies as well as resettlement of a number of ISFs. Qualified ISFs are entitled by the law in the Philippines to moving into a resettlement site yet no such site is readily available to date nor is there abundant available space in Mandaue City where development can be initiated. The companies, on the other hand, are operating in an economic zone yet there is no other unoccupied land that belongs to an economic zone. If these companies are provided with a land that is not part of the economic zone, they would lose some of the preferential treatments they are currently enjoying and hence would most likely be worse off compared to pre-project level. These constraints of land pose a

major challenge in providing suitable places to live and do business for the ISFs and companies under the tightly set timeline between the detailed design and the construction of the project.

11.2 Recommendations

Based on the abovementioned conclusion, the following matters should be taken into consideration during the implementation stage:

(1) Highway Design

- Vertical clearance under the viaduct of Mandaue Coastal Road should be reviewed especially at the industrial area passing over the factories, oil pipelines and shipyards in close coordination with the project-affected companies.
- Location of Mandaue Interchange may need to be reviewed in close coordination with Mandaue City. The size of the interchange should also reviewed in consideration of the traffic safety and the design speed. Whereas the design speed of interchange ramps of Mandaue Interchange was determined as 50 km/h in this survey, it may be worth to reconsider to adopt 40 km/h from the viewpoint of cost reduction.
- Traffic safety at the consecutive intersections at Lapu-Lapu Interchange was confirmed in this survey by analyzing directional traffic flow during peak hour and the traffic capacities of the intersections. However it should be reexamined during the detailed design stage based on the final plan.

(2) Bridge Design

- The construction of 4th Cebu-Mactan Bridge is restricted by navigational clearance and aviation limit. These restrictions needs to be incorporated in the design especially on the construction method. In case some part of the restricted area needs to be occupied temporarily by construction works, close coordination with concerned agencies such as Philippine Coast Guard and Cebu Port Authority would be required in early stage of the construction works.
- The adopted design wind speed of 88m/s seems very high. Since wind resistance is critical to finalize the fundamental dimension and its system of 4th Cebu-Mactan Bridge, the wind stability should be examined at the early stage of detailed design. Furthermore, construction of a bridge structure having branch girders at side span of the 215 m main would be the first experience in the world. Three-dimensional wind tunnel test must be carried out.
- In case the construction of Mandaue Global City reclamation project would be overlapped with the Project, close coordination with the reclamation project would be required specifically on construction schedule and plan.
- Damages of bridge pavement and slab have been reported in the Philippines and DPWH is facing some difficulty on maintenance of large scale bridge such as the 2nd Cebu-Mactan Bridge. Since there would not be much experience in the Philippines on applying pavement on the orthotropic deck, technology transfer on operation and maintenance of steel girder bridge should be incorporated in the project implementation.
- Difficulty on construction of Lapu-Lapu Interchange is high because construction of the two-layered bridge structure shall be carried out over the existing road with high traffic volume and limited space beside shopping malls. The construction plan such as construction procedure and traffic management should be carefully considered in order to minimize the adverse impact

for the activities outside of the construction site.

11.3 Risk Management Framework

In general, Japan's ODA loan projects in developing countries may not be completed within the expected completion timing and budget even if project management is sufficiently carried out at the implementation stage, and there may be cases where the benefits after project completion do not reach the initial expected level.

In order to consider in advance measures against risks that may occur in the implementation stage while preventing the occurrence of such cases in advance, potential risk items at the initial stage of project formation needs to be identified and measures taken.

In this regard, risk management framework for the Project was prepared and is summarized in Table 11.3.1.

Table 11.3.1 Risk Management Framework

Potential Project Risks	Assessment
1. Stakeholder Risk	
• Low commitment on ODA project including priority of the policy, financial support • Sustainability of the priority in the government policy even if the administration would be changed during project implementation	Probability: Low Impact: Mean Analysis of probability and impact: • The 4th Cebu-Mactan Bridge and Mandaue Coastal Road are the high-priority project under current administration. • In case if the political leader would be changed and if the new leader would have different mind of development, change of plan or design may be required. Mitigation measures: • Keep updating the progress of the Project at national and regional levels. • Foresee and prepare for the provable administrative change and avoid drastic changes. Action during the implementation: • Present the progress of the Project at RDC and MCDCB meetings • Closely communicate with LGUs (Mandaue City and Lapu-Lapu City) and prepare for such risk. Contingency plan (if applicable): • N/A
• Consistency with the need of public • Possibility to receive opposition from vested interests	Probability: Mean Impact: High Analysis of probability and impact: • The Project site is located in the Key Biodiversity Area (KBA) and there is a possibility of existence of threatened species of migratory birds such as Chinese Egret or Grey-Tailed Tattler (even though the existence has not been confirmed yet). There is a possibility that NGO may oppose to the project implementation. • There are private land development proposals in Mandaue City and Lapu-Lapu City where the Project road will pass through. Even though LGUs (Mandaue City and Lapu-Lapu City) have not been received officially, these developer may oppose to the project implementation. Mitigation measures: • Awareness of the Project scope including the proposed mitigation measures for conservation of natural environment. • Obtain basic consent for the Project by proper communications. Action during the implementation: • Conduct the biodiversity survey including detailed bird survey during detailed design stage and bird monitoring during construction stage and disclose the survey result to public. • Continue consultation with the project-affected companies Contingency plan (if applicable): • N/A • Change road alignment if it is reasonable.
• Possibility of private finance	Probability: N/A

Potential Project Risks	Assessment
involvement into the Project	Impact: N/A Analysis of probability and impact: • N/A Mitigation measures: • N/A Action during the implementation: • N/A Contingency plan (if applicable): • N/A
2. Executing Agency Risk	
2.1. Capacity Risk	
• Provision of appropriate resources and authorities to executing agency	Probability: Low Impact: Mean Analysis of probability and impact: • DPWH has implemented several roads and bridges construction projects under Japanese ODA Loan and thus it has sufficient human resources for undertaking the Project. • DPWH-UPMO is the executing body in DPWH and has sufficient human resources. • Responsibility of each section of DPWH is clear. Mitigation measures: • N/A Action during the implementation: • N/A Contingency plan (if applicable): • N/A
• Accountability of financial management and procurement process, technical ability of project administration • Practical application of rules to ensure the freedom from political pressure	Probability: Low Impact: Low Analysis of probability and impact: • DPWH has implemented several roads and bridges construction projects under Japanese ODA Loan and thus it has sufficient human resources for undertaking the Project. Mitigation measures: • N/A Action during the implementation: • N/A Contingency plan (if applicable): • N/A
• Accountability of capability to finance the project from its own financial resource • Accountability of capability to control financial status	Probability: Low Impact: Mean Analysis of probability and impact: • DPWH has a knowledge and technical capacity for maintenance of roads and small-scale bridges. However, DPWH recognizes the difficulty in securing maintenance budget and technical capability for large-scale bridges such as 2nd Cebu-Mactan Bridge. • The Maintenance Section of the District Engineering Office is responsible for the physical maintenance activities for roads and bridges so that the staffs of should be aware the proper maintenance of the large-scale bridge. • The maintenance budget of DPWH is steadily increased in recent years. Mitigation measures: • N/A Action during the implementation: • N/A Contingency plan (if applicable): • N/A
• Possibility in delay in payment to the contractor	Probability: High Impact: Mean Analysis of probability and impact: • Under DPWH projects, payment process normally takes about 2 months (check by Consultant: 2 weeks, check by DPWH-UPMO: 2 weeks, DPWH-Accounting Division: 2 weeks, and JICA's concurrence: 2 weeks). In case if there would be a delay in each process, payment will also be delayed. Mitigation measures: • Simplification of checking process

Potential Project Risks	Assessment
	<u>Action during the implementation:</u> • Instruction to the Contractor about the payment process and required documents for payment. <u>Contingency plan (if applicable):</u> • N/A
2.2. Governance Risk	
• Cooperation System among Relevant Entities and Implementation System	Probability: Low Impact: Low <u>Analysis of probability and impact:</u> • Joint Coordinating Committee for the Project has been officially launched since April 30, 2019. <u>Mitigation measures:</u> • N/A <u>Action during the implementation:</u> • The Director of DPWH-UPMO is going to appoint the Project Manager for handling the Project. • The Joint Coordinating Committee should monitor the progress of the Project. <u>Contingency plan (if applicable):</u> • N/A
• Delay in government approval	Probability: Low Impact: Low <u>Analysis of probability and impact:</u> • RDC Project Endorsement is currently under preparation. <u>Mitigation measures:</u> • N/A <u>Action during the implementation:</u> • Closely communicate with LGUs and Regional Development Council. <u>Contingency plan (if applicable):</u> • N/A
2.3. Fraud & Corruption Risk	
• Appropriateness and effectiveness of financial and procurement management regulations	Probability: Low Impact: Low <u>Analysis of probability and impact:</u> • DPWH-UPMO has responsibility of managing project implementation and functions as a coordinator for technical review of design and cost estimation by Bureau of Design (BOD), Bureau of Construction (BOC), Environmental Social Safeguards Division and other concerned sections including Financial & Management Service. <u>Mitigation measures:</u> • N/A <u>Action during the implementation:</u> • N/A <u>Contingency plan (if applicable):</u> • N/A
3. Project Risk	
3.1. Design Risk	
• Appropriateness of Scope or Works • Adoption of excessively advanced technology	Probability: Mean Impact: Mean <u>Analysis of probability and impact:</u> • Application of the main span length of 215 m for steel box girder bridge with orthotropic steel deck is not special and there are many similar cases in Japan. However, this scale of bridge is the first experience in the Philippines. • Considering that the applied design speed of 88 km/s is higher than Japanese standard and the main bridge will have widening section for merging and diverging, much more highly advanced technology would be required than similar scale bridge construction. • It should be noted that the construction works of the main bridge will be restricted by the navigational clearance and aviation limit of Cebu-Mactan International Airport. <u>Mitigation measures:</u> • N/A <u>Action during the implementation:</u>

Potential Project Risks	Assessment
	• Involve highly experienced bridge engineers in the bridge wind resistant design and large-scale bridge design. • Select experienced contractor. • Consider wind-resistant stability during construction works. • Closely coordinate with Philippine Coast Guard and Civil Aviation Authority of the Philippines for preventing the occurrence of any incidental accident. Contingency plan (if applicable): • N/A
• Preparation for phased construction	Probability: Mean Impact: Mean Analysis of probability and impact: • Constructions of the interchange connecting to the 1st Cebu-Mactan Bridge and extension of Mandaue Coastal Road to Consolacion are not included in the Project and it will be implemented in future. The bridge design should fully consider the possibility of accommodating such future expansion. • In case the construction of Mandaue Coastal Road will be divided into multiple packages, connectivity at the boundary of the packages should also be carefully considered. Mitigation measures: • N/A Action during the implementation: • Since the structural durability of the existing 1st Cebu-Mactan Bridge is not enough to accommodate heavy vehicles and widening of the existing bridge would not be possible, replacement of bridge would be required for connection of the 1st Cebu-Mactan Bridge and Mandaue Coastal Road. Therefore, careful engineering study including bridge design and construction plan need to be prepared. • Provision of temporary access may need to be considered in case the timing of each contract package would not much and if early opening of the completed section would be required. Contingency plan (if applicable): • N/A
• Safety control during construction stage at the work near the facilities handling farmable materials	Probability: High Impact: Mean Analysis of probability and impact: • The sections passing over the pipelines of the oil tank facility would need special safety control against farmable materials during construction. Mitigation measures: • Construction method which can minimize the period of site work (such as launching girder erection method) should be applied as much as possible. • High-performance anticorrosion method should also be applied in order to minimize the necessity of maintenance work. Action during the implementation: • Regulate the transportation of construction materials in order to minimize the conflict and use of fire. • Require high safety control to the contractor and conduct safety management in close coordination with the affected companies. Contingency plan (if applicable): • N/A
• Reliability of project monitoring system	Probability: Low Impact: Mean Analysis of probability and impact: • It is considered that DPWH is capable of monitoring the project implementation timely with respect to both financial status and progress of construction works as it has sufficient engineers and accountants. • It is considered that DPWH will properly use the loan according to the agreements and contracts as it has a financial audit officer. Mitigation measures: • N/A Action during the implementation: • N/A Contingency plan (if applicable): • N/A
• Packages for Procurement of Contractor • Capability of Contractor	Probability: Low Impact: Mean Analysis of probability and impact: • The estimated construction cost for the Project is too high to expect involving

Potential Project Risks	Assessment
	many bidders if it is a single package and thus dividing the scope into at least 2 packages was recommended in order to balance the scale of the project. • The bridges across Mactan Channel requires special structural type of bridge and would need experienced contractor to be involved. Mitigation measures: • All the procedures in selecting the contractor should carefully be monitored by JICA Action during the implementation: • Requirements for bidders should be verified during the detailed design stage and it should be reflected to the bidding documents. Contingency plan (if applicable): • N/A
• Weakness to the increase in the Project cost by external factors	Probability: Mean Impact: High Analysis of probability and impact: • There is a possibility of increase in the cost of equipment and material due to international market condition Mitigation measures: • Provision of contingency in budget for economic evaluation Action during the implementation: • Cost effectiveness should be reviewed during Detailed Engineering Design Stage in view of Value Engineering. Contingency plan (if applicable): • N/A
• Weakness to the decrease in demand by external factors	Probability: Low Impact: Mean Analysis of probability and impact: • The traffic demand forecast conducted in this Survey considered all of the proposed developments in the vicinity of the Project site. Therefore, there is a possibility of decreasing in the traffic demand. However, the current traffic volume has reached the traffic capacity of the existing two (2) bridges across Mactan Channel and therefore, the 4th Bridge would be required under any circumstances. • Currently the urban roads in Mandaue City has serious traffic congestion in peak hours. Construction of a bypass road is required for mitigating traffic congestion in those roads. Therefore, even if the traffic demand will be decreased, project purpose to mitigate traffic congestion in city center will be attained. Mitigation measures: • N/A Action during the implementation: • N/A Contingency plan (if applicable): • N/A
3.2. Program & Donor Risk	
• Other related projects in the vicinity of the Project site	Probability: Mean Impact: Mean Analysis of probability and impact: • There is a reclamation plan at Mandaue City. Depending on the progress of the implementation, the timing of the construction of the Project and the reclamation project may overlap. Mitigation measures: • N/A Action during the implementation: • Closely coordinate with Mandaue City. Contingency plan (if applicable): • N/A
• Necessary change of government policy or regulation for achieving the Project effect	Probability: N/A Impact: N/A Analysis of probability and impact: • There is no necessity of change of government policy or regulation for achieving the Project effect because the Project road will not be a toll road and will not need new institutional framework. Mitigation measures: • N/A

Potential Project Risks	Assessment
	<u>Action during the implementation:</u> • N/A <u>Contingency plan (if applicable):</u> • N/A
• Coordination with other donor agencies	Probability: N/A Impact: N/A <u>Analysis of probability and impact:</u> • There is no necessity to coordinate with other donor agencies and the Project can be implemented alone. <u>Mitigation measures:</u> • N/A <u>Action during the implementation:</u> • N/A <u>Contingency plan (if applicable):</u> • N/A
3.3. Delivery Quality Risk	
• Difficulty in the measurement of the Project performance indicators	Probability: Low Impact: Low <u>Analysis of probability and impact:</u> • There is no difficulty in measuring the performance indicators of the Project where it can be measured by traffic survey. <u>Mitigation measures:</u> • N/A <u>Action during the implementation:</u> • N/A <u>Contingency plan (if applicable):</u> • N/A
• Difficulty in operation and maintenance for ensuring sustainability of the development effect	Probability: Low Impact: High <u>Analysis of probability and impact:</u> • In case if the bridges to be constructed by the Project would not be properly maintained, serious deterioration may occur because the Project road will be constructed with elevated viaduct (total length of approximately 10 km) including steel girder bridges (2.4 km in total). • DPWH has institutional framework for maintenance of the bridges and Cebu 6th District Engineering Office (DEO) will be the main body of maintenance works. Cebu 6th DEO is currently maintaining the existing two large bridges across Mactan Channel and has experience in maintenance of large-scale bridges. But the institutional capability should be improved for ensuring better maintenance <u>Mitigation measures:</u> • During the implementation stage, technology transfer on maintenance of steel girder bridge should be carried out for strengthening the institutional capability. <u>Action during the implementation:</u> • Carry out the following technology transfers for the staffs of DPWH ➢ Anti-corrosion technology for extending durability of bridges ➢ Bridge inspection technology <u>Contingency plan (if applicable):</u> • N/A
• Probability of impact on the Project implementation by natural disasters or security	Probability: Mean Impact: Mean <u>Analysis of probability and impact:</u> • There if a possibility of temporary interruption of construction works by typhoon or other extreme climate event. Especially, construction of long-span bridge sections need special care for preventing any occurrence of accident. <u>Mitigation measures:</u> • Construction plan should be carefully prepared in consideration of the possibility of occurrence of extreme climate event. <u>Action during the implementation:</u> • Monitor the climate condition and prepare for any extreme climate event. <u>Contingency plan (if applicable):</u> • N/A
• Probability of inappropriate and illegal use of facilities	Probability: Low Impact: Mean <u>Analysis of probability and impact:</u>

Potential Project Risks	Assessment
	• There are a lot of similar roads in the vicinity of the Project site and the usage of road is widely known in the region. • Metro Cebu is politically stable and secure. Therefore, probability of occurrence of a vandalism, which induce structurally fatal for the bridges, would be low. <u>Mitigation measures:</u> • Bridge substructures should be securely protected against vessels and vehicles. <u>Action during the implementation:</u> • Design protection measure of bridge substructures. <u>Contingency plan (if applicable):</u> • N/A
• Probability of increase in maintenance cost by inappropriate use of facilities	Probability: Mean Impact: Mean <u>Analysis of probability and impact:</u> • There is a probability of use by over-loaded vehicles, which may deteriorate the pavement or bridge structures. <u>Mitigation measures:</u> • Management of vehicles axle-load by installation of weigh-in-motion. • Application of heavy-duty pavement type. <u>Action during the implementation:</u> • Include the above mitigation measures in the project component during Detailed Engineering Design. <u>Contingency plan (if applicable):</u> • N/A
• Probability of unbalanced benefit to the specific group • Probability of limited beneficiaries range of the development effect	Probability: Low Impact: Low <u>Analysis of probability and impact:</u> • During the public hearings and focus group discussions conducted in this Survey, the scope and components of the Project was explained to the people living in the vicinity of the Project site. • There would be low probability that development effects will be biased towards a specific group or limited beneficiaries. <u>Mitigation measures:</u> • Involvement of local communities and stakeholders. • Assessment of the needs from local communities and stakeholders. <u>Action during the implementation:</u> • Conduct public consultation meetings during the Detailed Engineering Design stage and incorporate the reasonable suggestions from the public into the project component as much as possible. <u>Contingency plan (if applicable):</u> • N/A
4. Other Risk	
N/A	N/A
5. Overall Risk Rating	
Overall evaluation	Probability: Mean Impact: Mean

APPENDIX 1 DRAWINGS

COORDINATE SYSTEM: UTM WGS 84 ZONE 51 NORTH

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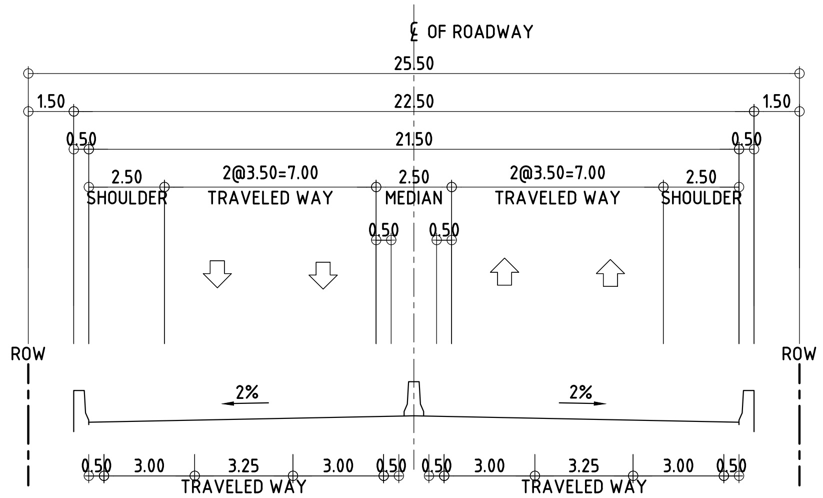
Almec Corporation

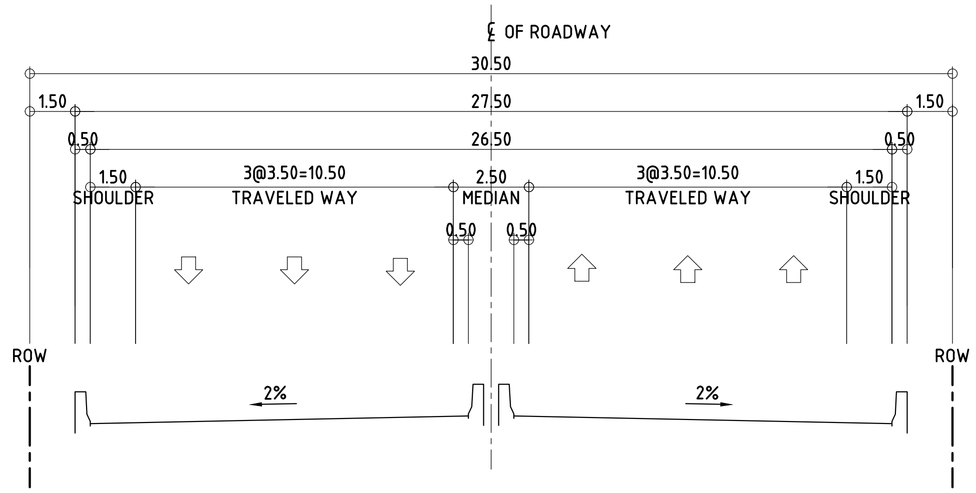
Drawing No. 01

LOCATION MAP

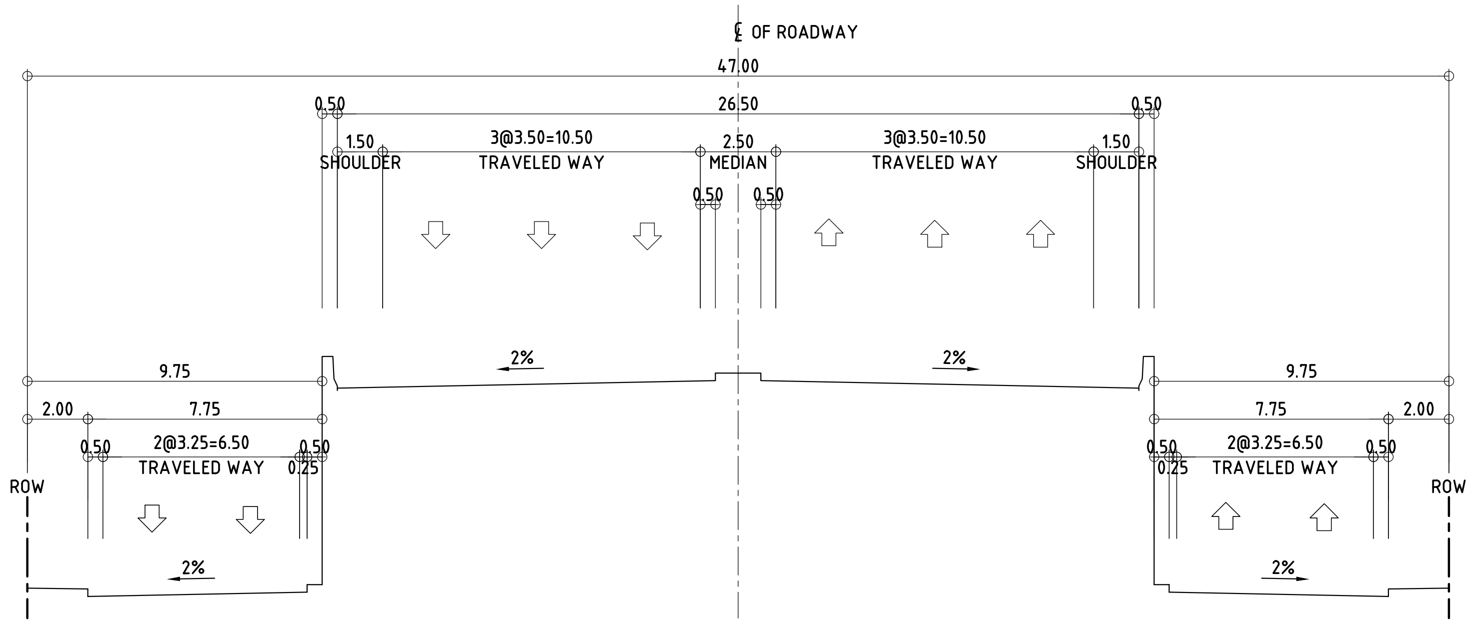
Scale (A3) 1:15,000



VIADUCT SECTION 2 : 1ST BRIDGE - END POINT



VIADUCT SECTION 1 : BEGINNING POINT - 1ST BRIDGE



APPROACH SECTION AT BEGINNING POINT

MANDAUE COASTAL ROAD

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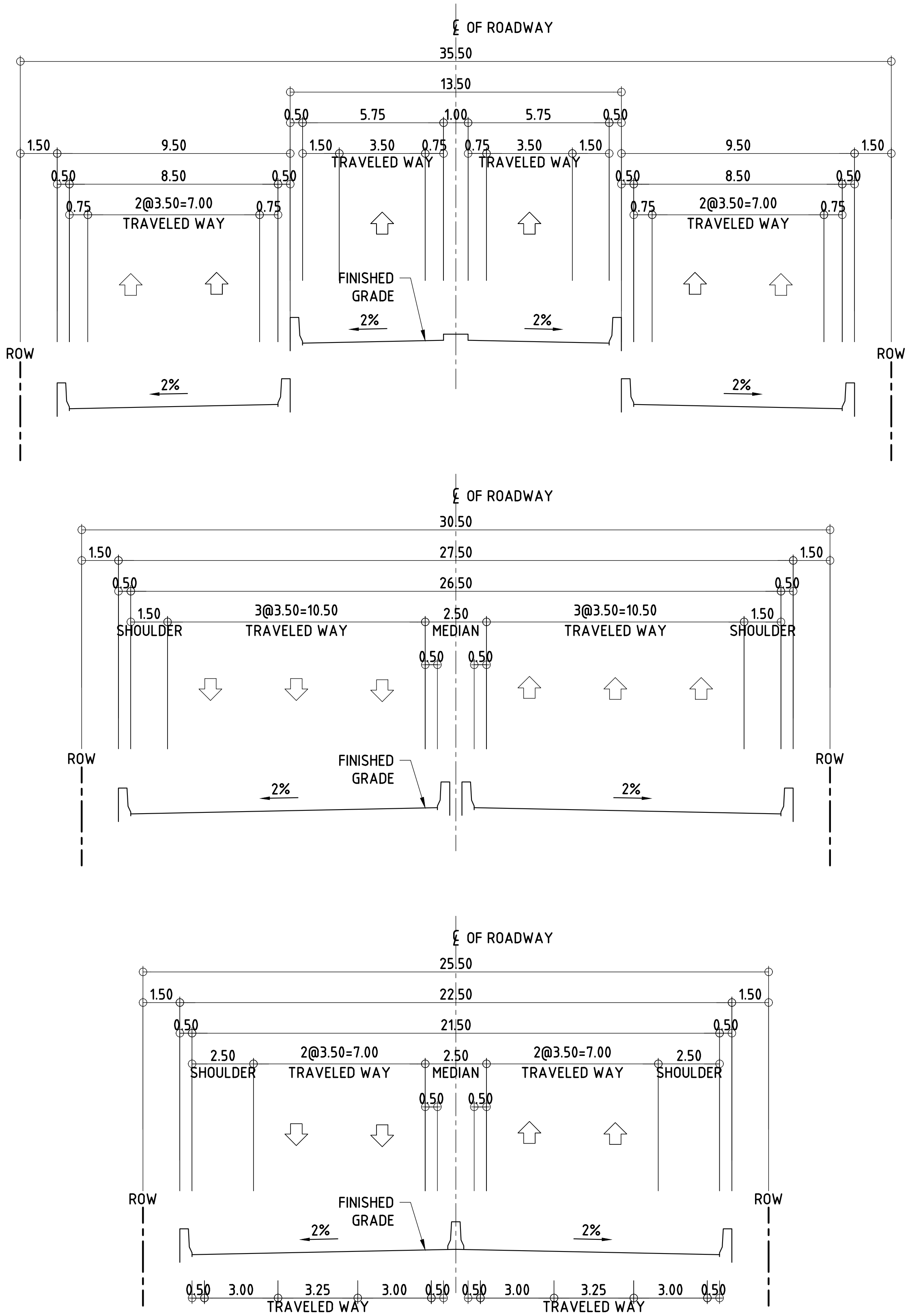
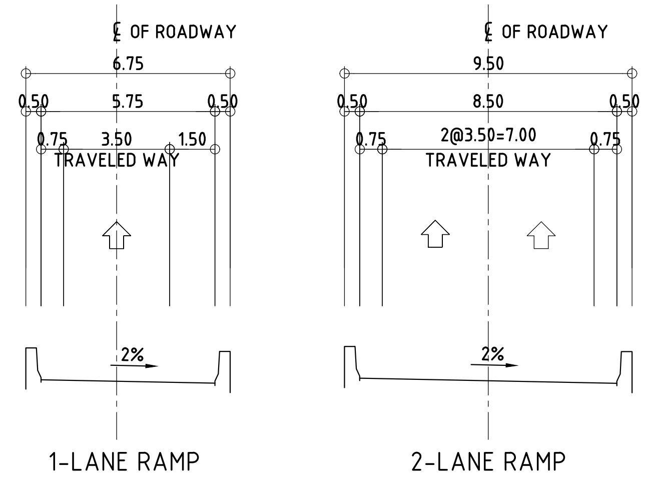
Drawing No. XX

TYPICAL CROSS SECTIONS

Scale (A3) 1:250



4TH CEBU-MACTAN BRIDGE



INTERCHANGE RAMPS

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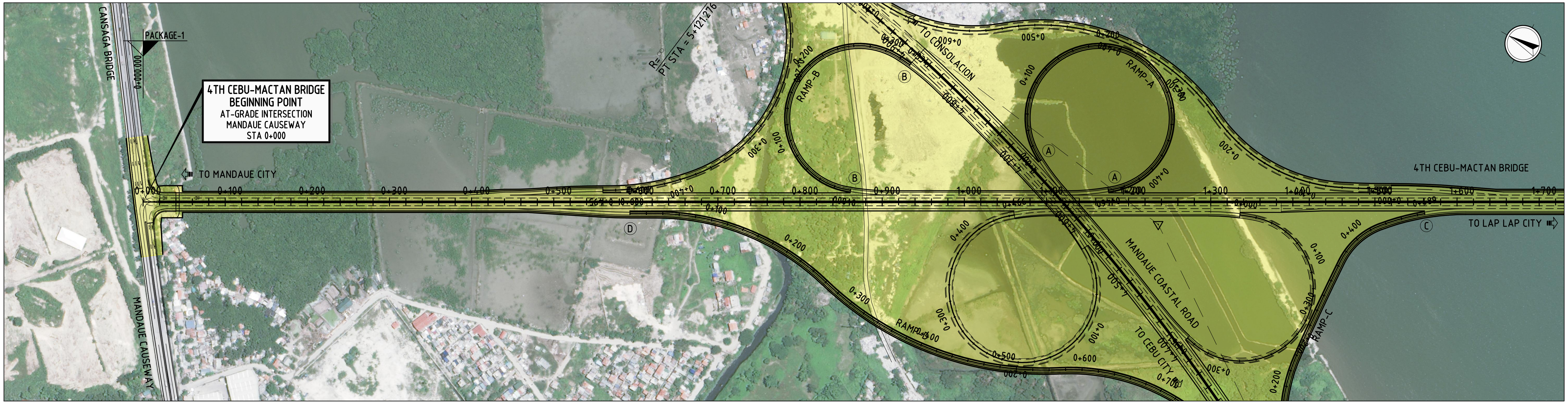
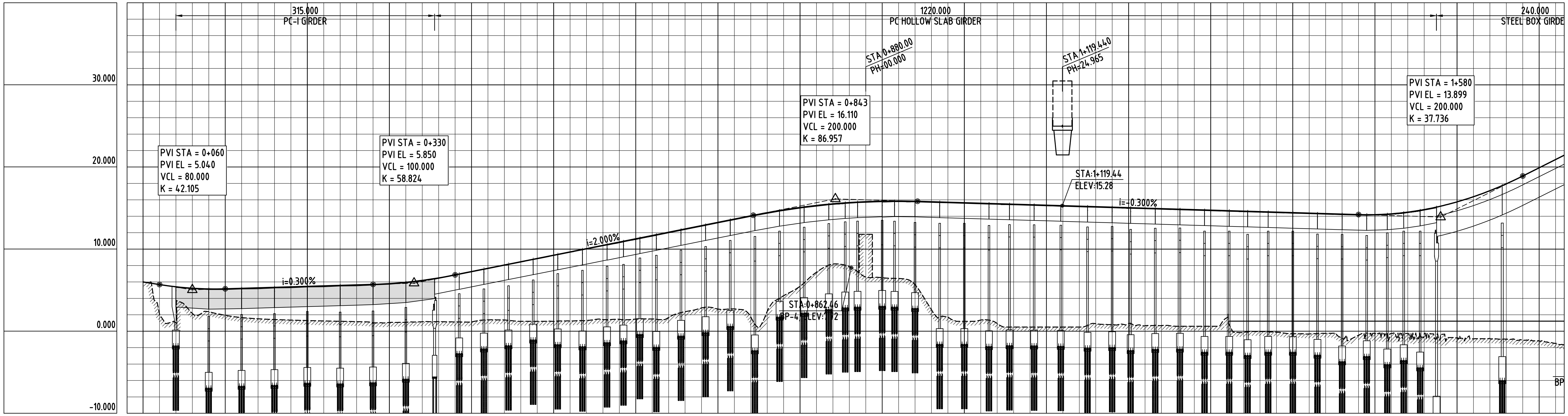
Almec Corporation

