CHAPTER 13
FEASIBILITY STUDY OF 7th BRIDGE

13.1 Objectives of the Project

The 7th Bridge is planned to be constructed at about 400m upstream side of the existing Carmen Bridge which is one of two bridges accessing to CDO CBD and is the most congested section in the Study Area. Objectives of the project are as follows:

Objectives of the Project

- To reduce traffic congestion of existing Carmen Bridge.
- To improve accessibility to CDO CBD.
- To guide and accelerate sound urbanization in the eastern area of Cagayan de Oro River.

13.2 Physical Features of the Project Site

Steep slope is formed at the west side of CDO River and ground elevation changes from 12m to 4m with the slope gradient of about 7%. The width of CDO River at low water level is about 120m. Topography of the east side of CDO River is relatively flat with ground elevation of 3 to 5m. Residential area has been developed at the ground elevation of 6 to 9m.

The geological formation consists of gravel, shale and tuffaceous sandstone which is called as "Cagayan Terrace Gravel". The gravel consists of unsorted, slightly consolidated, subrounded to rounded pebbles and boulders with the diameter of sometimes more than 1m. The east lowland is used to be a river bed and is flooded during heavy rain.

Land use of the west side of CDO Riverd is predominantly residential. The east lowland is an open space at present.

13.3 Engineering Surveys Conducted

The following three surveys were undertaken:

- Orthophoto Maping utilizing existing aerial photos
- Road Alignment Survey
- Geo-technical Survey and Soils/Materials Survey

1) Orthophoto Mapping
   - Existing aerial photos : Photo Scale = 1/15,000
   - Orthophoto Mapping : Scale = 1/5,000

2) Road Alignment Survey
   - Control points survey
   - Center line survey (50m interval)
   - Profile survey (50m interval)
   - Cross-section survey (50m interval, width=60m)
   - River profile / cross section survey (Cagayan de Oro river)
3) Geo-technical Survey and Soils/Material Source Survey
   - Bridge site geo-technical survey (depth=10~45m)
   - Soft ground investigation (depth=20m)

13.4 Selection of Route Alignment

13.4.1 Control Points for Selecting Route Alignment

Control points for selecting route alignment are as follows (see Figure 13.4-1):

- At the west bank side, there are many houses. Relocation of houses cannot be avoided, thus how to minimize social impact is the key issue.
- At the east bank side, mainly open spaces extend, however, there are some on-going development along Tomas Saco Street. An alignment should be selected not to affect such development.
- The beginning point shall be at the curved portion of CDO-Talakag Road.
- An alignment ends at Tomas Saco Street, where least social impact is achieved.
- A link road to directly connect the 7th Bridge alignment with CBD needs to be developed. An extension of A. Velez Street is selected for a link road.
- It is proposed that Carmen Bridge and 7th Bridge be operated as one-way; Carmen Bridge for west bound traffic and 7th Bridge for east bound traffic.

13.4.2 Alternative Alignments

Two alternative alignments were developed with regard to vertical alignments, two alternatives were developed; one is to achieve an at-grade intersection at Acacia Street, thus traffic on Acacia Street can utilize 7th Bridge, and the other is to over pass Acacia Street to provide better vertical alignment for 7th Bridge. Alternatives of horizontal alignment are shown in Figure 13.4-1. Alternatives for vertical alignments are shown in Figure 13.4-2.

13.4.3 Evaluation of Alternative Alignments and Selection of the Best Alignment

Four alternatives were evaluated and selected as shown in Table 13.4-1.

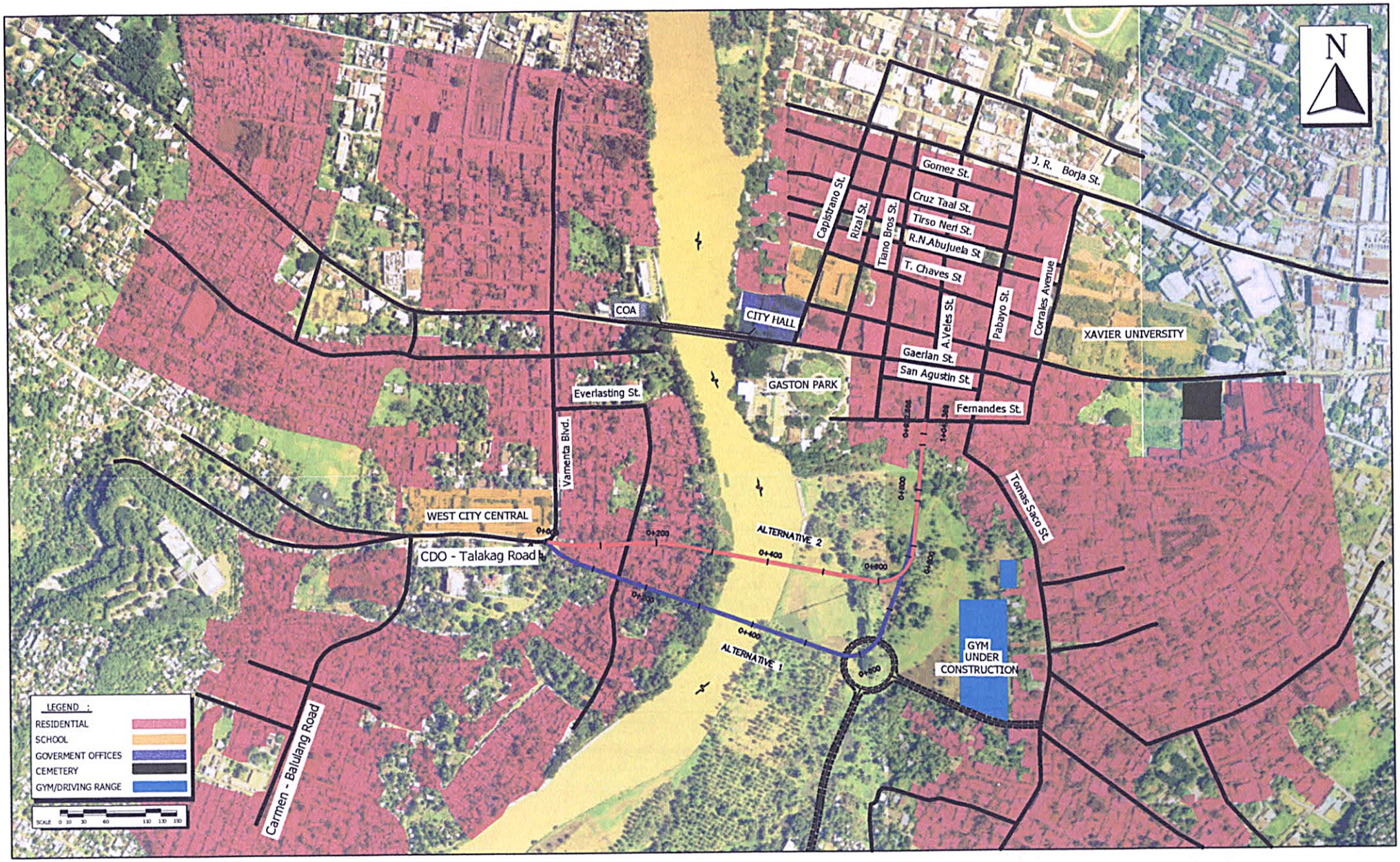
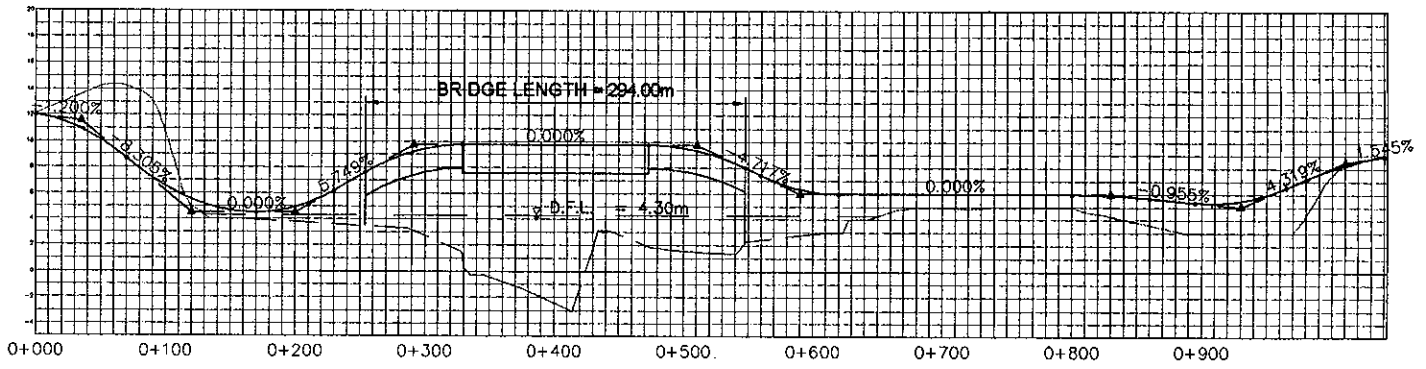
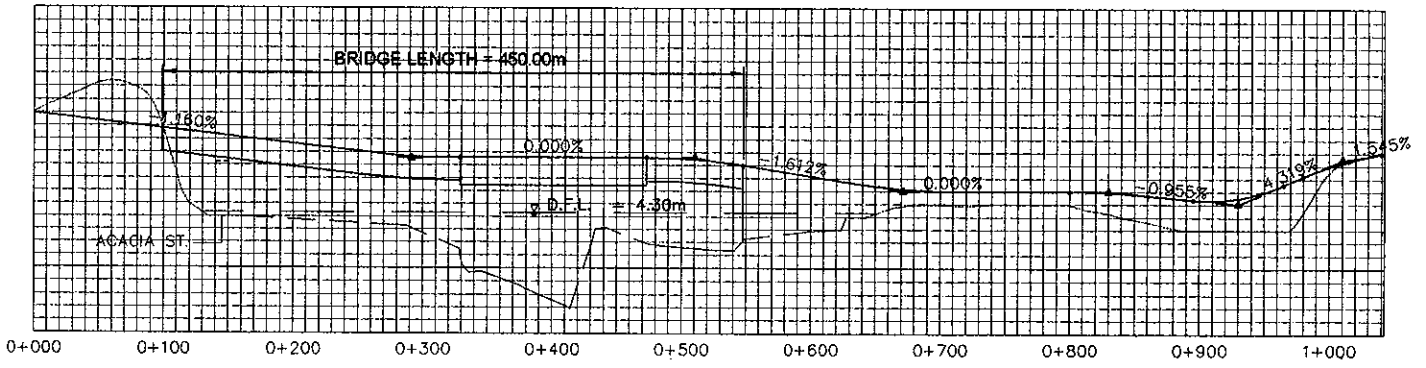


FIGURE 13.4-1 ALTERNATIVE ALIGNMENTS ON THE 7TH BRIDGE



AL−1A



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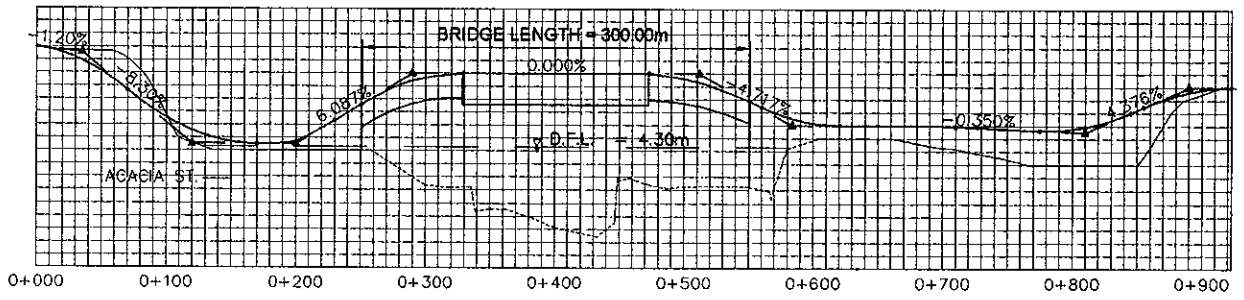
CDO 7th BRIDGE ALTERNATIVE 1



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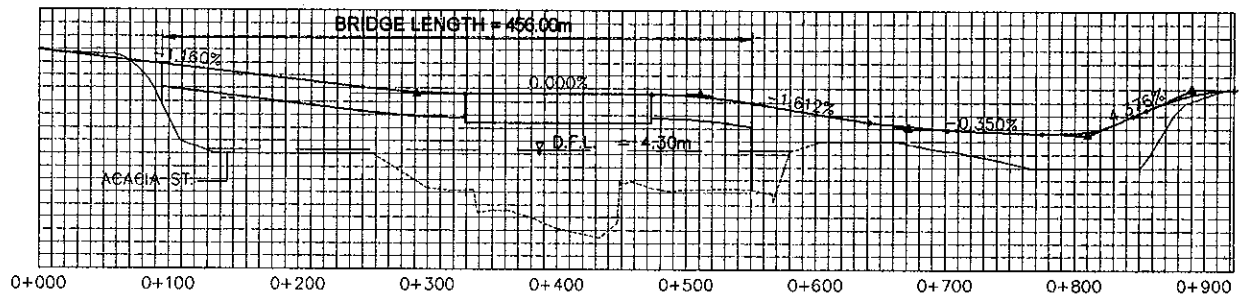


AL−2B

CDO 7th BRIDGE ALTERNATIVE 2

Figure 13.4-2 7th Bridge Alternative Profiles

TABLE 13.4-1 EVALUATION OF ALTERNATIVE ALIGNMENTS : 7th BRIDGE

		Alternative - 1		Alternative - 2	
		1-A	1-B	2-A	2-B
1) Site Conditions and Issues		• Western area is heavily built-up. An alignment which minimize social impact should be selected. • Eastern area is low land subjected to flood. • Elevation difference between CDO-Talakag Road and Acacia St. is about 7.5m.			
2) Planning Concept		• To pass through one of less built-up area. • Bridge section on tangent alignment. • At-grade intersection with Acacia St.	• Same as 1-A, except an alignment overpass Acacia St.	• To pass through another less built-up area. • At-grade intersection with Acacia St.	• Same as 2-A, except an alignment overpass Acacia St.
3) Scope of Civil Work	Road Length (km)	0.746	0.590	0.620	0.464
	Bridge Length (km)	0.294	0.450	0.300	0.456
	Total (km)	1.040	1.040	0.920	0.920
4) Construction Cost (Million P)	Road	31.9	25.9	26.3	20.2
	Bridge	132.3	194.7	144.0	206.4
	Total	164.2	220.6	170.3	226.6
5) ROW / Relocation Cost (Million P)	ROW	18.9	18.9	16.6	16.6
	Relocation	7.2	5.8	8.2	6.6
	Total	26.1	24.7	24.8	23.2
6) Evaluation	a) Horizontal Alignment	Rmin.=60m	Rmin.=60m	Rmin.=60m	Rmin.=60m
	b) Vertical Alignment	i =8.3% Cut height = 6.0 m	i =4.3% Emb. height = 5.5 m	i =8.3% Cut height = 3 m	i =4.3% Emb. height = 7 m
	c) Construction Cost	- (1.00)	+56.4 (1.34)	+6.1 (1.04)	+62.4 (1.38)
	d) ROW / Relocation Cost	- (1.00)	-1.4 (0.95)	-1.3 (0.95)	-2.9 (0.89)
	e) Social Impact (No.of Affected Structures)	36	29	41	33
	f) Advantages / Disadvantages	• Most economical • Slightly higher social impact. • Steep gradient. • Accessible from Acacia Street.	• Expensive. • Least social impact. • Gentle gradient. • Not accessible from Acacia St.	• 7% higher cost. • Highest social impact. • Steep gradient. • Accessible from Acacia St.	• Most expensive. • Slightly higher social impact. • Gentle gradient. • Not accessible from Acacia St.
7) Recommendation		◎ Recommended	X	X	X

13.5 Traffic Forecast

Estimated traffic volume by section is shown in Table 13.5-1 and number of lanes required is shown in Figure 13.5-1.

Although traffic volume will exceed traffic capacity of a 2-lane bridge, the bridge is recommended to be constructed as a 2-lane bridge, since connecting roads in CBD are all 2-lane roads.