Drawing No. XX

TYPICAL CROSS SECTIONS

Scale (A3) 1:250





VERTICAL ALIGNMENT: -1.600% L=20.000 | 5.040 0+060 | +0.300% L=180.000 | 5.850 0+330 | +2.000% L=363.000 | 16.110 0+843 | -0.300% L=537.000 | 13.899 1+580

STATION	FINISHED GROUND	EXISTING GROUND
0+000	6.000	5.99
+020	5.680	2.12
+040	5.407	1.01
+060	5.230	2.17
+080	5.147	2.38
0+100	5.160	1.94
+120	5.220	1.66
+140	5.280	1.51
+160	5.340	1.42
+180	5.400	1.35
0+200	5.460	1.29
+220	5.520	1.25
+240	5.580	1.20
+260	5.640	1.16
+280	5.700	1.03
0+300	5.794	1.06
+320	5.956	1.08
+340	6.186	1.15
+360	6.484	1.17
+380	6.850	1.13
0+400	7.250	1.13
+420	7.650	1.38
+440	8.050	1.36
+460	8.450	1.20
+480	8.850	1.20
0+500	9.250	1.20
+520	9.650	1.25
+540	10.050	1.31
+560	10.450	1.41
+580	10.850	1.44
0+600	11.250	1.48
+620	11.650	1.49
+640	12.050	1.67
+660	12.450	2.38
+680	12.850	2.83
0+700	13.250	2.70
+720	13.650	2.71
+740	14.050	1.73
+760	14.433	2.42
+780	14.771	4.32
0+800	15.063	5.47
+820	15.309	7.18
+840	15.509	8.17
+860	15.663	7.86
+880	15.771	6.59
0+900	15.833	6.52
+920	15.849	6.42
+940	15.818	5.67
+960	15.759	2.61
+980	15.699	1.72
1+000	15.639	1.20
+020	15.579	1.35
+040	15.519	0.94
+060	15.459	0.50
+080	15.399	0.50
1+100	15.339	0.50
+120	15.279	0.50
+140	15.219	0.50
+160	15.159	0.91
+180	15.099	0.80
1+200	15.039	0.92
+220	14.979	0.66
+240	14.919	0.68
+260	14.859	0.60
+280	14.799	0.60
1+300	14.739	0.60
+320	14.679	1.65
+340	14.619	-0.14
+360	14.559	-0.04
+380	14.499	-0.13
1+400	14.439	-0.31
+420	14.379	-0.33
+440	14.319	-0.26
+460	14.259	-0.87
+480	14.199	-0.49
1+500	14.192	-0.30
+520	14.291	-0.28
+540	14.496	-0.31
+560	14.807	-0.36
+580	15.224	-0.46
1+600	15.747	-0.81
+620	16.376	-0.94
+640	17.111	-0.90
+660	17.952	-0.96
+680	18.899	-1.05
1+700	19.899	-1.22
+720	20.899	-1.48

HORIZONTAL ALIGNMENT: L=1913.240

SUPERELEVATION

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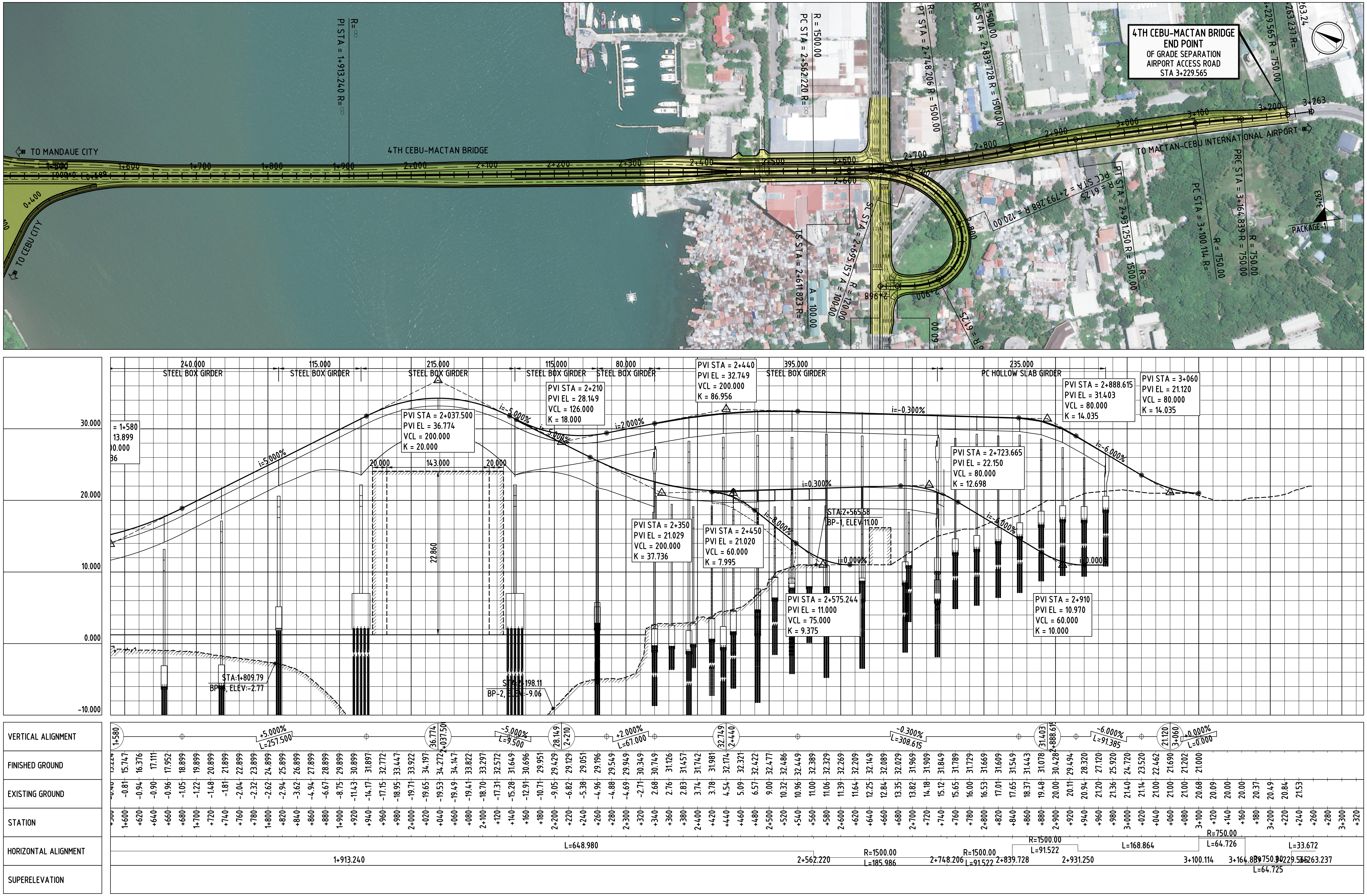
Drawing No. 10

PLAN AND PROFILE

4th CEBU-MACTAN BRIDGE STA 0+000 - 1+600

Scale (A3): H=1/2,500, V=1/200



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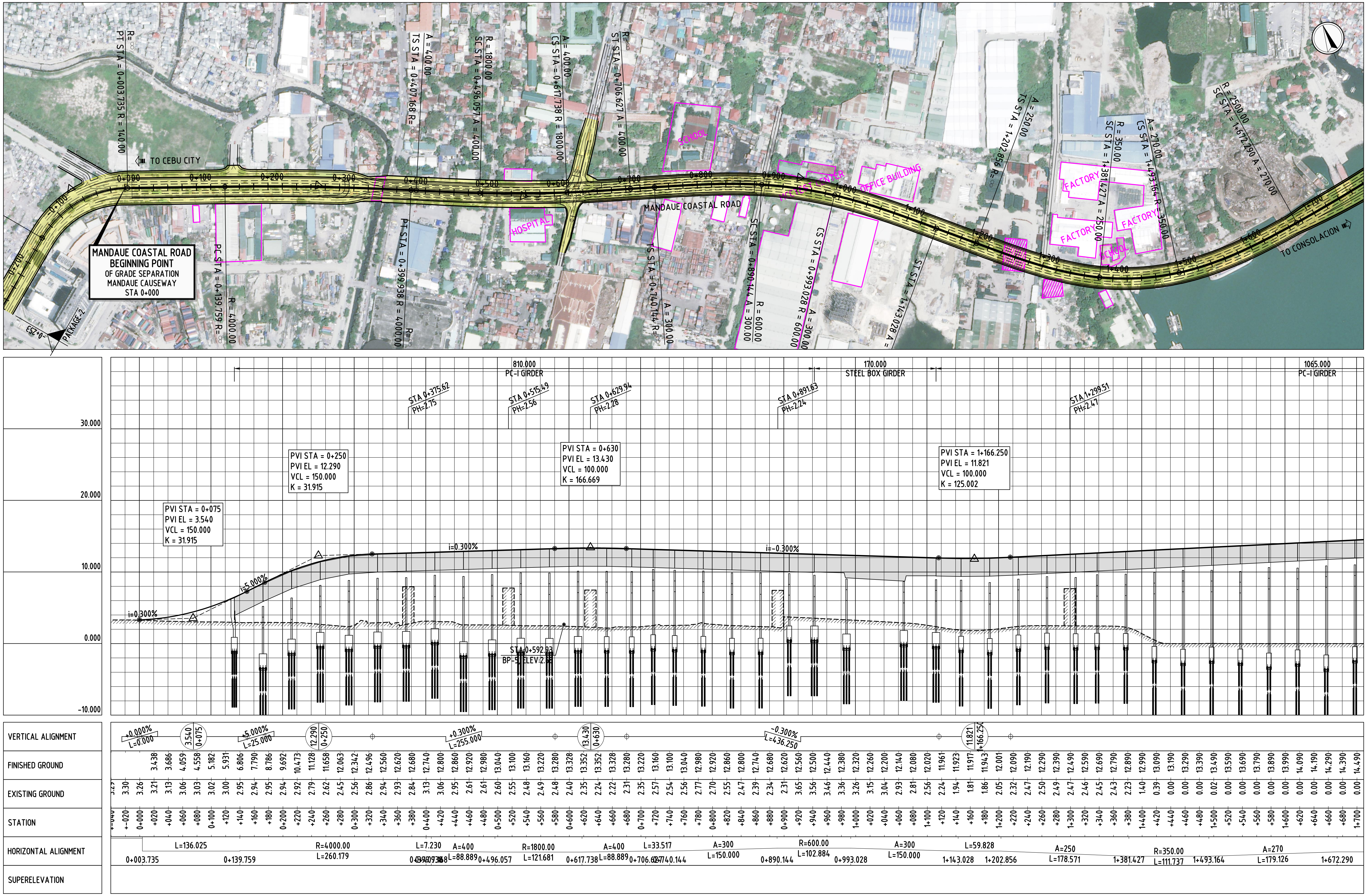
Almec Corporation

Drawing No. 10

PLAN AND PROFILE
4th CEBU-MACTAN BRIDGE STA 1+600 - XXX

Scale (A3): H=1/2,500, V=1/200



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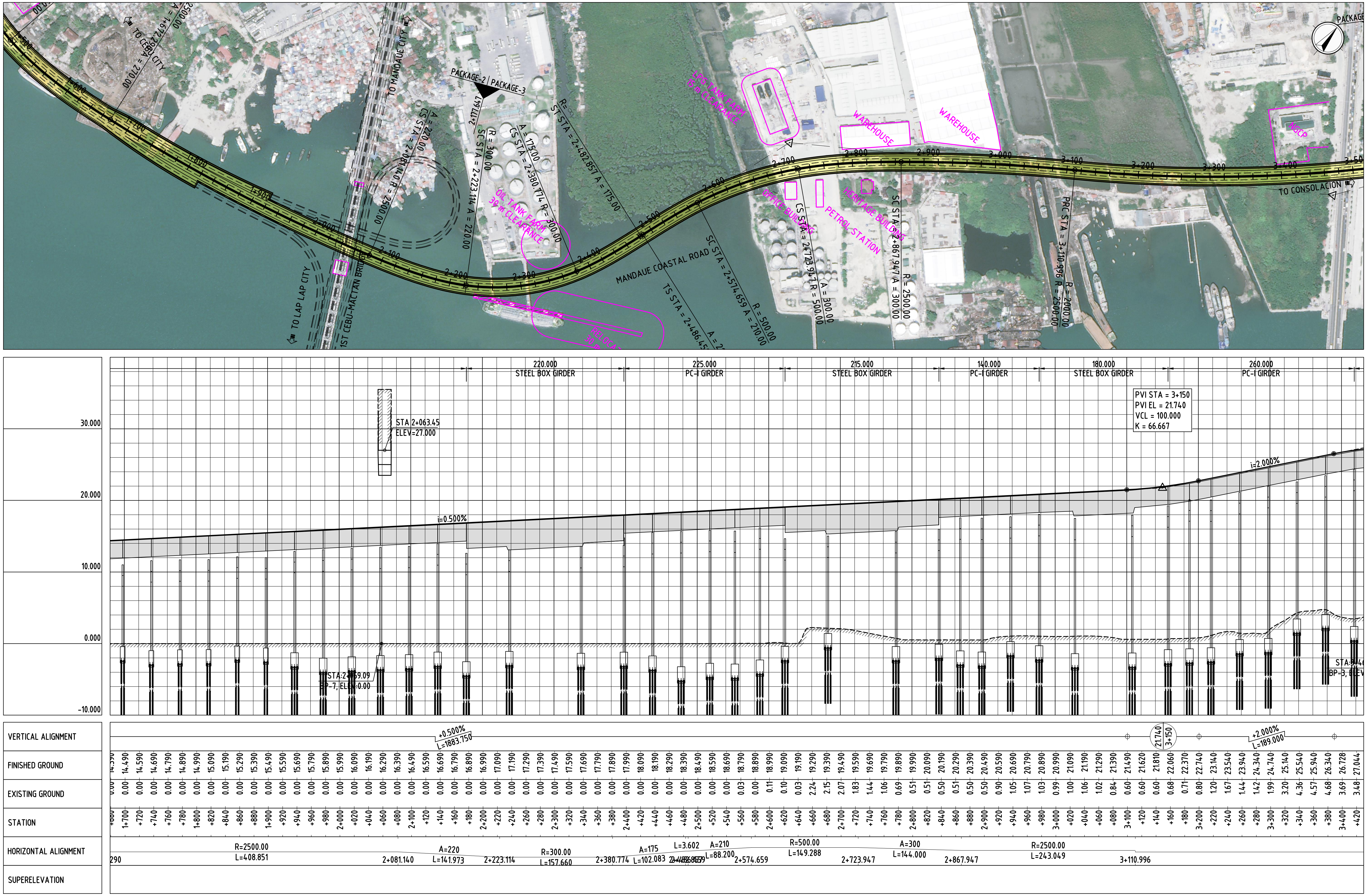
Drawing No. 10

PLAN AND PROFILE

MANDAUE COASTAL ROAD STA 0+000 - 1+600

Scale (A3): H=1/2,500, V=1/200



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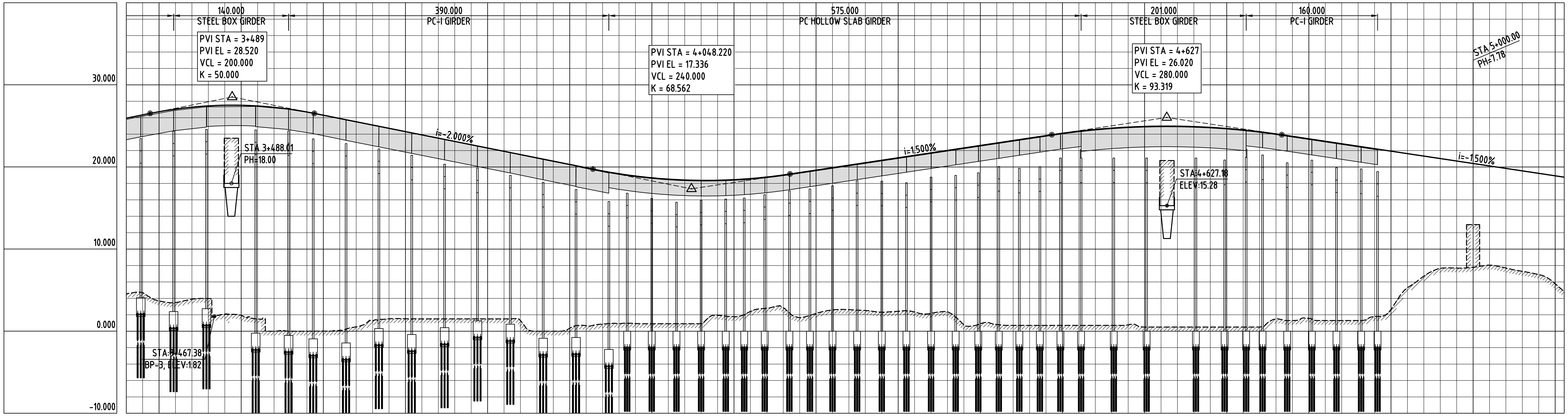
Almec Corporation

Drawing No. 10

PLAN AND PROFILE
MANDAUE COASTAL ROAD STA 1+600 - 3+200

Scale (A3): H=1/2,500, V=1/200



VERTICAL ALIGNMENT: 28.520 / 3+489; −2.000% L=339.220; 17.336 / 4+048.22; +1.500% L=318.780; 26.020 / 4+627; −1.500% L=473.000

STATION	FINISHED GROUND	EXISTING GROUND
+360	25.940	4.57
+380	26.340	4.68
3+400	26.728	3.69
+420	27.044	3.48
+440	27.280	3.89
+460	27.436	3.98
+480	27.512	2.07
3+500	27.508	1.93
+520	27.424	1.48
+540	27.260	0.00
+560	27.016	0.00
+580	26.692	0.00
3+600	26.300	0.01
+620	25.900	0.11
+640	25.500	0.53
+660	25.100	1.26
+680	24.700	1.51
3+700	24.300	1.52
+720	23.900	1.50
+740	23.500	1.50
+760	23.100	1.50
+780	22.700	1.50
3+800	22.300	1.50
+820	21.900	1.50
+840	21.500	1.28
+860	21.100	0.00
+880	20.700	0.00
3+900	20.300	0.36
+920	19.900	0.67
+940	19.510	0.86
+960	19.174	0.91
+980	18.896	0.93
4+000	18.676	0.90
+020	18.514	0.90
+040	18.411	0.90
+060	18.366	0.92
+080	18.380	1.95
4+100	18.452	1.77
+120	18.582	2.41
+140	18.771	2.80
+160	19.018	2.85
+180	19.313	1.66
4+200	19.613	2.16
+220	19.913	2.59
+240	20.213	2.62
+260	20.513	2.52
+280	20.813	2.31
4+300	21.113	2.43
+320	21.414	2.33
+340	21.714	2.17
+360	22.014	2.35
+380	22.314	0.77
4+400	22.614	0.91
+420	22.914	0.81
+440	23.214	0.70
+460	23.514	0.70
+480	23.814	0.70
4+500	24.105	0.70
+520	24.356	0.70
+540	24.564	0.70
+560	24.729	0.70
+580	24.851	0.78
4+600	24.931	0.50
+620	24.967	0.50
+640	24.961	0.50
+660	24.912	0.50
+680	24.819	0.50
4+700	24.684	0.50
+720	24.507	0.50
+740	24.286	0.50
+760	24.022	1.50
+780	23.725	1.30
4+800	23.425	1.56
+820	23.125	1.30
+840	22.825	1.30
+860	22.525	1.30
+880	22.225	1.80
4+900	21.925	2.65
+920	21.625	5.27
+940	21.325	6.70
+960	21.025	7.64
+980	20.725	7.68
5+000	20.425	7.78
+020	20.125	8.04
+040	19.825	7.69
+060	19.525	7.29
+080	19.225	6.89
5+100	18.925	5.78

HORIZONTAL ALIGNMENT: R=2000.00 L=716.828; 3+827.824; L=115.161; 3+942.985; R=2500.00 L=1178.291; 5+

SUPERELEVATION

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Nippon Koei Co., Ltd.
Almec Corporation

Drawing No. 10

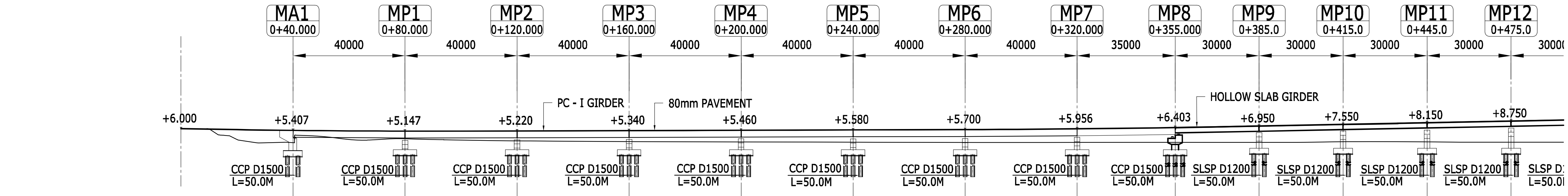
PLAN AND PROFILE
MANDAUE COASTAL ROAD STA 3+200 - 4+800

Scale (A3): H=1/2,500, V=1/200

TO MANDAUE CITY

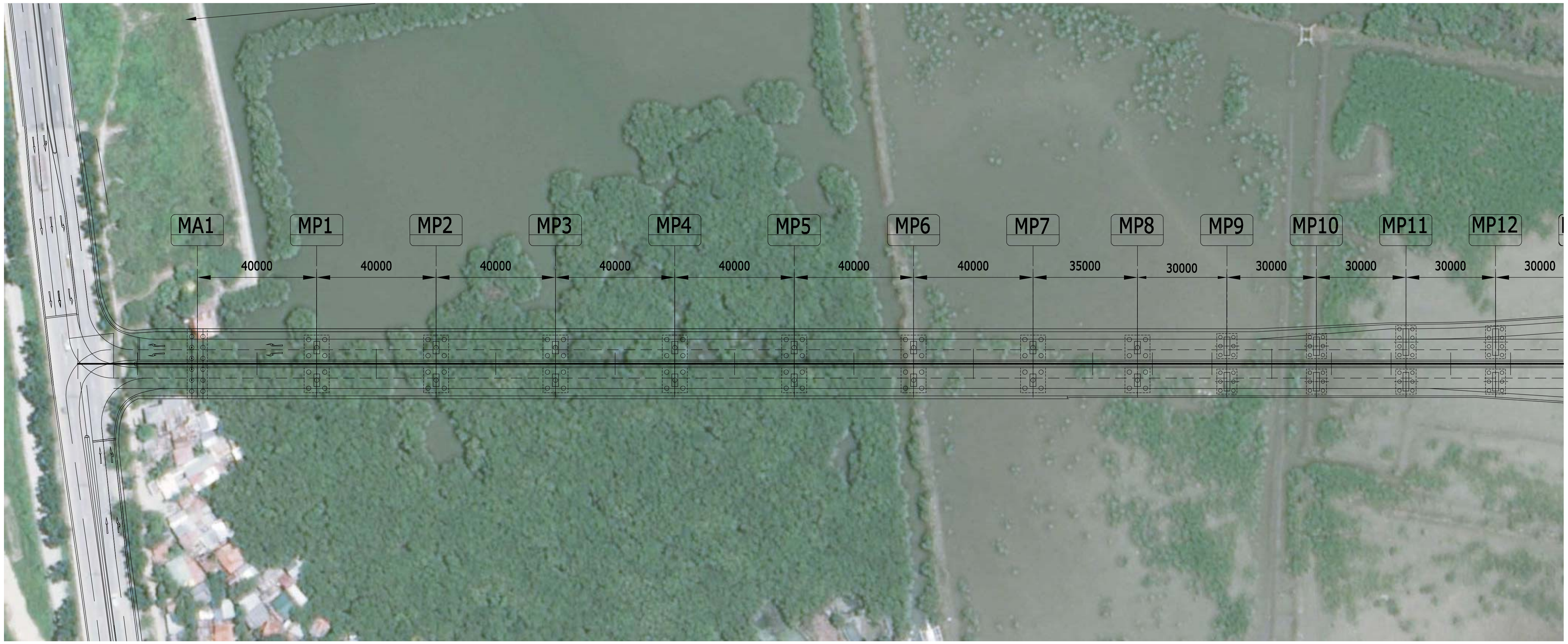
TO LAPU LAPU CITY

ELEVATION S=1:1500



FINISHED HEIGHT	+6.000	+5.407	+5.147	+5.220	+5.340	+5.460	+5.580	+5.700	+5.956	+6.403	+6.950	+7.550	+8.150	+8.750
EXISTING GROUND	+5.990	+1.006	+2.381	+1.654	+1.414	+1.291	+1.201	+1.027	+1.080	+1.153	+1.124	+1.357	+1.322	+1.197
HORIZONTAL														
VERTICAL ALIGNMENT	-2.000% L=20.000		5.040 0+060		+0.300% L=180.000				5.850 0+330					
CROSS SLOPE		-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	0+0.0	0+40.0	0+80.0	0+120.0	0+160.0	0+200.0	0+240.0	0+280.0	0+320.0	0+355.0	0+385.0	0+415.0	0+445.0	0+475.0

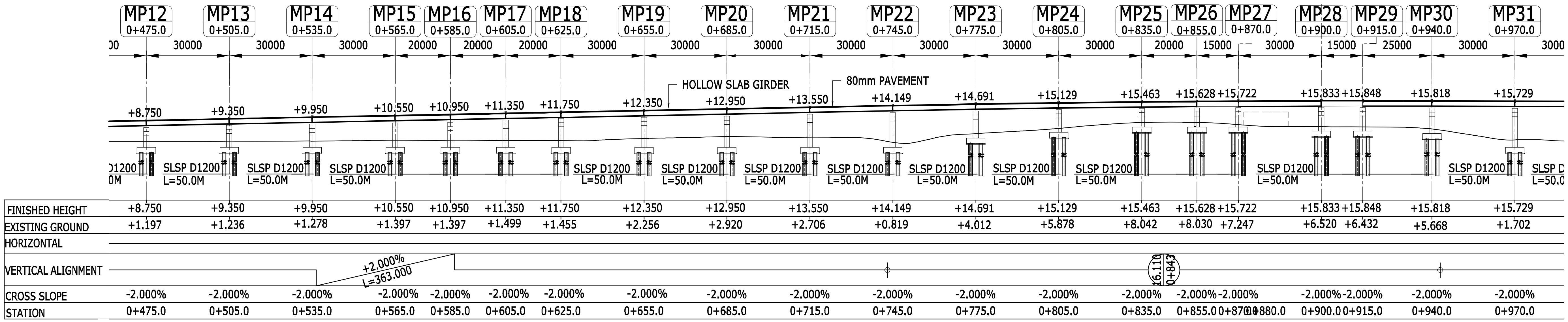
PLAN S=1:1500



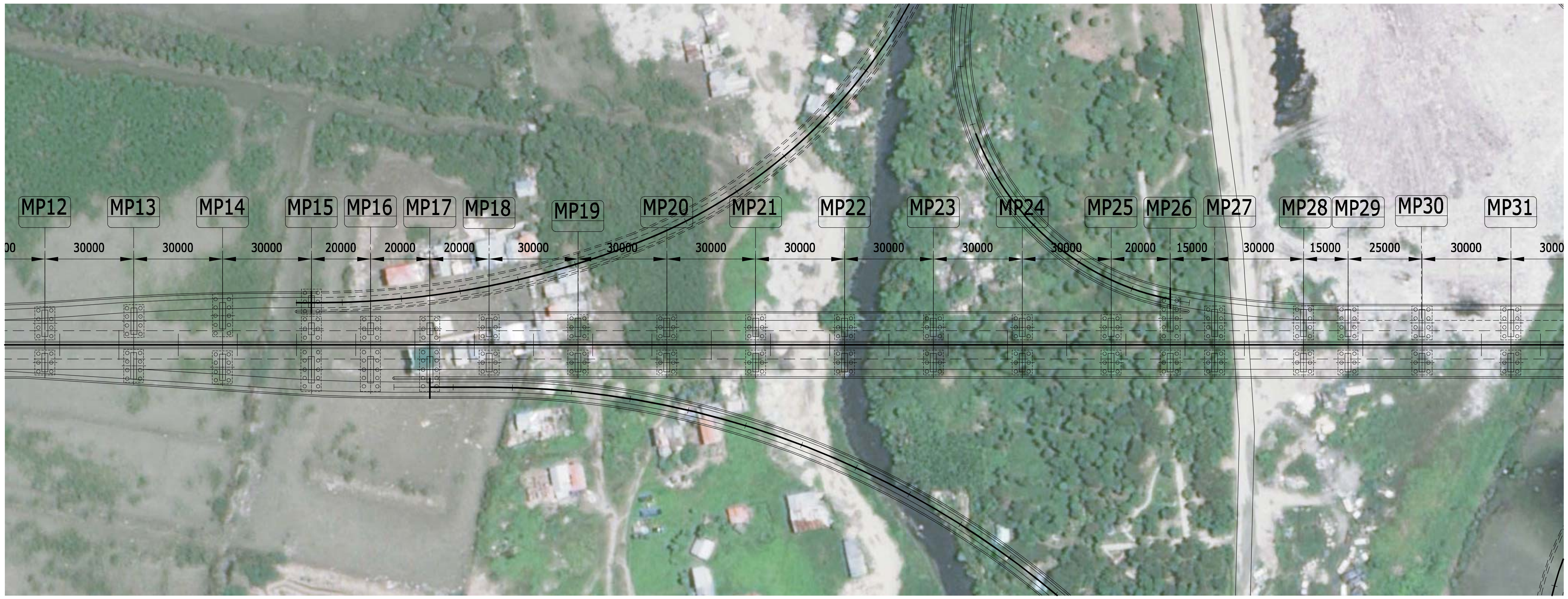
TO MANDAUE CITY

TO LAPU LAPU CITY

ELEVATION S=1:1500



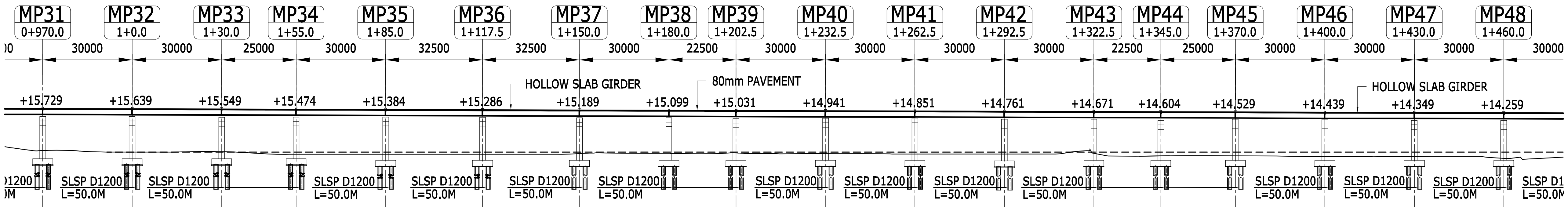
PLAN S=1:1500



TO MANDAUE CITY

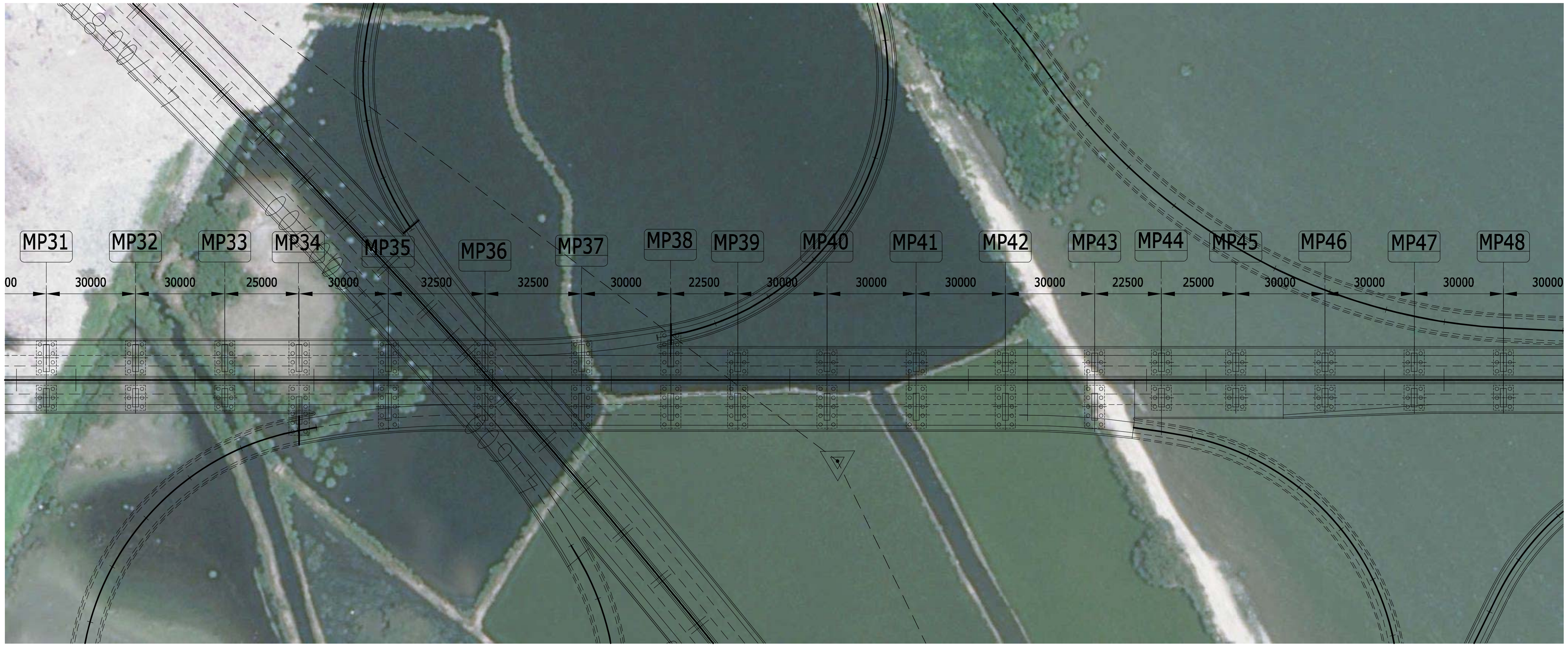
TO LAPU LAPU CITY

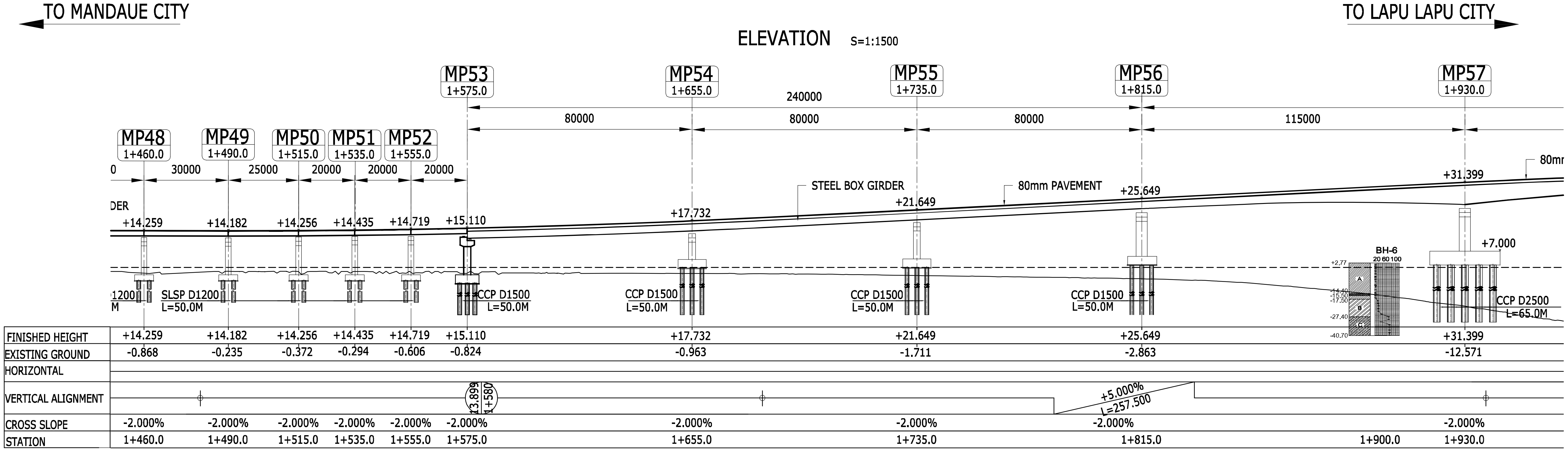
ELEVATION S=1:1500



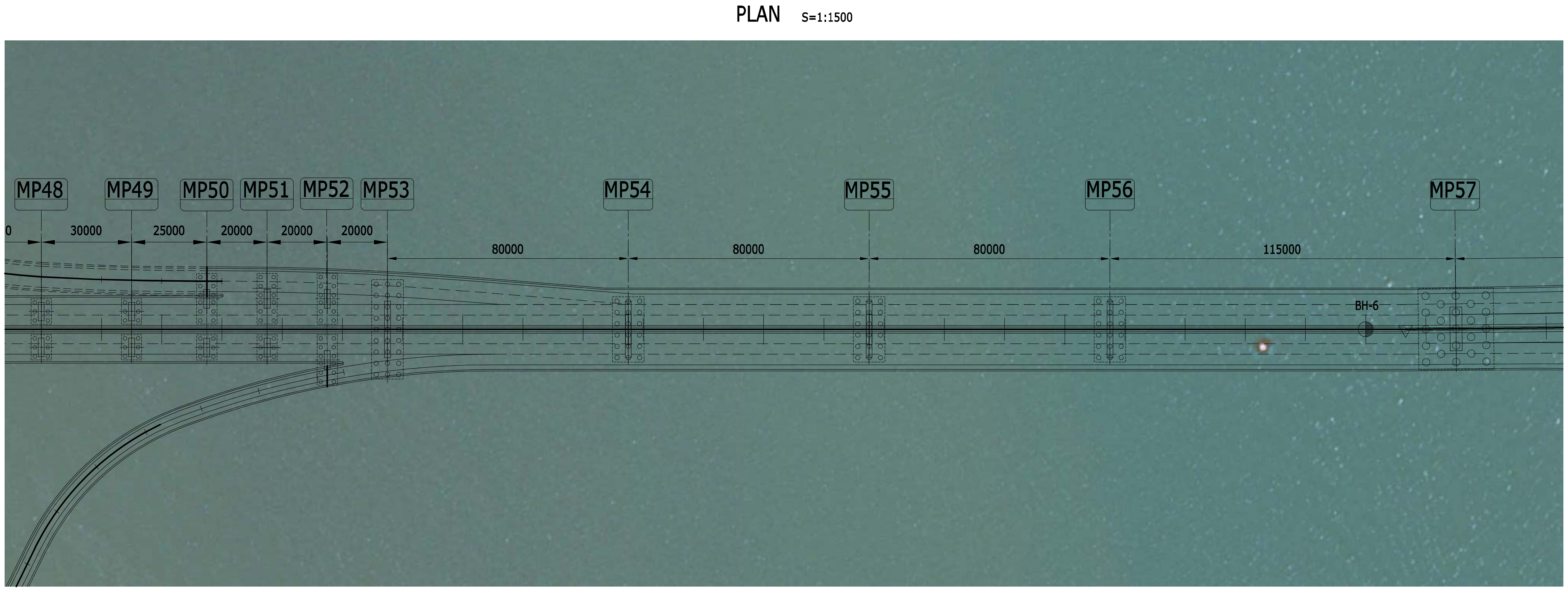
FINISHED HEIGHT	+15.729	+15.639	+15.549	+15.474	+15.384	+15.286	+15.189	+15.099	+15.031	+14.941	+14.851	+14.761	+14.671	+14.604	+14.529	+14.439	+14.349	+14.259
EXISTING GROUND	+1.702	+1.197	+1.347	+0.497	+0.497	+0.497	+0.718	+0.801	+0.945	+0.719	+0.597	+0.597	+0.809	-0.073	-0.075	-0.310	-0.288	-0.868
HORIZONTAL																		
VERTICAL ALIGNMENT									-0.300% L=537.000									
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	0+970.0	1+0.0	1+30.0	1+55.0	1+85.0	1+117.5	1+150.0	1+180.0	1+202.5	1+232.5	1+262.5	1+292.5	1+322.5	1+345.0	1+370.0	1+400.0	1+430.0	1+460.0

PLAN S=1:1500





FINISHED HEIGHT	+14.259	+14.182	+14.256	+14.435	+14.719	+15.110	+17.732	+21.649	+25.649		+31.399
EXISTING GROUND	-0.868	-0.235	-0.372	-0.294	-0.606	-0.824	-0.963	-1.711	-2.863		-12.571
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%		-2.000%
STATION	1+460.0	1+490.0	1+515.0	1+535.0	1+555.0	1+575.0	1+655.0	1+735.0	1+815.0	1+900.0	1+930.0



PREPARATORY SURVEY FOR NEW MACTAN BRIDGE CONSTRUCTION PROJECT IN THE REPUBLIC OF THE PHILIPPINES
Japan International Cooperation Agency
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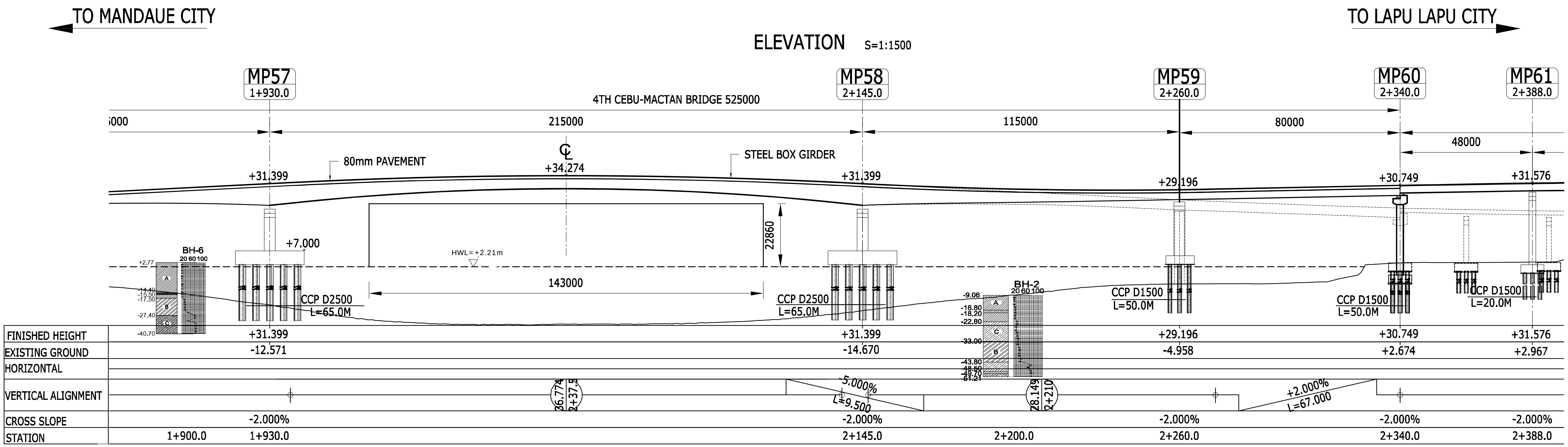
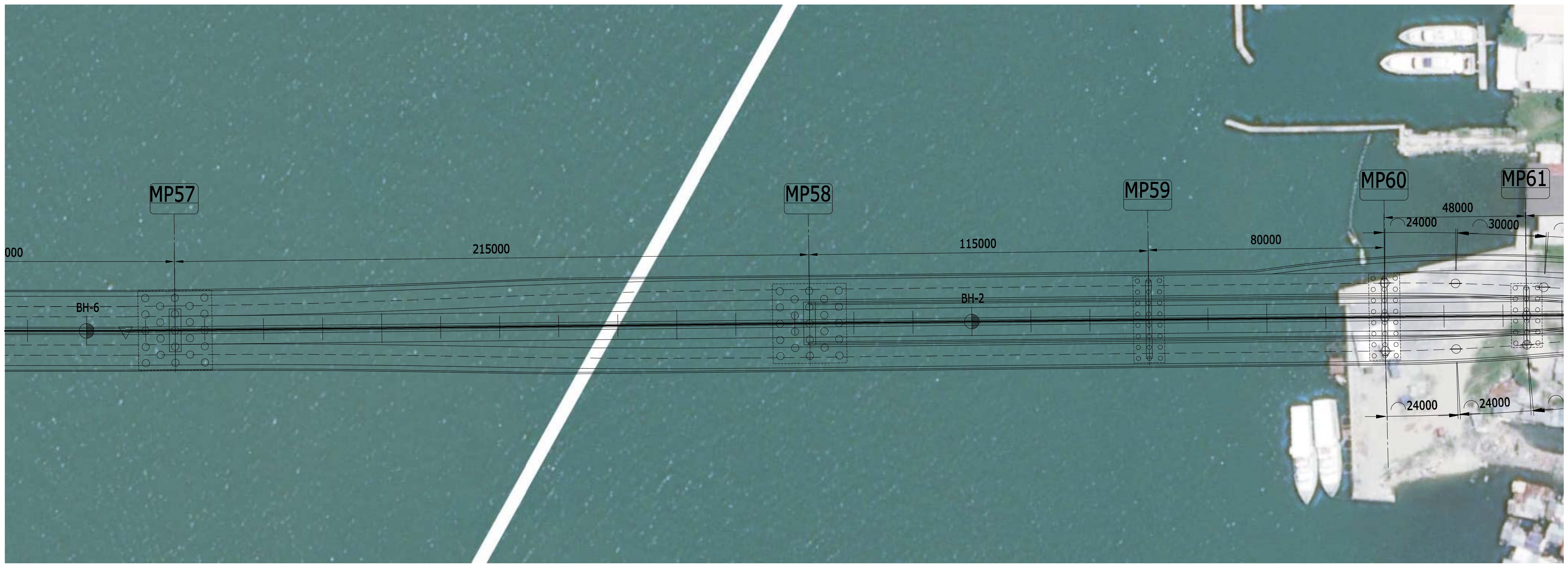
Chodai Co., Ltd.
Nippon Koei Co., Ltd.
Almec Corporation

ELEVATION S=1:1500



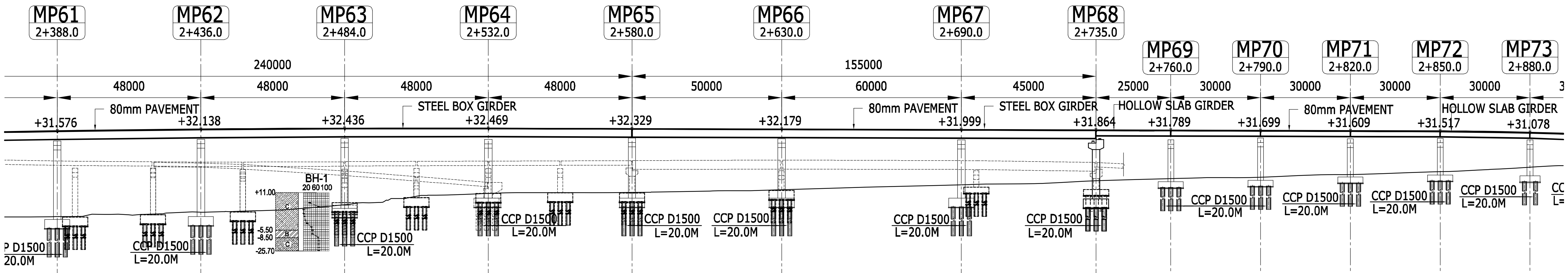
PLAN S=1:1500



TO MANDAUE CITY

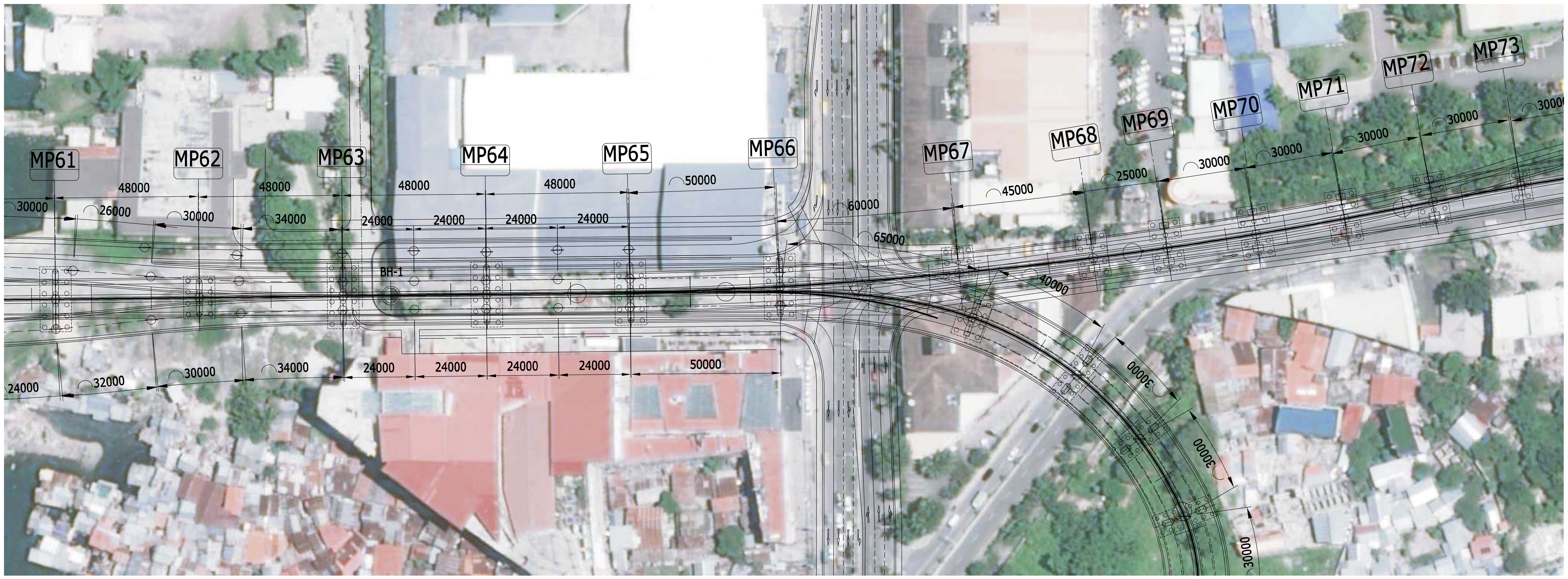
TO LAPU LAPU CITY

ELEVATION S=1:1500



FINISHED HEIGHT	+31.576	+32.138	+32.436	+32.469	+32.329	+32.179	+31.999	+31.864	+31.789	+31.699	+31.609	+31.517	+31.078
EXISTING GROUND	+2.967	+4.445	+6.908	+10.702	+11.060	+11.940	+13.599	+14.997	+15.645	+16.121	+17.012	+17.965	+19.485
HORIZONTAL													
VERTICAL ALIGNMENT		32.749 2+440					-0.300% L=308.615						31.403
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	2+388.0	2+436.0	2+484.0 2+500.0	2+532.0	2+580.0	2+630.0	2+690.0	2+735.0	2+760.0	2+790.0	2+820.0	2+850.0	2+880.0

PLAN S=1:1500



PREPARATORY SURVEY FOR NEW MACTAN BRIDGE CONSTRUCTION PROJECT IN THE REPUBLIC OF THE PHILIPPINES

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Oriental Consultants Global Co., Ltd.
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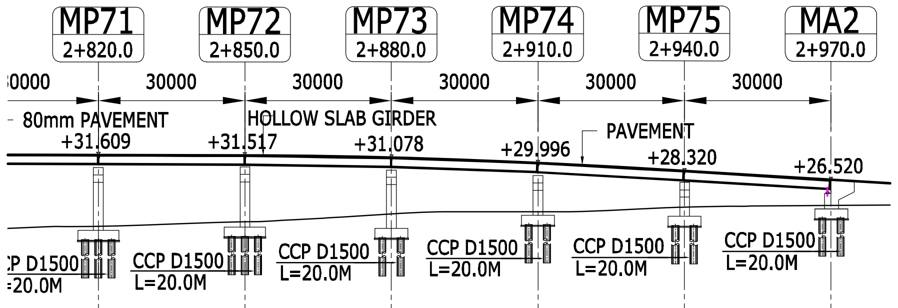
Almec Corporation

TO MANDAUE CITY

TO LAPU LAPU CITY

ELEVATION S=1:1500



FINISHED HEIGHT	+31.609	+31.517	+31.078	+29.996	+28.320	+26.520
EXISTING GROUND	+17.012	+17.965	+19.485	+19.997	+20.933	+21.277
HORIZONTAL						
VERTICAL ALIGNMENT			31.403 2+888.615			-6.000% L=91.385
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	2+820.0	2+850.0	2+880.0	2+910.0	2+940.0	2+970.0

PLAN S=1:1500

LEGEND:

LAYER A:
Very soft to medium stiff, dark gray/brown, stiff CLAY, with traces of sand and shell fragments.

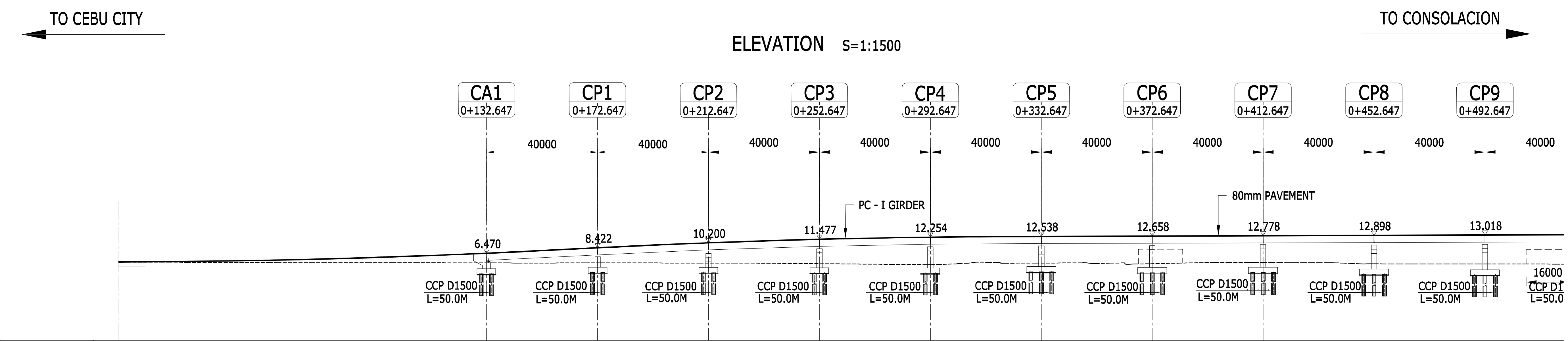
LAYER B:
Stiff to hard, dark gray, CLAY, with little amount of limestone fragments.

LAYER C:
Loose to very dense, brown/gray, sand-sized LIMESTONE fragments, with some clay.

LAYER D:
vVery loose, dark gray, clayey SAND, medium plastic, with traces of shell fragments.

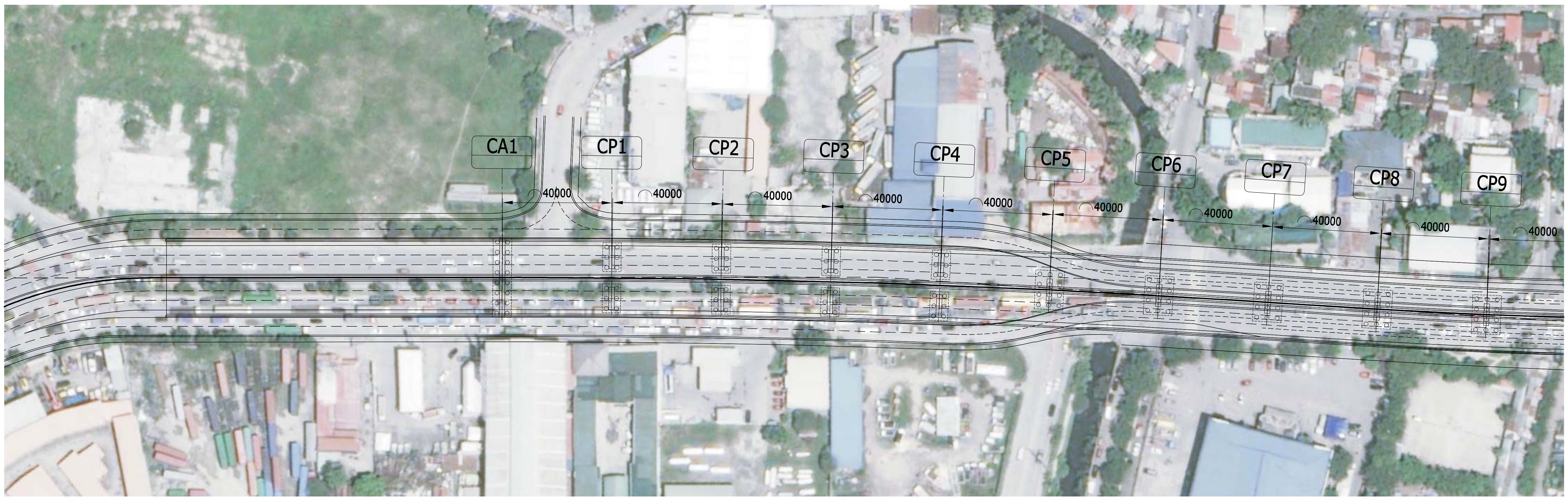
LAYER E:
Very dense, gray, SAND and GRAVEL mixture, with clay.

ELEVATION S=1:1500



		CA1	CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8	CP9
FINISHED HEIGHT		6.470	8.422	10.200	11.477	12.254	12.538	12.658	12.778	12.898	13.018
EXISTING GROUND		2.977	2.959	2.925	2.684	2.351	2.914	2.684	3.120	2.631	2.598
HORIZONTAL	L=136.025				R=4000.00 L=260.179				L=7.230	A=400 L=88.889	
VERTICAL	3.540 0+075		+5.000% L=25.000		12.290 0+250					+0.300% L=255.000	
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
CHAINAGE	0.000	0+132.647	0+172.647	0+212.647	0+252.647	0+292.647	0+332.647	0+372.647	0+412.647	0+452.647	0+492.647

PLAN S=1:1500



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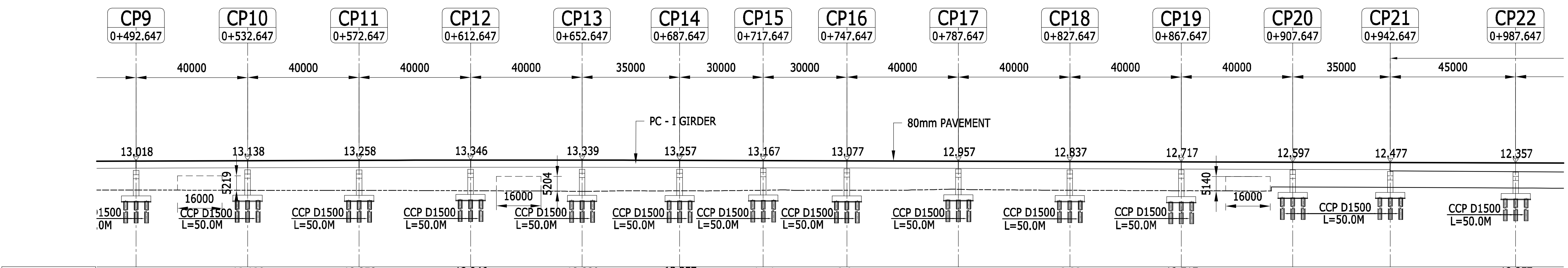
Almec Corporation

TO CEBU CITY

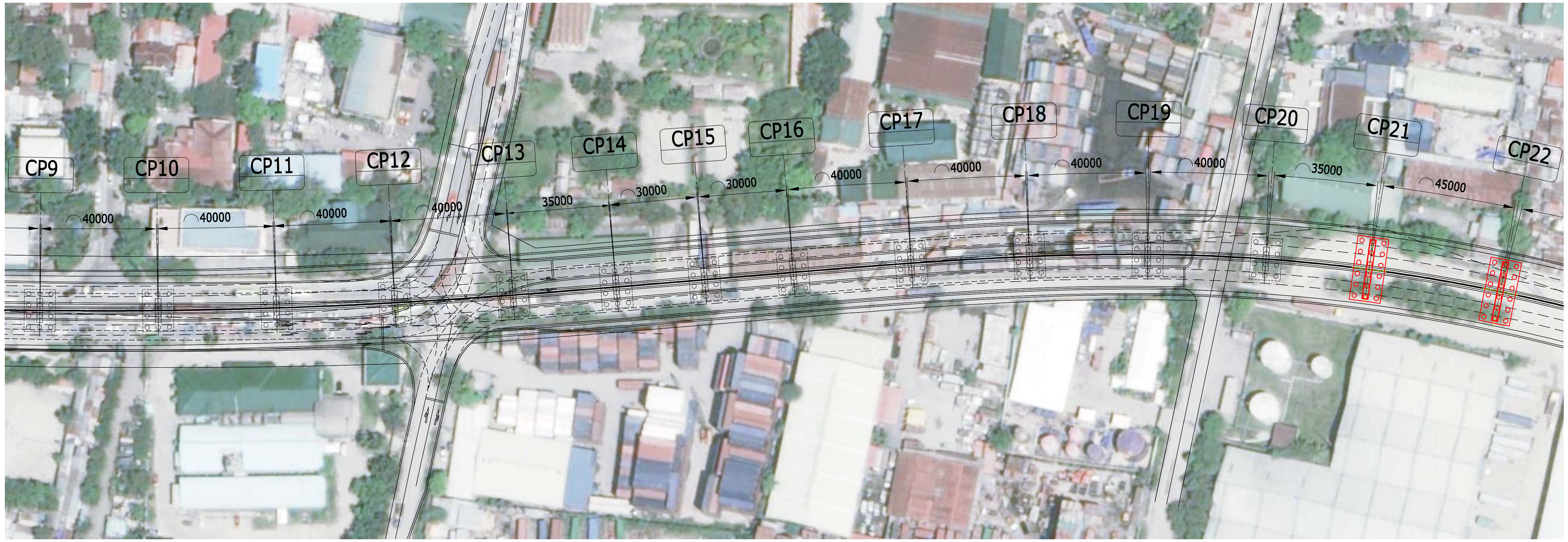
TO CONSOLACION

ELEVATION S=1:1500



FINISHED HEIGHT	13.018	13.138	13.258	13.346	13.339	13.257	13.167	13.077	12.957	12.837	12.717	12.597	12.477	12.357
EXISTING GROUND	2.598	2.518	2.496	2.366	2.168	2.326	2.528	2.538	2.865	2.520	2.379	3.713	3.518	3.318
HORIZONTAL			R=1800.00 L=121.681		A=400 L=88.889		L=33.517			A=300 L=150.000			R=600.00 L=102.884	
VERTICAL				13.430 0+630						-0.300% L=436.250				
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	0+492.647	0+532.647	0+572.647	0+612.647	0+652.647	0+687.647	0+717.647	0+747.647	0+787.647	0+827.647	0+867.647	0+907.647	0+942.647	0+987.647

PLAN S=1:1500



PREPARATORY SURVEY FOR NEW MACTAN BRIDGE CONSTRUCTION PROJECT IN THE REPUBLIC OF THE PHILIPPINES

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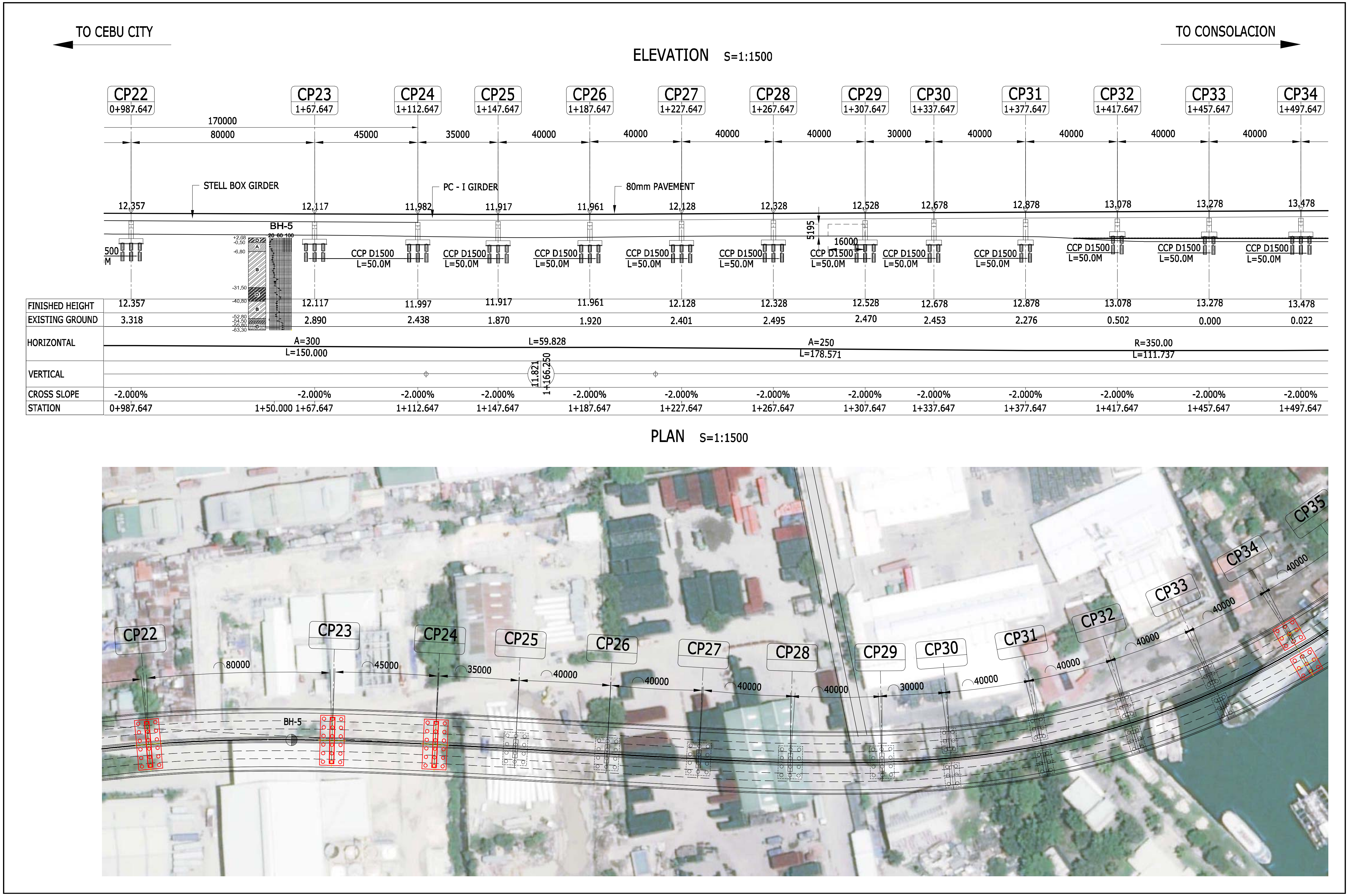