TABLE 13.5-1 ESTIMATED TRAFFIC VOLUME BY SECTION

			7th Bridge	Approach E (Bridge Extension)	Approach N (Link Road)
Traffic Volume (100 PCU)	2010		26.9	22.5	23.1
	2016		34.9	30.8	27.5
	2022		41.7	33.7	39.4
V/C Ratio	2-lane	2010	0.90	0.75	0.77
		2016	1.16	1.03	0.92
		2022	1.39	1.12	1.31

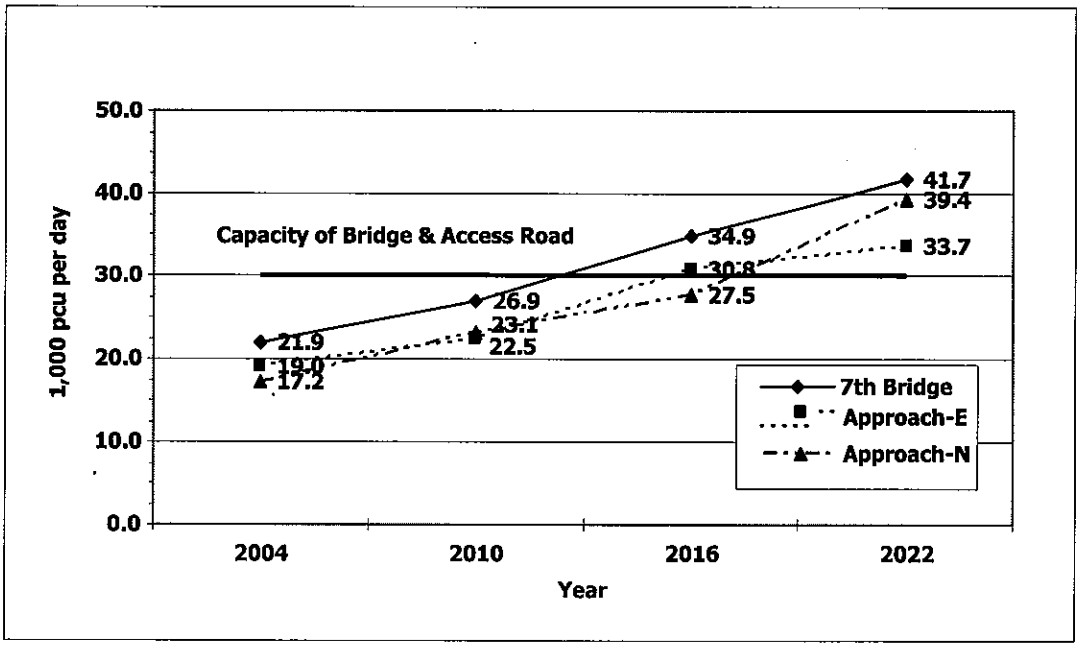


FIGURE 13.5-1 NO. OF LANES REQUIRED

13.6 Construction Phasing

Since it is recommended to be constructed as a 2-lane bridge, stage construction is not possible. The bridge should be constructed as early as possible.

13.7 Preliminary Design

13.7.1 Design Concepts and Criteria

1) Design Concepts

Traffic concentrates at Carmen Bridge which is one of two bridges providing access to CDO CBD at present. The 7th Bridge provides another access route to CDO CBD, thus reduces traffic congestion of Carmen Bridge.

The 7th Bridge will be connected with the existing 2-lane roads in CDO CBD.

The design concepts were established as follows:

Design Concept

- Design speed of 50 km/hour is selected. It is governed by those of the connecting roads.
- To minimize adverse social impact at the west bank side area, slope protection works are to be adopted in order to reduce ROW width.
- Carmen Bridge and the 7th Bridge are planned to be operated as one-way.
- Intersections are so designed that a left-turn lane is provided.

2) Road and Intersection Design Criteria

Highway design criteria are shown in Table 13.7-1. The same intersection design criteria shown in Table 12.7-2 were adopted.

Typical cross-sections are shown in Figure 13.7-1.

Road right-of-way was established as follows:

Standard ROW : 20m including an access road.

TABLE 13.7-1 HIGHWAY DESIGN CRITERIA

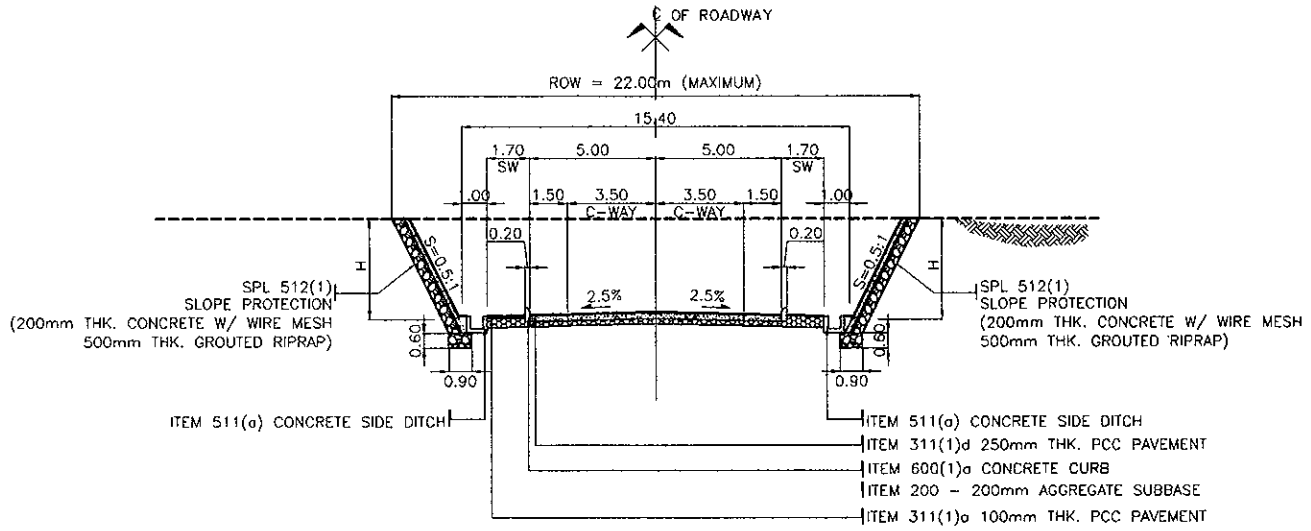
Element	Unit	Rolling/Flat Terrain
Design Speed	Km/hr.	50
No. of Lanes	-	2
Type of Pavement	-	PCCP
Lane Width	m	3.5
PUV Loading / Unloading Lane	m	2.0
Median	m	-
Sidewalk	m	1.5
Stopping Sight Distance	m	65
Passing Sight Distance	m	340
Minimum Horizontal Radius	m	80
Minimum Horizontal Radius for Normal Cross Slope	m	1,200
Maximum Vertical Grade	%	8 10(300^{m})
Minimum Length of Vertical Curve	m	60
Maximum Superelevation	%	6
Normal Cross Slope	%	2~2.5
Vertical Clearance	m	5

3) Bridge and Structures

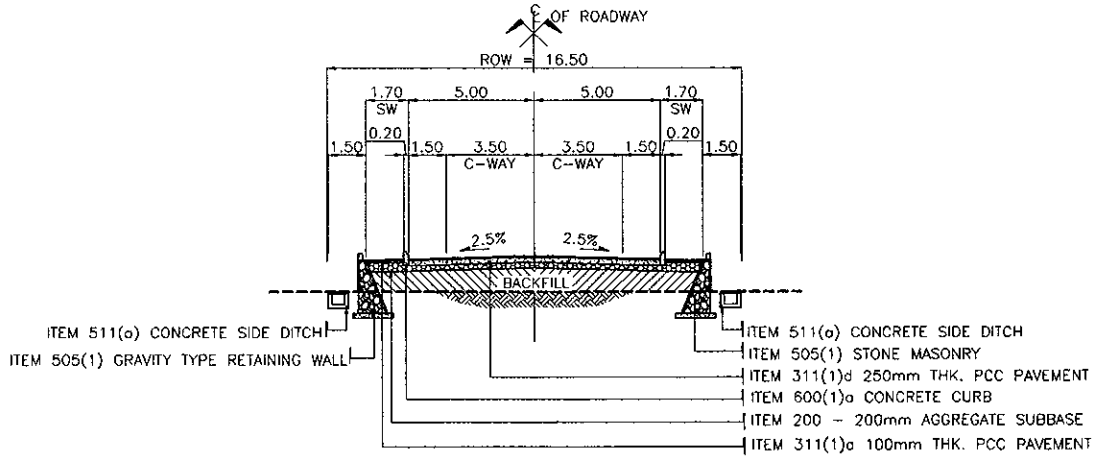
The same design criteria as shown in Section 12.7.1 were adopted.

4) Drainage and Cross Drainage Facilities

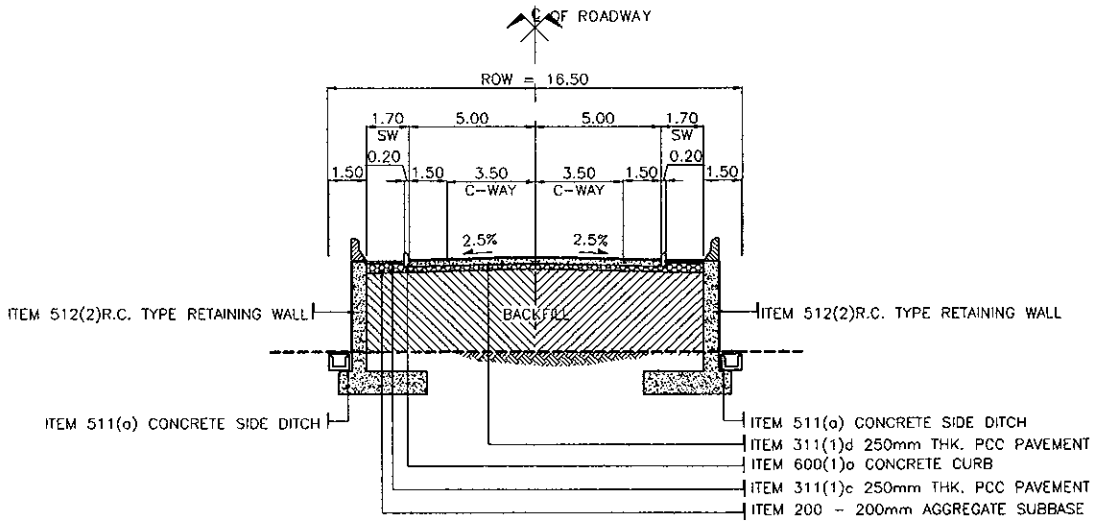
The same design criteria as shown in Section 12.7.1 were adopted.



CUT SECTION H < 5.00 m

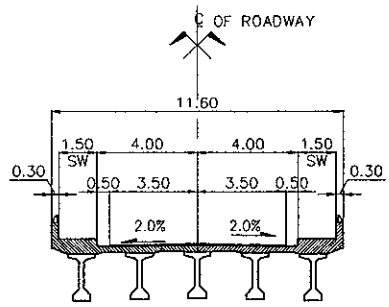


EMBANKMENT SECTION H<1.00 m

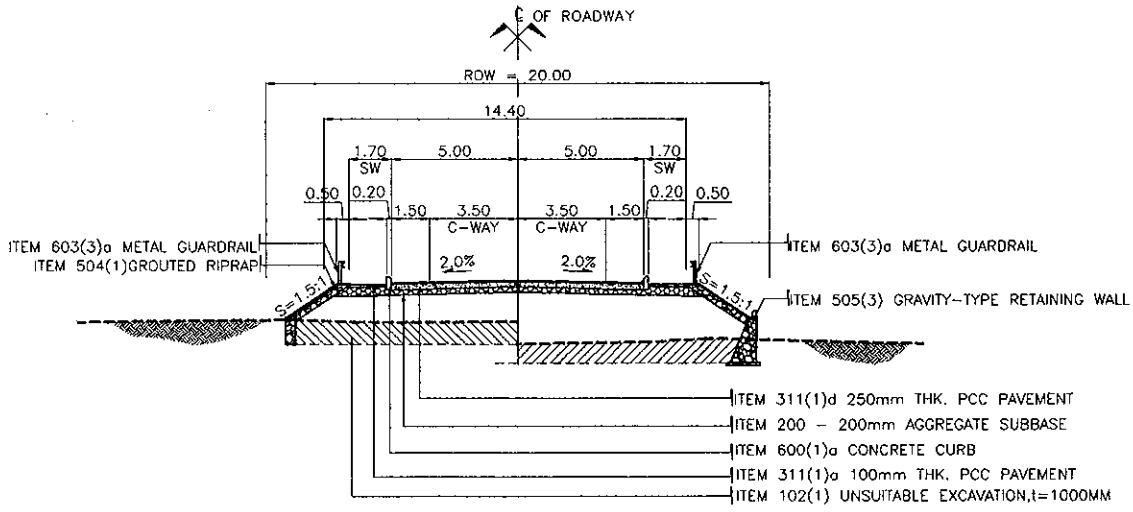


APPROACH SECTION (WEST SIDE)

FIGURE 13.7-1 (1/2) TYPICAL CROSS SECTIONS : 7th BRIDGE AND ACCESS ROAD



BRIDGE SECTION



EMBANKMENT SECTION H<1.00 m

FIGURE 13.7-1 (2/2) TYPICAL CROSS SECTIONS : 7th BRIDGE AND ACCESS ROAD

13.7.2 Road and Intersection Design

1) Horizontal Alignment

Horizontal alignment was designed to satisfy the design speed of 50km/hour, and is shown in Figure 13.7-2. Minimum horizontal curve used is 60 m in radius with superelevation of 6%.

2) Vertical Alignment

Control points for vertical alignment design were as follows:

- Elevation of CDO-Talakag Road (beginning point)
- Elevation of Acacia Street from which access is made to 7th Bridge.
- Bridge elevation which is determined from the maximum flood level, freeboard of 1.5m and structural depth required.
- Minimum depth of 0.6m from road surface to the top of pipe culvert to avoid reinforcement of pipe culvert.

3) Typical Cross-sections Applied

Typical cross-sections were applied to the following sections:

Type of Typical Cross-Sections	Applied Section	Length
Cut Section	Km 0+000 – Km 0+110	L = 0.110 km
Bridge Approach Section	Km 0+200 – Km 0+254	L = 0.054 km
Embankment Section	Km 0+548 – Km 0+990	L = 0.352 km

4) Intersection Design

All major intersections were provided with left turn lanes. Major intersections are as follows:

- Intersection with CDO-Talakag Road (Figure 13.7-3)
- Intersection with CBD Access Road

5) Traffic Operation Scheme

The 7th Bridge is going to be connected with roads in CBD which are all 2-lane road. Carmen Bridge and its connecting roads are also 2-lane roads. It is recommended that one-way traffic operation system be introduced in this area as shown in Figure 13.7-4.

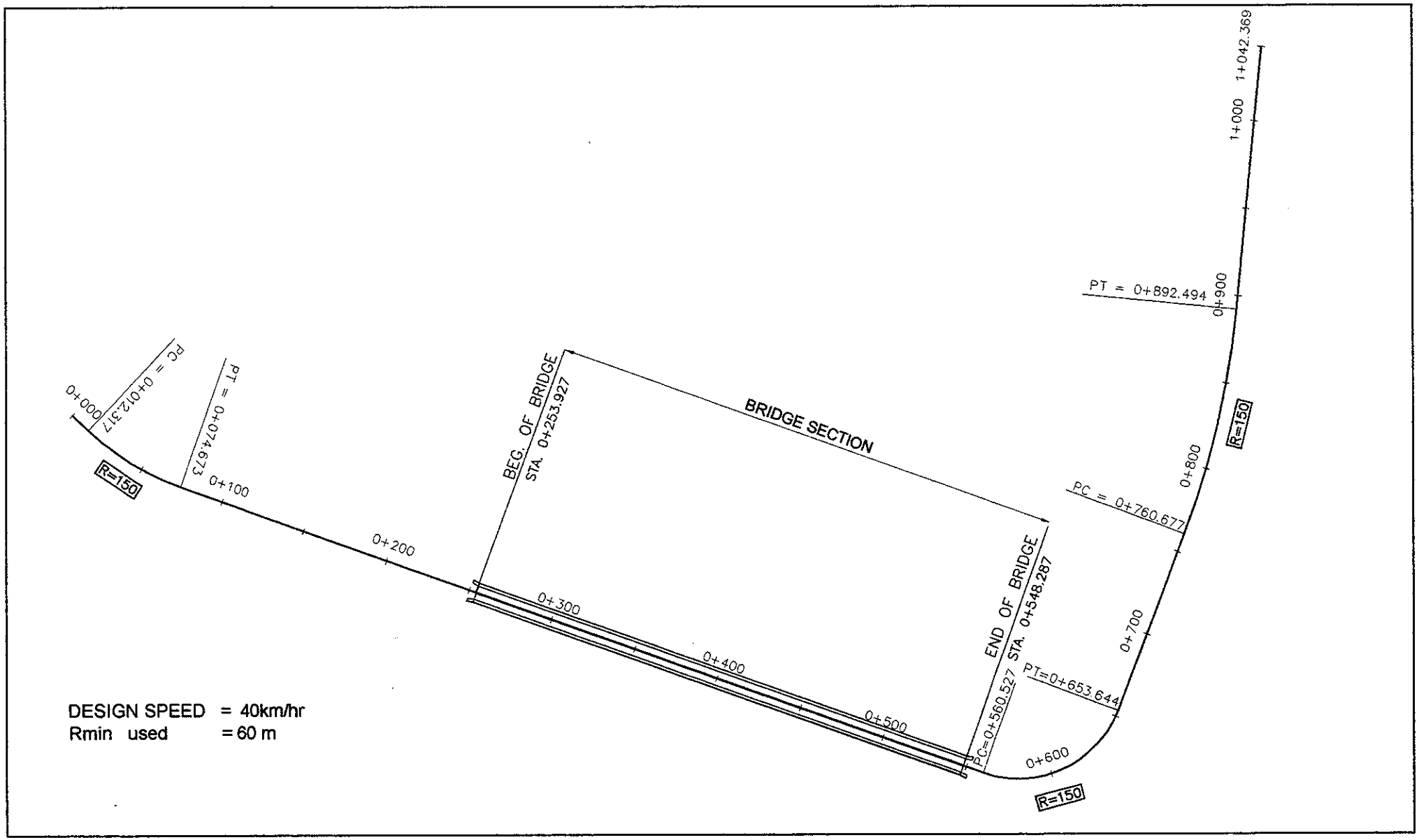
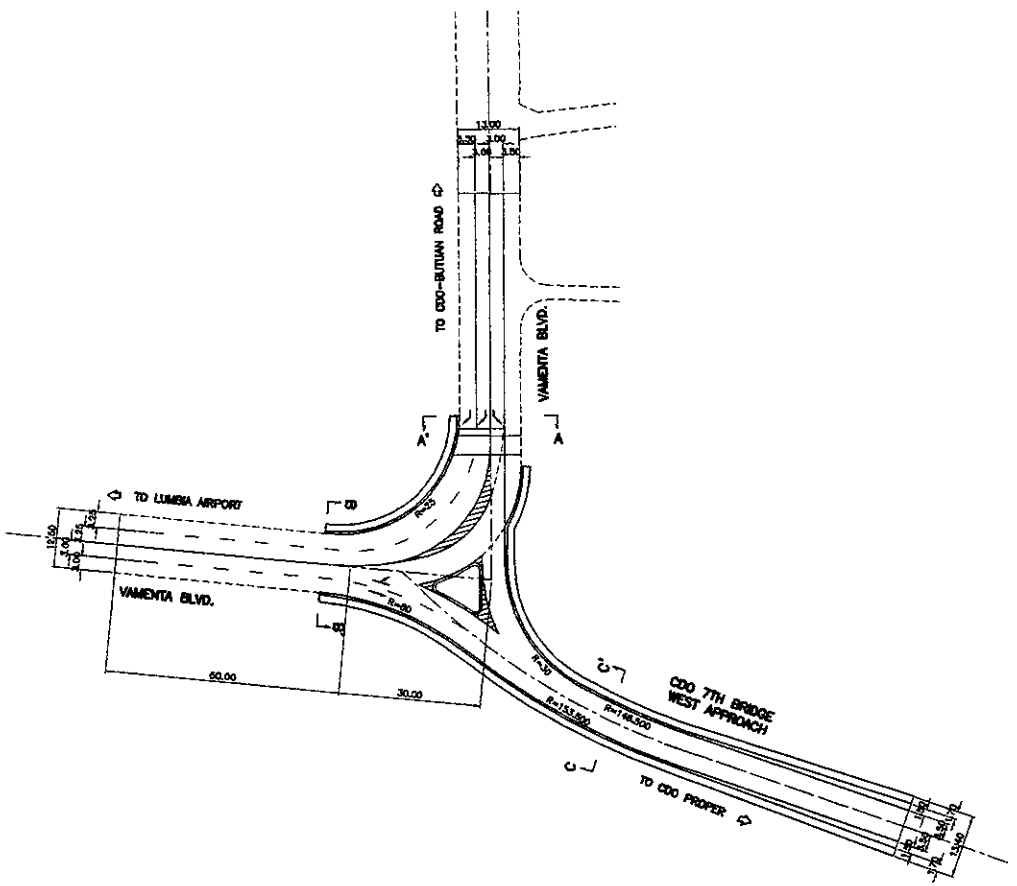
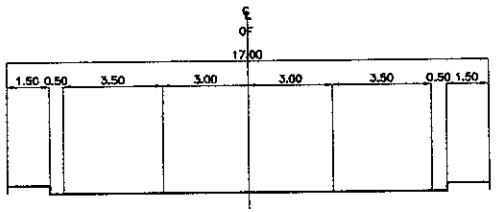
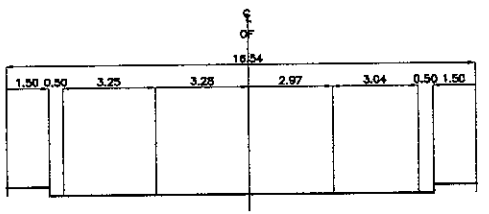


FIGURE 13.7-2 7tH BRIDGE HORIZONTAL ALIGNMENT

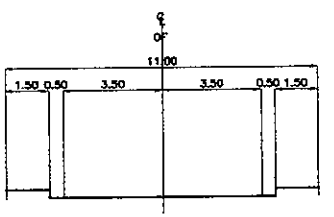




A–A' : VAMENTA BLVD.

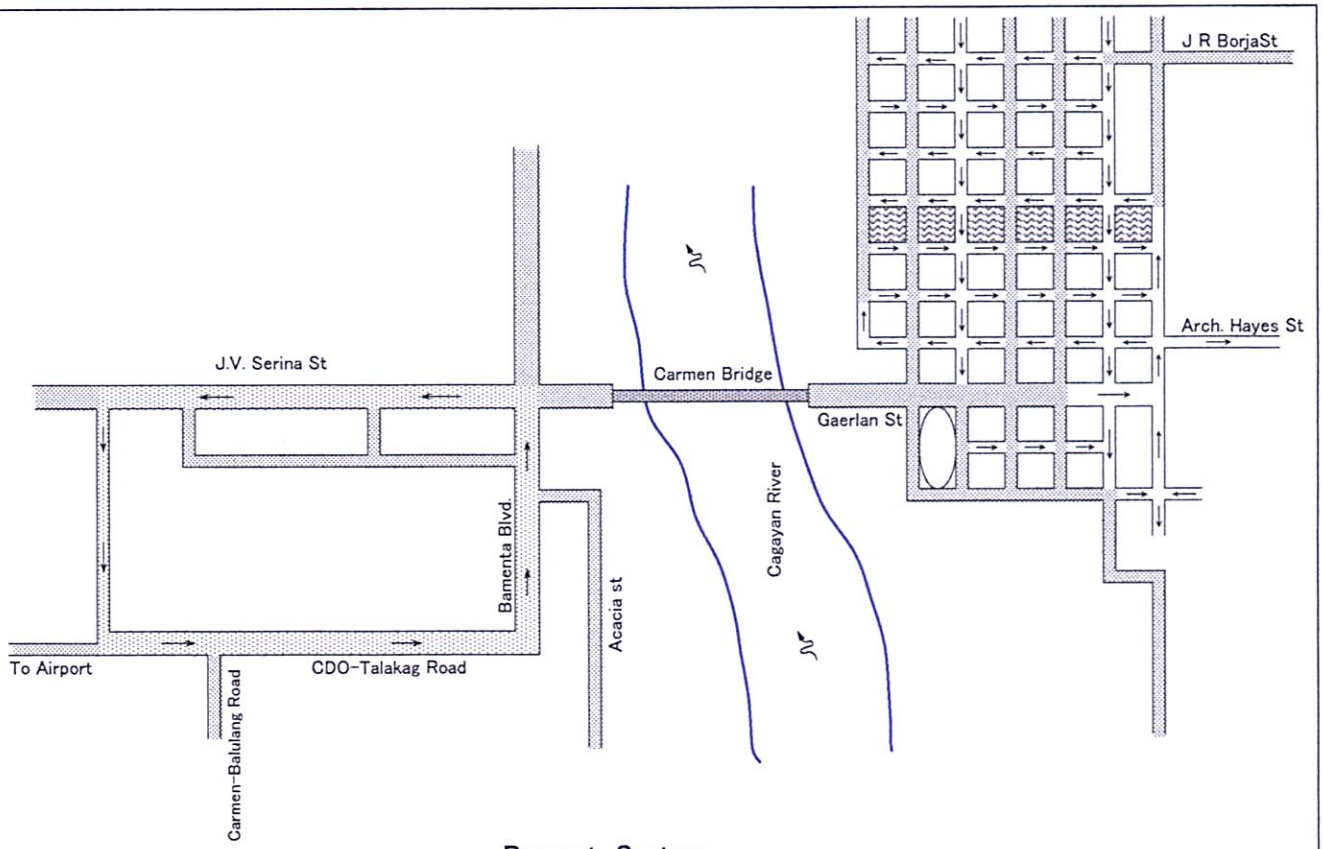


B–B' : VAMENTA BLVD.

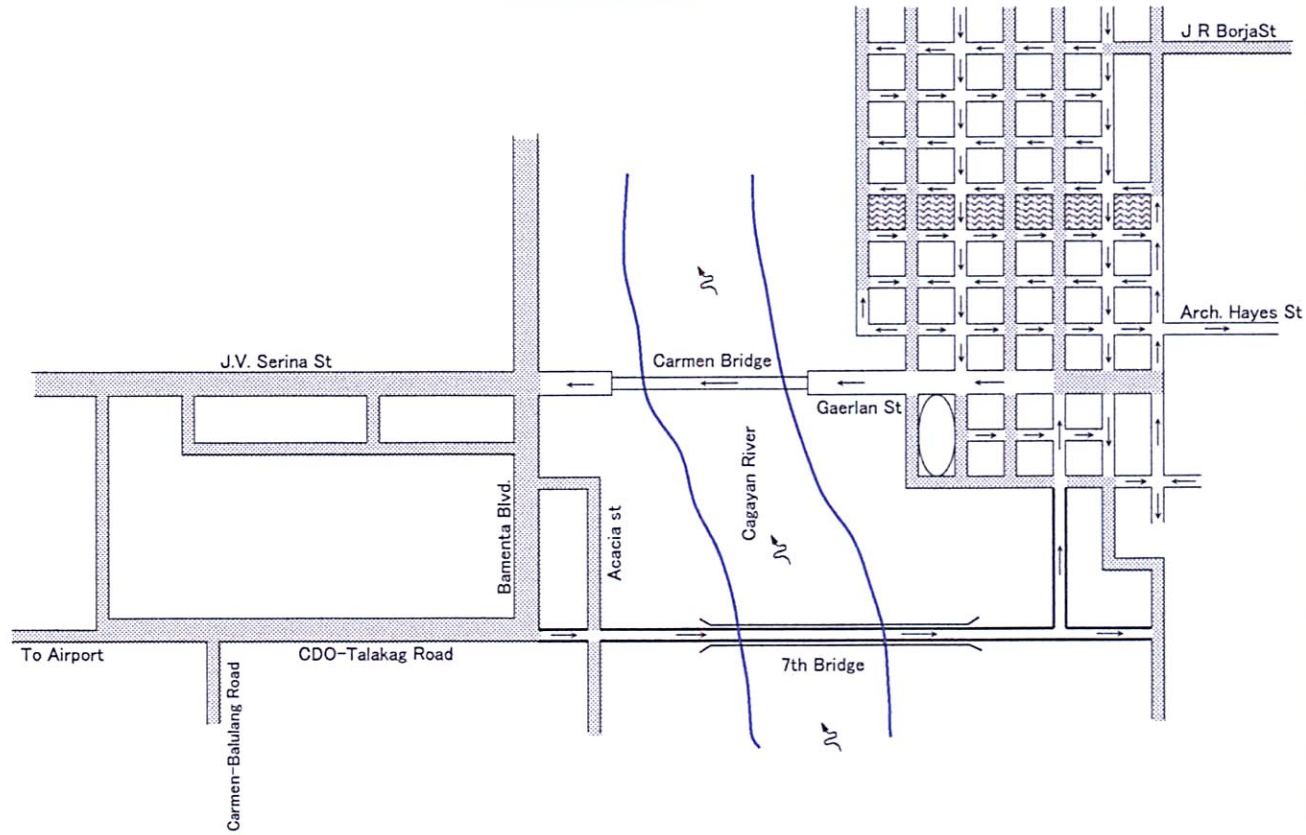


C–C' : CDO 7TH BRIDGE WEST APPROACH

FIGURE 13.7-3 INTERSECTION WITH VAMENTA BLVD.
STA. 0+029.138, BEG. OF CDO 7TH BRIDGE



Present System



After 7th Bridge Completed

LEGEND:

- 2-WAYS
- 1-WAY
- 1-WAY (7AM～9AM, 5PM～7PM)

FIGURE 13.7 - 4 PROPOSED ONE-WAY TRAFFIC OPERATION SYSTEM

13.7.3 Pavement Design

Pavement design was made in accordance with the AASHTO Guide for Design of Pavement Structures, 1993.

Table 13.7.3-1 shows the design requirements. Bus and truck factors were determined with reference to the axle load survey results undertaken along Mindanao Section of Pan-Philippine Highway in 1998.

Bus factor (number of ESAL per bus) : 0.9
Truck factor (number of ESAL per truck) : 2.3

PCC pavement was selected for the pavement type, as soft ground is not expected.

Table 13.7.3-2 shows traffic loading. Cumulative ESAL is 16.8 Million for 20 years.

Required pavement thickness is as follows:

Subbase course : 20cm
PCC pavement : 25cm

TABLE 13.7.3-1 DESIGN REQUIREMENT (7th Bridge)

Category	Description
a. Design Variable	
a.1 Time Constraints • Initial Performance Period	PCCP : 20 years
a.2 Traffic Loading	Directional Distribution Factor : 0.5
a.3 Bus and Truck Factor	Bus : 0.9 Truck : 2.3
a.4 Reliability	Z_R = 1.037 for 85% Reliability So = 0.35 (Rigid)
b. Performance Criteria	
b.1 Serviceability	(Rigid) PSI = Po - Pt = 4.5 - 2.5 = 2.0
c. Material Properties for Structural Design	
c.1 Effective Modulus of Subgrade Reaction	K-Value (pci) ; 410pci (CBR : 5%, Subbase : 20cm)
c.2 Pavement Layer Materials Characterizati	E_C = Modulus of Elasticity of PCC (4.20 x 10^6 psi)
c.3 PCC Modulus of Rupture (Rigid) (Flexural Strength)	S'c = 797 psi , Sc = 690 psi
d. Pavement Structural Characteristics	
d.1 Drainage	Rigid CD = Drainage Coefficient ; 1.0
d.2 Load Transfer (Rigid)	J = 3.8 (Plane jointed, Untied Shoulder)
e. Required Pavement Thickness	
e1. Subbase Course	t = 20cm
e2. PCC Pavement	t = 25cm

TABLE 13.7.3-2 TRAFFIC LOADING (7th Bridge)

Year	AADT (Both Direction) Bus	Track	Cumulative ESAL
2011	94	1,407	606,102
2012	97	1,470	1,239,100
2013	100	1,536	1,900,192
2014	103	1,604	2,590,626
2015	107	1,676	3,311,707
2016	110	1,751	4,064,756
2017	111	1,804	4,840,404
2018	112	1,859	5,639,334
2019	113	1,916	6,462,254
2020	114	1,975	7,309,892
2021	116	2,035	8,182,997
2022	117	2,097	9,082,430
2023	118	2,128	9,995,258
2024	119	2,160	10,921,682
2025	121	2,193	11,861,904
2026	122	2,226	12,816,131
2027	123	2,259	13,784,571
2028	124	2,293	14,767,436
2029	125	2,327	15,764,943
2030	127	2,362	16,777,309
TOTAL	**2,273**	**39,080**	**16,777,309**

13.7.4 Structure Design

The Proposed 7th Bridge is a new bridge and road construction 1.2kms long with two lanes of road section. The proposed site is located 500m upstream of the existing Carmen Bridge starting from CDO Talakag Road and terminating at Fernandez St. to connect A. Velez St. Future improvement is to be carried-out by Cagayan de Oro City with additional leg connections and a 100m rotunda.

This section discusses the preliminary design aspects of the proposed 7th Bridge crossing Cagayan River along the alignment.

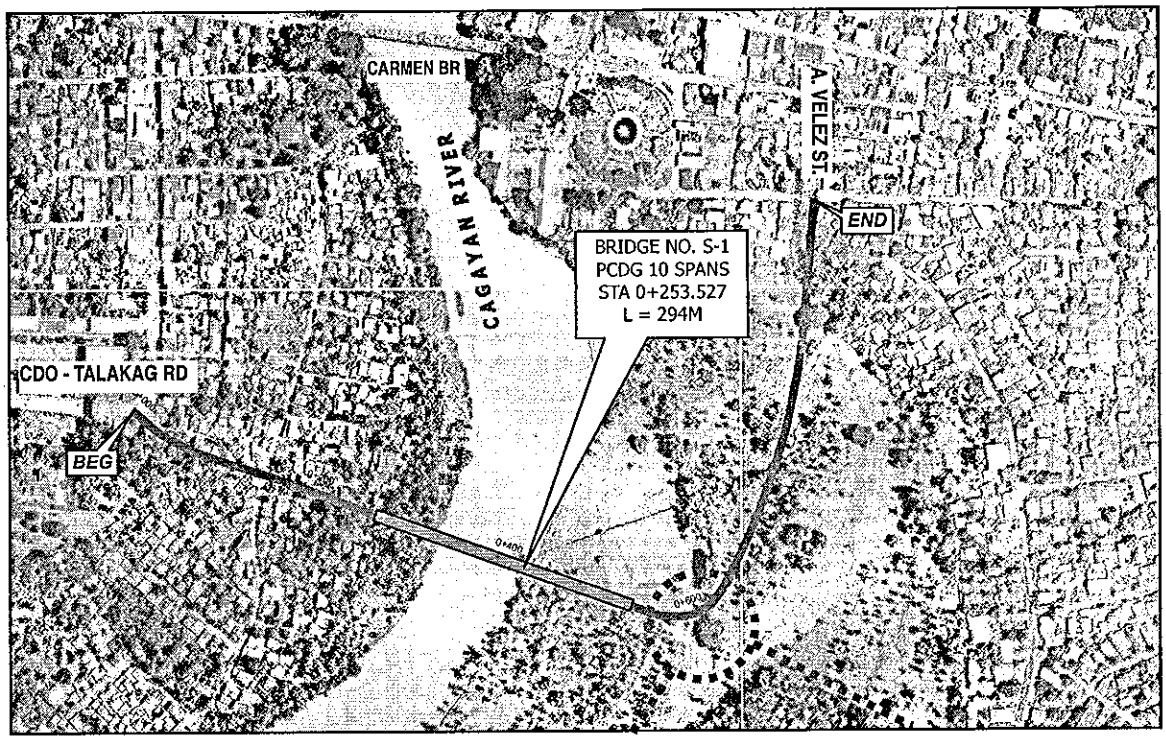


FIGURE 13.7.4-1 BRIDGE LOCATION MAP

13.7.4.1 Present Condition of the Proposed Bridge Site

Site investigation was carried-out to verify the condition of waterway along the alignment and determine the appropriate type and span of bridge suitable for the proposed site. Figure 13.7.4-1 shows the location of the proposed bridge while Figure 13.7.4-2 presents the conditions of Cagayan River along the proposed 7th Bridge alignment.