PREPARATORY SURVEY FOR NEW MACTAN BRIDGE CONSTRUCTION PROJECT IN THE REPUBLIC OF THE PHILIPPINES

Japan International Cooperation Agency

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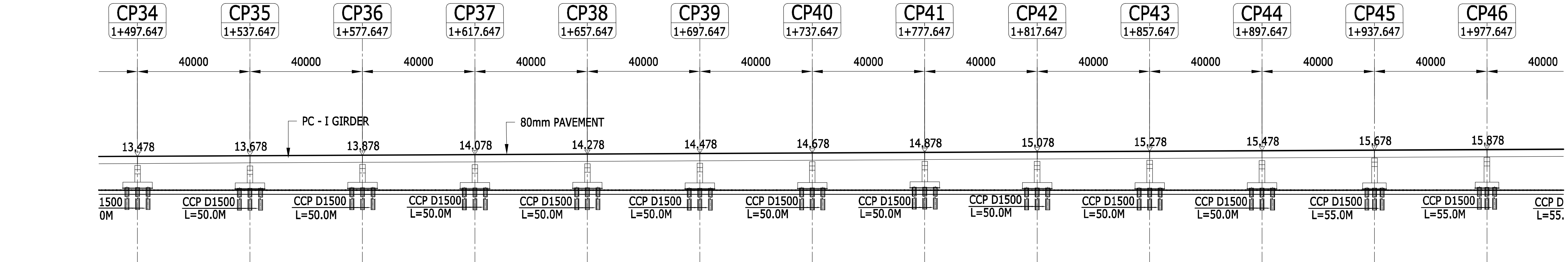
Nippon Koei Co., Ltd.
Almec Corporation

TO CEBU CITY

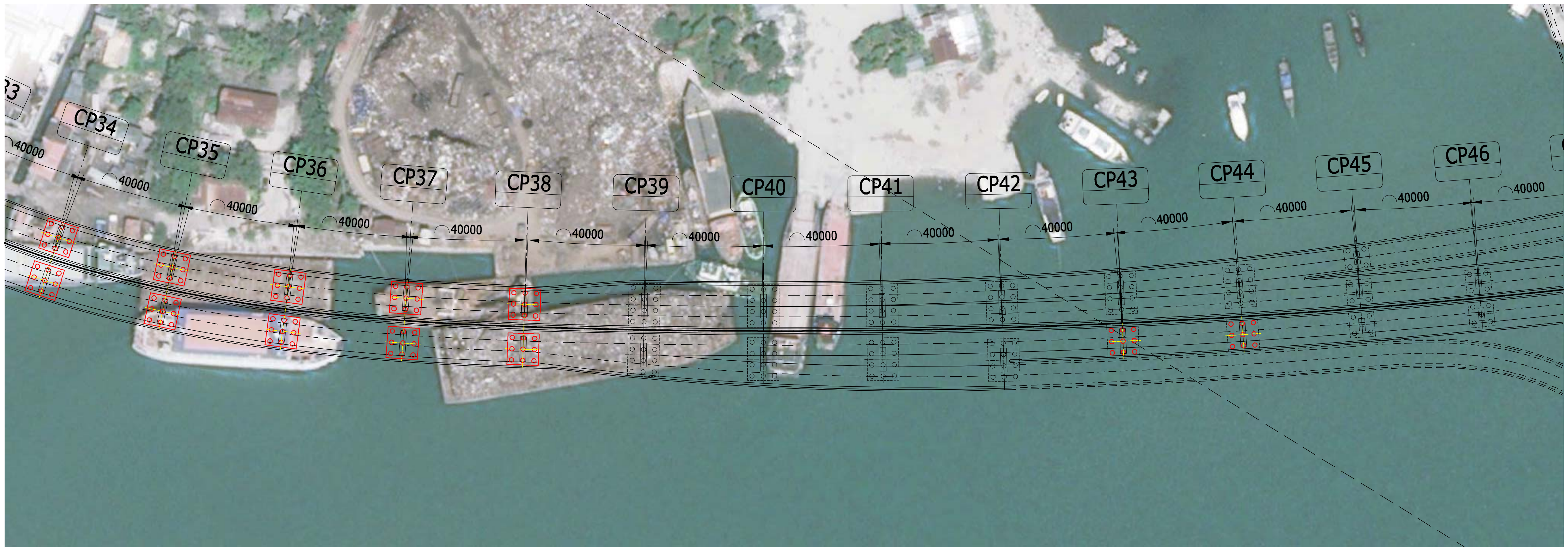
TO CONSOLACION

ELEVATION S=1:1500



	CP34	CP35	CP36	CP37	CP38	CP39	CP40	CP41	CP42	CP43	CP44	CP45	CP46
FINISHED HEIGHT	13.478	13.678	13.878	14.078	14.278	14.478	14.678	14.878	15.078	15.278	15.478	15.678	15.878
EXISTING GROUND	0.022	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HORIZONTAL			A=270 L=179.126								R=2500.00 L=408.851		
VERTICAL													
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	1+497.647	1+537.647	1+577.647	1+617.647	1+657.647	1+697.647	1+737.647	1+777.647	1+817.647	1+857.647	1+897.647	1+937.647	1+977.647

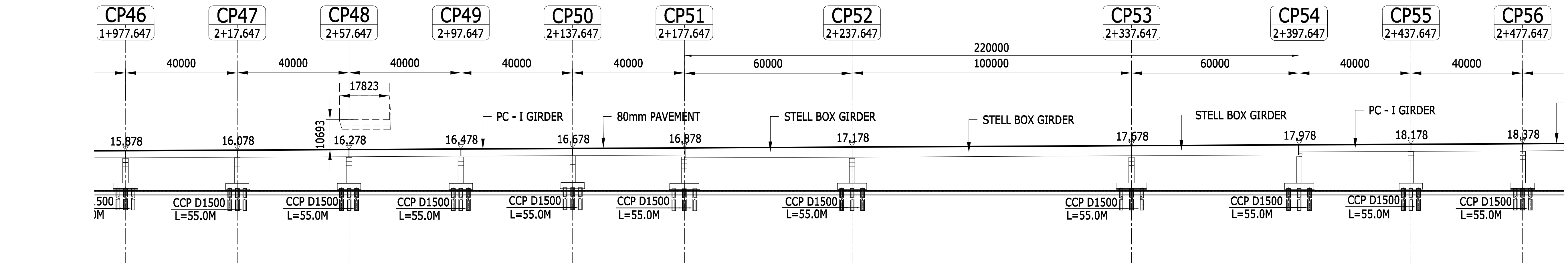
PLAN S=1:1500



TO CEBU CITY

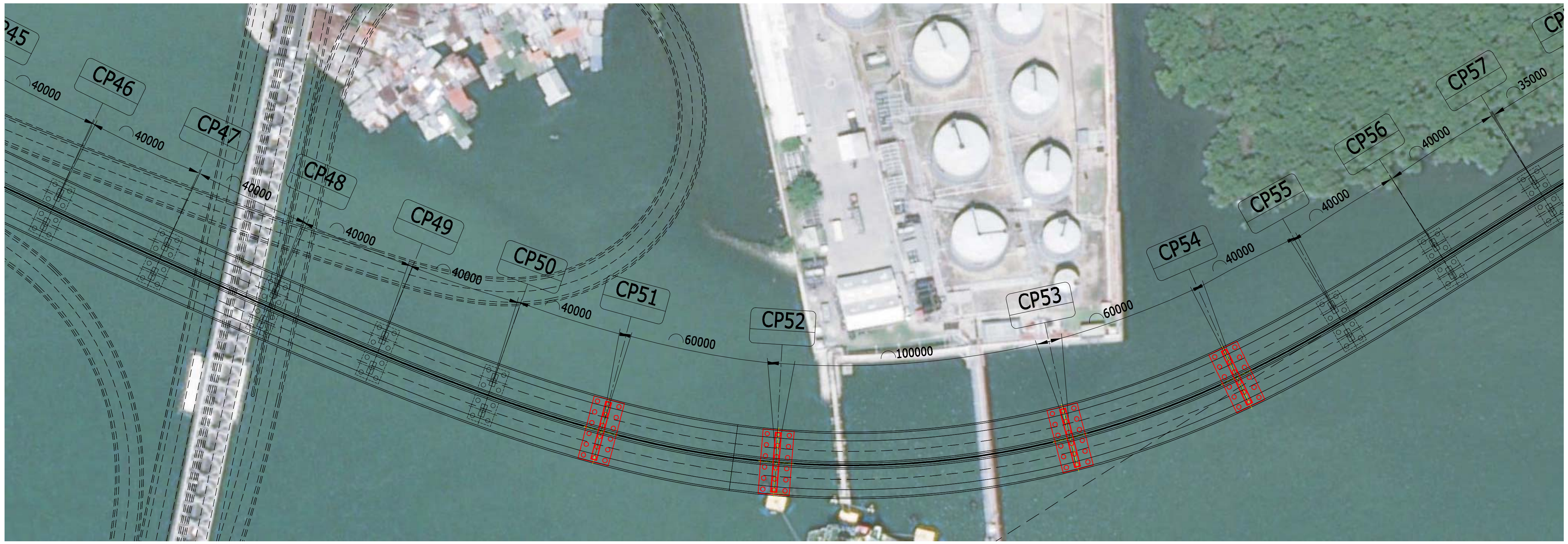
TO CONSOLACION

ELEVATION S=1:1500



	CP46	CP47	CP48	CP49	CP50	CP51	CP52	CP53	CP54	CP55	CP56
FINISHED HEIGHT	15.878	16.078	16.278	16.478	16.678	16.878	17.178	17.678	17.978	18.178	18.378
EXISTING GROUND	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HORIZONTAL	A=220 L=141.973						R=300.00 L=157.660		A=175 L=102.083		L=3.602
VERTICAL	+0.500% L=1883.750										
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	1+977.647	2+17.647	2+57.647	2+97.647	2+137.647	2+177.647	2+237.647	2+337.647	2+397.647	2+437.647	2+477.647

PLAN S=1:1500



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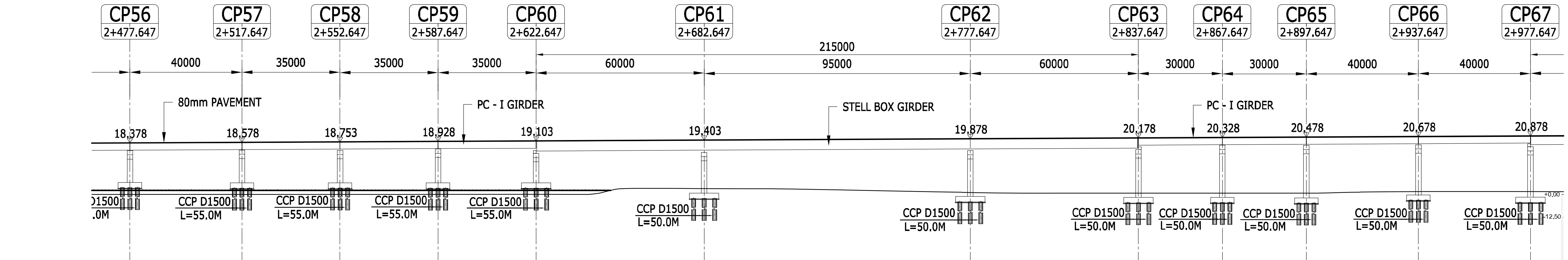
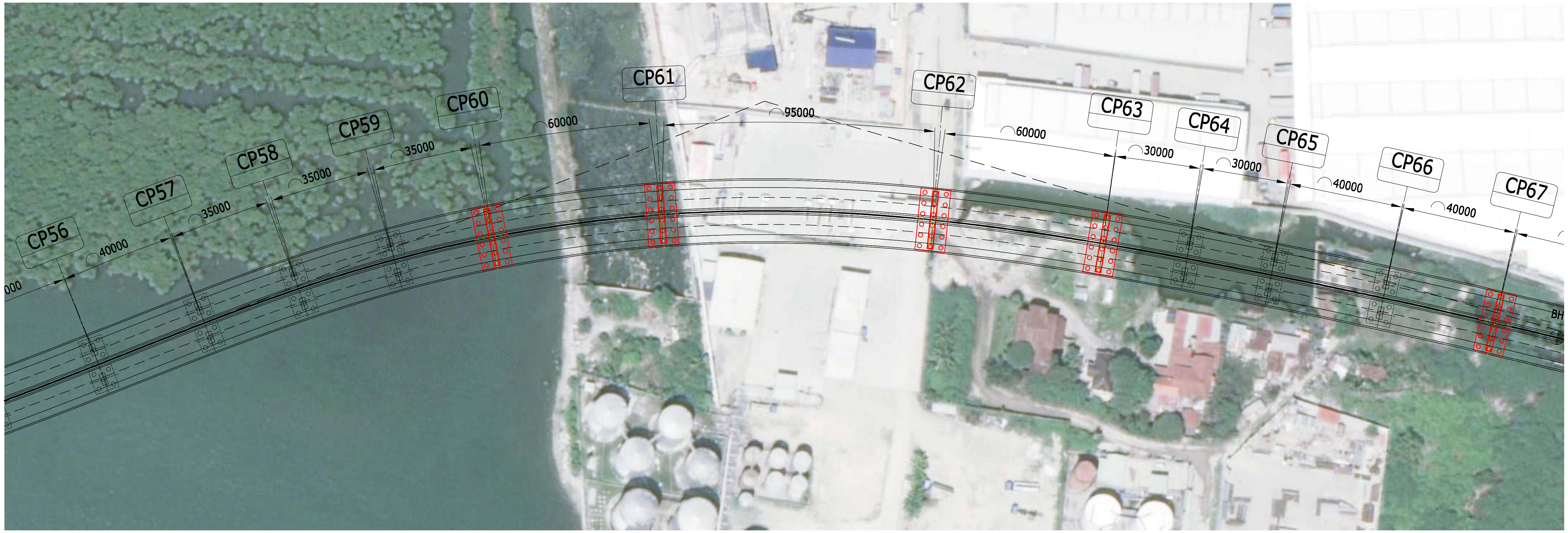
TO CONSOLACION

ELEVATION S=1:1500



	CP56	CP57	CP58	CP59	CP60	CP61	CP62	CP63	CP64	CP65	CP66	CP67
FINISHED HEIGHT	18.378	18.578	18.753	18.928	19.103	19.403	19.878	20.178	20.328	20.478	20.678	20.878
EXISTING GROUND	0.000	0.000	0.016	0.021	0.108	2.161	0.805	0.502	0.503	0.503	1.023	1.049
HORIZONTAL	L=3.602	A=210 L=88.200			R=500.00 L=149.288		A=300 L=144.000					R=2500.00 L=243.049
VERTICAL												
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	2+477.647	2+517.647	2+552.647	2+587.647	2+622.647	2+682.647	2+777.647	2+837.647	2+867.647	2+897.647	2+937.647	2+977.647

PLAN S=1:1500



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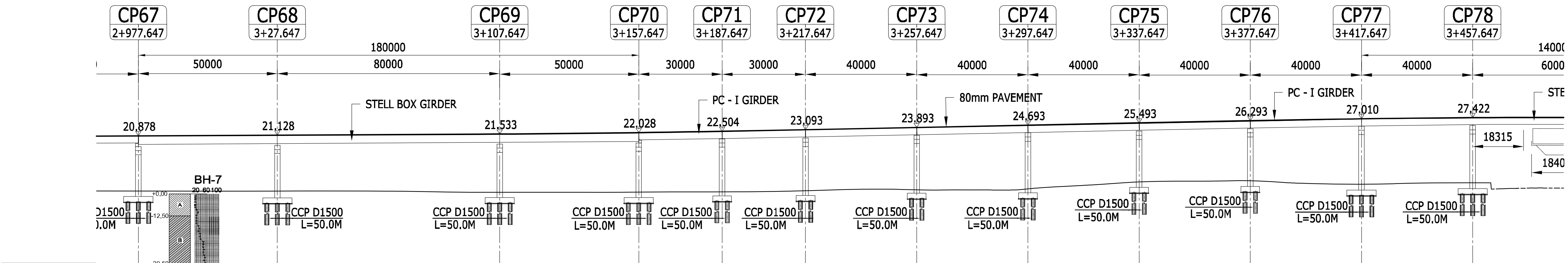
TO CEBU CITY

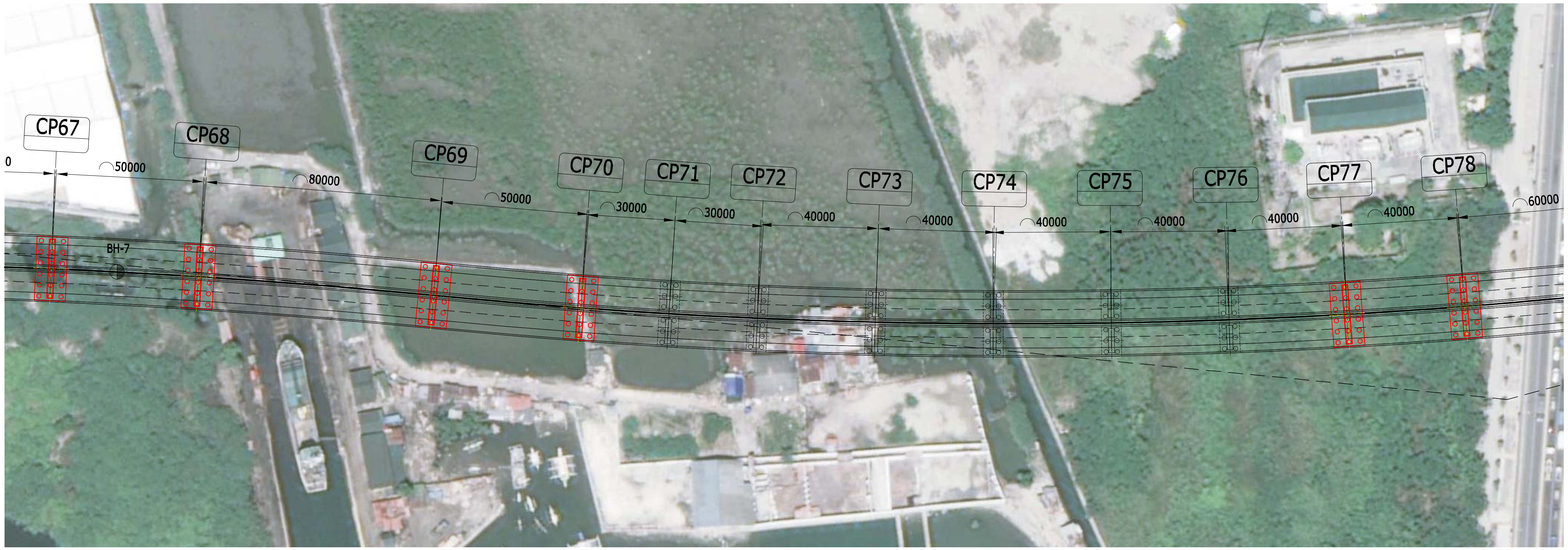
TO CONSOLACION

ELEVATION S=1:1500



	CP67		CP68	CP69	CP70	CP71	CP72	CP73	CP74	CP75	CP76	CP77	CP78
FINISHED HEIGHT	20.878		21.128	21.533	21.028	22.504	23.093	23.893	24.693	25.493	26.293	26.010	27.422
EXISTING GROUND	1.049		1.017	0.602	0.605	0.728	0.996	1.520	1.460	4.096	4.765	3.461	3.993
CROSS SLOPE	-2.000%		-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	2+977.647	3+0.000	3+27.647	3+107.647	3+157.647	3+187.647	3+217.647	3+257.647	3+297.647	3+337.647	3+377.647	3+417.647	3+457.647

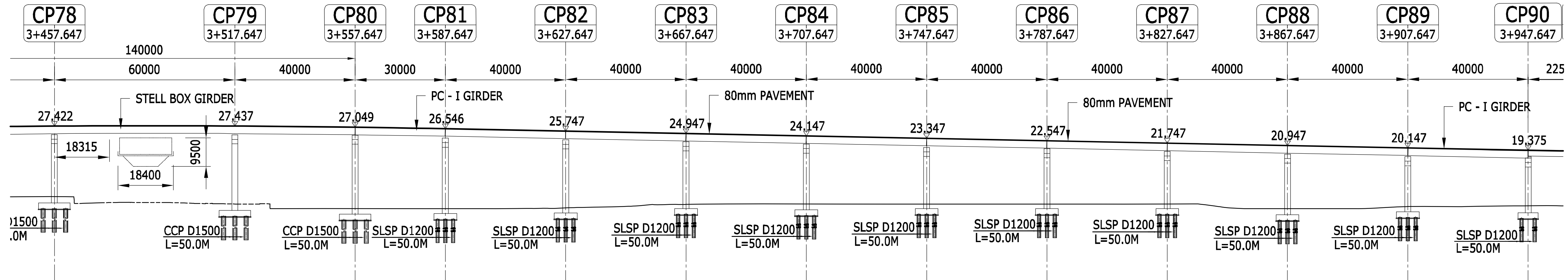
PLAN S=1:1500



TO CEBU CITY

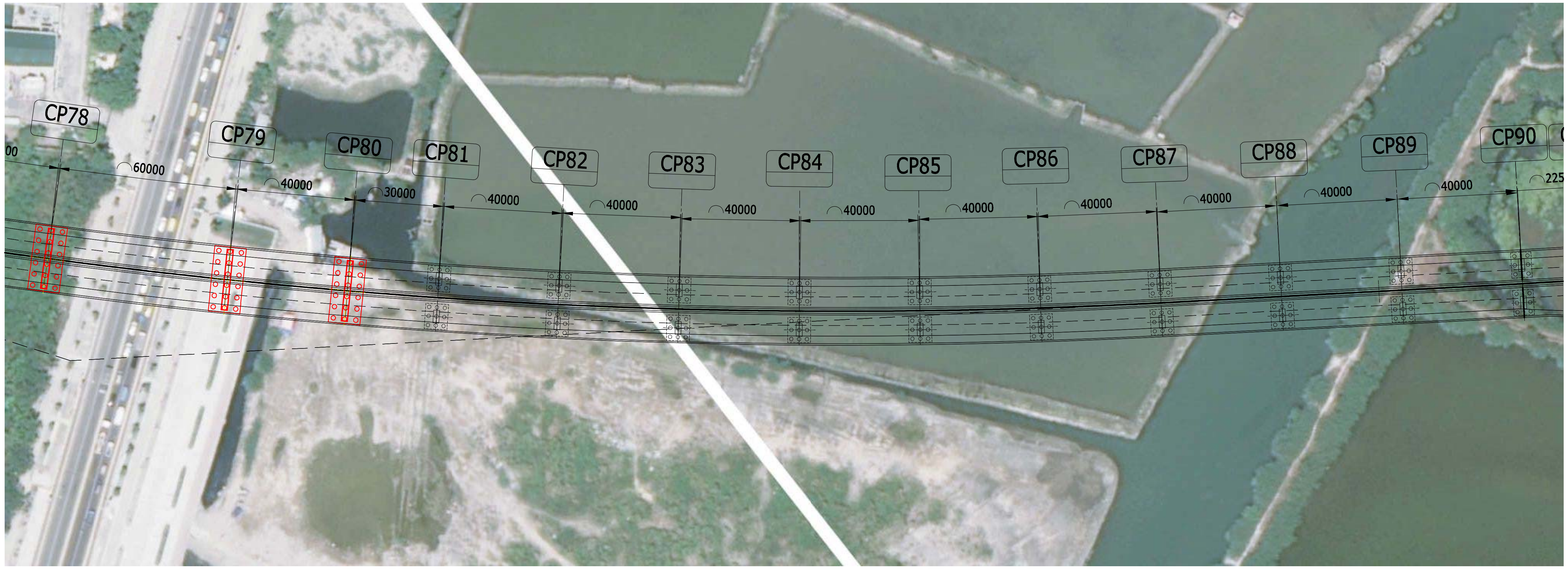
TO CONSOLACION

ELEVATION S=1:1500



FINISHED HEIGHT	27.422	27.437	27.049	26.546	25.747	25.947	24.147	23.347	22.547	21.747	21.947	20.147	19.375
EXISTING GROUND	3.993	1.567	0.037	0.003	0.093	1.386	1.507	1.502	1.502	1.502	0.000	0.564	0.926
HORIZONTAL	R=2000.00 L=716.828										L=115.161		
VERTICAL	28.520 3+489						-2.000% L=339.220						
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	3+457.647	3+517.647	3+557.647	3+587.647	3+627.647	3+667.647	3+707.647	3+747.647	3+787.647	3+827.647	3+867.647	3+907.647	3+947.647

PLAN S=1:1500



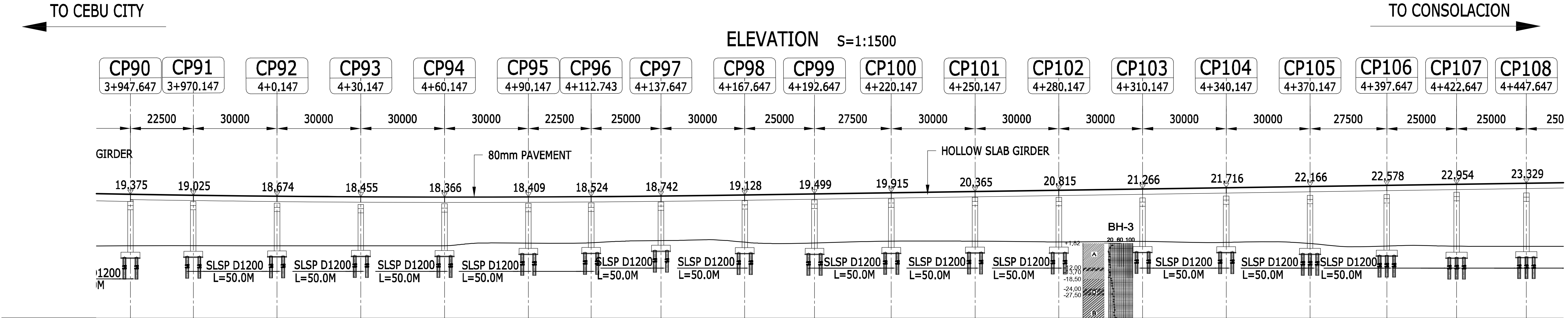
PREPARATORY SURVEY FOR NEW MACTAN BRIDGE CONSTRUCTION PROJECT IN THE REPUBLIC OF THE PHILIPPINES

Japan International Cooperation Agency
Oriental Consultants Global Co., Ltd.
Chodai Co., Ltd.
Nippon Koei Co., Ltd.
Almec Corporation

TO CEBU CITY

TO CONSOLACION

ELEVATION S=1:1500

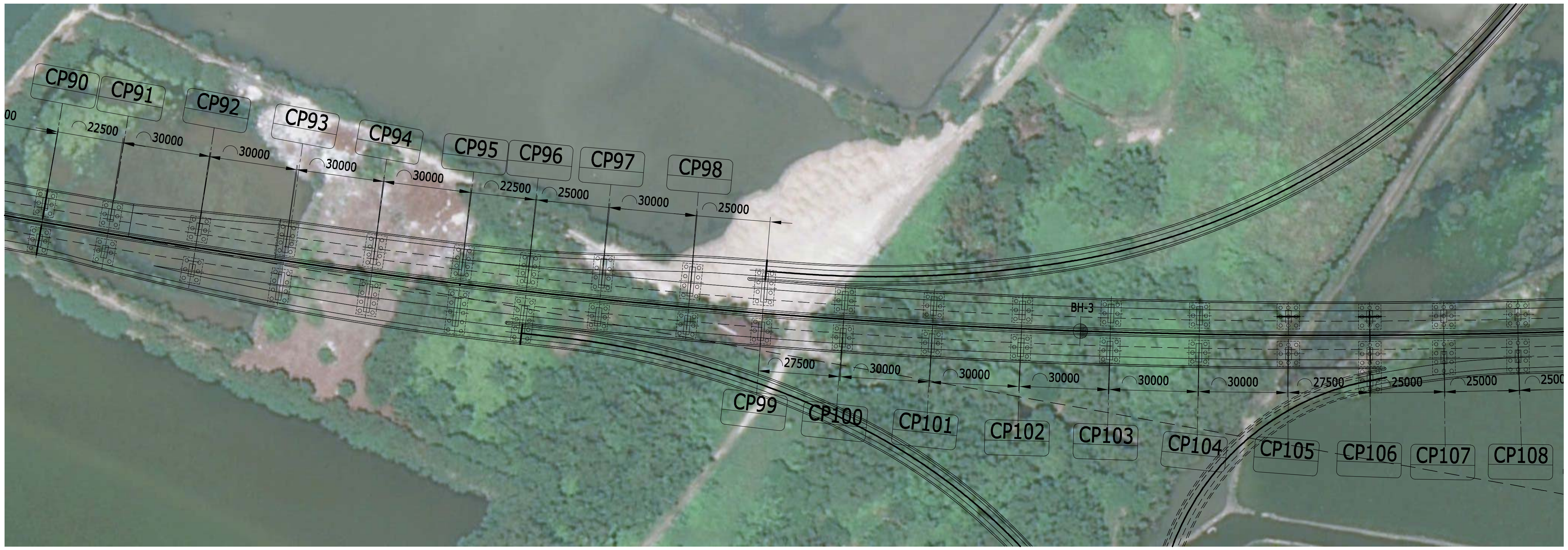


	FINISHED HEIGHT	EXISTING GROUND	CROSS SLOPE	STATION
CP90	19.375	0.926	-2.000%	3+947.647
CP91	19.025	0.971	-2.000%	3+970.147
CP92	18.674	0.901	-2.000%	4+0.474
CP93	18.455	0.900	-2.000%	4+30.147
CP94	18.366	0.923	-2.000%	4+60.147
CP95	18.409	1.829	-2.000%	4+90.147
CP96	18.524	2.034	-2.000%	4+112.647
CP97	18.742	2.780	-2.000%	4+137.647
CP98	19.128	2.226	-2.000%	4+167.647
CP99	19.499	1.921	-2.000%	4+192.647
CP100	19.915	2.591	-2.000%	4+220.147
CP101	20.365	2.566	-2.000%	4+250.147
CP102	20.815	2.309	-2.000%	4+280.147
				4+300.000
CP103	21.266	2.491	-2.000%	4+310.147
CP104	21.716	2.171	-2.000%	4+340.147
CP105	22.166	1.712		4+370.147
CP106	22.578	0.835	-2.000%	4+397.647
CP107	22.954	0.781	-2.000%	4+422.647
CP108	23.329	0.701	-2.000%	4+447.647

HORIZONTAL

VERTICAL: 17.336 4+048.220; +1.500% L=318.780; -2.000%

PLAN S=1:1500



PREPARATORY SURVEY FOR NEW MACTAN BRIDGE CONSTRUCTION PROJECT IN THE REPUBLIC OF THE PHILIPPINES
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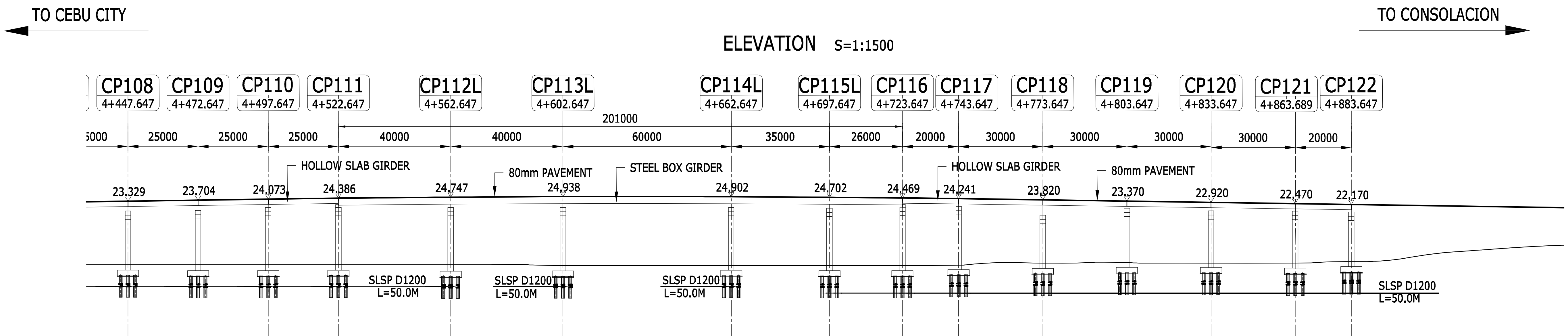
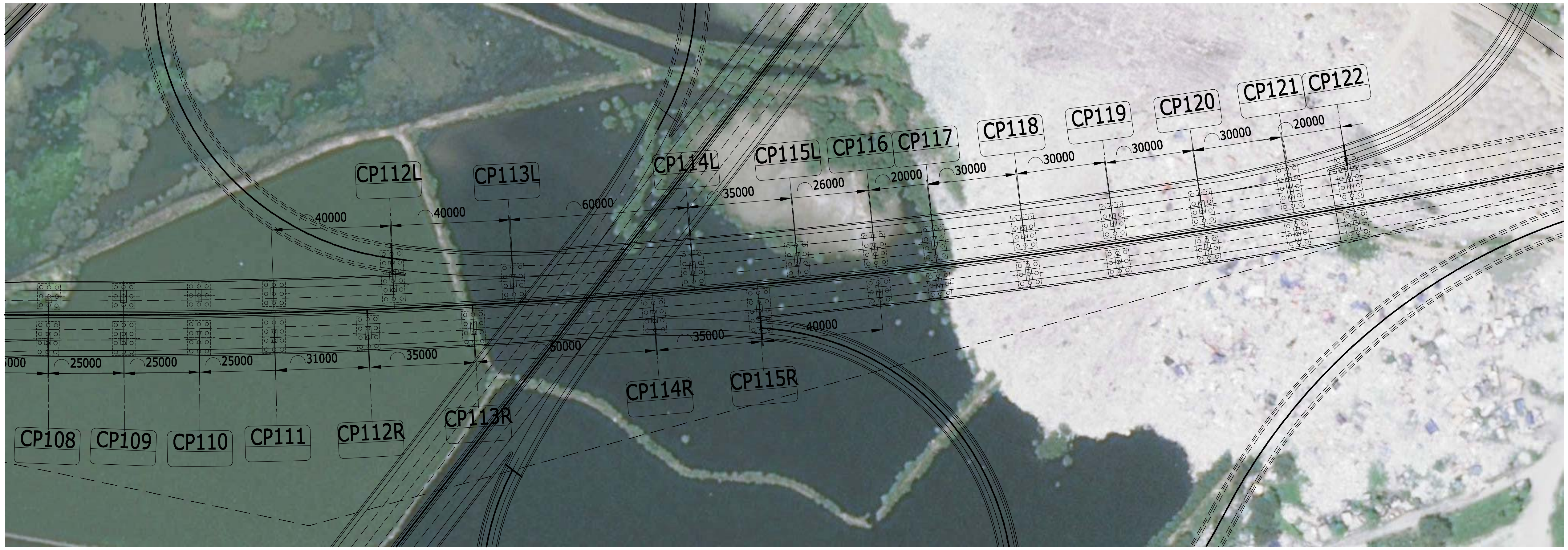
Almec Corporation