The following features describe briefly the proposed bridge sites:

Topography

- The proposed alignment beginning at CDO-Talakag Road passes through residential areas on rolling terrain sloping down towards the Cagayan River. Steep slope is formed in this area with ground elevation changing from 12m to 4m. However, the other side of the river is mostly vacant, low-lying lots.

- The area is considered flood-prone, thus dikes are provided on the upstream

side of the proposed site (about 380m long on the east bank and 250m long on the west bank upstream of the existing Carmen Bridge). Plans to construct additional dikes on the upstream side have been partially implemented until 700m upstream of Carmen Bridge on the west bank.

- The City plans to develop the east bank, however, no flood control dike exist in this area with ground level 3m to 6m lower than the residential area.

- A local road (Acacia St.) exists between the river and the beginning of alignment. The final scheme is decided by allowing access to and from this local road to the proposed bridge crossing. An 8% grade results by providing access to this road.

- The Cagayan de Oro City proposes an alignment (which becomes the basis of the proposed alignment) but will traverse several residential houses on the west bank. Right-of-way preparation is on-going with the city so that the present proposed alignment will utilize a similar alignment to the city with slight modification to minimize the number of affected houses.

Rivers/Streams

- The proposed bridge is about 500m upstream of the existing 4-span steel truss Carmen Bridge with pier span of 49.5m and a total length of 198m. The river section is about 150m at this location.

- Concrete dikes exist on the downstream side of the proposed site with the narrowest section 100m wide at 350m downstream of the proposed site. The eastern bank section of the dike is partially collapsed.

- The river section at the proposed site is about 105m wide. No flood dike exists in this area subjecting the residential areas on the west bank to annual flood. The eastern bank side of the river has elevations 1m to 2m lower than the western side.

- The river meanders on both the upstream and downstream sides of the proposed site.

- Minimal scouring was observed on site but debris consisting of small trees and twigs were seen in the river.

The river discharge for a 50-year return period is calculated for the proposed bridge site and presented in Table 13.7.4-1.

TABLE 13.7.4-1 RIVER DISCHARGE FOR PROPOSED BRIDGE SITE

BRIDGE NO.	RIVER NAME	50-YEAR DISCHARGE (cu.m/sec)	DFWL (EL. +m)	VELOCITY (m/s)	BRIDGE SPAN (m)	
					Minimum	Provided
S-1	Cagayan River	3,125.0	4.30	3.41	36	36

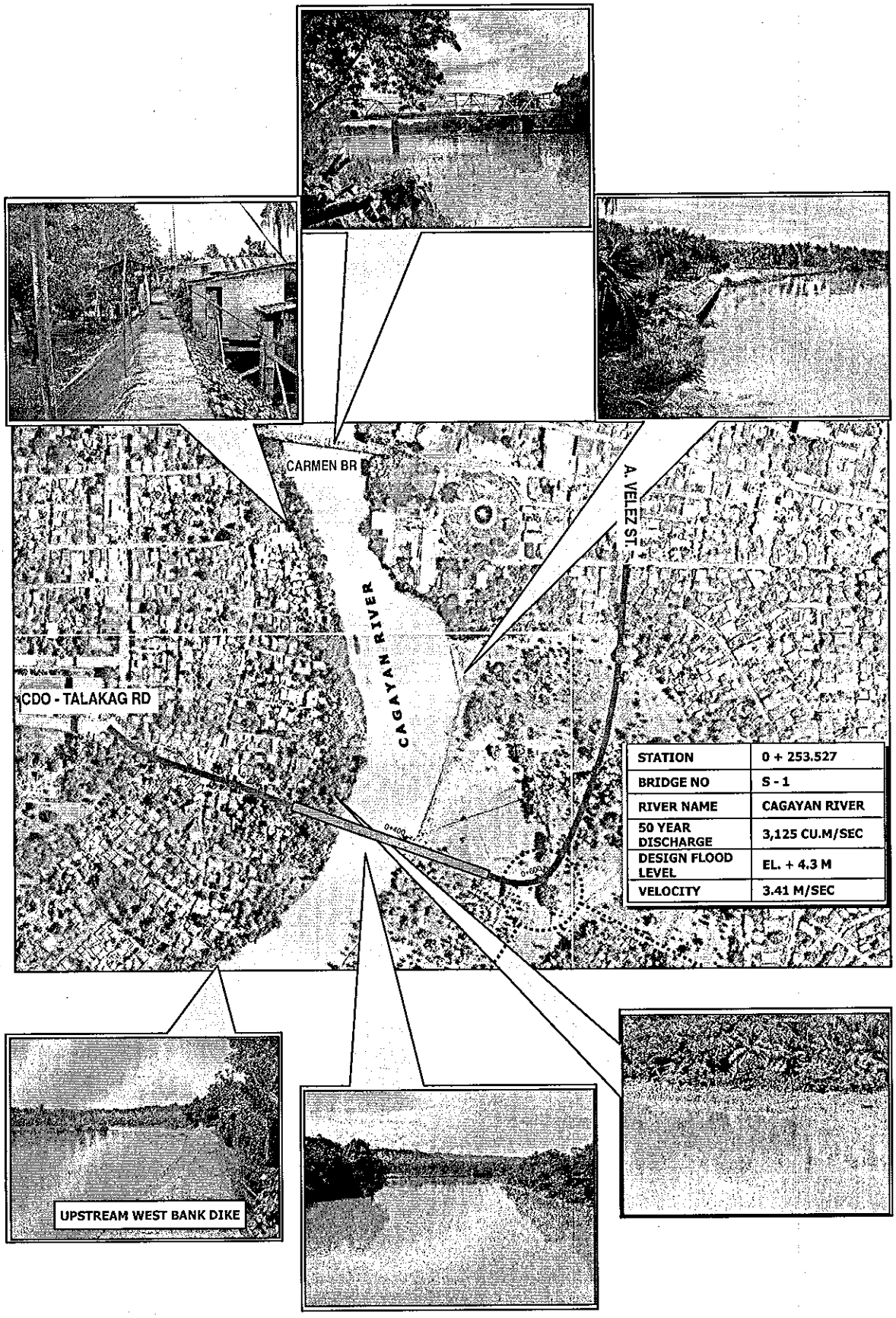


FIGURE 13.7.4-2 RIVER CONDITION AT PROPOSED BRIDGE SITE

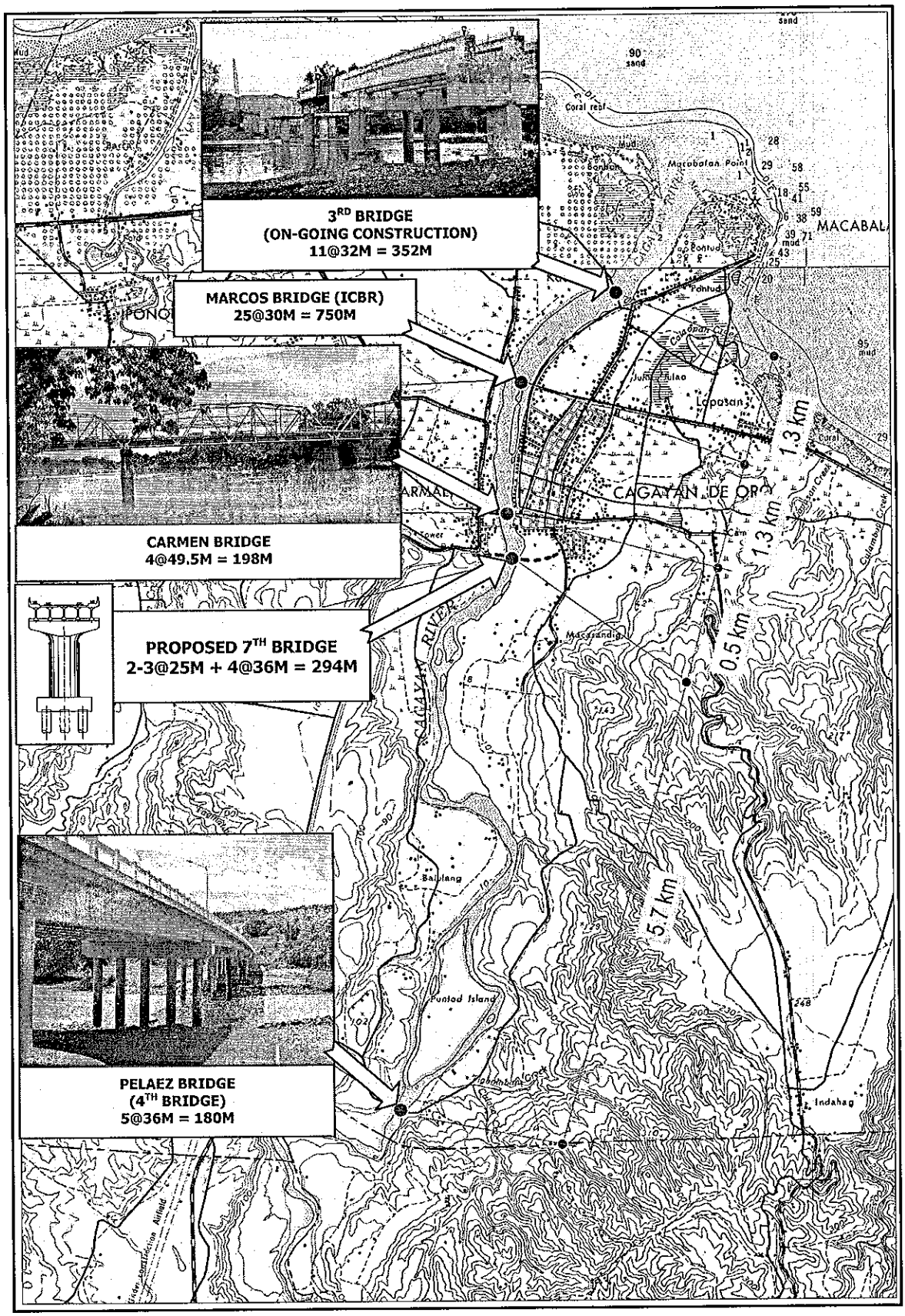


FIGURE 13.7.4-3 EXISTING BRIDGES CROSSING CAGAYAN RIVER

Geotechnical

- Geotechnical investigations were carried-out for the proposed bridge site (BH1 to BH3) which revealed the following subsurface characteristics:

    - The results of boreholes BH1 and BH2 (located at the east and west banks of the river) indicated the presence of about 4.0m thick of brown to dark brown, very soft clayey silt with N-values ranging from 0 - 3. Underneath this layer is the dense gray coarse sand layer with thickness of 2m - 3m and N-values of 20 to 42. The third layer encountered consists of thick cobbles/boulders formation persisting down to the end of boreholes at 10m deep. Penetration is found quite difficult below this level.

    - Results of borehole BH3 (located 50m near abutment A2) may be idealized into three different soil layers, namely:

        - *Layer A* - the uppermost 7.0m thick soil deposit consisting of loose, medium to fine sand with N-values ranging from 3 to 5 overlain by 2.5m to 3.0m soft, slightly plastic silt.

        - *Layer B* - until 39.6m deep, consists of underlying gray, medium dense to dense, non-plastic sand with appreciable amount of non-plastic fines. Samples have generally medium to fine grain (<2.0mm diameter) with N-values ranging from 30 to 35.

        - *Layer C* - below 39.6m consists of very dense gray gravel with sand hitting refusal at N>50.

    - The site can be considered not susceptible to liquefaction phenomena.

13.7.4.2 Design Concept for Structures

(1) Superstructure

The superstructure preliminary design basically adheres to the following concepts:

Bridge Deck Section

- The bridge deck section should conform with the travelway/carriageway width of the highway. Typical bridge section is illustrated in Figure 13.7.4-4. Since the Proposed 7th Bridge is to be implemented with two lanes of travelway, the bridge deck section will be provided with two lanes of carriageway in the same configuration as the highway. However, the road shoulder of 1.5m is not continued to the bridge section but a curb-to-curb width of 8.0m is provided on the bridge.

- A 1.5m wide sidewalk is provided at both sides of the deck similar to the road section since the proposed road is located in an urbanized area.

- A two-lane travelway is proposed for the 7th Bridge since all road connections on the west bank are only two-lane roads. Moreover, the bridge is proposed to be a one-way direction bridge which will cater for the east-bound traffic coupled with the one-way two-lane existing Carmen Bridge for west bound

traffic.

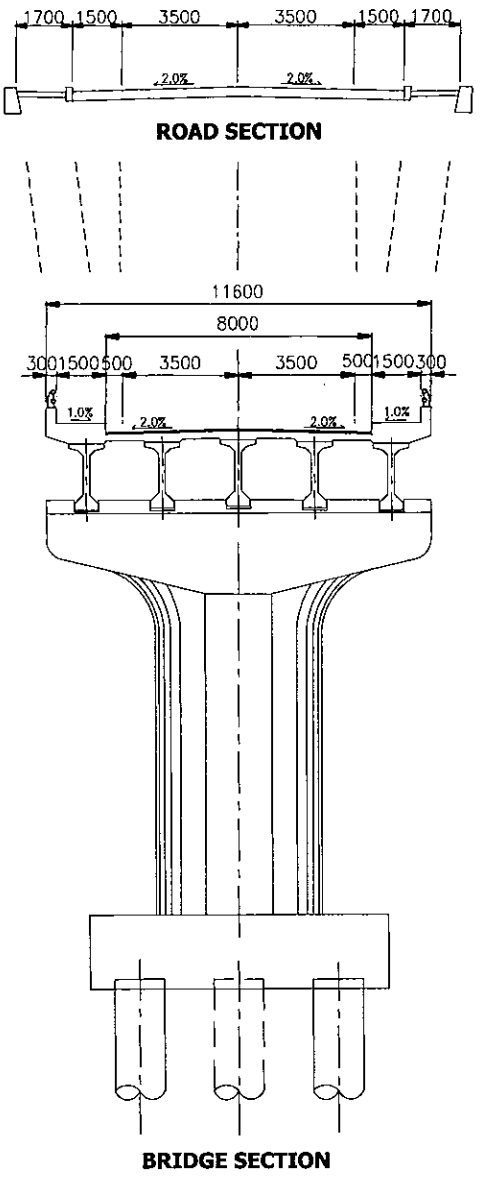


FIGURE 13.7.4-4 TYPICAL BRIDGE SECTION

Span and Bridge Length Consideration

- The span length taken in planning the bridge is based on:
    - Design discharge (requiring a minimum of 36m spans on main channel),
    - Pier encroachment to be ≤ 5% of river section,
    - Existing bridge spans (upstream has span of 36m while downstream bridges have spans of 49.5m, 30m and 32m spans).

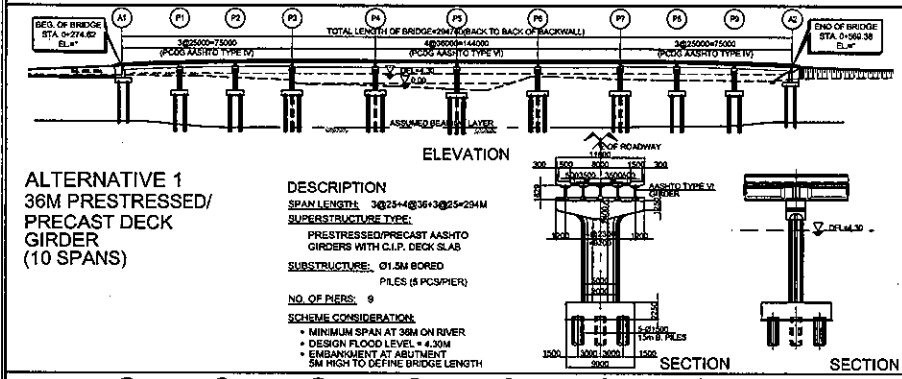
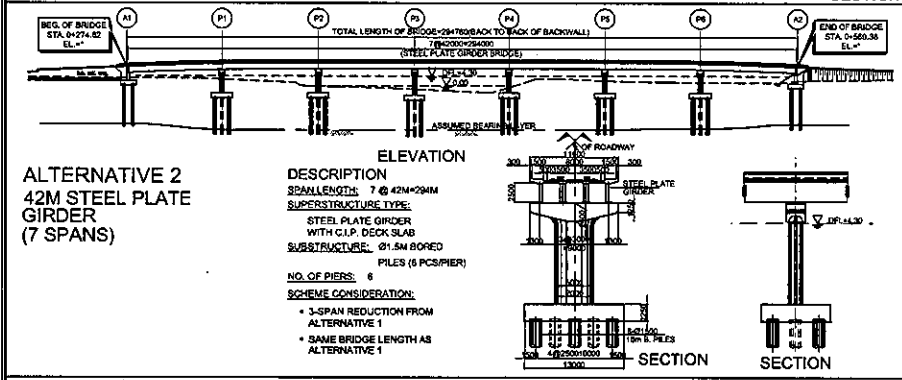
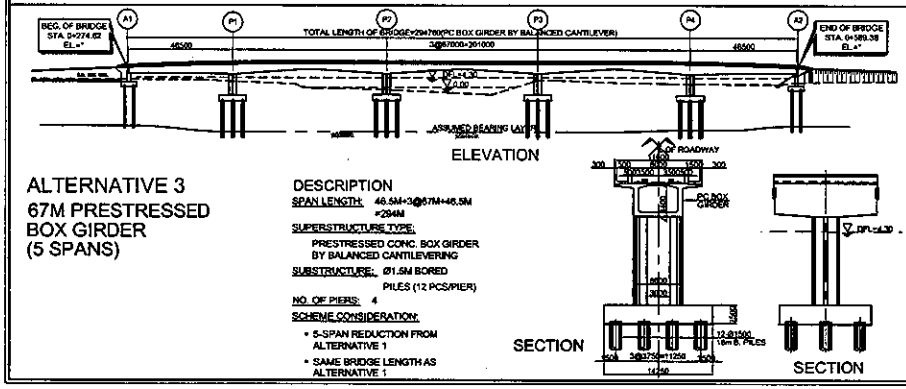
- The bridge length taken in planning the bridge is based on:
    - Design Flood Water Level at Elevation +4.30m,
    - Bank distance to be covered by bridge without river encroachment is 105m,
    - Embankment height at abutment to be around 5m,
    - Abutment position should not encroach the proposed rotunda for the city's future improvement,
    - Under these conditions, it is proposed that the length of the bridge be 294m to span Cagayan Rriver and minimize embankment behind the abutment. As indicated in the borehole data, the upper six meters of soil in the area is a relatively soft layer so that minimal height of embankment is desired. Shorter bridge length tends to require embankment in the order of 8m which will require additional treatment of soft ground.
- A comparative study on possible bridge schemes for the 7th Bridge is presented in Table 13.7.4-2. Three alternative schemes are considered which includes:
    - *Alternative 1* - 10-Span, 36m/25m Prestressed/Precast Deck Girder based on the minimum span of 36m for the river discharge.
    - *Alternative 2* - 7-Span, 42m Steel Plate Girder by reducing the number of piers to 6.
    - *Alternative 3* - 5-Span, 67m Prestressed Box Girder by reducing the number of piers to 4.
- Among the three alternative schemes in Table 13.7.4-2, Alternative 1 or the 36m Precast/Prestressed Deck Girder Bridge is chosen as the most appropriate scheme for the 7th Bridge.

Girder Types

- As presented in Table 13.7.4-2, three alternative girder types are considered for the proposed bridge. Although there are merits in using other girder types, the AASHTO girder is considered to be most appropriate since it is the cheapest and simplest to construct.
- The bridge vertical profile is controlled by the provision of access to Acacia St. (at-grade) so that in order to meet the minimum vertical clearances and grade requirements, the depth of the girders at side spans are varied from that of the main channel spans. The proposed girder would then be AASHTO Type VI for the main span (36m) and AASHTO Type IV (25m) for the side spans.
- To enhance seismic performance, PCDG are made continuous over the intermediate piers allowing transfer of superstructure horizontal forces directly to the substructure.

Table 13.7.4-2 7th Bridge Alternatives

COMPARISON OF BRIDGE ALTERNATIVES FOR 7TH BRIDGE

BRIDGE ALTERNATIVE	EVALUATION CRITERIA			EVALUATION	
	COST (MILLION₱) (50 PTS.)	STRUCTURE ASPECT (25 PTS.)	CONSTRUCTION ASPECT (25 PTS.)	POINTS	RANK
 **ALTERNATIVE 1** **36M PRESTRESSED/ PRECAST DECK GIRDER (10 SPANS)** **DESCRIPTION** SPAN LENGTH: 3@25+4@36+3@25=294M SUPERSTRUCTURE TYPE: PRESTRESSED/PRECAST AASHTO GIRDERS WITH C.I.P. DECK SLAB SUBSTRUCTURE: Ø1.5M BORED PILES (5 PCS/PIER) NO. OF PIERS: 9 SCHEME CONSIDERATION: • MINIMUM SPAN AT 36M ON RIVER • DESIGN FLOOD LEVEL = 4.30M • EMBANKMENT AT ABUTMENT 5M HIGH TO DEFINE BRIDGE LENGTH	SUPERSTRUCTURE: 98.20 SUBSTRUCTURE: 59.90 TEMPORARY WORKS: CRANEWAY/ACCESS: 9.50 COFFERDAM: 16.80 ₱184.40M 50	• SUPERSTRUCTURE ON BEARINGS BUT MADE CONTINUOUS UNDER LIVE LOAD (3 SPAN & 4 SPAN CONTINUOUS) • MULTIPLE BORED PILES ADVANTAGEOUS TO GENERAL AND LOCAL SCOUR • SINGLE WALL TYPE COLUMN ADVANTAGEOUS TO RIVER HYDRAULIC • SUPERSTRUCTURE HEAVIER THAN ALTERNATIVE 2 • MOST NUMBER OF PIERS 15	• Ø1500 DRILLED AND CAST ON SITE, BEST FOR SOIL WITH LARGE BOULDERS • PRECAST GIRDERS ERECTED BY 2-CRANES • SLAB CAST-IN-PLACE ON SUSPENDED FORMWORKS • SUB-STRUCTURE TAKES LONGER DURATION THAN OTHER ALTERNATIVES • CONSTRUCTION PERIOD =20 MONTHS • LOCAL CONTRACTORS HAVE MUCH EXPERIENCE ON THIS BRIDGE TYPE • SIMPLEST SUPERSTRUCTURE CONSTRUCTION 25	90	1
 **ALTERNATIVE 2** **42M STEEL PLATE GIRDER (7 SPANS)** **DESCRIPTION** SPAN LENGTH: 7 @ 42M=294M SUPERSTRUCTURE TYPE: STEEL PLATE GIRDER WITH C.I.P. DECK SLAB SUBSTRUCTURE: Ø1.5M BORED PILES (6 PCS/PIER) NO. OF PIERS: 6 SCHEME CONSIDERATION: • 3-SPAN REDUCTION FROM ALTERNATIVE 1 • SAME BRIDGE LENGTH AS ALTERNATIVE 1	SUPERSTRUCTURE: 177.30 SUBSTRUCTURE: 70.60 TEMPORARY WORKS: CRANEWAY/ACCESS: 9.50 COFFERDAM: 13.20 ₱270.60M 30	• PLATE GIRDER ON BEARING BUT CONTINUOUS OVER PIERS (3-SPAN AND 4-SPAN CONTINUOUS • LIGHTER SUPERSTRUCTURE DUE TO STEEL GIRDER, LESS SEISMIC FORCES • 3 PIERS LESS THAN ALTERNATIVE 1 PROVIDES WIDER RIVER AREA • MULTIPLE BORED PILES AND SINGLE WALL COLUMN SAME AS ALTERNATIVE 1 20	• Ø1500 BORED PILES SAME AS ALTERNATIVE 1 • PLATE GIRDERS ERECTED USING TEMPORARY BENTS AND CRANES, REQUIRES TEMPORARY BENT FOR ERECTION • SLAB CAST-IN-PLACE SAME AS ALTERNATIVE 1 • LESSER DURATION ON SUB-STRUCTURE CONSTRUCTION THAN ALTERNATIVE 1 • CONSTRUCTION PERIOD =19 MONTHS • LOCAL CONTRACTORS NEEDS QA/QC ON PLATE GIRDER BRIDGE CONSTRUCTION 20	70	3
 **ALTERNATIVE 3** **67M PRESTRESSED BOX GIRDER (5 SPANS)** **DESCRIPTION** SPAN LENGTH: 46.5M+3@67M+46.5M =294M SUPERSTRUCTURE TYPE: PRESTRESSED CONC. BOX GIRDER BY BALANCED CANTILEVERING SUBSTRUCTURE: Ø1.5M BORED PILES (12 PCS/PIER) NO. OF PIERS: 4 SCHEME CONSIDERATION: • 5-SPAN REDUCTION FROM ALTERNATIVE 1 • SAME BRIDGE LENGTH AS ALTERNATIVE 1	SUPERSTRUCTURE: 161.15 SUBSTRUCTURE: 74.70 TEMPORARY WORKS: CRANEWAY/ACCESS: 8.10 COFFERDAM: 9.90 ₱253.85M 40	• BOX GIRDER CONTINUOUS AND RIGID WITH PIER HAS BETTER SEISMIC PERFORMANCE • LEAST NUMBER OF PIERS OFFERS WIDEST RIVER AREA • ONE PIER LOCATED AT MIDDLE OF RIVER • MULTIPLE BORED PILES AND SINGLE WALL COLUMN SAME AS ALTERNATIVE 1 • BETTER BRIDGE AESTHETIC THAN ALTERNATIVE 1 & 2 • SUITES CURVE ALIGNMENT DUE TO HIGH TORSIONAL RIGIDITY 25	• Ø1500 BORED PILES SAME AS ALTERNATIVE 1 • PRESTRESSED BOX GIRDER ERECTED BY BALANCED CANTILEVERING • LESSER SUBSTRUCTURE CONSTRUCTION DURATION THAN ALTERNATIVE 1&2 • CONSTRUCTION PERIOD =16 MONTHS • NEEDS SPECIALIZED CONTRACTOR FOR BALANCED CANTILEVER CONSTRUCTION • MOST COMPLEX CONSTRUCTION METHOD 15	80	2

Vertical Clearance

- A minimum vertical clear height of 1.5m is provided since debris is expected at maximum design flood level.

(2) Substructures

Piers

- The type of substructure chosen for the 7th Bridge is the single-column pier on multiple piles. Although other forms of substructures have been adopted on some bridges utilizing two or three column pile bents, this study recommends single column on multiple piles based on:

    - Single column on multiple piles with pile cap are more stable under general scour and uneven scour condition when river beds tend to become deeper due to scouring,
    - The upstream pile/column on multiple column/pile bents tend to produce more eddies/vortices on its wake which tends to complicate the flow on the downstream columns/piles resulting to uneven scour (either general or local) of the pier,
    - Uneven scouring (upstream vs downstream side) tends to result in unsymmetrical length of columns/piles for multiple column/pile bents thus producing unbalanced forces in the substructure,
    - Uneven scouring for columns on multiple piles does not present much structural problem since forces are transmitted as vertical pile reactions, unlike pile bents which requires moment resistance of piles on unbalanced loading,
    - Plastic hinging of the proposed substructure form is defined at the column base which can be easily verified in the event of a major earthquake. Plastic hinging for pile bents occur at the top and somewhere at the buried section of the pile which is very difficult to inspect and repair.

- Preliminary design for substructures considers the seismic design requirements based on the AASHTO Div. I-A Seismic Design recommendations.

- Plastic hinges are expected to form at pier substructures so that design forces of foundations will utilize the said forces. In cases where elastic seismic forces are smaller than plastic forces, elastic forces are applied to the foundation.

Pile Foundation

- Multiple pile foundation is chosen for the substructure based on the soil condition at the proposed site. Upper six meters tend to be soft in this area necessitating founding the structure at a layer below this stratum.

- Bored pile is chosen over RC precast piles based on:
    - The subsurface soil consists of a layer of cobbles/boulders in the range of 0.5 - 1.2m in diameter (similar to upstream soil condition) which is very difficult for driven piles to penetrate.
    - The bored pile size proposed is thus ϕ1500mm which can be constructed and drilled even at the boulder layer.
    - In the event of a very large seismic excitation, the bored piles have more moment resisting capacity than precast driven piles.
    - Bored piles can be drilled and terminated at the desired competent bearing strata.
    - The seismic requirement (plastic forces of pier columns) for driven piles will result in relatively large number of driven piles as compared to bored piles.
    - Pile cap size can be reduced by utilizing lesser number of piles.
- Likewise, foundation for the abutment utilizes bored pile foundation.

Abutments

- Abutment type is the inverted T cantilever wall seat type abutment. This type, being a closed type abutment is more reliable since it is difficult to guarantee the stability of slope in front of the abutment. Existing soil condition tends to be soft in the upper 6m, in which case, a closed-type abutment is preferred.
- Abutment preliminary design basically follows the AASHTO Div. I-A recommendations using Mononobe-Okabe formulation to calculate seismic forces due to retained earth.
- Retained earth at the back of the abutment is limited to 5m above the existing ground to minimize settlement and soil improvement of the upper soil layer.
- Expansion joints for the superstructures are provided at abutment locations.

13.7.4.3 Proposed Bridge

Details of the proposed bridge crossing Cagayan River, with a total length of 294m are presented in Table 13.7.4-3 below.

TABLE 13.7.4-3 PROPOSED BRIDGE FOR 7TH BRIDGE ALIGNMENT

BRIDGE NO.	RIVER NAME	STATION		BRIDGE LENGTH (m)	SUPERSTRUCTURE			SUBSTRUCTURE			
								PIER		ABUTMENT	
		BEG.	END		TYPE	SPAN	SKEW (deg)	COLUMN TYPE	FOUNDATION	TYPE	FOUNDATION
S-1	Cagayan River	Sta. 0+253.527	Sta. 0+548.287	294.00	PCDG AASHTO Type VI, IV	3@25m + 4@36m + 3@25m	-	Wall Type 1.8mx5.0m	ϕ1500 Bored Pile N=5, 4 L=16m, 18m, 19m	Closed Inverted-T Cantilever	ϕ1000 Bored Pile N=6; L=18m

TOTAL BRIDGE LENGTH : 294 m

13.7.5 Drainage Design

13.7.5.1 Principle and Methodology

Refer to Sub section 12.7.5.1 for the principle and methodology.

13.7.5.2 Hydrological and Hydraulic Analyses

Refer to Sub section12.7.5.2 for the hydrological and hydraulic analyses.

13.7.5.3 Results of Hydrological Analysis

The hydrological analysis reveals that the catchment areas for this proposed bridge is 1347 sq km .See Fig. 13.7.5-1 for the catchment area map of Seventh Bridge Cagayan River. The result of the hydrological analysis is shown in Table 13.7.5-1.

13.7.5.4 Results of the Hydraulic Analysis

The hydraulic analysis reveals that there are one (1) bridge and one (1) culvert proposed for the road. The bridge schedule is shown in Section 13.7.4 and the list of proposed culvert is shown in Table 13.7.5-2.

13.7.5.5 Flood Flow Analysis

The flood flow analysis is conducted for the catchment area. The result of the analysis is shown in Table 13.7.5-3.