ELEVATION S=1:1500



	CP108	CP109	CP110	CP111	CP112L	CP113L	CP114L	CP115L	CP116	CP117	CP118	CP119	CP120	CP121	CP122
FINISHED HEIGHT	23.329	23.704	24.073	24.386	24.747	24.938	24.902	24.702	24.469	24.241	23.820	23.370	22.920	22.470	22.170
EXISTING GROUND	0.701	0.700	0.700	0.700	0.700	0.500	0.500	0.500	0.500	0.573	1.300	1.486	1.300	1.300	1.797
HORIZONTAL	R=2500.00 L=1178.291														
VERTICAL						26.020 4+627							-1.500% L=473.000		-1.500 L=490.0
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	4+447.647	4+472.647	4+497.647	4+522.6	4+562.647	4+602.647	4+662.647	4+697.647	4+723.647	4+743.647	4+773.647	4+803.647	4+833.647	4+863.647	4+883.647

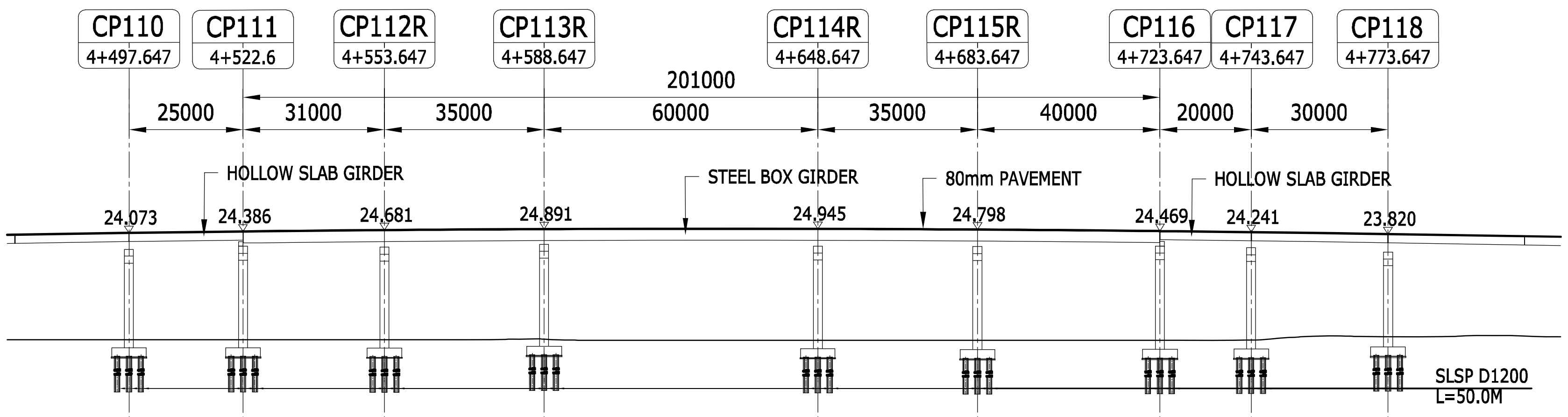
PLAN S=1:1500



TO CEBU CITY

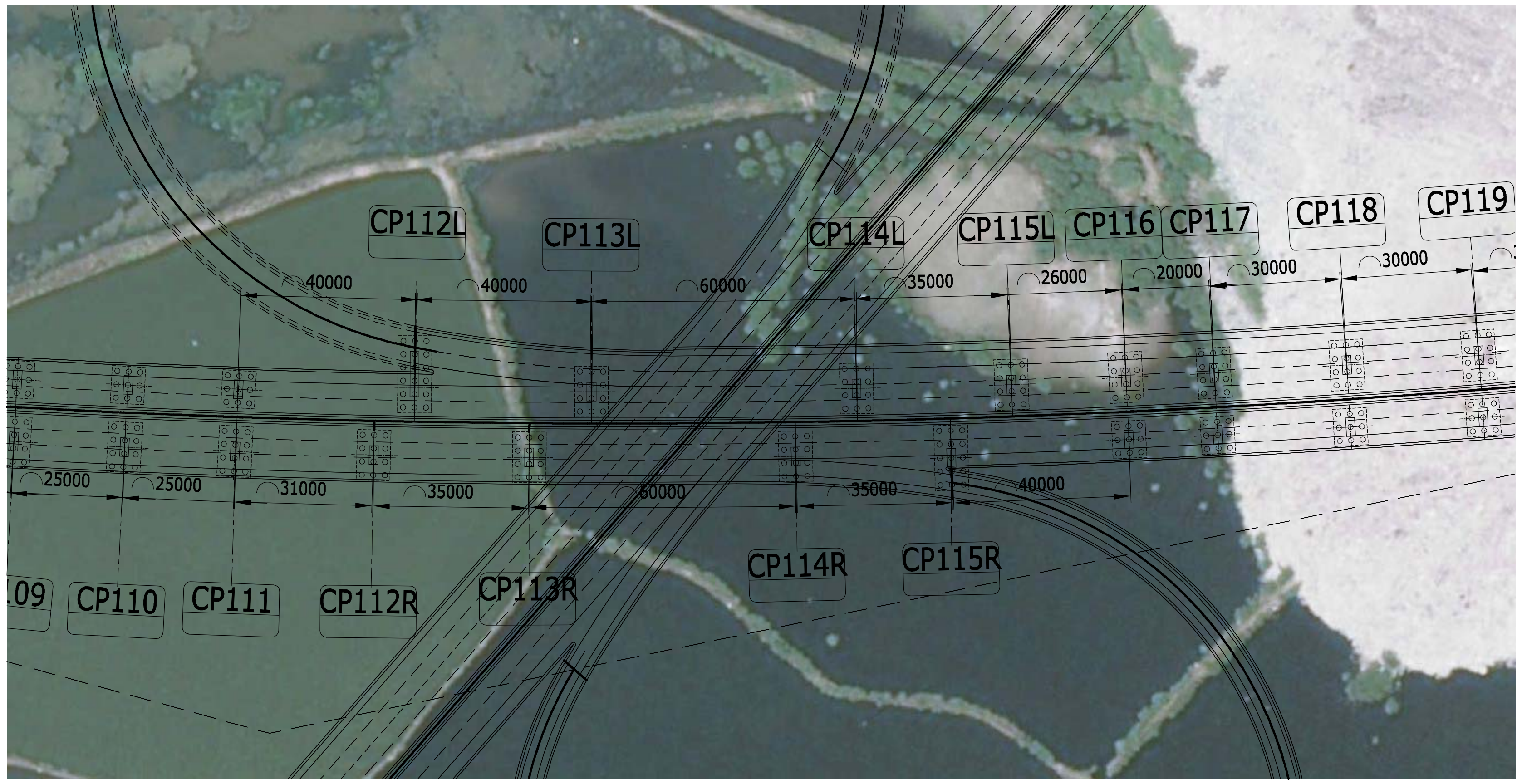
TO CONSOLACION

ELEVATION S=1:1500



FINISHED HEIGHT	24.073	24.386	24.681	24.891	24.945	24.798	24.469	24.241	23.820	23.370
EXISTING GROUND	0.700	0.700	0.700	0.803	0.500	0.500	0.500	0.573	1.300	1.486
HORIZONTAL	R=2500.00, L=1178.291									
VERTICAL	26.020 4+627									-1.500% L=473.00
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	4+497.647	4+522.6	4+553.647	4+588.647	4+648.647	4+683.647	4+723.647	4+743.647	4+773.647	4+803.647

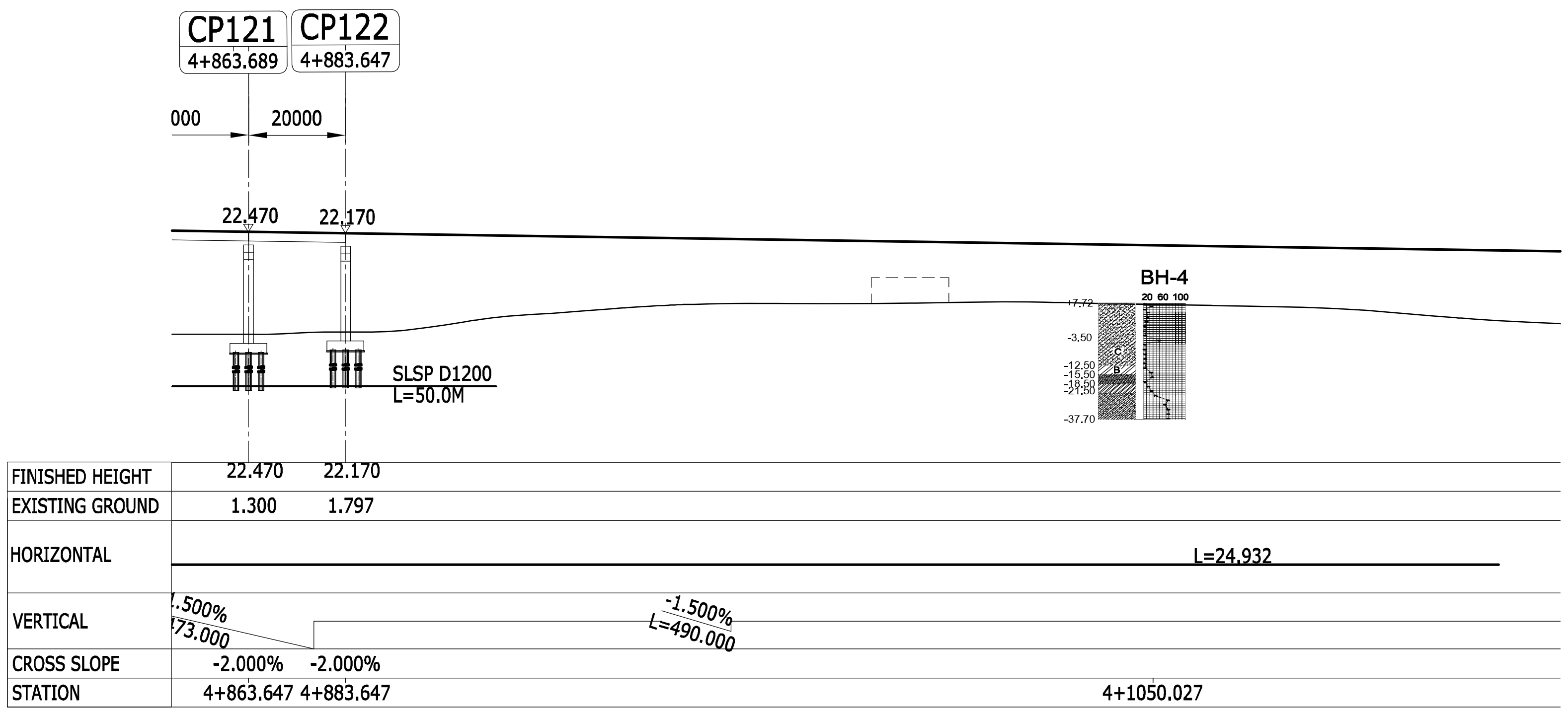
PLAN S=1:1500



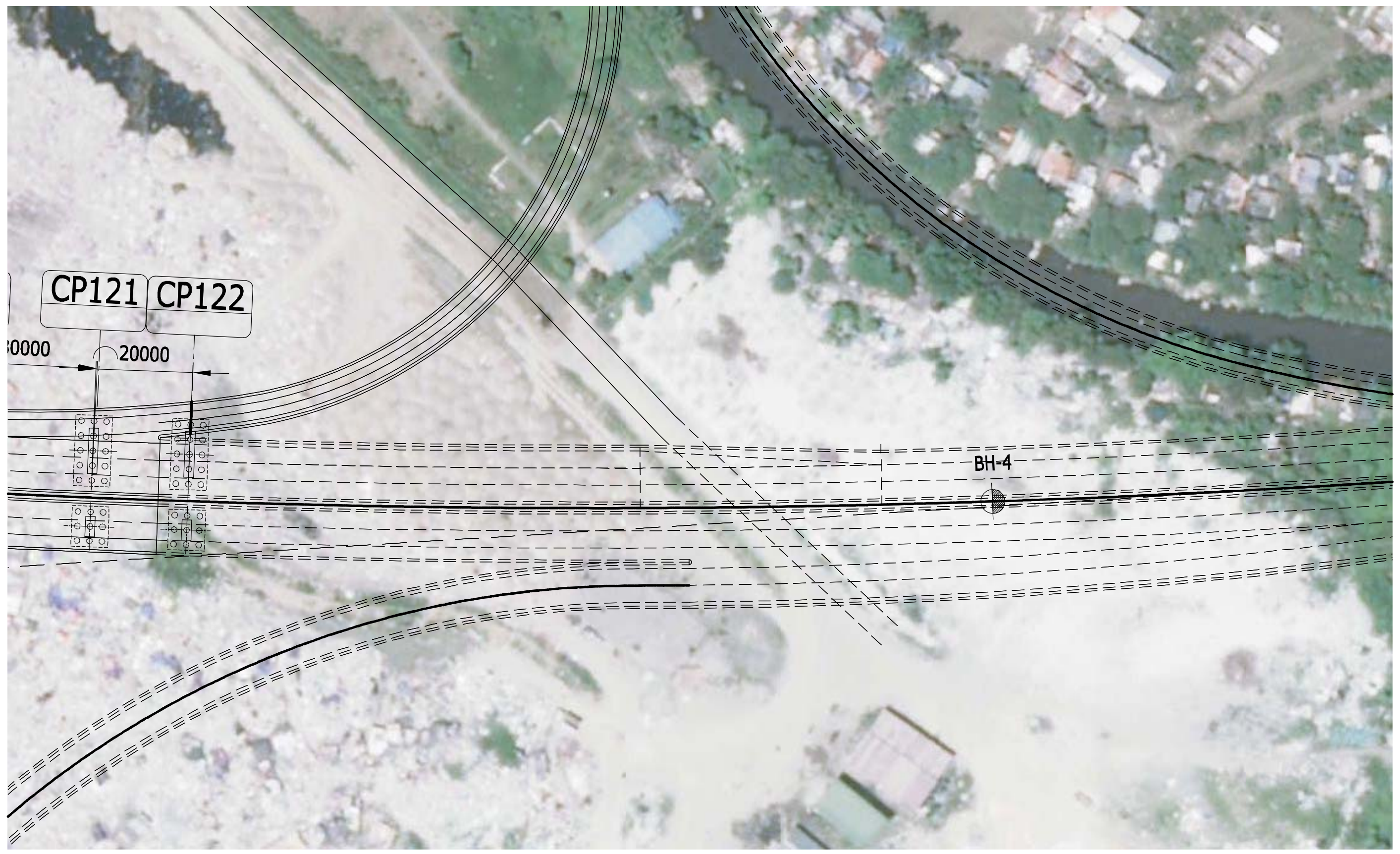
TO CEBU CITY

TO CONSOLACION

ELEVATION S=1:1500



PLAN S=1:1500



LEGEND:

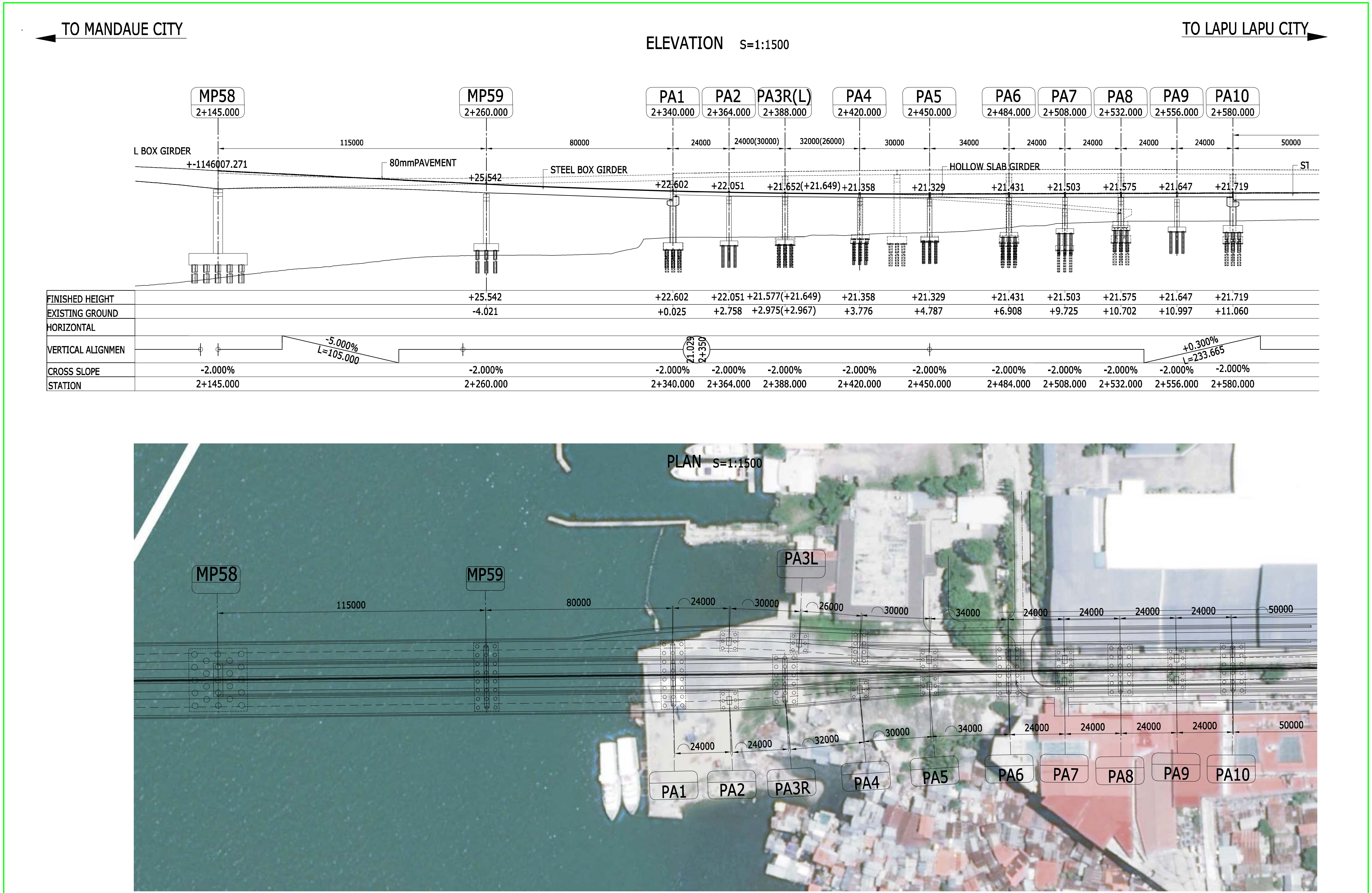
LAYER A:
Very soft to medium stiff, dark gray/brown, stiff CLAY, with traces of sand and shell fragments.

LAYER B:
Stiff to hard, dark gray, CLAY, with little amount of limestone fragments.

LAYER C:
Loose to very dense, brown/gray, sand-sized LIMESTONE fragments, with some clay.

LAYER D:
vVery loose, dark gray, clayey SAND, medium plastic, with traces of shell fragments.

LAYER E:
Very dense, gray, SAND and GRAVEL mixture, with clay.



PREPARATORY SURVEY FOR NEW MACTAN BRIDGE CONSTRUCTION PROJECT IN THE REPUBLIC OF THE PHILIPPINES
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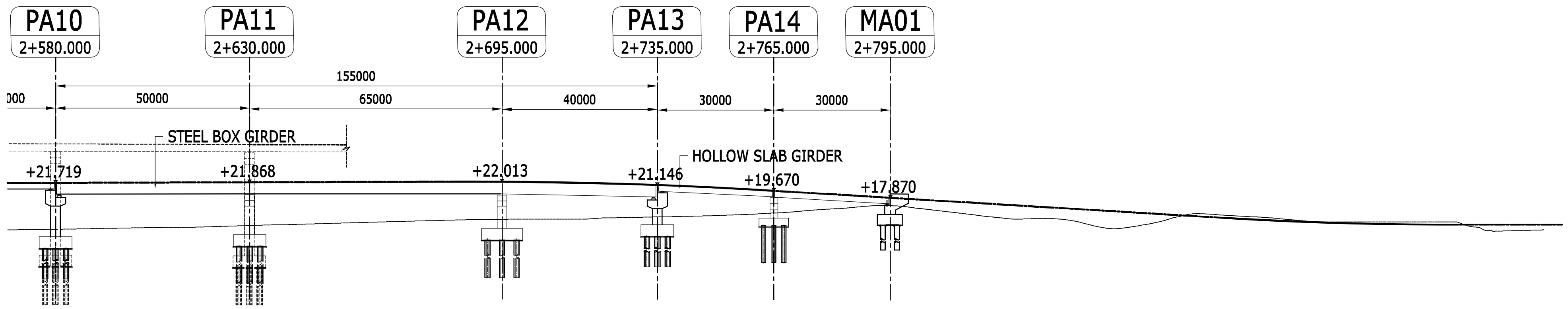
Almec Corporation

TO MANDAUE CITY

TO LAPU LAPU CITY

ELEVATION S=1:1500



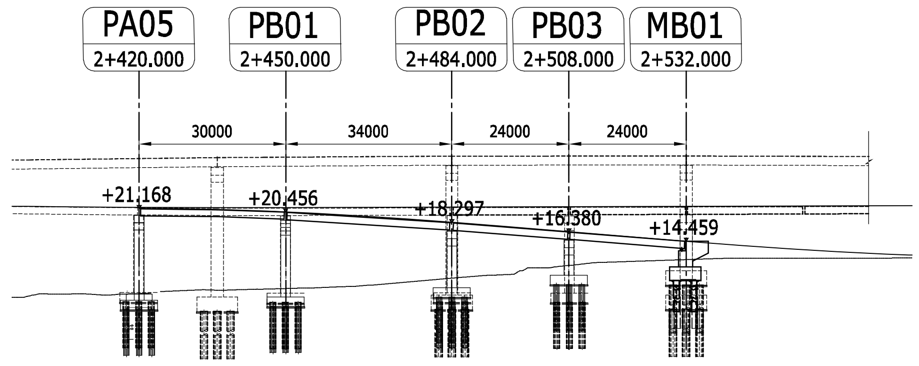
FINISHED HEIGHT	+21.719	+21.868	+22.013	+21.146	+19.670	+17.870
EXISTING GROUND	+11.060	+11.940	+13.725	+14.997	+15.777	+16.307
HORIZONTAL						
VERTICAL ALIGNMENT	0% 3.665			22.150 2+723.6		-6.000% L=116.335 20.970 2+910 +5.000% L=257.500
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	2+580.000	2+630.000	2+695.000	2+735.000	2+765.000	2+795.000

PLAN S=1:1500

TO MANDAUE CITY

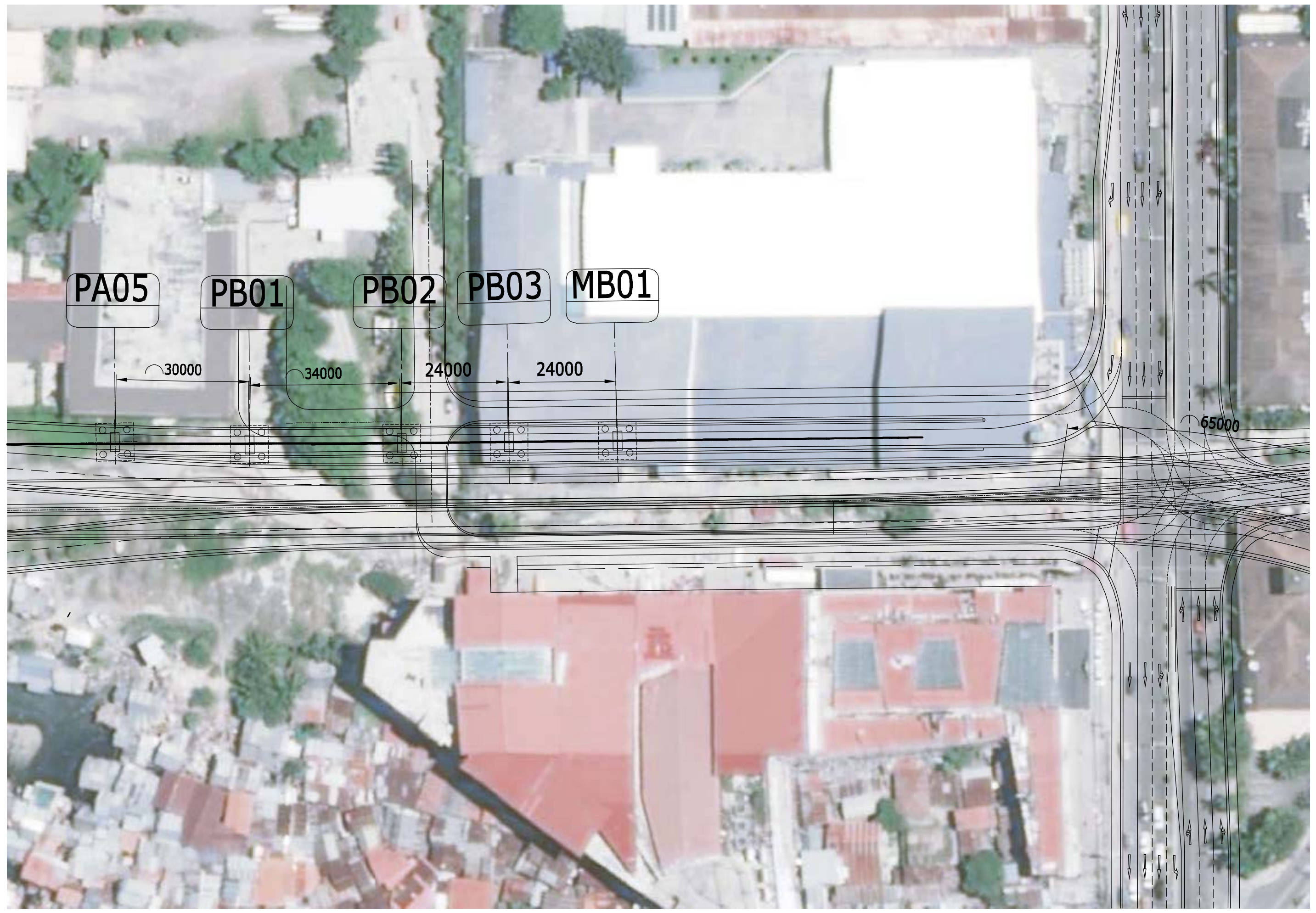
TO LAPU LAPU CITY

ELEVATION S=1:1500



FINISHED HEIGHT	+21.168	+20.456	+18.297	+16.380	+14.459
EXISTING GROUND	+3.776	+4.787	+6.908	+9.725	+10.702
HORIZONTAL					
VERTICAL ALIGNMENT		32.749 2+440			
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	2+420.000	2+450.000	2+484.000	2+508.000	2+532.000

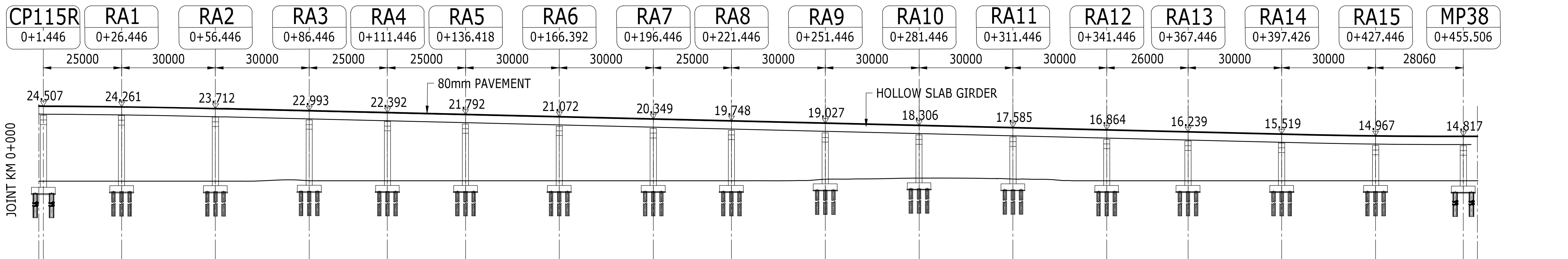
PLAN S=1:1500



TO CEBU CITY

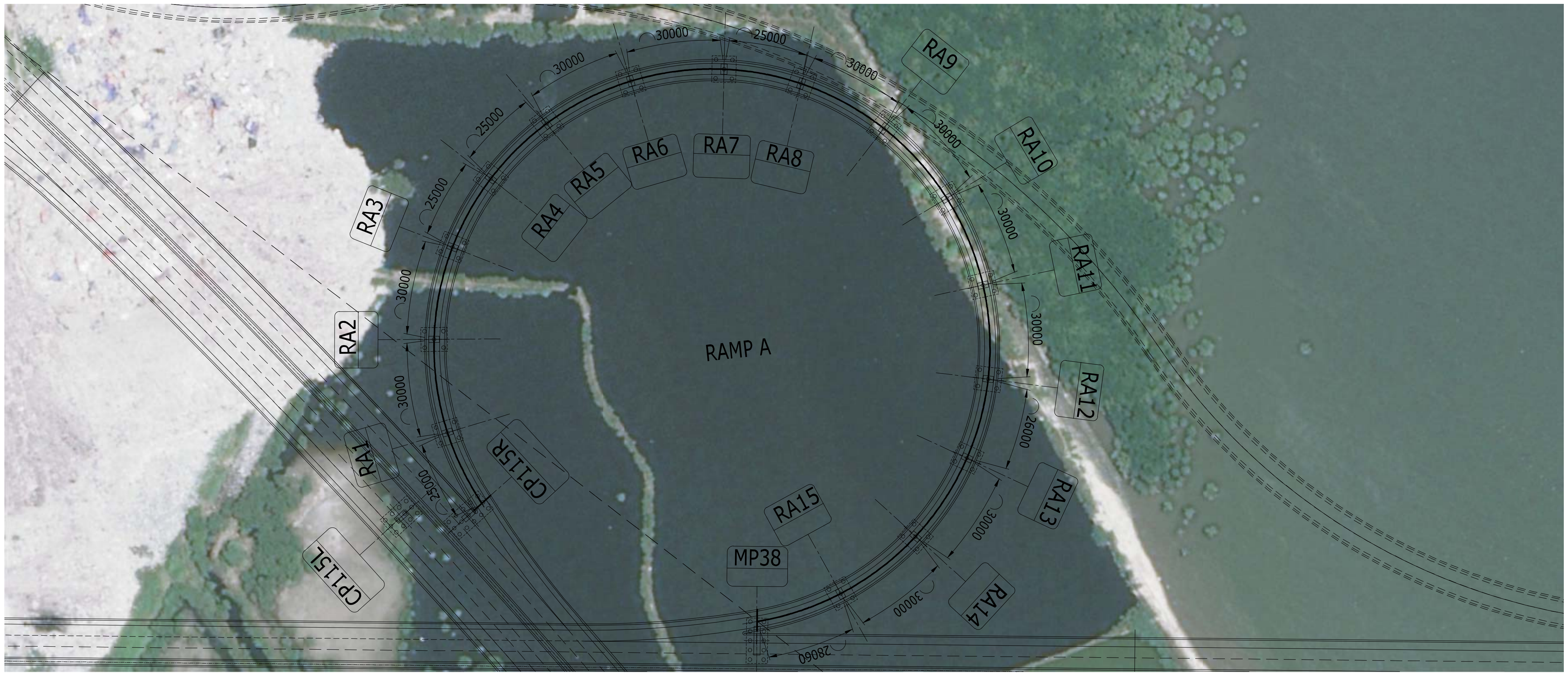
TO LAPU LAPU CITY

ELEVATION S=1:1500



	CP115R	RA1	RA2	RA3	RA4	RA5	RA6	RA7	RA8	RA9	RA10	RA11	RA12	RA13	RA14	RA15	MP38
FINISHED HEIGHT	24.507	24.261	23.712	22.993	22.392	21.792	21.072	20.349	19.748	19.027	18.306	17.585	16.864	16.239	15.519	14.967	14.817
EXISTING GROUND	0.500	0.500	0.508	0.633	0.600	0.600	0.600	0.600	0.601	1.081	1.443	1.160	0.600	0.600	0.600	0.600	0.600
HORIZONTAL	R=298.25 L=6.665								L=447.526								R=298.25 L=6.041
VERTICAL	24.515 0+000	24.350 0+030						-2.404% L=400.000								14.736 0+430	14.826 0+460
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
CHAINAGE	0.000 0+1.446	0+26.446	0+56.446	0+86.446	0+111.446	0+136.418	0+166.392	0+196.446	0+221.446	0+251.446	0+281.446	0+311.446	0+341.446	0+367.446	0+397.426	0+427.446	0+455.506