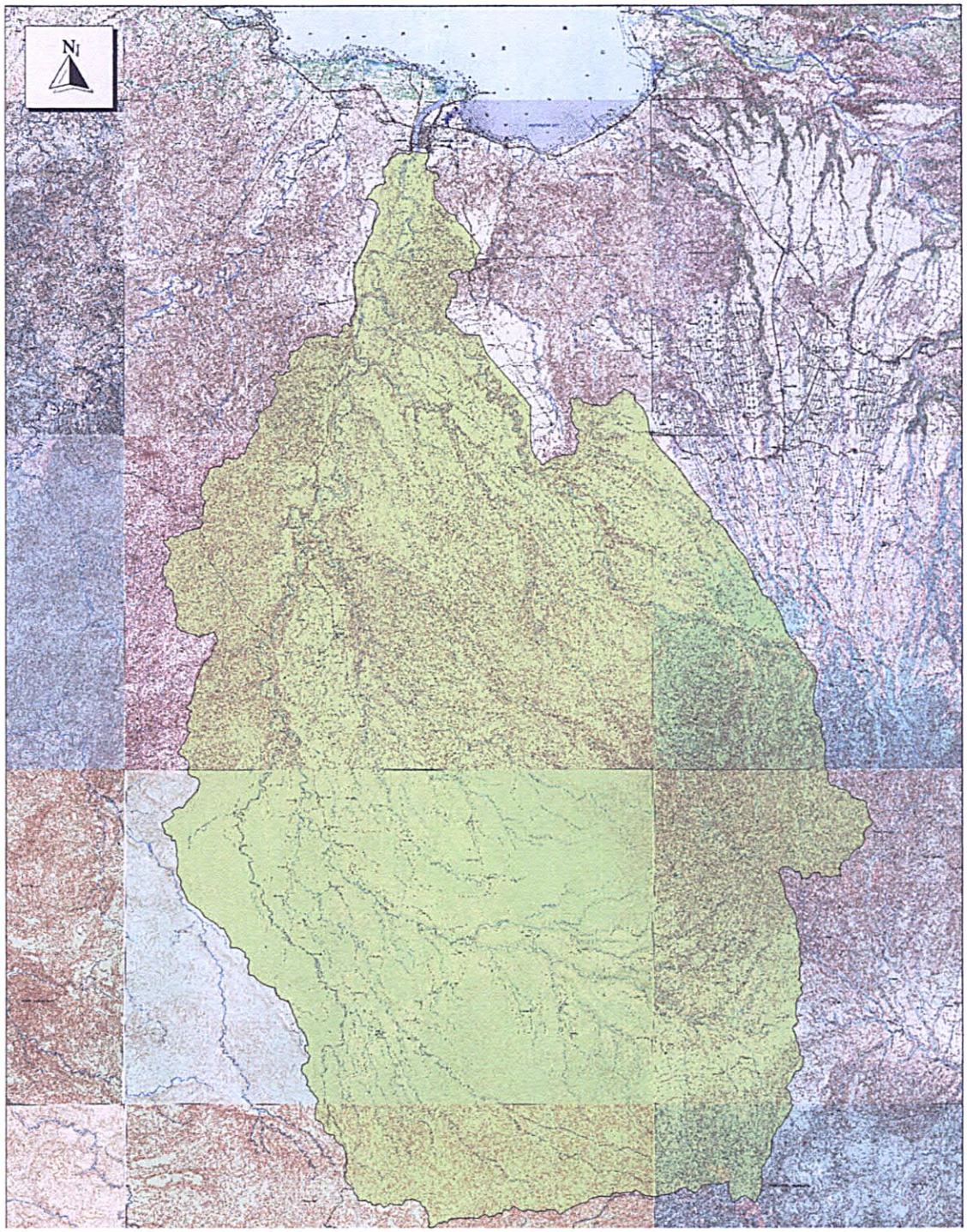


FIGURE 13.7.5-1 SEVENTH BRIDGE CAGAYAN RIVER CATCHMENT AREA MAP

Table 13.7.5 - 1

HYDROLOGICAL ANALYSIS

Road Section: ***SEVENTH BRIDGE***

Basin Number	STATION		DISCHARGE			
	BEGINNING	END	2 year	10 year	25 year	50 year
			m^3/sec.	m^3/sec.	m^3/sec.	m^3/sec.
1	0 + 253.93	0 + 548.69	1,333.60	2,287.35	2,767.32	3,124.77

TABLE 13.7.5 - 2

HYDRAULIC ANALYSIS

The Study on Road Network Improvement on Development of Regional Growth Centers

SEVENTH BRIDGE

BASIN NUMBER	STATION (km)	SIZE		LENGTH	REMARKS / RECOMMENDATION
		RCPC	RCBC		
		mmØ	SPAN X HEIGHT		
	0 + 930.00		2- 3.00X3.00	19.00	

TABLE 13.7.5-3 FLOOD FLOW ANALYSIS

CAGAYAN SEVENTH BRIDGE , METRO CAGAYAN DE ORO

HIGHWAY STATION (km)	BRIDGE NUMBER	BRIDGE NAME	CATCHMENT AREA (km2)	DISCHARGE 50 YEARS (cms)	VELOCITY (mps)	DFL (m)	M.F.L. FROM FIELD SURVEY (m)	WATER WIDTH (m)	REMARKS
0 + 401	S-1	Cagayan	1347.00	3124.77	3.41	4.30	4.60	320	

13.8 COST ESTIMATES

13.8.1 Construction Cost

(1) Unit Cost Analysis

The project cost was estimated based on the July 2004 prices with breakdown of foreign and local currency components and a tax component.

The foreign exchange rates used were as follows:

1 US $ = 56.04 P = 109.64 Yen (July, 2004)

A market price survey was conducted to obtain information on market or prevailing prices of construction materials, labor cost and equipment cost. Based on these prices, a unit cost analysis was conducted to develop unit costs for construction items. Unit prices of major construction items are presented in Tables 13.8-1, 2, 3 and 4, respectively.

(2) Construction Cost

Estimated construction cost is presented in Table 13.8-5. The construction cost of 7th Bridge was estimated at 193.5 Million pesos, composing of 42.1% a foreign currency component (or 81.5 Million pesos), 42.6% of a local currency component (or 82.5 Million pesos) and 15.3 % of a tax component (or 29.5 Million pesos). Detailed breakdown of construction cost is presented in Appendix 13.8-1.

TABLE 13.8-5 CONSTRUCTION COST

(Million Pesos)

	Foreign	Local	Tax	Total
Amount	81.5	82.5	29.5	193.5
%	42.1%	42.6%	15.3%	100%

TABLE 13.8-1 MARKET PRICE OF CONSRUCTION MATERIALS IN CAGAYAN DE ORO

(July 2004 Prices)

Price No.	Description	Unit	Unit Price (P)
1	Portland Cement	bag	143.00
2	Reinforcing Steel Bar, Gr. 40	kg.	28.00
3	Reinforcing Steel Bar, Gr. 60	kg.	34.00
4	Gasoline, Premium	lit.	26.68
5	Gasoline, Regular	lit.	26.13
6	Diesel	lit.	20.56
7	Lumber	bd.ft.	29.00
8	Ordinary Plywood 1/2"	pc	380.00
9	Emulsified Asphalt SS-1	drum	4,823.16
10	Asphalt Cement Pen. 85-100	drum	5,023.16
11	Thinner	gal.	130.00
12	Tie Wire #16	kg.	45.00

SOURCE:

- *Study Team Survey*

TABLE 13.8-2 LABOR COST

(July 2004 Prices)

Labor Category	Hourly Rate (Pesos)	Daily Rate (Pesos)
Foreman	34.66	277.30
Operator	26.24	209.90
Driver	26.24	209.90
Carpenter	26.24	209.90
Re-Bar Worker	26.24	209.90
Masonry	26.24	209.90
Blaster	31.25	250.00
Welder	26.24	209.90
Painter	26.24	209.90
Mechanic	26.24	209.90
Electrician	26.24	209.90
Skilled Labor	26.24	209.90
Unskilled Labor	25.00	200.00

SOURCE:

- *DPWH*
- *National Health Insurance Program*
- *Social Security System*

TABLE 13.8-3 HOURLY (OR DAILY) COST OF CONSTRUCTION EQUIPMENT

(July 2004 Prices)

	Construction Equipment	Unit	Cost (P)
1	Tractor, crawler w/dozer (Bulldozer, 15t)	hr	2,243.00
2	Tractor, crawler w/dozer (Bulldozer, 21t)	hr	3,623.00
3	Backhoe, hydraulic, crawler, 0.61m3	hr	1,295.00
4	Backhoe, hydraulic, crawler, 0.80m3	hr	1,766.00
5	Dump Truck, 6.0-9.0 cu-yds (4.6-6.9m3)	hr	807.00
6	Motor Grader, 3.71m	hr	1,748.00
7	Vibratory Tandem Smooth Drum 10.6t	hr	1,622.00
8	Four Tamping Foot Wheels (Tire Roller) 16t	hr	1,583.00
9	Water Wagon/Pump Truck 500-1000 gal	hr	968.00
10	Asphalt Paver/Finisher, 4.7m	hr	1,974.00
11	Truck Mixer 5.0-6.0 cu-yds	hr	1,066.00
12	Concrete Batch Plant 40m3/hr with silo	hr	1,990.00
13	Crawler Drill	hr	428.00
14	Concrete Vibrator *(operator not included)*	day	456.00
15	Concrete Cutter *(operator not included)*	day	1,080.00
16	Concrete Paver/Finisher	hr	870.00
17	Truck Crane, Hydraulic 21-25t	hr	1,297.00
18	Concrete Pump Vehicle 100cu-yds/hr (76.5m3/hr)	hr	1,668.00
19	Air Compressor 456-500 cfm	hr	876.00
20	Aggregate Crusher 100t/hr *(operator not included)*	hr	2,730.00
21	Trailer 20t	hr	1,588.00
22	Welding Machine 250A	hr	300.00
23	Generator 51-100 kW *(operator not included)*	day	3,310.00
24	Bar Bender *(operator not included)*	day	1,310.00
25	Electric Bar Cutter	day	1,310.00

SOURCE: Associated Construction Equipment Lessors (ACEL)

TABLE 13.8-4 UNIT COST OF MAJOR CONSTRUCTION ITEM (1/2)

Item No.	Description	Unit	Unit Cost	Component(%)		
				Foreign	Local	Tax
	PART C - EARTHWORK					
100(1)	Clearing and Grubbing	ha.	53,000.00	57	27	16
102(1)	Unsuitable Excavation	m3	179.00	59	17	24
102(2)a	Surplus Common Excavation	m3	179.00	60	24	15
102(2)b	Surplus Common Excavation with Big Boulders	m3	210.00	60	24	15
103(2)a	Bridge Excavation, Common (AWL)	m3	200.00	53	31	16
103(2)b	Bridge Excavation, Common (BWL)	m3	750.00	51	34	15
104(1)a	Embankment from Excavation	m3	195.00	54	20	26
104(1)b	Embankment from Borrow	m3	390.00	56	30	15
104(1)c	Selected Borrow for Backfilling	m3	550.00	54	20	26
105(1)	Subgrade Preparation (Common Material)	m2	17.00	57	27	16
	PART D - SUBBASE AND BASE COURSE					
200	Aggregate Subbase Course	m3	550.00	54	32	14
	Sub Total					
	PART E - SURFACE COURSE					
311(1)a	PCC Pavement(Plain) (t=0.10m)	m2	420.00	62	23	15
311(1)b	PCC Pavement(Plain) (t=0.20m)	m2	620.00	62	23	15
311(1)d	PCC Pavement(Plain) (t=0.25m)	m2	770.00	62	23	15
311(1)e	PCC Pavement(Plain) (t=0.28m)	m2	850.00	62	23	15
311(2)	PCC Pavement(Reinforced) for Approach Slab, t=300mm	m2	4,450.00	62	23	15
	PART F - BRIDGE CONSTRUCTION					
400(4)	Precast Concrete Piles (0.45m×0.45m), Furnished and Driven	m	3,200.00	52	28	20
400(15)	Test Piles (0.45m×0.45m)	m	370.00	52	35	13
400(16)a	Cast-in-Place Concrete Bored Piles, φ1000mm	m	23,800.00	38	45	17
400(16)b	Cast-in-Place Concrete Bored Piles, φ1200mm	m	32,500.00	38	45	17
400(16)c	Cast-in-Place Concrete Bored Piles, φ1500mm	m	47,000.00	38	45	17
400(19)	Piles Shoes for 0.45m×0.45m Piles	ea	1,750.00	55	30	15
401	Concrete Railings	m	2,240.00	38	49	13
404(1)	Reinforcing Steel, Grade 40 (Fy=275Mpa)	kg	39.00	50	37	13
404(2)	Reinforcing Steel, Grade 60 (Fy=415Mpa)	kg	40.00	50	37	13
404(3)	Prestressing Steel, Grade 270 (Fu=1860Mpa)	kg	255.00	50	37	13
405(1)	Structural Concrete Class"A1" for Substructure (f'c=24Mpa)	m3	3,200.00	34	50	16
405(2)	Structural Concrete Class"A2" for Superstructure (f'c=24Mpa)	m3	5,040.00	34	50	16
405(3)	Structural Concrete Class"A3" for Others (f'c=21Mpa)	m3	4,130.00	34	50	16
405(4)	Structural Concrete Class"A4" for Others (f'c=41Mpa)	m3	7,180.00	34	50	16
405(5)	Seal Concrete	m3	420.00	34	50	16
405(6)	Structural Concrete "Lean Concrete" (f'c=17 Mpa)	m3	2,480.00	43	37	20
406(1)a	Prestressed Concrete Girder, AASHTO Type IV-B, L=20m	ea	308,910.00	22	62	16
406(1)b	Prestressed Concrete Girder, AASHTO Type IV-B, L=22m	ea	331,400.00	22	62	16
406(1)c	Prestressed Concrete Girder, AASHTO Type IV-B, L=25m	ea	391,250.00	25	59	16
406(1)d	Prestressed Concrete Girder, AASHTO Type IV-B, L=26m	ea	405,480.00	22	62	16
406(1)e	Prestressed Concrete Girder, AASHTO Type IV-B, L=27m	ea	419,645.00	22	62	16
406(1)f	Prestressed Concrete Girder, AASHTO Type IV-B, L=28m	ea	441,755.00	20	65	15
406(1)g	Prestressed Concrete Girder, AASHTO Type V, L=30m	ea	505,185.00	20	65	15
406(1)h	Prestressed Concrete Girder, AASHTO Type V, L=31m	ea	520,815.00	20	65	15
406(1)i	Prestressed Concrete Girder, AASHTO Type V, L=35m	ea	647,400.00	17	69	14
406(1)j	Prestressed Concrete Girder, AASHTO Type VI, L=36m	ea	672,500.00	19	67	14
406(1)k	Prestressed Concrete Girder, AASHTO Type VI, L=40m	ea	815,870.00	17	69	14
406(1)l	Prestressed Concrete Girder, AASHTO Type IV-A, L=36m	ea	598,500.00	17	69	14
406(1)m	Prestressed Concrete Girder, AASHTO Type IV-B, L=19m	ea	293,500.00	22	62	16
407(1)a	Elastomeric Bearing Pad, 400×350×60 (Duro 60)	ea	18,100.00	55	30	15
407(1)b	Elastomeric Bearing Pad, 500×350×60 (Duro 60)	ea	21,100.00	55	30	15
407(1)c	Elastomeric Bearing Pad, 625×400×60 (Duro 60)	ea	30,100.00	55	30	15
407(2)	Expansion Joint, 50mm Gap	m	46,300.00	55	30	15
407(4)	Metal Drain (φ150mm G.I. Drain Pipe)	m	985.00	55	30	15
408	Chain Link Railing	m	1,570.00	55	30	15
	PART G - DRAINAGE AND SLOPE PROTECTION STRUCTURES					
500(1)a	Reinforced Concrete Pipe Culvert, 610mmφ (Extra. Str.)	m	4,451.00	57	28	15
500(1)b	Reinforced Concrete Pipe Culvert, 910mmφ (Extra. Str.)	m	6,600.00	57	28	15
500(1)c	Reinforced Concrete Pipe Culvert, 1070mmφ (Extra. Str.)	m	10,000.00	57	28	15
500(1)d	Reinforced Concrete Pipe Culvert, 1220mmφ (Extra. Str.)	m	10,600.00	57	28	15
500(1)e	Reinforced Concrete Pipe Culvert, 1520mmφ (Extra. Str.)	m	18,700.00	57	28	15
500(3)a1	Reinforced Concrete Box Culvert 1-1.5m x 1.5m	m	16,200.00	42	43	15
500(3)a2	Reinforced Concrete Box Culvert 2-1.5m x 1.5m	m	25,600.00	42	43	15
500(3)a3	Reinforced Concrete Box Culvert 3-1.5m x 1.5m	m	35,800.00	42	43	15
500(3)b1	Reinforced Concrete Box Culvert 1-2.4m x 2.4m	m	27,300.00	42	43	15
500(3)b2	Reinforced Concrete Box Culvert 2-2.4m x 2.4m	m	46,100.00	42	43	15
500(3)b3	Reinforced Concrete Box Culvert 3-2.4m x 2.4m	m	65,400.00	42	43	15
500(3)c1	Reinforced Concrete Box Culvert 1-3.0m x 3.0m	m	37,300.00	42	43	15
500(3)c2	Reinforced Concrete Box Culvert 2-3.0m x 3.0m	m	65,300.00	42	43	15
500(3)c3	Reinforced Concrete Box Culvert 3-3.0m x 3.0m	m	92,000.00	42	43	15
500(3)d1	Reinforced Concrete Box Culvert 2-4.0m x 2.5m	m	2.00	42	43	15
501(4)	Subsurface Drain, Type SSD(G/P)-B	m	490.00	42	43	15
501(5)	Filter Layer	m3	800.00	42	43	15
502(2)b1	Reinforced Concrete Headwall, 1-910mmφ RCPC	ea.	18,800.00	28	57	15
502(2)b2	Reinforced Concrete Headwall, 2-910mmφ RCPC	ea.	25,200.00	28	57	15
502(2)c1	Reinforced Concrete Headwall, 1-1070mmφ RCPC	ea.	21,500.00	30	55	15
502(2)c2	Reinforced Concrete Headwall, 2-1070mmφ RCPC	ea.	31,300.00	30	55	15
502(2)d1	Reinforced Concrete Headwall, 1-1220mmφ RCPC	ea.	26,700.00	31	54	15
502(2)d2	Reinforced Concrete Headwall, 2-1220mmφ RCPC	ea.	37,500.00	31	54	15
502(2)f1	Reinforced Concrete Headwall, 1-1520mmφ RCPC	ea.	36,200.00	33	52	15
502(2)f2	Reinforced Concrete Headwall, 2-1520mmφ RCPC	ea.	51,700.00	33	52	15

TABLE 13.8-4 UNIT COST OF MAJOR CONSTRUCTION ITEM (2/2)

Item No.	Description	Unit	Unit Cost	Component(%)		
				Foreign	Local	Tax
502(10)a1	Reinforced Concrete Headwall, Box Culvert 1-1.5m x 1.5m	ea.	49,900.00	44	41	15
502(10)a2	Reinforced Concrete Headwall, Box Culvert 2-1.5m x 1.5m	ea.	59,800.00	45	40	15
502(10)a3	Reinforced Concrete Headwall, Box Culvert 3-1.5m x 1.5m	ea.	70,700.00	45	40	15
502(10)b1	Reinforced Concrete Headwall, Box Culvert 1-2.4m x 2.4m	ea.	102,000.00	44	41	15
502(10)b2	Reinforced Concrete Headwall, Box Culvert 2-2.4m x 2.4m	ea.	122,000.00	45	40	15
502(10)b3	Reinforced Concrete Headwall, Box Culvert 3-2.4m x 2.4m	ea.	141,000.00	45	40	15
502(10)c1	Reinforced Concrete Headwall, Box Culvert 1-3.0m x 3.0m	ea.	148,000.00	44	41	15
502(10)c2	Reinforced Concrete Headwall, Box Culvert 2-3.0m x 3.0m	ea.	178,000.00	45	40	15
502(10)c3	Reinforced Concrete Headwall, Box Culvert 3-3.0m x 3.0m	ea.	201,000.00	45	40	15
502(3)a1	Catch Basin for RCPC 1-φ610	ea.	16,800.00	45	40	15
502(3)b1	Catch Basin for RCPC 1-φ910	ea.	24,300.00	38	47	15
502(3)b2	Catch Basin for RCPC 2-φ910	ea.	37,900.00	39	46	15
502(3)c1	Catch Basin for RCPC 1-φ1070	ea.	28,400.00	38	47	15
502(3)c2	Catch Basin for RCPC 2-φ1070	ea.	45,500.00	39	46	15
502(3)d1	Catch Basin for RCPC 1-φ1220	ea.	37,100.00	38	47	15
502(3)d2	Catch Basin for RCPC 2-φ1220	ea.	60,900.00	39	46	15
502(3)e1	Catch Basin for RCPC 1-φ1520	ea.	47,500.00	38	47	15
502(3)e2	Catch Basin for RCPC 2-φ1520	ea.	80,300.00	39	46	15
504(5)	Grouted Riprap, Class "A"	m3	2,120.00	49	36	15
505(1)	Stone Masonry	m3	2,200.00	55	30	15
505(2)	Gravity Type Retaining Wall(H=1.0~1.5m)	m3	5,220.00	44	41	15
505(3)	Gravity Type Retaining Wall(H=1.0~3.0m)	m	4,200.00	44	41	15
506	Loose Boulder Apron 300mm ϕ min.,S.G=2.65	m3	2,250.00	44	41	15
507	Steel Sheet Pile (85×400×8mm), Furnished and Driven	m	1,430.00	55	30	15
509	Gabions	m3	3,620.00	51	34	15
510	Rubble Concrete Slope Protection, t = 350mm	m3	1,940.00	51	34	15
511(a)	Concrete Side Dicth (0.5 x 0.5)	m	2,230.00	38	47	15
511(b)	Concrete Side Dicth (1.0 x 0.5)	m	3,100.00	38	47	15
511(c)	Concrete Side Dicth (2.0 x 1.5)	m	8,400.00	38	47	15
SPL512(1)	Slope Protection for Cut	m2	4,500.00	44	41	15
SPL512(2)	RC L-Type Retaining Wall(H=3.0~5.0m)	m	12,500.00	44	41	15
	PART H - MISCELLANEOUS STRUCTURES					
600(1)a	Concrete Curb, Type A (200x450mm)	m	629.00	58	27	15
600(1)c	Concrete Curb for Edge of Sidewalk(200*500)	m	741.00	58	27	15
600(3)a	Combination Concrete Curb & Gutter/Side Strip, Type A (675x364mm)	m	1,050.00	58	27	15
603(3)a	Metal Guardrail	m	2,300.00	58	27	15
610	Sodding	m2	200.00	58	27	15
SPL620(1)	Traffic Signal (3-leg intersection)	ea.	2,082,000.00	20	65	15
SPL620(2)	Traffic Signal (4-leg intersection)	ea.	2,268,500.00	20	65	15
	Other Miscellaneous (Road Signs,Pavement Stud,etc)	km	1,500,000.00	70	20	10
	PART A,B- ENGINEER'S FACILITY AND MOBILIZATION / DEMOBILIZATION					
	(5% of PART C to H)					
	CONTINGENCY					
	(5% of PART A to H)					

13.8.2 ROW Acquisition and Compensation Cost (7th Bridge)

1) Unit Price

Unit prices for road right-of-way acquisition and compensation are obtained from respective municipality/city Assessor's Offices and regional office of BIR. The Republic Act 8974 provides that compensation cost for land shall be BIR zonal value that is normally far lower than prevailing market prices. Since the agricultural land around the study area has strong potential demand for residential use, price of the land currently transacted around area is fairly higher than zonal value. For the purpose of obtaining practical cost estimate for the project, prevailing market prices are adopted in this study.

Prices of structures are determined based on schedule of prices available in the Assessor's Office. The unit prices of structures are determined without any depreciation to obtain replacement cost of structures.

Unit prices are summarized in **Table 13.8-6.**

TABLE 13.8-6 UNIT PRICES OF LAND ACQUISITION AND COMPENSATION

Item	Zonal Value Assessed Value (P/m^2)	Prevailing Market Price (P/m^2)
Land Acquisition	Zonal Value	
Residential	500 – 800	800-1,400
Rice Field	50 – 100	100-200
Residential / Mountain	450 – 700	800
Structures (floor area in m^2)	Assessed Value	
Concrete House	6,000 – 6,300	
Semi Concrete House	4,800 – 5,000	
Light Material House	3,000 – 3,500	

2) Compensation Cost

Land area to be acquired by present land uses are computed based on aerial-photo map and verified by field survey. Number of houses is tentatively obtained from aerial-photo map and will be verified by field investigation during social impact survey. Summary of compensation is presented in **Table 13.8-7.** Detail is presented in Appendix 13.8-2.

TABLE 13.8-7 ESTIMATED LAND ACQUISITION AND COMPENSATION COST

Item	Quantity	Amount (P1,000)
Land Acquisition	**18,856**	**8.0**
Residential	6,688 m^2	6.7
Rice Field	12,168	1.3
Structures	33 structures	14.0
Other Compensation		1.7
Total		**23.7**

13.8.3 Detailed Engineering and Construction Supervision Cost

Engineering services cost for a detailed design ranges from 3 to 5% of construction cost, and a construction supervision from 5 to 9%. An average of 4% of construction cost was adopted for the detailed design and 8% for the construction supervision for this project.

TABLE 13.8-8 ENGINEERING SERVICE COST

Unit: Million Pesos

	Component			TOTAL
	Foreign	Local	Tax	
Detailed Design	4.2 (55%)	2.7 (35%)	0.8 (10%)	7.7 (100%)
Construction Supervision	8.5 (55%)	5.4 (35%)	1.6 (10%)	15.5 (100%)
Total	**12.7 (55%)**	**8.1 (35%)**	**2.4 (10%)**	**23.2 (100%)**

13.8.4 Summary of Project Cost

Summary of project cost is shown in Table 13.8-9.

TABLE 13.8-9 SUMMARY OF PROJECT COST

Unit: Million Pesos

	Component			TOTAL
	Foreign	Local	Tax	
Detailed Design	4.2	2.7	0.8	7.7
ROW/Resettlement	-	21.3	2.4	23.7
Construction	81.5	82.5	29.5	193.5
Construction Supervision	8.5	5.4	1.6	15.5
Total	**94.2**	**111.9**	**34.3**	**240.4**

13.8.5 Maintenance Cost for New 7TH Bridge and Access Road

(1) Road and Bridge Conditions

Road and bridge conditions and EMK factors are determined as follows.

Item	Conditions	EMK Factor
Road Length (km)	0.9	-
Traveled Way Width (m)	2-lane<7.5m	1.0
Bridge Length (total) (l.m)	300	0.01
AADT (2016)		
Opening Year	2011	-

Note: AADT is estimated by PCU divided by 1.3. EMK factor is limited at 1.38 for 2-lane and 1.48 for 4-lane road. Total EMK=Road Length (km) x (Width F. x Surface Type F.) + Bridge Length x (Bridge F.)

(2) Base Cost

See Chapter 13.8.5 of Part B.

(3) Maintenance Cost Estimate

Maintenance cost is estimated based on EMK and base costs of routine and periodic maintenance, and shown in Table 16.8-10.

TABLE 13.8-10 MAINTENANCE COST OF NEW 7TH BRIDGE AND ACCESS ROAD

	Calendar Factors				EMK	Financial Cost (x1000Peso)			Economic Cost (x1000Peso)		
	Year	AADT	Lane	Bridge	(km)	Routine	Periodic	Total	Routine	Periodic	Total
1	2011	1.20	1.00	3.00	4.08	344	0	344	260	0	260
2	2012	1.20	1.00	3.00	4.08	345	0	345	261	0	261
3	2013	1.21	1.00	3.00	4.09	346	0	346	261	0	261
4	2014	1.22	1.00	3.00	4.10	346	0	346	262	0	262
5	2015	1.23	1.00	3.00	4.11	347	0	347	262	0	262
6	2016	1.24	1.00	3.00	4.12	348	0	348	263	0	263
7	2017	1.24	1.00	3.00	4.11	348	0	348	263	0	263
8	2018	1.23	1.00	3.00	4.11	347	0	347	263	0	263
9	2019	1.23	1.00	3.00	4.11	347	0	347	262	0	262
10	2020	1.23	1.00	3.00	4.10	347	0	347	262	0	262
11	2021	1.22	1.00	3.00	4.10	346	0	346	262	0	262
12	2022	1.22	1.00	3.00	4.10	346	0	346	262	0	262
13	2023	1.22	1.00	3.00	4.10	346	0	346	262	0	262
14	2024	1.22	1.00	3.00	4.10	346	0	346	262	0	262
15	2025	1.22	1.00	3.00	4.10	346	0	346	262	0	262
16	2026	1.22	1.00	3.00	4.10	346	0	346	262	0	262
17	2027	1.22	1.00	3.00	4.10	346	0	346	262	0	262
18	2028	1.22	1.00	3.00	4.10	346	0	346	262	0	262
19	2029	1.22	1.00	3.00	4.10	346	0	346	262	0	262
20	2030	1.22	1.00	3.00	4.10	346	0	346	262	0	262

13.9 ENVIRONMENTAL IMPACT ASSESSMENT (Cagayan de Oro, CU-3)

13.9.1 General Characteristics of the Project Road

The project is to construct a new bridge over Cagan River at Carmen District in the center of Cagayan de Oro City. Approximately 0.95km of access road that connects the east and west areas of the city is also proposed to be constructed. The proposed new bridge is expected to lessen traffic congestion of existing Carmen Bridge. Land use of the western approach is residential while the eastern approach is agricultural planted with rice and coconut trees.

Urbanization in the eastern area is hampered by frequent inundations with flood water spilled from the Cagayan River.

The proposed project is the construction of a two-lane bridge with a total length of about 300m with a 0.95km of approach road. Required standard ROW width is 30m while ROW width in residential areas is narrowed to 12 to 17m to minimize relocation of residents.

The Initial Environmental Examination conducted in June 2004 revealed that there are no significant environmentally critical spots, such as historical structures, religious institutions, and environmentally protected areas along the project road. However, the required ROW along the entire stretch of the road shall be acquired and 33 households are required to relocate from proposed ROW boundary.

13.9.2 Social Acceptability

The criterion provided by the DENR DAO 96-37[1] for evaluating the social acceptability of a project has been considered during the course of the study to a certain extent. **Table 13.9-1** shows the action taken to ascertain social acceptability at the feasibility study level.

TABLE 13.9-1 ACTION TAKEN BY THE STUDY TEAM TO ASCERTAIN SOCIAL ACCEPTABILITY

Criteria	Action Taken
1) Consistency with land use plan	. Provincial and municipal land use plans and infrastructure development plan are obtained and examined. The proposed widening project is confirmed with the local infrastructure development plan.
2) Public Participation	. Officials from regional offices of national government (NEDA, DENR, DOTC), local government units and private sector were consulted during selection the project road and its improvement level. • Public consultation meeting involving the communities along the project road were held by barangay level.
3) Promotion of Social Equity	. Preferential hiring of local labor and provision of alternative means of livelihood are considered as mitigating and enhancement measures to address adverse socio-economic impacts.
4) Mitigating and Enhancement Measures	• Included in **Table 13.9-5**
5) Involve Women and Vulnerable Groups	• Active participation of women and vulnerable groups, such as informal settlers and tenants/renters are included in this report as mitigating and enhancement measures to address adverse socio-economic impacts.
6) Environmental Monitoring and Evaluation	• Included in **Table 13.9-6**

[1] Department of Environment and Natural Resources, Administrative Order No. 37, Series 1996. This Administrative Order provides detailed procedures of the EIA System.

13.9.3 Data Gathering for Baseline Information

The parameters of baseline data needed to establish historical trends and present condition of the physical, biological and socio-economic environment of project area were agreed during Level I Scoping Meeting (Technical Scoping) with EMB[2]. Based on the agreed parameters, the collection of baseline information has been carried out in July 2004. The result of baseline survey is discussed in the next section.

13.9.4 Description of Existing Environmental Condition

1) Physical Environment

Climate

The nearest synoptic meteorological station in the project area is located in Cagayan de Oro City. The climatic characteristics of the project road are identical to the New West Diversion Road as discussed in **Section 12.9.5**.

Terrain

Terrain of the western approach section of the road is hilly with an elevation of 14m and goes down to 4m toward 7th Bridge with average slope of 8.5%. Torrential surface flows from mountain slope frequently occur during heavy rains. Terrain of the eastern approach section is generally flat with an average elevation of 4m. The area is the floodplain of the Cagayan River, hence few houses are observed.

Air Quality

One (1) hour ambient air quality measurements for total suspended particulates (TSP) was conducted at Barangay Carmen, Zone 5, Cagayan de Oro City. Results of the sampling activity indicate that the concentration recorded for the project alignment ranges from 10.84 micrograms per normal cubic meter (μ/Ncm) to 35.72 (μ/Ncm). This concentration is way below the standard established by the Department of Environment and Natural Resources at 230.0 micrograms per normal cubic meter.

Water Quality

Water quality measurements were made at Cagayan River in Barangay Carmen, Cagayan de Oro City. Result of water quality measurements is shown in **Table 13.9-2.**

TABLE 13.9-2 WATER QUALITY MEASUREMENTS

Location	Temperature	Ph	Dissolved Oxygen (DO), mg/L	Total Dissolved Solids, mg/L	Salinity	Conductivity
Cagayan River Upstream	24.2°C	8.02	5.24	42.1	0.1	87.4
Cagayan River Downstream	24.7oC	8.03	5.33	39.9	0.1	82.8

[2] EMB: Environmental Management Bureau of DENR

Noise Level

Noise level measurements were made at Barangay Carmen, Zone 5, Cagayan de Oro City, adjacent the project roads.

The average readings taken at the time of sampling are shown in **Table 13.9-3**. By comparing with the standards established for the purpose, all readings for the project alignment are lower than the standards, meaning that the ambient noise level in the area is still low.

TABLE 13.9-3 NOISE LEVEL MEASUREMENTS

Trial Readings	Morning 5 AM - 9 AM	Daytime 9 AM - 6 PM	Evening 6 PM - 10 PM	Nighttime 10 PM - 5 AM
1	44.4	50.1	51.2	49.0
2	46.2	48.6	50.4	38.1
3	45.9	53.4	48.4	42.2
4	43.1	53.4	49.1	45.0
5	40.6	50.0	49.9	37.9
6	45.5	51.4	47.2	47.1
7	40.9	51.6	46.0	46.6
Minimum	43.1	48.6	46.0	37.9
Maximum	46.2	53.4	51.2	49.0
Average	43.8	51.2	48.9	43.7
Standard	50.0	55.0	50.0	45.0

Land Use

Land use of the western approach section is mostly residential and densely populated while the eastern approach section is ricefields with spotted vacant lots with coconut trees. Residential houses in the western section are mostly concrete with wood mix structures of one or two-storey buildings. Ricefields in the eastern section is the floodplain of the Cagayan River.

2) Biological Environment

Vegetation and Wildlife

One sampling station was established for the road alignment. The site is predominantly open grassland with an interspersion of tree species such as *Gmelina arborea* and acacia. Coconut trees also appear a dominant cover including small patches of land devoted to other crops such as chico, mango, and banana. Butterflies, dragonflies, fruitflies, bees, ants, and spiders were observed to thrive in this disturbed area.

The vegetations observed are found commonly growing in a grassland.

Aquatic Fresh/Marine Environment

There are no local account of freshwater fish present in the rivers sampled during the water quality measurements, but it has to be established preferably before the start of construction. It is likely that there could be endemic species in these rivers but that had not been noticed during the field survey.

3) Socio-Economic Environment

The socio-economic characteristics of the project area are identical to the New West Diversion Road as discussed in **Section 12.9.4**, since the two project roads are located close to each other.

13.9.5 Perception Survey

The Perception Survey was conducted in the four (4) barangays traversed by the proposed road. The respondents were disaggregated into two major identification (unless specified otherwise in the rest of the tables): (1) respondents within the barangays traversed by the alignment that are directly affected, and (2) respondents within the barangays that are not directly affected by the alignment.

A total of 208 respondents were identified during the survey. More than a tenth (13.0%) of these respondents were randomly selected within the barangays while more than four-fifths (87.0%) were directly selected within the barangays since they are most likely along the project alignment.

TABLE 13.9-4 DISTRIBUTION OF RESPONDENTS BY BARANGAY

City/Barangay	Directly Affected		Indirectly affected		Total	
	Number	%	Number	%	Number	%
Cagayan de Oro City						
Nazareth	0	0	30	16.6	30	14.4
Carmen	21	77.8	105	58.0	126	60.6
Barangay 1	6	22.2	6	3.3	12	5.8
Macasandig	0	0	40	22.1	40	19.2
Total	**27**	**100.0**	**181**	**100.0**	**208**	**100.0**
% Distribution		13.0		87.0	100	

1) Awareness about the Project

Nearly three-fourths (71.6%) of the respondents have already heard of the plans for the construction of the project. The percentage of directly affected respondents who have already heard of the project is relatively higher (83.2%) and the highest can be found in Barangary Carmen.