PLAN S=1:1500

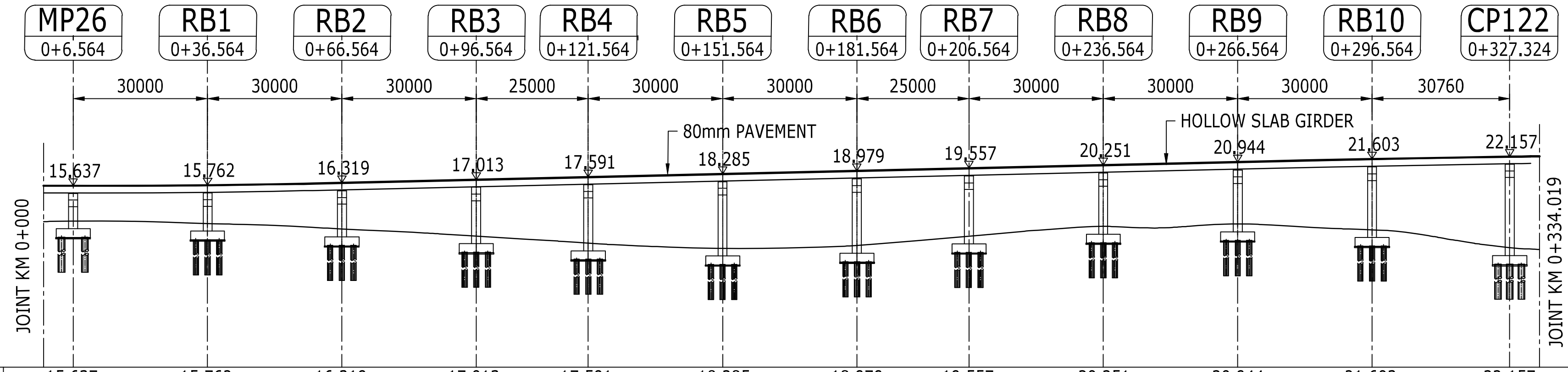


PREPARATORY SURVEY FOR NEW MACTAN BRIDGE CONSTRUCTION PROJECT IN THE REPUBLIC OF THE PHILIPPINES

TO LAPU LAPU CITY

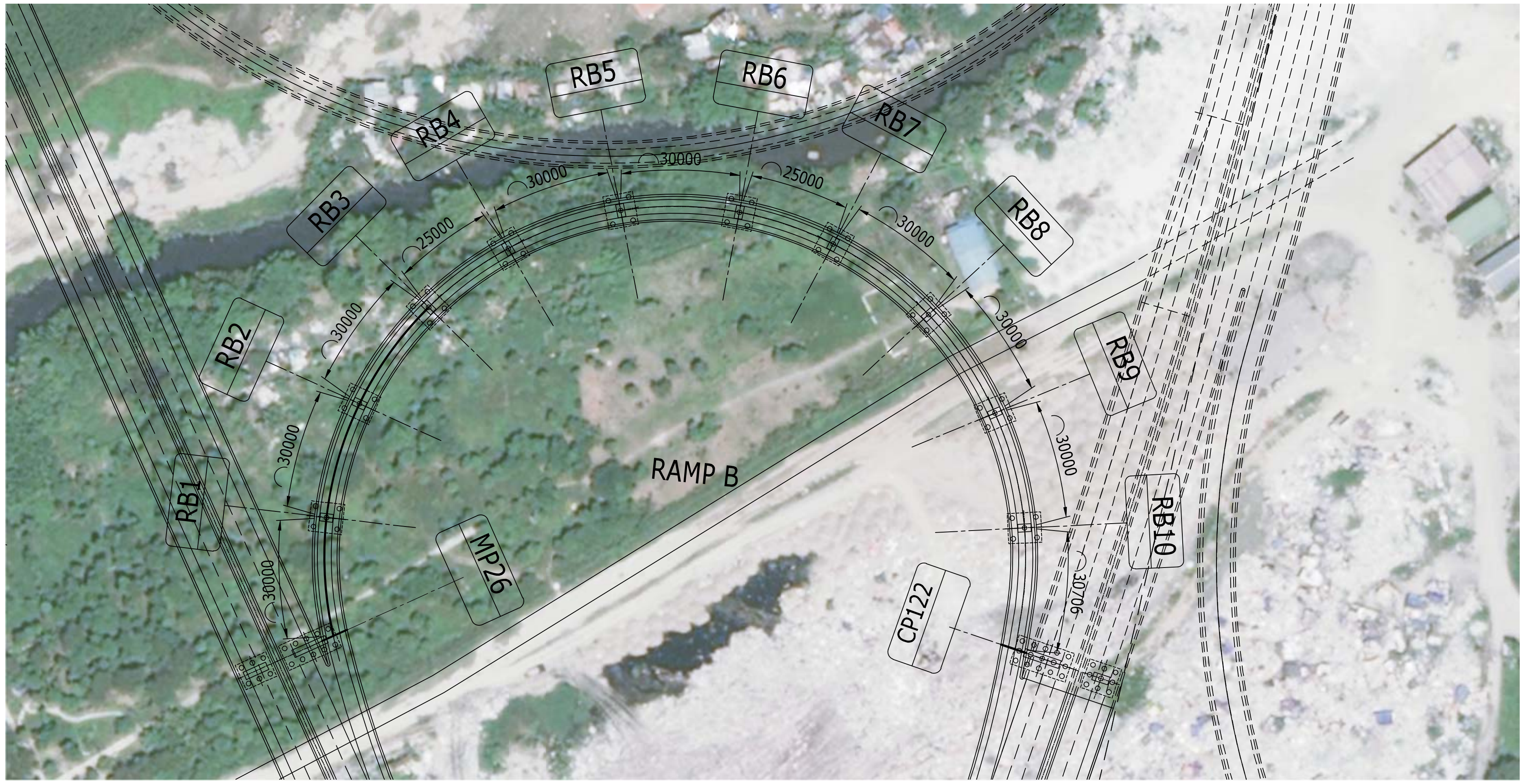
TO CEBU CITY

ELEVATION S=1:1500



FINISHED HEIGHT	15.637	15.762	16.319	17.013	17.591	18.285	18.979	19.557	20.251	20.944	21.603	22.157
EXISTING GROUND	7.769	7.161	5.993	4.369	2.778	1.635	2.292	4.358	6.571	7.089	5.795	1.827
HORIZONTAL	R=298.25 L=6.041					L=310.627						R=298.25 L=17.294
VERTICAL	15.669 0+000	15.474 0+030				+2.312% L=274.000					21.810 0+304	22.260 0+334
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
CHAINAGE	0.000 0+6.564	0+36.564	0+66.564	0+96.564	0+121.564	0+151.564	0+181.564	0+206.564	0+236.564	0+266.564	0+296.564	0+327.324

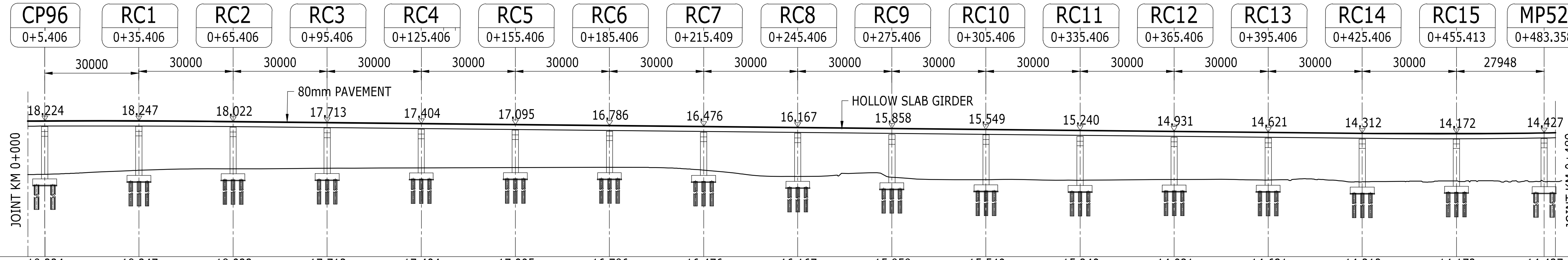
PLAN S=1:1500



TO CEBU CITY

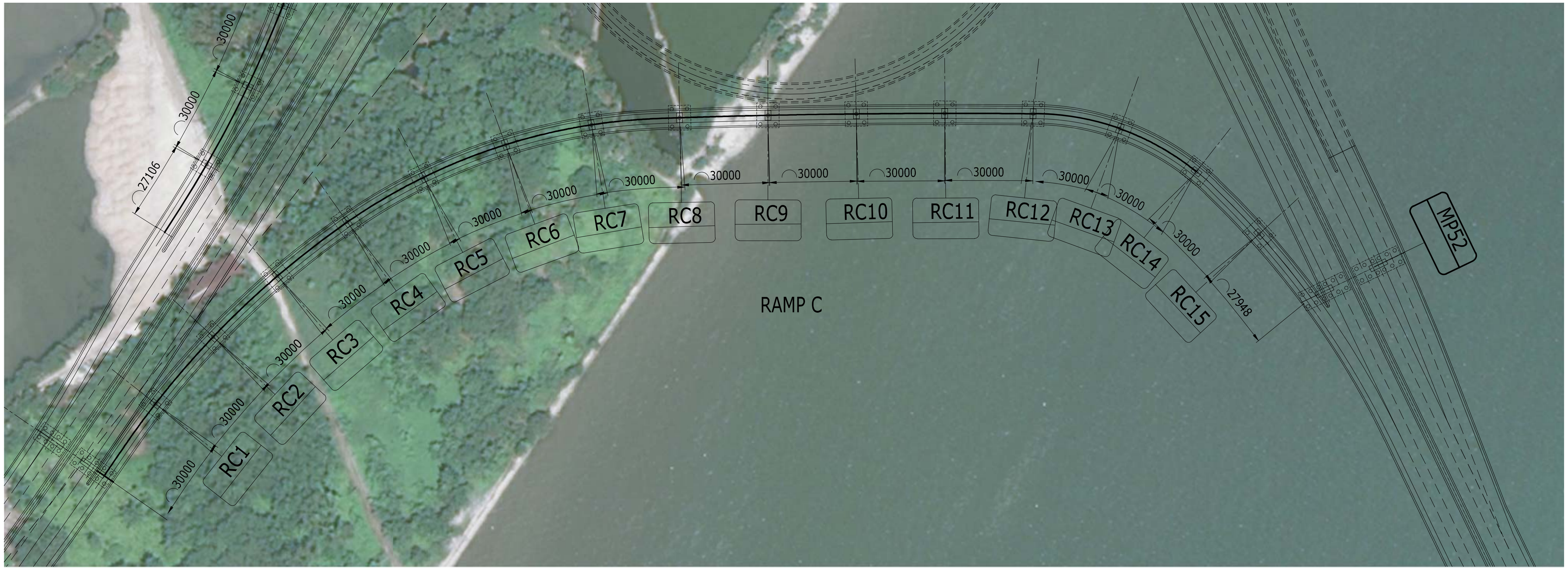
TO LAPU LAPU CITY

ELEVATION S=1:1500



	CP96	RC1	RC2	RC3	RC4	RC5	RC6	RC7	RC8	RC9	RC10	RC11	RC12	RC13	RC14	RC15	MP52
FINISHED HEIGHT	18.224	18.247	18.022	17.713	17.404	17.095	16.786	16.476	16.167	15.858	15.549	15.240	14.931	14.621	14.312	14.172	14.427
EXISTING GROUND	1.244	2.554	2.986	3.196	3.294	3.369	3.459	2.582	0.600	0.326	-0.464	-0.655	-0.41	-0.560	-1.127	-0.871	-1.098
HORIZONTAL	R=2514.25 L=16.198		R=298.25 L=108.279				R=198.25 L=114.145				R=2866.22 L=127.595			R=88.260 L=66.601		R=298.25 L=56.171	
VERTICAL	18.193 0+000	18.388 0+030							-1.031% L=429.000							13.967 0+459	14.522 0+489
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
CHAINAGE	0+005.406	0+35.406	0+65.406	0+95.406	0+125.406	0+155.406	0+185.406	0+215.406	0+245.406	0+275.406	0+305.406	0+335.406	0+365.406	0+395.406	0+425.406	0+455.413	0+483.358

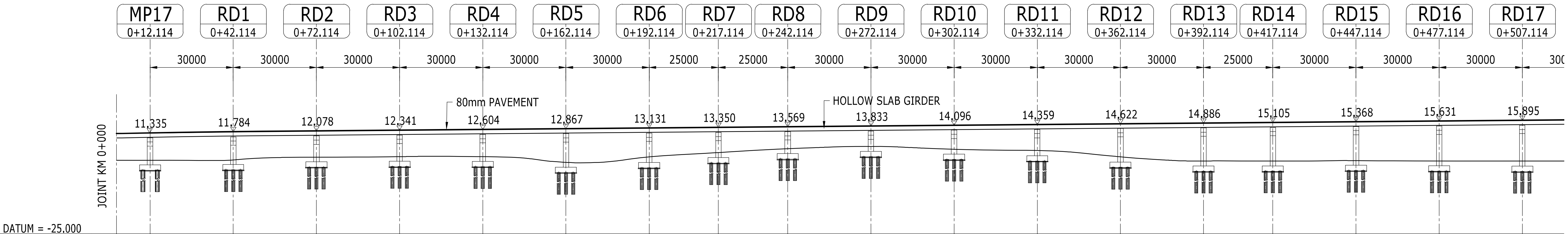
PLAN S=1:1500



TO MANDAUE CITY

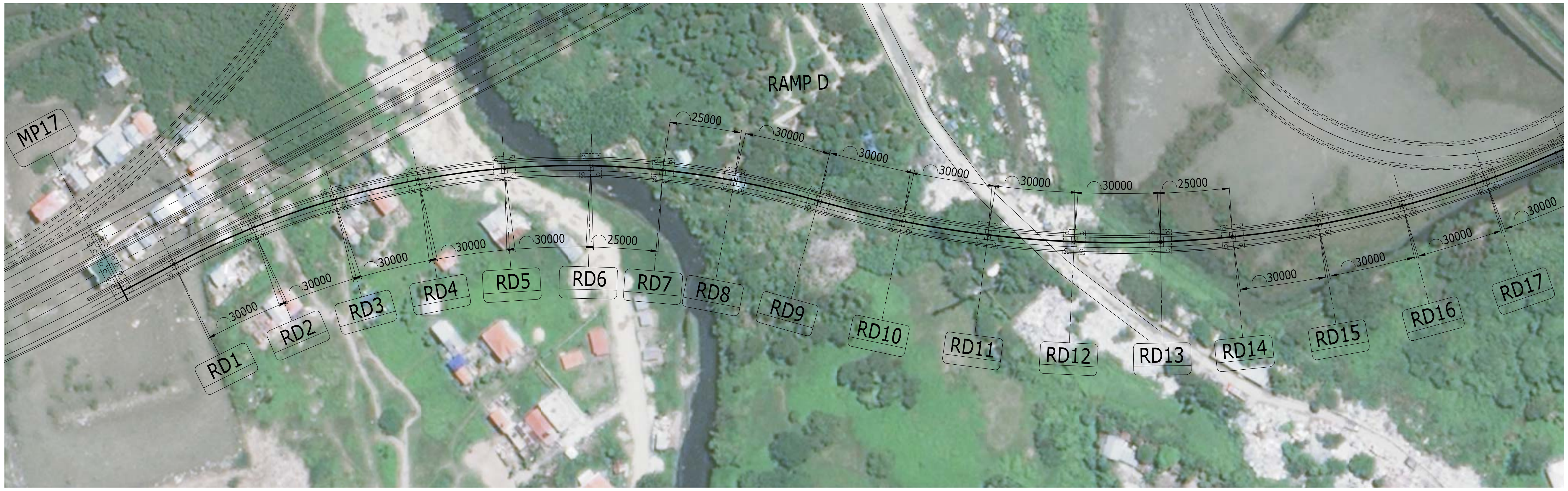
TO CEBU CITY

ELEVATION S=1:1500



		MP17	RD1	RD2	RD3	RD4	RD5	RD6	RD7	RD8	RD9	RD10	RD11	RD12	RD13	RD14	RD15	RD16	RD17
FINISHED GROUND		11.335	11.784	12.078	12.341	12.604	12.867	13.131	13.350	13.569	13.833	14.096	14.359	14.622	14.886	15.105	15.368	15.631	15.895
EXISTING GROUND		1.485	1.581	2.567	2.739	2.736	0.694	2.677	4.237	5.653	6.442	5.448	4.967	2.681	1.215	1.200	1.371	1.206	1.200
HORIZONTAL	L=31.600					R=298.25 L=228.368											R=383.870 L=313.223		
VERTICAL	10.823 0+000	11.423 0+030														+0.986% L=827.000			
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
CHAINAGE	0.000	0+12.114	0+42.114	0+72.114	0+102.114	0+132.114	0+162.114	0+192.114	0+217.114	0+242.114	0+272.114	0+302.114	0+332.114	0+362.114	0+392.114	0+417.114	0+447.114	0+477.114	0+507.114

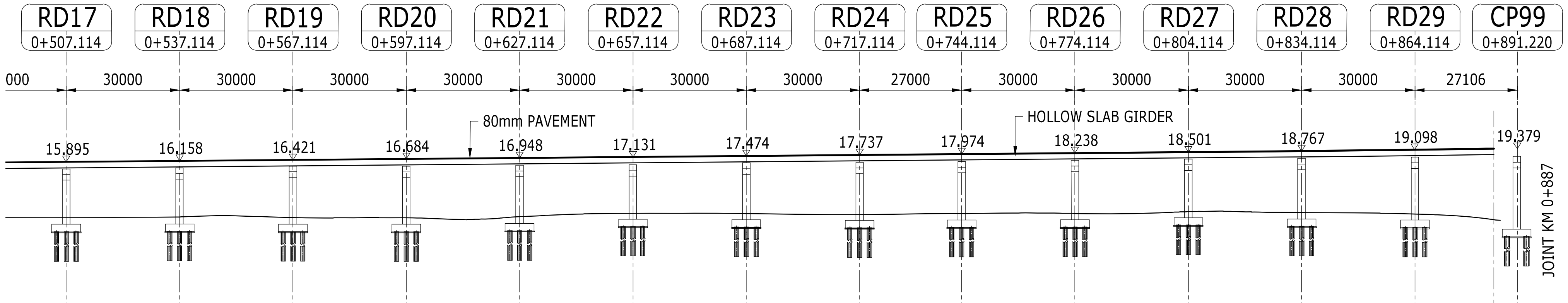
PLAN S=1:1500



TO MANDAUE CITY

TO CEBU CITY

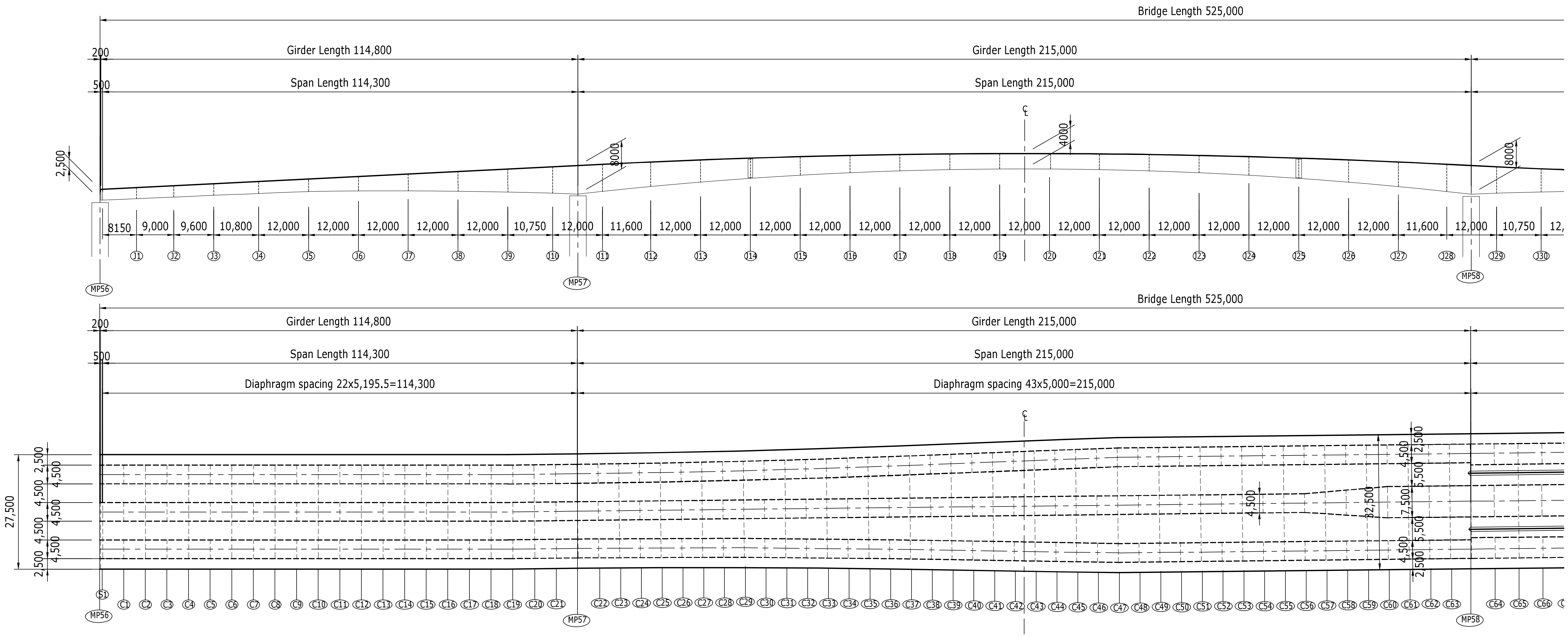
ELEVATION S=1:1500



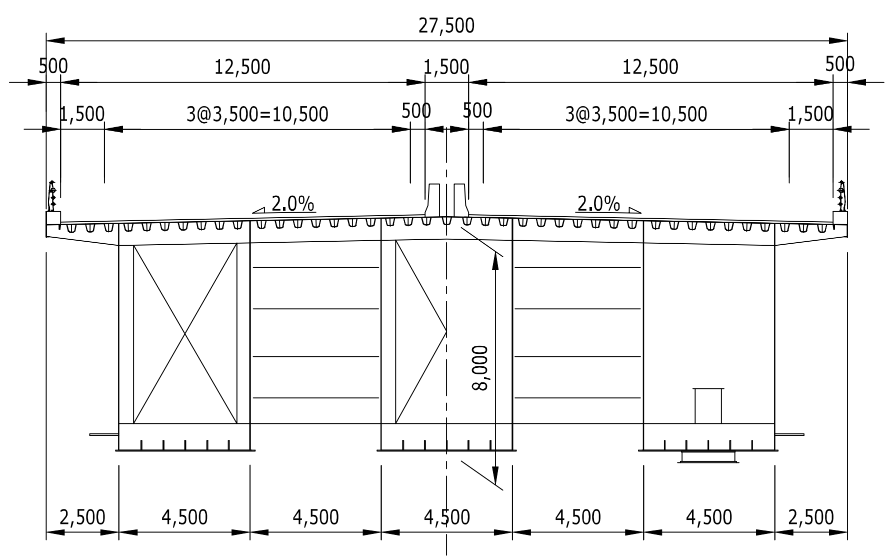
FINISHED HEIGHT	15.895	16.158	16.421	16.684	16.948	17.131	17.474	17.737	17.974	18.238	18.501	18.767	19.098	19.379
EXISTING GROUND	1.200	1.307	1.145	1.075	1.380	2.295	2.257	1.970	2.252	2.260	2.723	2.483	2.120	0.436
HORIZONTAL							R=248.230 L=208.915					R=397.570 L=89.221		R=2335.630 L=15.399
VERTICAL ALIGNMENT													19.580 0+857	19.130 0+887
CROSS SLOPE	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%	-2.000%
STATION	0+507.114	0+537.114	0+567.114	0+597.114	0+627.114	0+657.114	0+687.114	0+717.114	0+744.114	0+774.114	0+804.114	0+834.114	0+864.114	0+891.220

PLAN S=1:1500

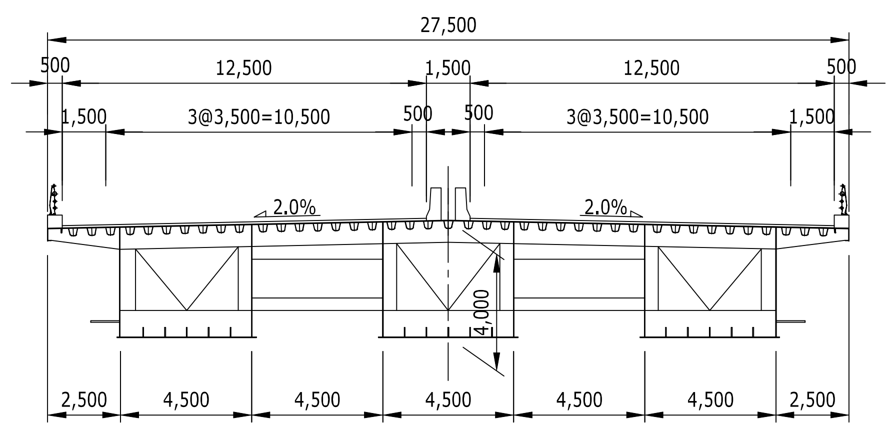
SUPERSTRUCTURE GENERAL VIEW (1/3) 4TH CEBU-MACTAN BRIDGE S=1:1000

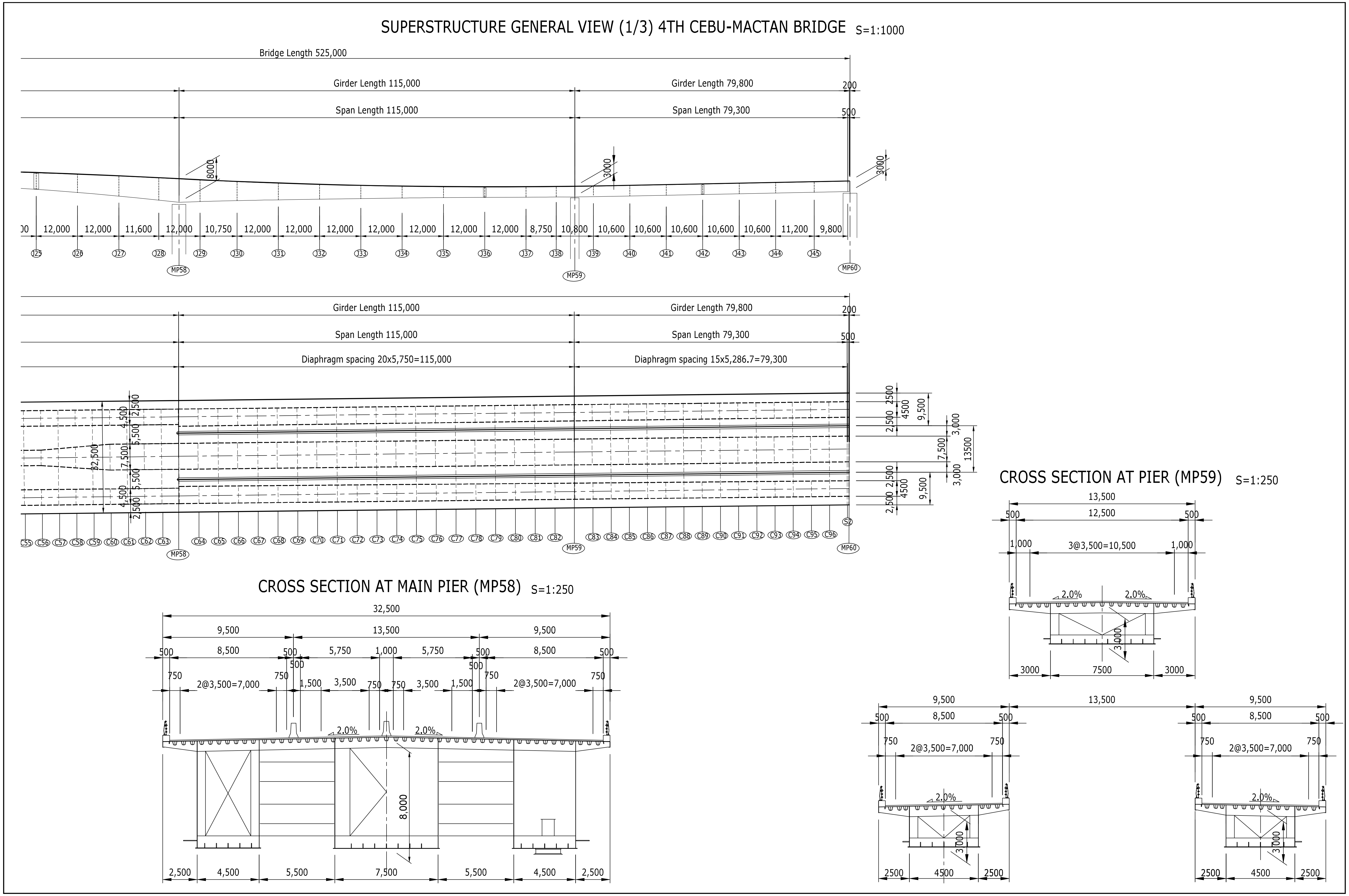


CROSS SECTION AT MAIN PIER (MP57) S=1:250



CROSS SECTION AT SPAN CENTER S=1:250





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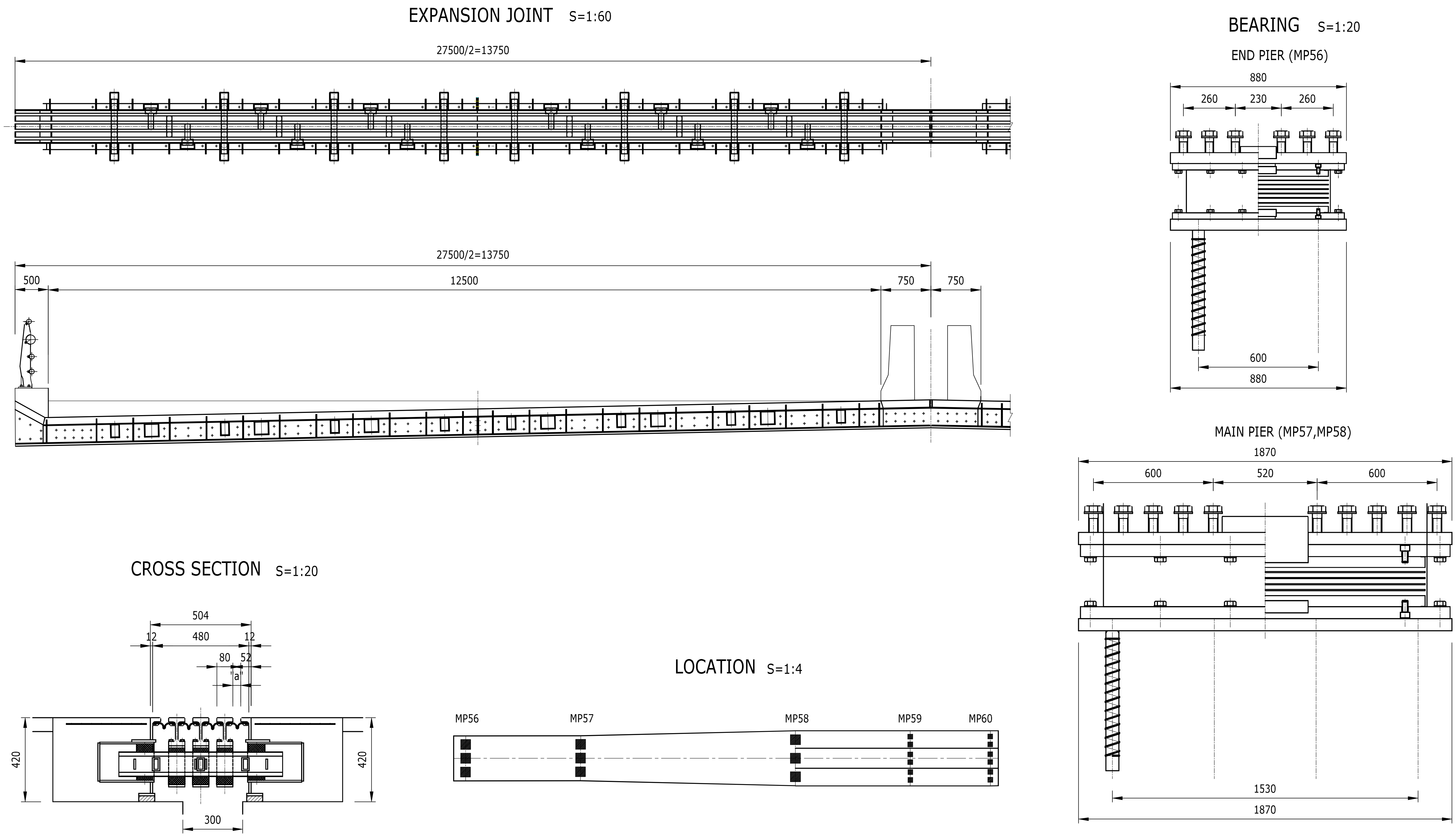
Nippon Koei Co., Ltd.
Almec Corporation

BEARING, EXPANSION JOINT OF 4TH CEBU-MACTAN BRIDGE



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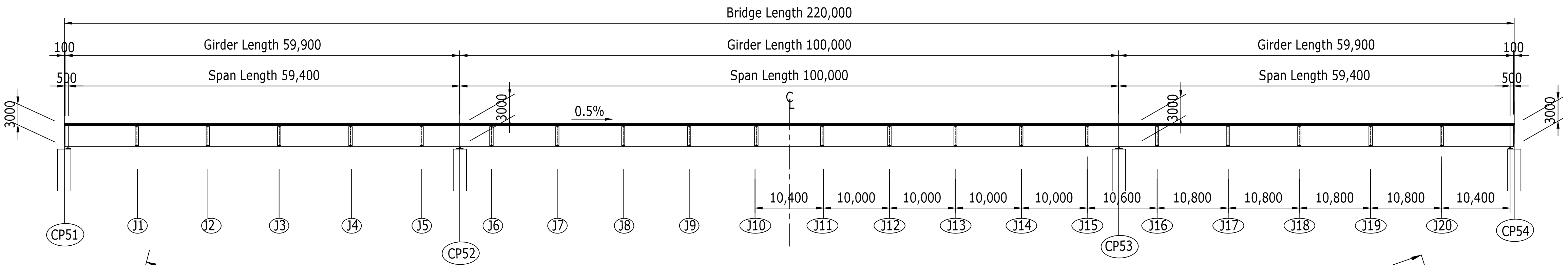
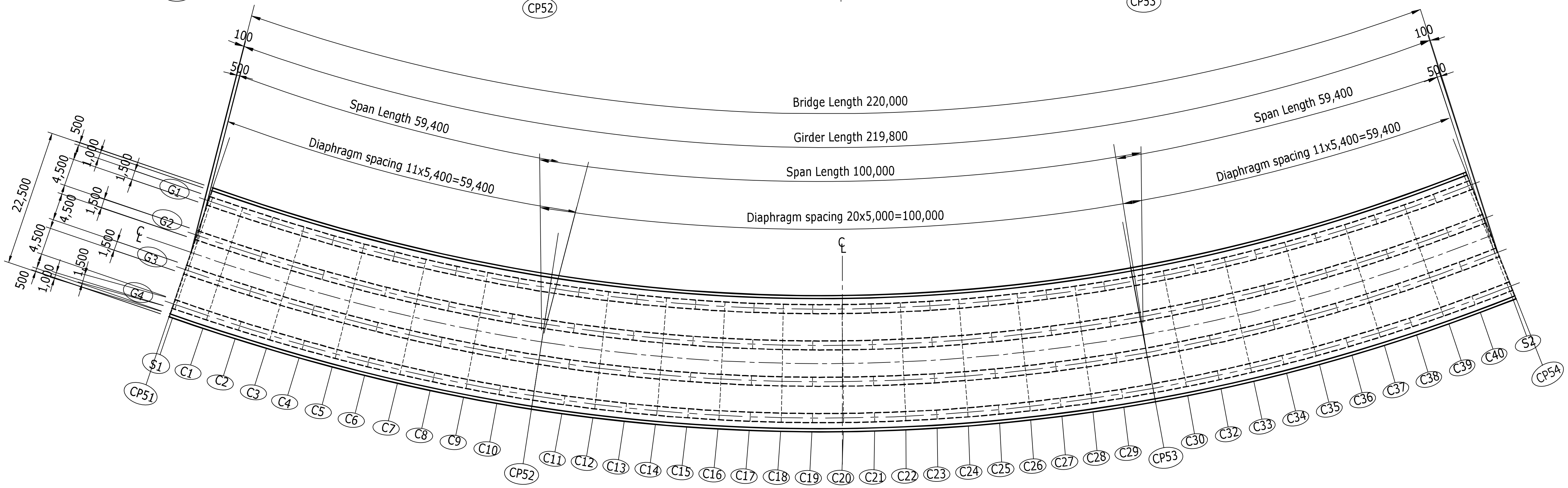
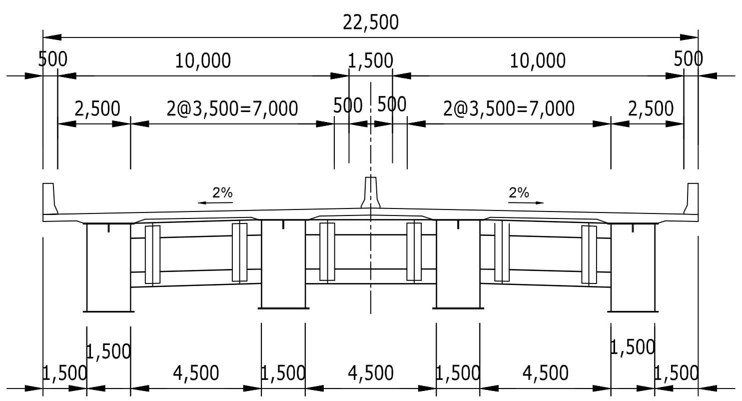
Almec Corporation

SUPERSTRUCTURE GENERAL VIEW (2/3) NARROW STEEL BOX GIRDER TYPE S=1:750





CROSS SECTION S=1:250

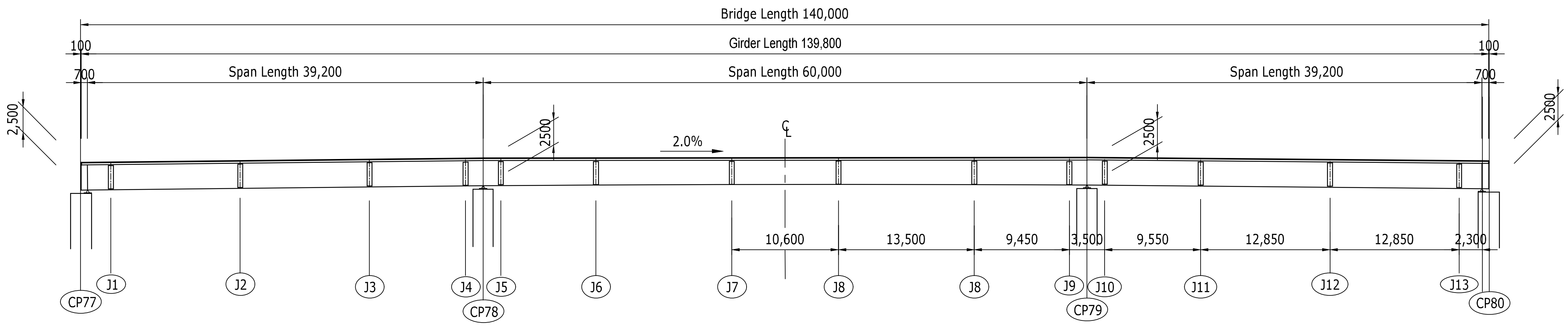


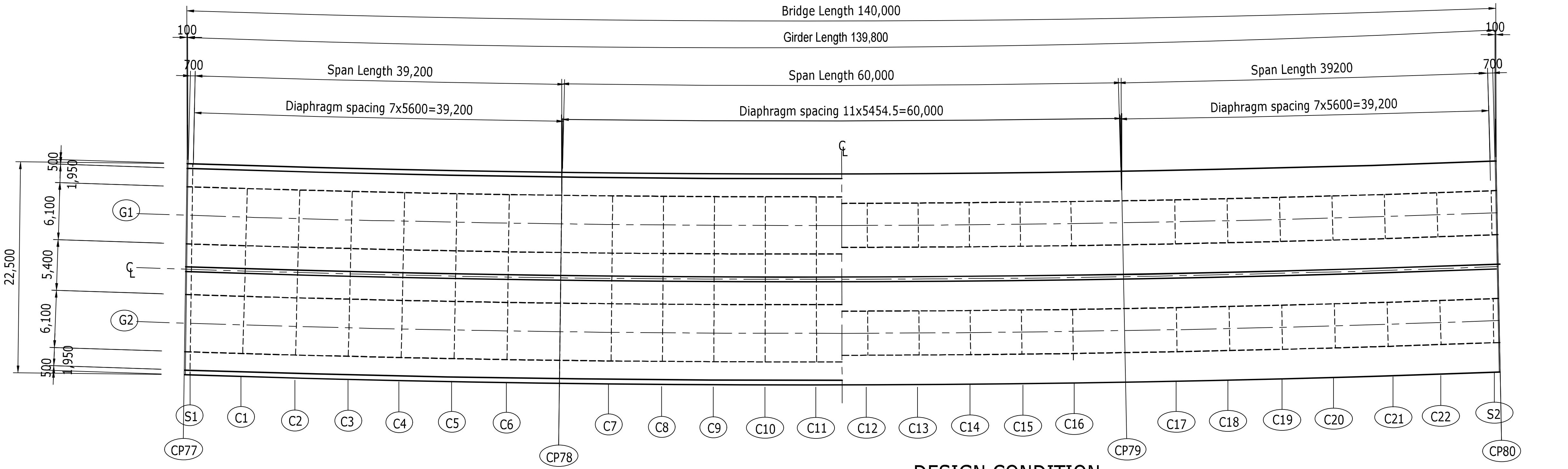
DESIGN CONDITION

Bridge name		FMC Overpass	Petron Jetty Overpass*	Tank Terminal Overpass	Shipyard Overpass	4th Mactan Bridge Overpass	Approach Bridge of 4th Mactan Bridge	Airport Link Viaduct
Road Class, Design Speed		80km/h	80km/h	80km/h	80km/h	80km/h	60km/h	60km/h
Bridge Length		170m	220m	215m	180m	210m	240m	240m, 155m
Span Arrangement		45+80+45(m)	60+100+60(m)	60+95+60(m)	50+80+50(m)	40+60+40(m)	80+80+80(m)	5 x 48(m) 50+60+45(m)
Width		2 x 13.5m	22.5m	22.5m	22.5m	10.5-20.8-16.5m 13-17.48-10.5m	2 x 13.5m	13.5m
Alignment	Plane Alignment	R=600, A=300(m)	A=220, R=300, A=175	R=500, A=300 (m)	R=2500(m)	R=2500(m)	Straight	Straight / Various
	Skew angle	90deg.	90deg.	90deg.	90deg.	90deg.	90deg.	90deg.
	Vertical	0.00%	0.50%	0.50%	0.50%	2.00% parabolic	5.00%	Var.(+2% to -0.3%)
	Cross fall	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%	2.00%
Pavement		Asphalt pavement 80mm						
Slab		Composite slab, t=260mm						
Material		SBHS500, SM490Y, SM400, SS400, S10T, F10T						
Design Specification		Design Guidelines, Criteria & Standards, Volume 5 Bridge Design 2015 Specifications for Highway Bridges, Japanese Road Association						

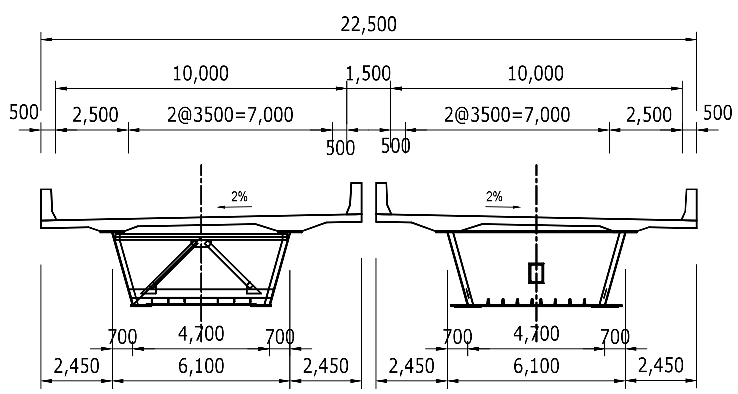
* This drawing show the structural view of Petron Jetty Overpass

SUPERSTRUCTURE GENERAL VIEW (3/3) TRAPEZOIDAL STEEL BOX GIRDER TYPE S=1:500





CROSS SECTION S=1:250

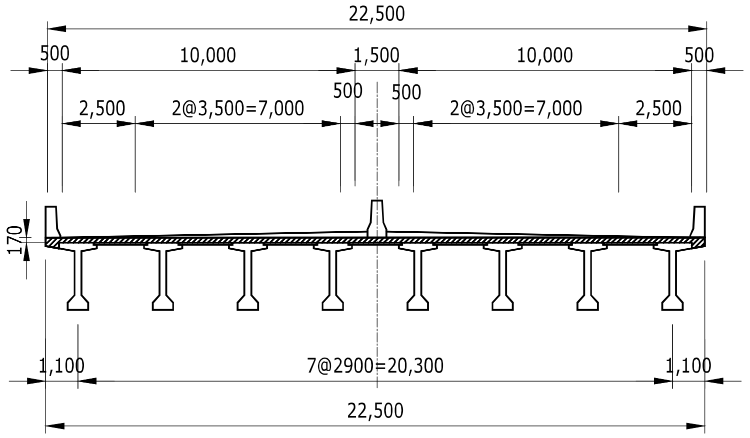


DESIGN CONDITION

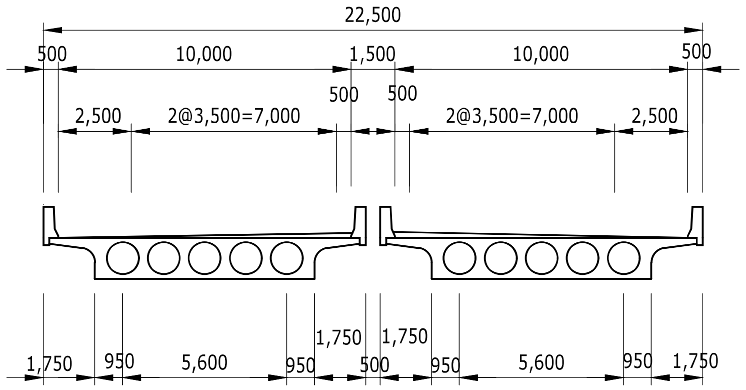
Bridge name		2nd Mactan Bridge Overpass*	Lapu Lapu IC Ramp A
Road Class, Design Speed		80km/h	50km/h
Bridge Length		140m	155m
Span Arrangement		40+60+40(m)	50+65+40(m)
Width		2 x 11.0m	2 x 9.5m
Alignment	Plane Alignment	R=2000m	
	Skew angle	90deg.	90deg.
	Vertical	2.00% parabolic	Var. (0.3% to -6%)
	Cross fall	2.00%	2.00%
Pavement		Asphalt pavement 80mm	
Slab		Composite slab, t=260mm	
Material		SM490Y, SM400, SS400, S10T, F10T	
Design Specification		Design Guidelines, Criteria & Standards, Volume 5 Bridge Design 2015 Specifications for Highway Bridges, Japanese Road Association	

* This drawing show the structural view of 2nd Mactan Bridge Overpass

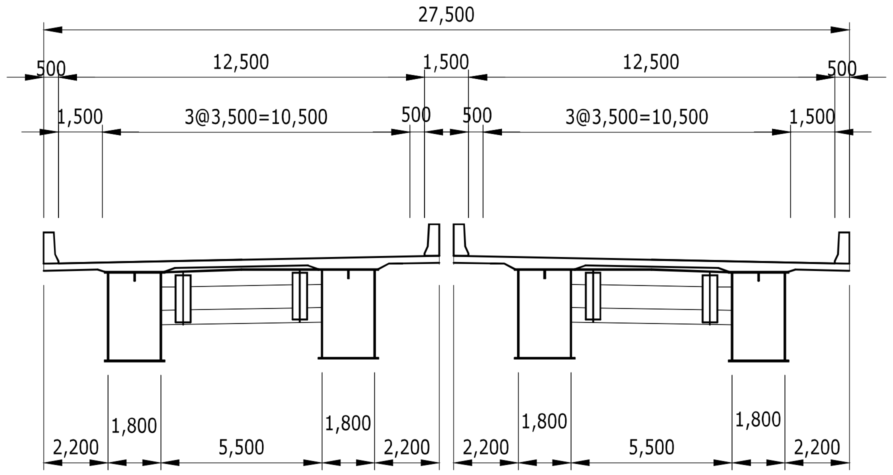
CROSS SECTION (1/3) 4TH CEBU-MACTAN BRIDGE



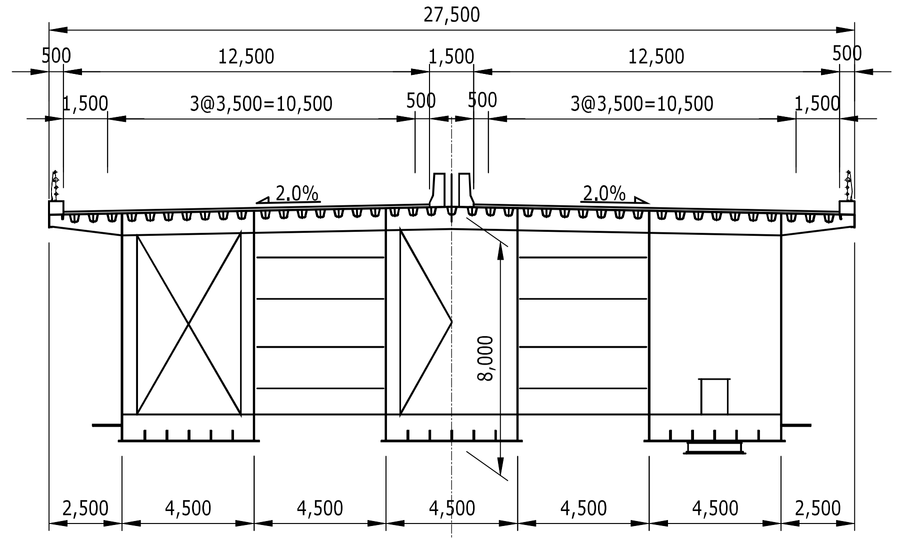
APPROACH BRIDGE ON LAND



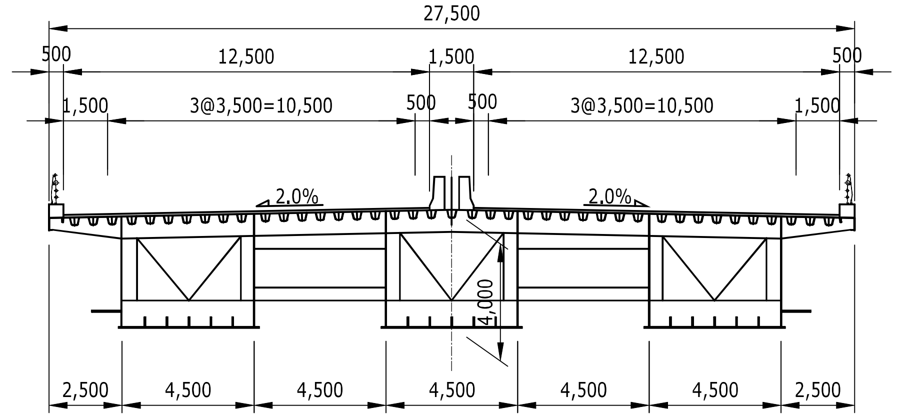
APPROACH BRIDGE IN MANDAUE RECRAMATION



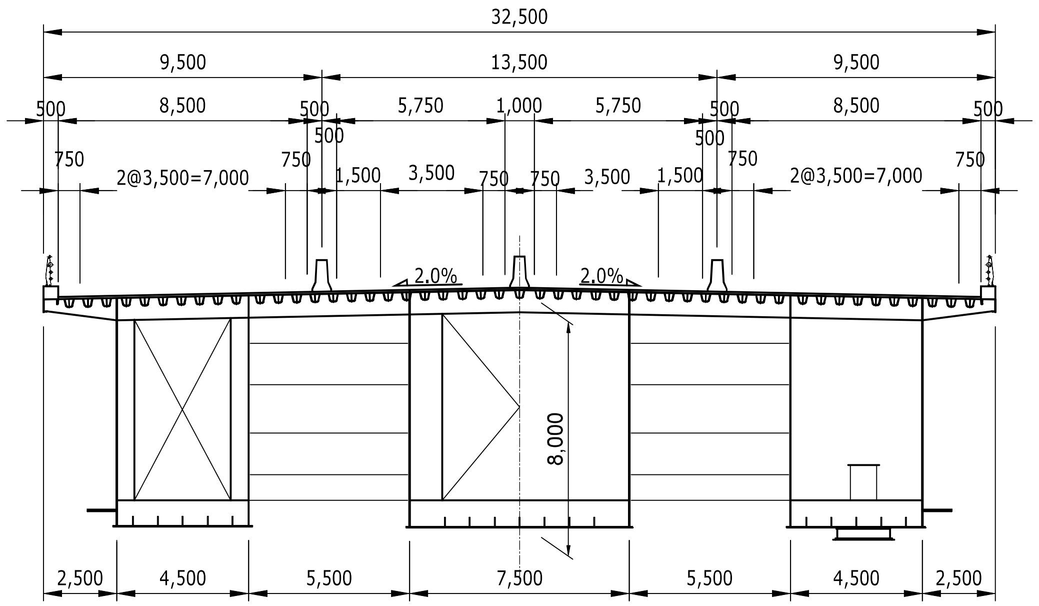
APPROACH BRIDGE ON WATER



CROSS SECTION AT MAIN PIER (MP57)

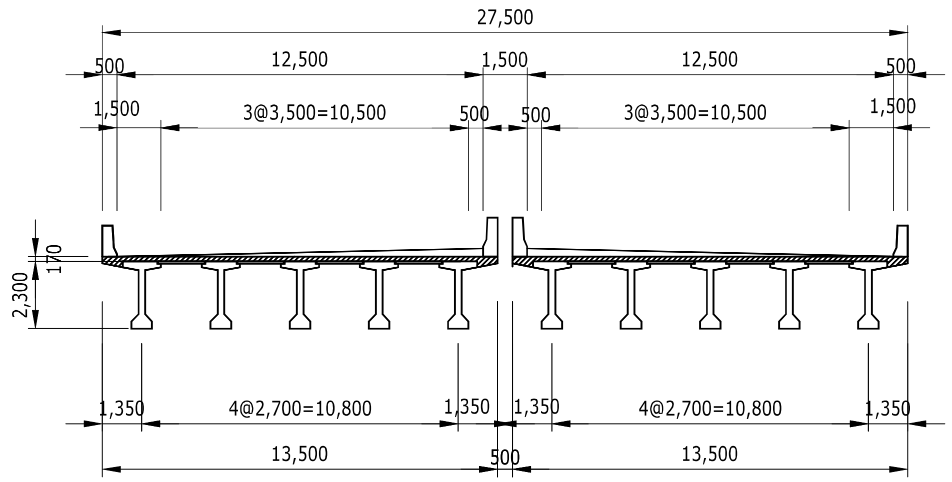


CROSS SECTION AT SPAN CENTER

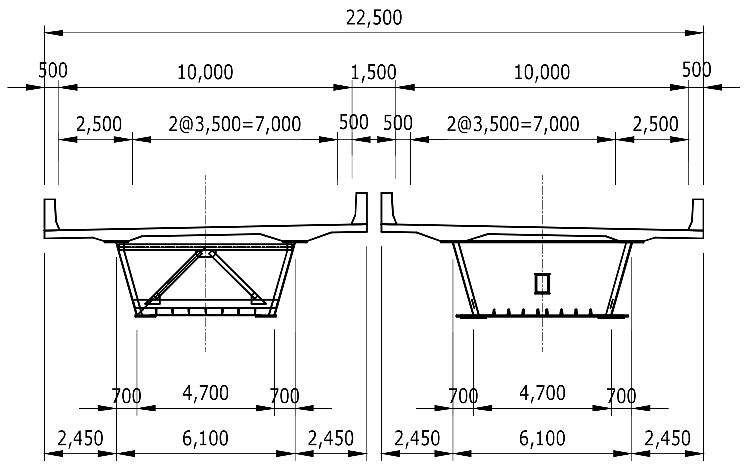


CROSS SECTION AT MAIN PIER (MP58)

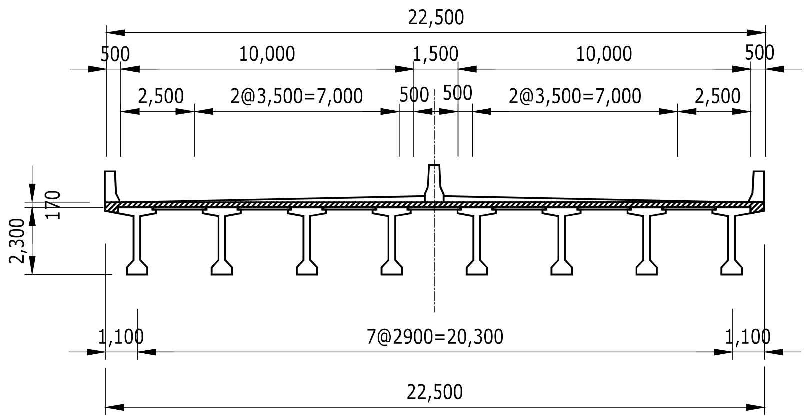
CROSS SECTION (2/3) COASTAL ROAD BRIDGE



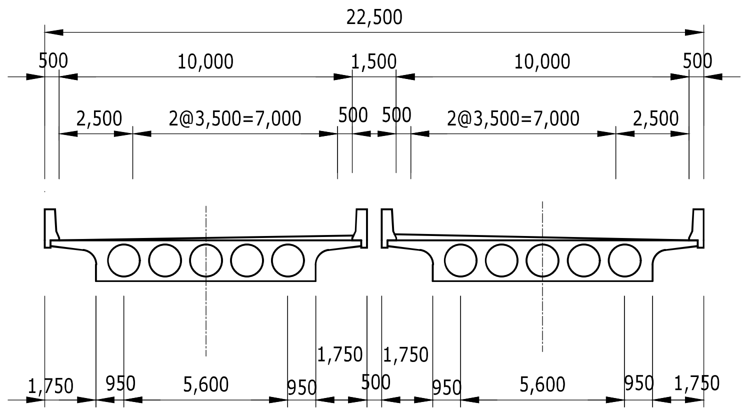
VIADUCT BEGINNING POINT - 1ST BRIDGE



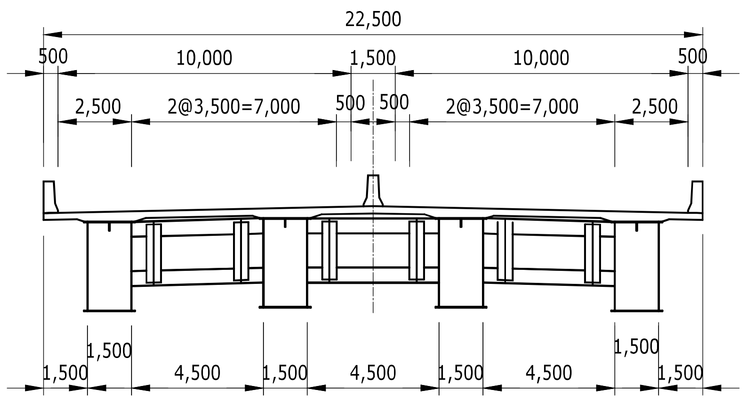
2ND MACTAN BRIDGE OVERPASS, 4TH MACTAN BRIDGE OVERPASS



VIADUCT 1ST BRIDGE - END POINT

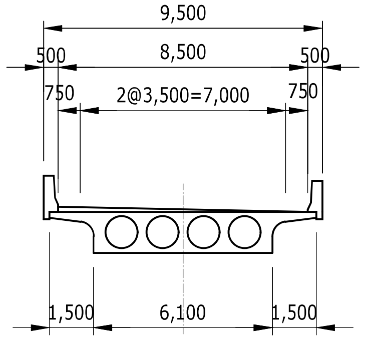


VIADUCT IN MANDAUE RECRAMATION

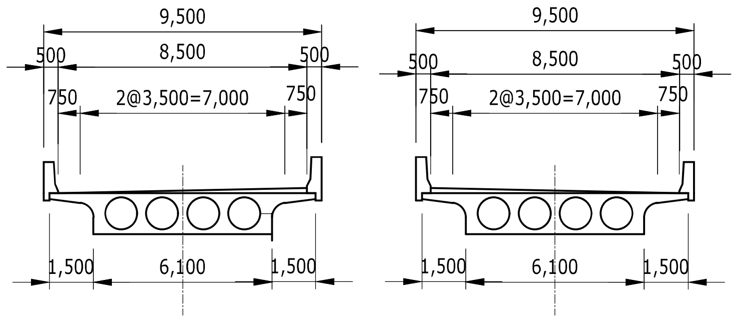


PETRON OVERPASS, TANK TERMINAL OVERPASS, SHIPYARD OVERPASS

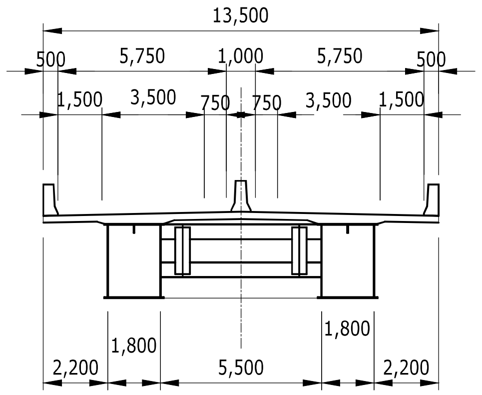
CROSS SECTION (3/3) RAMPWAY BRIDGE



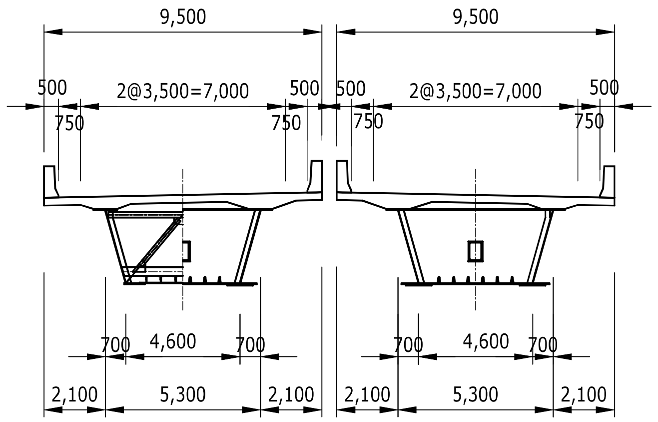
MANDAUE IC RAMPWAY BRIDGE



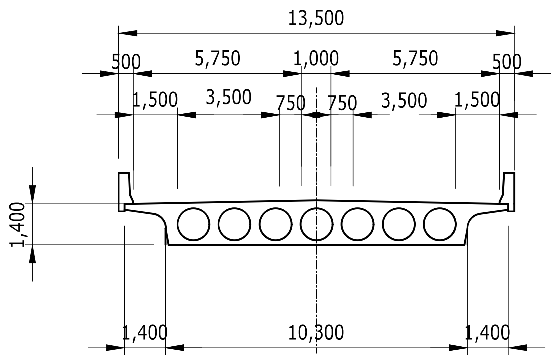
LAPU LAPU RAMP A BRIDGE



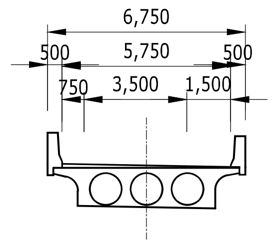
LAPU LAPU AIRPORT ACCESS BRIDGE (1) 48-60M BRIDGE



LAPU LAPU RAMP A OVERPASS



LAPU LAPU AIRPORT ACCESS BRIDGE (2) 30M BRIDGE



LAPU LAPU RAMP C BRIDGE

APPENDIX 2 ENVIRONMENTAL MONITORING FORMS FOR EIA (DRAFT)

MONITORING FORM (draft) for Environmental Impact Assessment Activities

1 Geology

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Ground shaking, ground rupture		Measurement Point · All the project affected area (at the buildings along the ROW) Frequency · Once during the DD Method · Ocular inspection · Site-specific seismic risk characterization

2 Soil Pollution

Date:						
Item	**Unit**	**Measured Value**	**Baseline Value (Mean)**	**Country's Standards (DENR Guidelines for site characterization No.2017-003) Residential/ Industrial**	**Referred International Standards (US EPA) Residential/ Industrial**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Aldrin	mg/Kg			0.029/0.1	0.029/0.1	Measurement Point · At one (1) sampling location: · Umapad dumpsite Frequency · Semi-Annual during the DD Method · Soil Sampling and Analyses in accordance with the prescribed procedures described in DMC 2017-
Chlordane	mg/Kg			1.6/6.5	1.6/6.5	
Total DDT (DDT+DDE+DDD)	mg/Kg			4/4	N/A	
Diedrin	mg/Kg			0.03/0.11	0.03/0.11	
Endrin	mg/Kg			18/180	18/180	
Heptachlor	mg/Kg			0.11/0.28	0.11/0.28	
HCB	mg/Kg			0.3/0.11	0.3/1.1	
Mirex	mg/Kg			0.027/0.096	0.027/0.096	
Toxaphese	mg/Kg			0.44/1.6	0.44/1.6	
PCBs Total	mg/Kg			0.22/0.74	0.22/0.74	
Dioxins (I-TEQ)	mg/Kg			0.00018	-	

3 Terrestrial Flora

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Cutting of trees along the alignment (Locations of trees cut, species and numbers of trees cut, volume of trees cut)	Observation place: Locations of trees cut: Species name: Nos: Size of trees:	Measurement Point ・ All the project affected area (along the ROW) Frequency ・ Daily during site clearing along the ROW Method ・ Ocular inspection
Replacement of cut trees along alignment (incl. relocation and compensatory plantation) (Number and species of the relocated trees and seedlings planted, survival rate of the seedlings planted and relocated trees)	Observation place: Locations reforested and relocated: Species name: Nos:	Measurement Point ・ Designated tree planting site and/or reforestation area designated by the DENR Central Office Frequency ・ Quarterly (until the 3-year maintenance period is completed) Method ・ Ocular inspection

4 Protected Area/Terrestrial Flora and Fauna

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Disturbance to KBA (Bird Population Count, Flying Route & Altitude, Roosting Area , etc)	Observation place: Locations observed: Species name: Nos:	Measurement Point ・ KBA/IBA Frequency ・ Semi-annual during the DD (two migration seasons) Method ・ Consultation Meeting and Survey with PAPs

1 Land Use Pattern, Zoning

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Change/Disturbance in land use pattern (Change of land use)		Measurement Point ・ All the project affected area Frequency ・ Monthly during Construction Phase or as needed Method ・ IEC

2 Cumulative Impacts from Mandaue Reclamation Project

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Cumulative impacts including increased land use change, noise, water pollution, dust and emissions, traffic by construction vehicles, restriction of access to sea water by local fisher folks (According to monitoring data of land use change, noise, water pollution, dust and emissions, traffic)		Measurement Point ・ All the project affected area Frequency ・ According to each monitoring data Method ・ IEC

3 Topo., Geology

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Alteration in topography, soil disturbance and loss of top soil (Rate of land modification)		<u>Measurement Point</u> ・ All the project affected area <u>Frequency</u> ・ Quarterly (until the 3-year maintenance period is completed) <u>Method</u> ・ Ocular inspection

4 Soil

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Soil pollution Cu Other parameters to be decided in consultation with DENR-EMB		Measurement Point · At three (3) sampling locations: · 1. Northern side of fishpond · 2. Southern side of fishpond · 3. C-St1 Landfill Frequency · Semi-Annual (dry and wet season) Method Soil Sampling and Analyses in accordance with the prescribed procedures described in DMC 2017-03
Soil contamination due to oil on lubricant spill (Oil spill)		Measurement Point · All construction sites Frequency · Weekly · Immediately after the spills Method · Ocular inspection

5 Waste (Solid waste)

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Generation of solid waste (Land and water contamination; aesthetic impacts; spread of diseases Proper waste management and disposal)		Measurement Point ・ All construction sites Frequency ・ Weekly Method ・ Checking compliance to RA 9003 - Ecological Solid Waste Management Act and RA 6969 - Toxic and Hazardous Substances

6 Terrestrial Fauna

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Continued use of wetland area as feeding ground by migratory birds (Species and number of migratory birds)	Observation place: Locations observed: Species name: Nos: Size of trees:	Measurement Point ・ Wetland areas near the interchange section Frequency ・ Every two months (Joint monitoring with DENR-CENRO to complement their quarterly monitoring) Method ・ Ocular inspection

7 Hydrology / Oceanographical Conditions

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Disruption of natural drainage pattern and increase in run-off (Situation of soil runoff and movement on slopes)		<u>Measurement Point</u> ・ All the project affected area (Slopes and waterways) <u>Frequency</u> ・ Quarterly (until the 3-year maintenance period is completed) <u>Method</u> ・ Ocular inspection

8 Water Quality

Item	Unit	Measured Value (Mean)	Baseline Value (Mean)	Country's Standards Marin Water Class SC	Referred International Standards (Japanese Standard/ Marin Water Class A)	Remarks (Measurement Point, Frequency, Method, etc.)
Date:						
pH	-		8.3	6.5-8.5	7.8-8.3	<u>Measurement Point</u> ・ At four (3) sampling locations: B-St1: Upstream Mactan Channel B-St2: Downstream Mactan Channel B-St3: Near Coastal Road Mactan Channel <u>Frequency</u> ・ Quarterly <u>Method</u> ・ Water Sampling and Analyses in accordance with the prescribed procedures described in DAO 2016-08
Oil & Grease	mg/l		<1	3	N/D	
BOD	mg/l		1	n/a	-	
COD	mg/l		<5	-	2	
Total Coliform Fecal	MPN/100ml		-			
TSS	mg/l		37	80	-	
Chromium (Cr)	mg/l		<0.02	0.05	0.01	
Cadmium (Cd)	mg/l		<0.003	0.005	0.003	
Lead (Pb)	mg/l		<0.01	0.05	0.01	

Item	Unit	Measured Value (Mean)	Baseline Value (Mean)	Country's Standards River Water Class C	Referred International Standards (Japanese Standard/ River)	Remarks (Measurement Point, Frequency, Method, etc.)
Date:						
pH	-		7.2	6.0-9.0	6.5-8.5	<u>Measurement Point</u> ・ At four (1) sampling locations: B-St4: Downstream Butuanon River <u>Frequency</u> ・ Quarterly <u>Method</u> ・ Water Sampling and Analyses in accordance with the prescribed procedures described in DAO 2016-08
Oil & Grease	mg/l		4	5	-	
BOD	mg/l		104	15	5	
COD	mg/l		221	-	-	
Total Coliform Fecal	MPN/100ml		-	5,000	5,000	
TSS	mg/l		73	110	50	

Chromium (Cr)	mg/l		<0.02	0.02	0.01	
Cadmium (Cd)	mg/l		<0.003	0.005	0.003	
Lead (Pb)	mg/l		<0.01	0.1	0.01	

9 Water Supply

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Competing use with the community (Usage situation of water supply)		<u>Measurement Point</u> ・ All the project affected area <u>Frequency</u> ・ Monthly during Construction Phase or as needed <u>Method</u> ・ IEC

10 Aquatic Flora and Fauna

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Removal of direct physical injury to aquatic flora and fauna (Result of monitoring for aquatic flora and fauna)		<u>Measurement Point</u> ・ All the project affected area <u>Frequency</u> ・ Monthly during Construction Phase or as needed <u>Method</u> ・ Ocular inspection
Vibration/disturbance from pile-driving (Vibration during construction)		<u>Measurement Point</u> ・ <u>All the project affected area</u> <u>Frequency</u> ・ <u>Monthly during Construction Phase or as needed</u>

		<u>Method</u> ・ Ocular inspection

11 Air Quality (Traffic/ Ambient Air Quality)

Date:						
Item	**Unit**	**Measured Value (Mean)**	**Baseline Value (Mean)**	**Country's Standards**	**Referred International Standards (Japanese Standard)**	**Remarks (Measurement Point, Frequency, Method, etc.)**
NO_2	μg/Ncm		<0.02	150	0.04-0.06	<u>Measurement Point</u> ・ At three (3) sampling locations: A-St1: National High School A-St2: Village Social Housing Area A-St3: Commercial/Mall <u>Frequency</u> ・ Quarterly ・ Immediately based on complaints <u>Method</u> Air quality sampling and analyses using the following methodologies: ・ TSP, PM10 - High Volume-Gravimetric Method ・ SO2 - Impinger-Pararosaniline Colorimetric Method ・ NO2 - Impinger-Griess Saltzman Reaction Method Note: 24-hour sampling at both stations
SO_2	mg/Ncm		23	180	0.1ppm	
PM_{10}	μg/Ncm		40	150	-	
TSP	μg/Ncm		-	230	0.2mg/m^3	

12 Noise

Date:						
Item	**Unit**	**Measured Value (Mean)**	**Baseline Value (Mean)**	**Country's Standards**	**Referred International Standards (Japanese Standard)**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Noise	dBA		A-ST1 (Class AA area) Morning :53 Daytime :62 Evening :56 Nighttime :57 A-ST2 (Class A area) Morning :57 Daytime :50 Evening :56 Nighttime :48 A-ST3 (Class B area) Morning :62 Daytime :62 Evening :55 Nighttime :50	*Standard for areas directly facing four-lane roads Class AA area Morning :50 Daytime :55 Evening :50 Nighttime :45 Class A area Morning :55 Daytime :60 Evening :55 Nighttime :50 Class B area Morning :65 Daytime :70 Evening :65 Nighttime :60	85	<u>Measurement Point</u> ・ At three (3) sampling locations: A-St1: National High School A-St2: Village Social Housing Area A-St3: Commercial/Mall <u>Frequency</u> ・ Quarterly ・ Immediately based on complaints <u>Method</u> Measurement by sound level meter L_{Aeq}, L_5, L_{50}, L_{95} Note: 24-hour sampling at both stations

Note: Morning 5:00 A.M. to 7:00 A.M.
Daytime 7:00 A.M. to 5:00 P.M.
Evening 5:00 P.M. to 9:00 P.M.
Nighttime 9:00 P.M. to 5:00 A.M.

13 Traffic Safety (Pedestrian, Motorist)

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Implementation of TMP approved by City Traffic Management; Designation of well-trained traffic aide/flagman at critical construction areas.		Measurement Point ・ At critical construction sites, particularly along viaduct column sites and station location Frequency ・ Weekly Method ・ Ocular inspection

14 Traffic Congestion

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Implementation of TMP approved by City Traffic Management; Implementation of minimized restriction of traffic flow during day time hours; Implementation of equipment move-in at non-peak day-time; Implementation of placement of traffic decking in stages; Limitation of parking of idle dump trucks and other construction vehicles along the constructed area; Designation of well-trained traffic aide/flagman at critical construction areas.		Measurement Point ・ At critical traffic area Frequency ・ Weekly Method ・ Ocular inspection

1 Soil pollution

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Soil contamination from accidental releases of chemicals, fuel, oil, lubricants (Situation of soil contamination)		<u>Measurement Point</u> ・ All the project affected area <u>Frequency</u> ・ Semi-Annual <u>Method</u> <u>Ocular inspection</u>

2 Terrestrial Flora and Fauna

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Replacement of cut trees (Survival rate of the seedlings planted)	Observation place: Locations harvested and reforested: Species name: Nos: Size of trees to cut down	<u>Measurement Point</u> ・ Designated tree planting site and/or reforestation area designated by the DENR Central Office <u>Frequency</u> ・ Quarterly (until the 3-year maintenance period is completed) <u>Method</u> ・ Ocular inspection
Continued use of wetland area as feeding ground by migratory birds (Species and number of migratory birds)	Observation place: Locations observed: Species name: Nos:	<u>Measurement Point</u> ・ Designated tree planting site and/or reforestation area designated by the DENR Central Office <u>Frequency</u> ・ Semi-annual (northward migration and southward migration periods) <u>Method</u> ・ Ocular inspection

3 Water Quality

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Accidental releases of fuel, oil, lubricant and other chemicals, contamination/degradation of water quality (Accidental releases record)		Measurement Point ・ All the project affected area Frequency ・ Semi-annual or as needed Method ・ Ocular inspection

4 Oceanography

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Sedimentation of marine water (Water quality)		Measurement Point ・ All the project affected area Frequency ・ Semi-annual or as needed Method ・ Ocular inspection

5 Aquatic Flora and Fauna

Date:		
Monitoring Item	**Monitoring Results during Report Period**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Deterioration of habitat due to lighting along the bridge and release of contaminants, chemicals, liquid wastes, etc. (Lighting system and water quality management)		<u>Measurement Point</u> ・ All the project affected area <u>Frequency</u> ・ Semi-annual or as needed <u>Method</u> ・ Ocular inspection

6 Noise

Date:						
Item	**Unit**	**Measured Value (Mean)**	**Baseline Value (Mean)**	**Country's Standards**	**Referred International Standards (Japanese Standard)**	**Remarks (Measurement Point, Frequency, Method, etc.)**
Noise	dBA		A-ST1 (Class AA area) Morning :53 Daytime :62 Evening :56 Nighttime :57 A-ST2 (Class A area) Morning :57 Daytime :50 Evening :56 Nighttime :48 A-ST3 (Class B area) Morning :62 Daytime :62 Evening :55 Nighttime :50	*Standard for areas directly facing four-lane roads Class AA area Morning :50 Daytime :55 Evening :50 Nighttime :45 Class A area Morning :55 Daytime :60 Evening :55 Nighttime :50 Class B area Morning :65 Daytime :70 Evening :65 Nighttime :60	Daytime (6am-10pm) Nighttime:70 (10pm-6am):65	<u>Measurement Point</u> · At three (3) sampling locations: A-St1: National High School A-St2: Village Social Housing Area A-St3: Commercial/Mall <u>Frequency</u> · Quarterly · Immediately based on complaints <u>Method</u> Measurement by sound level meter L_{Aeq}, L_5, L_{50}, L_{95} Note: 24-hour sampling at both stations

Note: Morning 5:00 A.M. to 7:00 A.M.
Daytime 7:00 A.M. to 5:00 P.M.
Evening 5:00 P.M. to 9:00 P.M.
Nighttime 9:00 P.M. to 5:00 A.M.

APPENDIX 3 ENVIRONMENTAL MONITORING FORM FOR RAP (DRAFT)

3.1 INTERNAL MONITORING FORM (DRAFT)

Monitoring Form (draft) for Resettlement Activities (general)

Date : ____________________

Recorded by : ____________________

Progress of Resettlement Activities

Activities	Number Completed	Unit	Progress (%)		Completion Date (planned)	Responsible Organization
			up to last quarter	up to this quarter		
Procurement of Consultant		MM				
RAP Survey		MM				
Validation of RAP		Date Completed				
Verification of PAPs and Properties		HHs				
Land Acquisition		m2				
Relocation		HHs				
Compensation		HHs				

Resettlement Site Development

No.	Description of Resettlement Site (e.g. location, number of HHs)	Progress (resettled HHs)	Description and Issues of Concern (if any)	Actions Required (if any)	Completion Date (planned)
1					
2					

Livelihood and Income Restoration

No.	Items Implemented	Description and Results	Issues of Concern (if any)	Actions Required (if any)
1				
2				
3				

Public Consultation

No.	Date	Venue	Record of Discussions
1			
2			
3			

Grievances and Complaints

No.	Description of Grievances/Complaints	Description of Response/Redress Measures	Actions Required (if any)
1			
2			
3			

Monitoring Form (draft) for Progress of Resettlement Activities

Name of HH Head : ______________________ Code No. (if applicable) : ______________________
Location : ______________________

Activities	Completion Date	Issues of Concern (if any)	Actions Required (if any)	Recorded by
Notice of Taking				
Confirmation of Proof of Ownership				
Payment Offer*				
Acceptance of Offer				
Payment (land)				
Payment (structure)				
Payment (improvements)				
Payment (others)				
Provision of Other Assistance				
Transfer of Title				
Notification of Demolition				
Relocation/Land Clearance				
Demolition of Structure				

*Payment offer must be based on fair market value of land, replacement cost for structures and improvements and current fair market value for crops and trees.

Monitoring Form (draft) for Livelihood and Income Restoration

Form No. : ____________________

Name of HH Head : ____________________ Code No. (if applicable) : ____________________

Location : ____________________

Date	Location	Occupation	Income Level		Issues of Concern	Actions Required	Recorded by
			vis-a-vis pre-relocation	monthly average (PhP)			
			better/no change/worse				
			better/no change/worse				
			better/no change/worse				
			better/no change/worse				
			better/no change/worse				
			better/no change/worse				
			better/no change/worse				

*Twice in the first year. Once in the second and third year.

Monitoring Form (draft) for Grievances and Complaints

Form No. : ____________________

Name of HH Head : ____________________ Code No. (if applicable) : ____________________

Location : ____________________

Date	Grievances/Complaints	Response/Redress Measures	Acceptance	Actions Required (if any)	Recorded by
			Y / N		
			Y / N		
			Y / N		
			Y / N		
			Y / N		
			Y / N		
			Y / N		

3.2 EXTERNAL MONITORING FORM (DRAFT)

External Monitoring Form (draft)

I. Evaluation of the RAP Process

No.	Items	Judgement	Description	Actions Required (if any)
1	Were the PAPs and their assets correctly enumerated?	Y / N / NA		
2	Was the time frame and budget sufficient to meet the objectives?	Y / N / NA		
3	Were entitlements too generous?	Y / N / NA		
4	Are activities for RAP implementation proceeding as planned?	Y / N / NA		
5	Were vulnerable groups identified and assisted?	Y / N / NA		
6	How did resettlement implementers deal with unforeseen problems?	Y / N / NA		

II. Livelihood and Income Restoration

No.	Items	Judgement	Description	Actions Required (if any)
1	Were compensation payments free of deduction for depreciation, fees or transfer costs to the PAP?	Y / N / NA		
2	Were compensation payments sufficient to replace lost assets?	Y / N / NA		
3	Did transfer and relocation payments cover these costs?	Y / N / NA		
4	Did income substitution allow for re-establishment of enterprises and production?	Y / N / NA		
5	Have enterprises affected received sufficient assistance to re-establish themselves?	Y / N / NA		
6	Have vulnerable groups been provided income-earning opportunities?	Y / N / NA		
7	Do the jobs provided restore pre-project income levels and living standards?	Y / N / NA		
8	Have PAPs adopted the housing options developed?	Y / N / NA		

III. Grievances and Complaints

No.	Items	Judgement	Description	Actions Required (if any)
1	How much do PAPs know about resettlement procedures and entitlements?	Y / N / NA		
2	Do PAPs know their entitlements?	Y / N / NA		
3	Do PAPs know if their entitlements have been met?	Y / N / NA		
4	How do PAPs assess the extent to which their own living standards and livelihoods been restored?	Y / N / NA		
5	How much do PAPs know about grievance redress and conflict resolution procedures?	Y / N / NA		
6	How satisfied are those who have used the said mechanisms?	Y / N / NA		

APPENDIX 4 ENVIRONMENTAL CHECKLIST

Environmental Checklist

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
1 Permits and Explanation	(1) EIA and Environmental Permits	(a) Have EIA reports been already prepared in official process?	(a) Y	(a) EIA (EIS report and IEE report/checklist) is required according to the environmental laws in the country. The EIA study report have been prepared in compliance to JICA's ESC guidelines, and in accordance with the country's environmental laws.
		(b) Have EIA reports been approved by authorities of the host country's government?	(b) N	(b) DPWH has forwarded the EIA report (Environmental Impact Statement) to DENR-EMB for its review, and then DENR-EMB will issue the Environmental Compliance Certificate (ECC) to DPWH in accordance with the Philippines environmental laws.
		(c) Have EIA reports been unconditionally approved? If conditions are imposed on the approval of EIA reports, are the conditions satisfied?	(c) N	(c) Same as above. In addition, mitigation measures, EMP, and EMoP are included in the EIA report in compliance with JICA's ESC guidelines.
		(d) In addition to the above approvals, have other required environmental permits been obtained from the appropriate regulatory authorities of the host country's government?	(d) N	(d) No particular environmental permits to execute the project were required other than the above approvals. However, cutting tree permit, effluent and discharge water permit, waste management and traffic management during construction will be required if they are mentioned so in the Environmental Compliance Certificates (ECC) of the Project.
	(2)Explanation to local stakeholders	(a) Have contents of the project and the potential impacts been adequately explained to the local stakeholders based on appropriate procedures, including information disclosure? Is understanding obtained from the Local stakeholders?	(a) Y	(a) The contents of the project and the potential impacts have been adequately explained to the Local stakeholders based on appropriate procedures, namely Information Education Communication (IEC) activities, public consultations/hearings and information disclosure. As a result, understanding has been obtained from the Local stakeholders.
		(b) Have the comment from the stakeholders (such as local residents) been reflected to the project design?	(b) Y	(b) The comments from the stakeholders such as local residents obtained during the meetings have been reflected to the project design.
	(3)Examination of alternatives	(a) Have alternative plans of the project been examined with social and environmental considerations?	(a) Y	(a) Several alternative plans have been examined comprehensively with social and environmental considerations.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
2 Pollution Control	(1) Air Quality	(a) Is there a possibility that air pollutants emitted from the project related sources, such as vehicles traffic will affect ambient air quality? Does ambient air quality comply with the country's air quality standards? Are any mitigating measures taken? (b) If air quality already exceed country's standards near the route, is there a possibility that the project will make air pollution worse?	(a) Y (b) N	(a) Although emission of the air pollutants from the vehicles traffic is expected, the predicted amount in the project locations are still complaint with the Philippines' air quality standard. (b) Forecasted values by using traffic volume estimation in 2039 on PM10, NO2 and SO2 are satisfied with adopted standard level. Thus the project negative impacts are negligible level.
	(2) Water Quality	(a) Is there a possibility that soil runoff from the bare lands resulting from earthmoving activities, such as cutting and filling will cause water quality degradation in downstream water areas? (b) Is there a possibility that the project will contaminate water sources, such as well water?	(a) N (b) N	(a) During construction, soil run off may possibly occur from the bare lands resulting from earth moving activities during heavy rains, however, impacts may be mitigated through erosion /sedimentation control measures, or stoppage of soil clearing during heavy rains, hence water quality degradation in downstream water areas with regards to soil runoff is not expected. (b) Contamination by surface runoff from roads of water sources such as groundwater is not possible as it will be drained to the existing outlet.
	(3) Noise and Vibration	(a) Do noise and vibrations from the vehicle traffic comply with the country's standards? (b) Do low frequency sound from the vehicle and train traffic comply with the country's standards?	(a) N (b) N	(a) Current noise level in the project area exceeds the country's general standards for the area which requires quietness such as an area within 100 m from school sites, and General residential areas, but the levels are within Philippine noise standards for areas directly facing four-lane roads. On the other hand, future forecast value also exceeds the IFC standard within 3 dB from the background level (Base Line level) for the area which requires quietness, therefore mitigation measures will be implemented for this area. Future forecast value of vibration is within the Japanese standard. (b) Based on the traffic volume estimation, the share of the heavy vehicle is limited, so there is a rare possibility to generate low frequency sound.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
3 Natural Environment	(1) Protected Areas	(a) Is the project site or discharge area located in protected areas designated by the country's laws or international treaties and conventions? Is there a possibility that the project will affect the protected areas?	(a) N	(a) There are no legally-designated protected areas in and around the project site.
	(2) Ecosystem	(a) Does the project site encompass primeval forests, tropical rain forests, ecologically valuable habitats (e.g., coral reefs, mangroves, or tidal flats)? (b) Does the project site encompass the protected habitats of endangered species designated by the country's laws or international treaties and conventions? (c) If significant ecological impacts are anticipated, are adequate protection measures taken to reduce the impacts on the ecosystem? (d) Are adequate protection measures taken to prevent impacts, such as disruption of migration routes, habitat fragmentation, and traffic accident of wildlife and livestock? (e) Is there a possibility that installation of roads will cause impacts, such as destruction of forest, poaching, desertification, reduction in wetland areas, and disturbance of ecosystems due to introduction of exotic (non-native invasive) species and pests? Are adequate measures for preventing such impacts considered?	(a) Y (b) Y (c) Y (d) Y (e) Y	(a) As the whole project area is included in the important bird area (IBA) and key biodiversity area (KBA), there is a concern about the negative impact on mangrove forests, tidal flats, and the organisms that use them (especially birds). (b) There are terrestrial trees to be possibly removed includes Molave (Vitex parviflora) classified under endangered category of the DAO No.1-2004. (c) Threatened species 'Molave' in considerable size or length should be replanted to protect from direct disturbance of construction equipment. Compensatory plantation of mangrove and terrestrial trees in accordance with DENR relevant regulation(s). (d) To minimize the risk and mitigate the impact, the following mitigation measures will be carried out: i) installment of road sign warning with birds and ii) recessed road lighting at the interchange area near the mangrove forest potentially used as roosting ground by birds. Furthermore, the following measures will be considered in the D/D phase: i) creation of wetland eco park near the interchange area, and ii) installment of more than 4m 'bird-car collision prevention poles' at the both sides of the balustrade of the coastal road and the bridge at intervals of around 2m. (e) Biodiversity Survey (i.e. detailed bird survey) will be carried out at the early stage of the D/D, and the results will be considered as an input in the design of coastal road, interchange and bridge to minimize the disturbance to IBA/KBA.
	(3) Hydrology	(a) Is there a possibility that alteration of topographic features and installation of structures, such as tunnels will adversely affect surface water and groundwater flows?	(a) Y	(a) There are activities which may affect groundwater flows such as excavation for viaduct.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
	(4) Topography and Geology	(a) Is there any soft ground on the route that may cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides, where needed? (b) Is there a possibility that civil works, such as cutting and filling will cause slope failures or landslides? Are adequate measures considered to prevent slope failures or landslides? (c) Is there a possibility that soil runoff will result from cut and fill areas, waste soil disposal sites, and borrow sites? Are adequate measures taken to prevent soil runoff?	(a) N (b) N (c) N	(a) Topography and Geology of the project area is known as limestone. Soft ground on the route that may cause slope failures or landslides was limited. (b) The Project does not include massive cutting and filling roads. (c) For the prevention of the soil runoff, vegetation in the borrow pit will be recovered by returning topsoil. Slope protection such as stone pitching or vegetation is adequate measures to be taken to prevent soil runoff.
4 Social Environment	(1) Resettlement	(a) Is involuntary resettlement caused by project implementation? If involuntary resettlement is caused, are efforts made to minimize the impacts caused by the resettlement? (b) Is adequate explanation on compensation and resettlement assistance given to affected people prior to resettlement?	(a) Y (b) Y	(a) The survey revealed that there were 42 land owners, 33 non-residential structure[1] and asset (e.g. fences) owners that belong to mainly private companies and government bodies, eight tenants and 243 persons that belong to 69 households affected by the project. Excluding any duplication among the land owners and structure and asset owners, the total number of affected persons and entities, considering each company to be one entity, is 322 in total. All of the 69 households (i.e. informal settlers) are all expected to be relocated. An initial effort to avoid or minimize the impacts caused by resettlement includes selecting a route passing through the coast of Cebu Island instead of that that passes through a more inland route, which was expected to result in five times more households subject to resettlement. Similarly, a route was selected for the bridge location that was expected to entail the least number of resettlement. (b) Explanation of the project, compensation and resettlement has been given to the PAPs twice in Mandaue City where all to-be-dislocated PAPs reside. In addition, information has been disseminated to them through their respective barangay captains. Similarly, group consultations have been held with project-affected companies twice in Mandaue City and twice in Lapu-Lapu City. In addition, DPWH has visited each company individually to explain and accommodate their requests for more

[1] While improvements include structures according to the definition in RA7279, structures, referring to buildings and other physical, relatively large objects are described separately from improvements in this report to give the readers better understanding of the assets that are affected.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
				than 15 times.
		(c) Is the resettlement plan, including compensation with full replacement costs, restoration of livelihoods and living standards developed based on socioeconomic studies on resettlement?	(c) Y	(c) A resettlement action plan (RAP) including compensation policy and package based on replacement cost and livelihood restoration program has been prepared based on the socio-economic study carried out during the socio-economic studies.
		(d) Are the compensations going to be paid prior to the resettlement?	(d) Y	(d) Compensation will be made prior to resettlement in accordance with the RAP.
		(e) Are the compensation policies prepared in document?	(e) Y	(e) Compensation policies including the Entitlement Matrix have been prepared and documented in the RAP.
		(f) Does the resettlement plan pay particular attention to vulnerable groups or people, including women, children, the elderly, people below the poverty line, ethnic minorities, and indigenous peoples?	(f) Y	(f) The RAP has been prepared with due respect to vulnerable groups of people including female-headed households, the elderly and people below the poverty line, which have been identified through the socio-economic surveys. There is no ethnic minority or indigenous people in the project-affected area or in the area nearby.
		(g) Are agreements with the affected people obtained prior to resettlement?	(g) N	(g) Agreements with the affected people are to be obtained during and/or after the detail design (D/D) where the PAPs will be finalized.
		(h) Is the organizational framework established to properly implement resettlement? Are the capacity and budget secured to implement the plan?	(h) N	(h) Organizational framework for resettlement has been prepared and documented in the RAP. It is expected to be established during and/or after the D/D (i.e. before project implementation). Necessary budget will be secured based on the amount estimated to be needed through the RAP study. DPWH has been carrying out compensation and resettlement in the past so they are considered to have sufficient capacity.
		(i) Are any plans developed to monitor the impacts of resettlement?	(i) Y	(i) A monitoring plan has been prepared and documented in the RAP.
		(j) Is the grievance redress mechanism established?	(j) N	(j) A grievance redress mechanism has been prepared and documented in the RAP. It is expected to be established during and/or after the D/D (i.e. before project implementation).
	(2) Living andLivelihood	(a) Where roads are newly installed, is there a possibility that the project will affect the existing means of transportation and the associated workers? Is there a possibility that the project will cause significant impacts, such as extensive alteration of existing land uses, changes in sources of	(a) Y/N	(a) Yes, the project will provide easy access in terms of transportation. The project will not cause any significant impacts on extensive alteration of existing land uses, but will possibly give additional sources of livelihood and employment.

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		livelihood, or unemployment? Are adequate measures considered for preventing these impacts? (b) Is there any possibility that the project will adversely affect the living conditions of the inhabitants other than the target population? Are adequate measures considered to reduce the impacts, if necessary? (c) Is there any possibility that diseases, including infectious diseases, such as HIV will be brought due to immigration of workers associated with the project? Are adequate considerations given to public health, if necessary? (d) Is there any possibility that the project will adversely affect road traffic in the surrounding areas (e.g., increase of traffic congestion and traffic accidents)? (e) Is there any possibility that roads will impede the movement of inhabitants? (f) Is there any possibility that bridges will cause a sun shading and radio interference?	(b) N (c) N (d)Y/ N (e) Y/N (f) N	(b) Significant change on living conditions of the inhabitants other than the target population is not expected because the project is construction of regional roads with less traffic volume. (c) The objective of the project is to build regional road network for local people, which is expected to recruit most of the workers from the locals. Therefore influence of such disease will be minimal. (d) Since the components of the project are local road construction in no road network area, traffic accidents are expected to increase. If necessary, it will be to establish traffic safety facilities. (e) Pedestrian crossings and other traffic safety facilities will be installed on and along the roads which improve movement of inhabitants. (f) No, elevated roads (bridge) in residential and agricultural area isn't to be constructed by the project.
	(3) Heritage	(a) Is there a possibility that the project will damage the local archeological, historical, cultural, and religious heritage? Are adequate measures considered to protect these sites in accordance with the country's laws?	(a) N	(a) No such facilities are identified in the project area.
	(4) Landscape	(a) Is there a possibility that the project will adversely affect the local landscape? Are necessary measures taken?	(a) N	(a) No local landscape in the project area that will be affected, hence impact on landscape is not anticipated.
	(5) Ethnic Minorities and Indigenous Peoples	(a) Are considerations given to reduce impacts on the culture and lifestyle of ethnic minorities and indigenous peoples? (b) Are all of the rights of ethnic minorities and indigenous peoples in relation to land and resources respected?	(a) N (b) N	(a) There are no ethnic minority located in the project area. (b) Same as above.
	(6) Working Conditions	(a) Is the project proponent not violating any laws and ordinances associated with the working conditions of the country which the project proponent should observe in the project? (b) Are tangible safety considerations in place for individuals involved in the project, such as the installation of safety	(a) Y (b) Y	(a) Securing the working condition is fully implemented based to the relevant Philippines laws and DPWH's guidelines. (b) Measures to prevent industrial accidents are secured by mitigation measures such as obligation of wearing safety boots

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		equipment which prevents industrial accidents, and management of hazardous materials? (c) Are intangible measures being planned and implemented for individuals involved in the project, such as the establishment of a safety and health program, and safety training (including traffic safety and public health) for workers etc.? (d) Are appropriate measures being taken to ensure that security guards involved in the project not to violate safety of other individuals involved, or local residents?	(c) Y (d) Y	and a helmet during the construction work, setting signboards, barricades. Training all personnel in hazard materials handling and storage procedure will also be conducted. (c) Contractor will prepare a safety and sanitation plan, including safety training for the workers and establishment of a safety health program. (d) Setting of signboards and fences in restricted and danger areas around the construction sites will be set up. Information Education Communication (IEC) will be conducted to the community in cooperation with the Local Government Units.
5 Others	(1) Impacts during Construction	(a) Are adequate measures considered to reduce impacts during construction (e.g., noise, vibrations, turbid water, dust, exhaust gases, and wastes)? (b) If construction activities adversely affect the natural environment (ecosystem), are adequate measures considered to reduce impacts? (c) If construction activities adversely affect the social environment, are adequate measures considered to reduce impacts?	(a) Y (b) Y (c) Y	(a) Generation of the certain noise, vibrations, dust, turbid water, exhaust gasses and waste are assumed. Mitigation measures and monitoring plan are established through EIA (EIS/IEE) study. (b) Development of waste management plan, basic instruction to the workers, adequate maintenance and cleaning of machines to mitigate adverse impact etc are recommended and presented in the EIA (EIS/IEE) study report. (c) Disturbance of movement and business, and traffic congestion are assumed. Mitigation measures such as adequate scheduling and communication with local communities in timely manner, traffic operation as a one-way alternating traffic, and monitoring plan are to be established and prepared in D/D stage.
	(2) Monitoring	(a) Does the proponent develop and implement monitoring program for the environmental items that are considered to have potential impacts? (b) What are the items, methods and frequencies of the monitoring program? (c) Does the proponent establish an adequate monitoring	(a) Y (b) Y (c) Y	(a) Monitoring plan has been made and shared with proponent. (b) The items, methods and frequencies of monitoring already included in the Environmental Monitoring Plan of the EIA (EIS/IEE) report. The monitoring items were decided considering the present condition survey results and impact evaluation. Monitoring methods were decided considering implementation practicability of Philippines government and securing accuracy. Frequency was decided considering types of work, local situation, and health damage. (c) Monitoring framework has been suggested in the monitoring

Category	Environmental Item	Main Check Items	Yes: Y No: N	Confirmation of Environmental Considerations (Reasons, Mitigation Measures)
		framework (organization, personnel, equipment, and adequate budget to sustain the monitoring framework)? (d) Are any regulatory requirements pertaining to the monitoring report system identified, such as the format and frequency of reports from the proponent to the regulatory authorities?	 (d) Y	plan. This framework has to be adapted reflecting the present condition of Philippine as possible. Proponent will designate or procure one staff or consultant as Environmental Social Safeguard Officer of this project who will specifically work for the liaison with other organizations and a core actor of supervising the monitoring. (d) Monitoring report shall be submitted by the contractor during the construction stage while the reports after the construction stage shall be prepared by DPWH. Format and frequency of reports will be based on the regulatory requirements.
6 Notes	Reference to Checklist of Other Sectors	(a) Where necessary, pertinent items described in the Forestry Projects checklist should also be checked (e.g., projects including large areas of deforestation). (b) Where necessary, pertinent items described in the Power Transmission and Distribution Lines checklist should also be checked (e.g., projects including installation of power transmission lines and/or electric distribution facilities).	(a) N (b) N/A	(a) Forestry Projects, such as work of cutting, processing and shipping woods, are out of the project scope. (b) N/A
	Note on Using Environmental Checklist	(a) If necessary, the impacts to transboundary or global issues should be confirmed, if necessary (e.g., the project includes factors that may cause problems, such as transboundary waste treatment, acid rain, destruction of the ozone layer, or global warming).	(a) N	(a) No pollution impacts to be reached toward surrounding countries due to the project type and location.