About two-fifths (39.9%) of the respondents heard of the project only just recently. More than a fourth (29.8%) heard about it 1 or 2 years ago. About a fifth (20.7%) on the other hand heard of it more than two years ago. Only less than a tenth (9.6%) did not provide any response.

Nearly half (49.5%) of the respondents heard that the project is about the construction of a new road/highway while more than a fifth (22.6%) said it is about the construction of a bridge. The remainder believed it is about other projects.

2) Agreement for the Project

Most (89.4%) of the respondents are in favor of the implementation of the project. More than two-fifths (40.4%) said that the project will give way to the development of the area and the province as a whole. About three-fourths (25.5%) said that the project will help solve the traffic congestion in the city while less than a fifth (15.9%) indicated that the project offers safe and efficient transport of people, goods, and services. Less than a tenth (7.2%) did not provide any response.

3) Effect on Source of Income

Majority (89.4%) of the respondents said that their livelihood will not be affected and that includes more than three-fourths (25.9%) of the directly affected respondents. More than a fifth (22.2%) said that there will be loss of livelihood, employment and property. Majority (89.9%) did not provide any response.

4) Good Things Seen about the Project

About a third (32.7%) of the respondents believed that with the project, there will be less traffic in the main highway, and that it will benefit the majority and opening of new business (28.4%). More than a fifth (21.6%) said that there will be easy and fast access to the region while less than a tenth (7.2%) added that the city or barangay will improve or develop.

5) Benefits Expected from the Project

About half (49%) of the total number of respondents said that travel time will become shorter (including faster and convenient transport of people and goods) while according to more than a fifth (26.4%) of the respondents, there will also be opening of new industries along the alignment and consequent offer of employment. The rest said that the project will provide housing/improvement of barangay (8.2%); increased aesthetic value of areas along the proposed road (3.8%); or did not provide any response or comment or do not know at all what to expect from the project.

6) Bad Things about the Project

Nearly a third (29.8%) of the total number of respondents believe that no bad things can be attributed to the project. Almost the same percentage (24.5%) said that there will be increased noise and air pollution level. Also more than a tenth (14.9%) said that there will be loss of livelihood/relocation of affected families. The rest are spread over to other responses such as fast moving vehicles causing accidents (10.1%); disruption of regular activities of barangay residents (8.7%); strangers will be coming into the barangays (4.8%); and increased crime rate (0.5%) among others.

7) Problems Foreseen for the Community as a Whole

Only less than a fifth (18.8%) of the respondents believe that the project will not bring any problems to the community as a whole. But nearly a third (31.7%) said there will increased pollution/problem of flooding/heavy erosion and landslide. A fifth (20.2%) said that there will be accidents/increased crime rates, drug-related incidents, robbery/hold-up cases, while a little less than a fifth (18.8%) indicated that there will be loss or properties/livelihood problems (lack of job).

13.9.6 Identified Impacts and Mitigation Measures

The predicted environmental impacts, along with the mitigation (for negative impacts) and enhancement (for positive impacts) measures are presented in **Table 13.9-5**, Impacts and Mitigation/Enhancement Matrix.

13.9.7 Environmental Management and Monitoring Plan

The Environmental Management and Monitoring Plan is presented in **Table 13.9-6.**

13.9.8 Resettlement Plan for Affected People

The survey on Resettlement Plan for affected people is currently being undertaken. Status of survey is discussed in **Section 12.10.**

TABLE 13.9-5 SUMMARY MATRIX OF IMPACTS AND MITIGATION AND ENHANCEMENT MEASURES (1/3)

Impacts	Type		Mitigation/Enhancement Measures
	Negative	Positive	
CONSTRUCTION PHASE			
Physical Environment			
Air Quality and Noise Levels			
Increase in levels of Total Suspended Particulates (TSP) such as dust, dirt, and oil soot.	Low		Use of water trucks equipped with horizontal spray jets located on the aft end and perpendicular to the direction of travel.
Increase in exhaust gas emission levels due to the operation of various heavy equipment and vehicles.	Low		Regular maintenance of heavy equipment and other smoke emitting machinery must be strictly complied with.
Increase in noise levels and vibration due to the operation of heavy equipment and vehicles.	Low		Use of mufflers and appropriate noise suppressors for heavy equipment and machinery.
			Scheduling of high noise generating activities during the daytime.
Temporary stockpiles of excavated and surplus materials as well as fill and embankment materials may also add to the present TSP levels.	Low		Excavate unsuitable materials and contraction spoils will be regularly hauled and disposed to DENR approved disposal site.
			Temporary stockpiles of fill and embankment materials will be covered with tarpaulin canvass or sack materials to prevent re-suspension of particulate matters.
Water Quality			
Increase in the amount of suspended solids of receiving natural water ways due to the deposition of high volumes of exposed, loose sediments transported by surface run-off.	Low		Since wetlands have the natural ability to filter and purify water, some areas, particularly those which have low agricultural productivity can be used as natural treatment facilities.
Possible contamination of surface and ground water due to borrow pits and quarries and other excavation activities.	Low		Contamination of surface and ground water due to borrow pits and quarries and other excavation activities may be minimized by carefully studying the substances profiles before any disturbance is started.
Increase in the bacteriological content of local surface water bodies due to domestic wastewater generated by construction personnel. This may eventually transmit diseases.	Low		Sanitation facilities should be provided by the Contractor to ensure that local water bodies are not polluted.
Washing of construction vehicles and other mobile equipment such as cement mixers, chutes, and related equipment will pollute the surface waters.	Low		Washing of construction vehicles and other mobile equipment along the waterways should be prohibited.
Improper storage and handling of chemicals such as lubricants, fuel, paint, and other solutions for routine vehicular operation may contaminate local surface and ground water.	Low		Chemicals such as lubricants, fuel, paint, and other solutions for routine vehicular operation must be handled with care and properly stored.
Biological			
As a result of an increase in noise levels and vibration, natural wildlife activates such as mating, nesting, and migratory patterns, particularly of birds will be disrupted/disturbed.	Low		Disruption/disturbance to natural wildlife activities such as mating, nesting, and migratory patterns is inevitable but reversible.
As a result of an increased turbidity of surface waters, the sediments will block light penetration into the rivers and creeks and inhibit both natural and algal photosynthesis and visibility of aquatic fauna required for location of food.	Low		Increased turbidity of surface waters is a short term and reversible type of adverse impact.

TABLE 13.9-5 SUMMARY MATRIX OF IMPACTS AND MITIGATION AND ENHANCEMENT MEASURES (2/3)

Impacts	Type		Mitigation/Enhancement Measures
	Negative	Positive	
Socio-Economic Environment			
Loss of Structure			
Number structures affected: 33	Moderate		Government must ensure that the affected structures are properly compensated based on 'Replacement Cost" method as provided by laws and regulations.
Loss of Land			
Residential 6,688 m^2 Ricefield 12,168 **Total 18,856 m^2**	High		The affected land shall be compensated with fair market value.
Loss of Other Improvement			
- Trees and other perennials - Other structures	Moderate		Trees and other perennials with commercial values shall be compensated based on schedule of prices available in municipal/city assessor's office. Other structures shall be compensated based on "Replacement Cost" method.
Agricultural Tenants			
Agricultural tenants residing within the proposed ROW will be displaced.	Moderate		Government must relocate tenant-farmers at a resettlement site or area they prefer where they can access to their agricultural land.
			Government must implement a sound Social Development Program (SDP) that will ensure that affected agricultural tenants get compensated for the disturbance.
Limited Accessibility to Farmlands			
During the construction phase, residents may experience temporal difficulty in terms of accessibility to the land they are cultivating.	Low		Contractors must provide a safe alternative route to farmers who need to cross the land they are cultivating (during and after construction phase).
Generation of temporary employment opportunities.		Moderate	Contractor must give priority to available local labor.

TABLE 13.9-5 SUMMARY MATRIX OF IMPACTS AND MITIGATION AND ENHANCEMENT MEASURES (3/3)

Impacts	Type		Mitigation/Enhancement Measures
	Negative	Positive	
OPERATIONAL PHASE			
Physical Environment			
Increase in vehicular gaseous emissions and noise level along the highway as a result of increase in vehicles due to increase in number of lanes.	Moderate		To improve air quality and noise level along the highway, LTO shall regulate operation of vehicles that emit smokes and make noise beyond limit provided by law. LGUs shall enforce strict traffic regulations to regulate speeding vehicles.
Socio-Economic Environment			
Means of livelihood of the dislocated people may not be restored properly as planned in Resettlement Plan.	Low		External and internal monitoring shall be regularly conducted to verify status of income restoration of dislocated people.
Improved accessibility to basic social services such as schools, hospitals, markets, churches, and communication facilities.		Moderate	DPWH must regularly maintain the bypass sections.
			DPWH must improve/construct access roads to the road so that more people can have better access to basic social services.
Reduction of transport costs due to improved traffic flow.		Moderate	DPWH must regularly maintain the road.
Better flow of industrial, commercial, and agricultural commodities.		Moderate	DPWH must regularly maintain the road to ensure continuous, undisrupted flow of agricultural products.
Urbanization and commercial development of non-agricultural and non-prime agricultural areas.		Moderate	Concerned LGUs must work hard towards achieving the development plans.
Increase in land values of areas traversed by and in the vicinity of the bypass sections.		Moderate	Landowners will benefit from increase of land values in areas traversed by or near the bypass sections.
Increase in employment opportunities as a result of commercial development.		Moderate	Government must ensure that qualified measures of the host community are given priority in the hiring of local labor force.

TABLE 13.9-6 ENVIRONMENTAL MANAGEMENT AND MONITORING MATRIX (CAGAYAN DE ORO, CU-3)

Parameters to be Monitored	Stations to be Monitored	Frequency of Monitoring	Methods of Analysis/Execution	DENR Standard	Implementor
CONSTRUCTION PHASE					
PHYSICAL					
Water quality BOD, TSS, and oil and grease of surface water	Cagayan River	Quarterly during construction	Standard EMPASS-EQD water quality analysis	Class "C" BOD - <10 mg/L TSS - <30 mg/L increase Oil & Grease - <3mg/L	DENR-Region 10
Air quality TSP, NO_2, and SO_2	Barangay Carmen in Cagayan de Oro City	Quarterly during construction	Standard EMPASS-WQD air quality analysis	TSP: 430, NO_2: 470, SO_2: 375	DENR-Region 10
BIOLOGICAL					
Tree cutting	Entire alignment where there are trees to be cut	Daily	Monitoring team must ensure that tree cutting is limited within the required ROW only	N. A.	MMT
Waste management and disposal	All portions with excavation and fill activities	Weekly during construction	Site inspection	Based on EMP	DENR-Region 10
SOCIAL					
Relocation of project affected families	All stretch of the project road and relocation site	Monthly	Monitoring team must ensure that affected families are properly compensated and their means of livelihood is maintained or restored	Based on RAP	MRIC External Monitoring Agent
Compliance of Contractor to occupational health and safety rules and regulation	All construction areas	Weekly	Site inspection of work areas including sanitation facilities	Based on EMP	MMT
Road safety	Signalized intersections, merging lanes	Quarterly	Site inspection	Based on DPWH Standard Operating Procedures	DPWH
OPERATIONAL PHASE					
BIOLOGICAL					
Tree planting and its maintenance on both sides of the highway	Designated environmental belts/zones	Monthly	Site inspection	Based on EMP	DENR-Region 10 MMT
SOCIAL					
Livelihood restoration	Resettlement site	Monthly	Interview with relocated families	Based on RAP	External Monitoring Agent
Informal settling/squatting/encroaching	Acquired ROW	Weekly	Site inspection	Based on EMP	LGUs, MMT
Illegal conversion of prime agricultural land	Areas adjacent to the bypass	Weekly	Site inspection	Based on EMP	LGUs, MMT
Road condition	Pavement and bridge, including drainage system and embankments	Based on standard DPWH maintenance procedures	Standard DPWH road and bridges maintenance works	Based on DPWH Standard Operating Procedures	DPWH

MMT : Multi-Partite Monitoring Team
MRIC : Municipal RAP Implementation Committee

13.10 SOCIAL IMPACT ASSESSMENT AND RESTTLEMENT ACTION PLAN

13.10.1 Measures Taken to Mitigate Negative Impacts

Two (2) alternative alignments were studied to determine the most feasible route, that which has the least impact on land and structures and which is the most technically and economically viable. The detailed process of alternatives selection is discussed in **Section 13.4**. The alternative which avoids built-up areas and major establishments was finally selected.

13.10.2 Barangays Affected by the Project

The following barangays of Cagayan de Oro City are affected by the project:

1. Nazareth
2. Carmen
3. One (1)
4. Macasandig

13.10.3 Community Consultation and Participation

Series of community consultation meetings have been held since the beginning of the study. The topics discussed in these meetings are presented below.

1) Workshops

The JICA Study Team has conducted workshops, whenever major study outputs are made, to present the process of the master plan and feasibility study to all concerned agencies and residents. The location of the final alignment and the extent of land acquisition and social impacts are also presented to the public and their comments and suggestions are incorporated in the study.

SUMMARY OF WORKSHOPS

	1st Workshop	2nd Workshop	3rd Workshop	4th Workshop
Date	November 2003	March 2004	July 2004	September 2004
Venue/Location	Cagayan de Oro City	Cagayan de Oro City	Cagayan de Oro City	Cagayan de Oro City
Topics Discussed	1. Outline of the study 2. Projects proposed by LGUs	1. Proposed road network plans	1. Selected road alignments 2. Social Impact Survey results	1. Presentation of Draft Final Report

Details of the workshops are presented in **Section 12.10.3**.

2) Meetings with City Officials

Prior to the Social Impact Survey, the Study Team visited the office of the Mayor of Cagayan de Oro City and the City Planning and Development Office, as discussed in **Section 12.10.3**.

3) Meetings with Barangay Captains

Meetings with the Barangay Captains of each of the affected barangays were held after coordination with their respective officials.

The dates of meetings with the Barangay Captains and the date of "**Barangay Endorsement**" in acceptance of the proposed project is summarized in **Table 13.10-1**.

TABLE 13.10-1 SUMMARY OF MEETINGS WITH BARANGAY CAPTAINS AND DATE OF ISSUANCE OF BARANGAY ENDORSEMENT

City	Date of Meeting	Venue / Location	Date of Issuance of Barangay Endorsement	
Cagayan de Oro City	17 June 2004	Brgy. Session Hall	Nazareth	21 June 2004
			Carmen	21 June 2004
			1	23 June 2004
			Macasandig	28 June 2004

4) Barangay Consultation Meetings

Consultation meetings with residents that could be possibly affected were held in each barangay as summarized below.

TABLE 13.10-2 SUMMARY OF BARANGAY CONSULTATION MEETINGS

Barangay	Location/Venue	Date and Time of Meeting
Cagayan de Oro City		
Nazareth	Basketball Court, Brgy. Nazareth	20 June 2004 3:00 PM
Carmen	Zone 7 – Sanchez Residence	18 June 2004 2:00 PM
1	F. Velez Street, Barangay 1	20 June 2004 1:00 PM
Macasandig	Barangay Hall	23 June 2004 5:00 PM

13.10.4 Identified Impacts

Identified impacts and corresponding compensation costs are summarized **Table 13.10-3**.

TABLE 13.10-3 SUMMARY OF IMPACT AND COMPENSATION COST

7th Bridge and Access Road

Description	No. of HHs	Unit	Rate/Unit	Quantity	Amount (Php)	Remarks
Compensation for Land and Other Assets						
1. Land						
1) Residential – 1	-	m^2	1,400	2,300	3,220,000	Name of land owners to be identified by parcellary survey.
2) Residential – 2	-	m^2	800	4,388	3,510,400	
3) Agricultural (Rice Field)	-	m^2	200	957	191,400	
4) Agricultural (Rice Field)	-	m^2	100	11,211	1,121,100	
Subtotal				**18,856**	**8,042,500**	
2. Structures						
1) Wood with GI sheet	7	m^2	1,140	366.00	417,240	
2) Concrete with wood	18	m^2	6,000	1,514.00	9,084,000	
3) Concrete	8	m^2	7,800	578.00	4,608,400	
Subtotal	**33**			**2,458.00**	**14,109,640**	
3. Other Fixed Structures						
1) Concrete/Steel Fence	3	m	200	62.00	12,400	
2) Signboard	2	Nos.	6,000	2	12,000	
3) Concrete wall/stairs	3	m^2	625	92.00	57,500	
	8				**81,900**	
4. Repair Cost	-	-	-	-	-	None
5. Electric Post Relocation	-	-	-	-	-	None
6. Perennials						
Various types	-	Nos.	various	153	53,550	
Subtotal					**22,287,590**	
Other Compensations						
1. Disturbance Allowance						
1) Severely affected land owners	-	-	-	-	-	None
	-	-	-	-	-	None
2) Agricultural lessees	-	-	-	-	-	None
3) Temporary land users	30	HH	10,000	30	300,000	
4) Severely affected structural owners						
2. Subsistence Allowance						
1) Income loss for shop owners	3	HH	15,000	3	45,000	
3. Financial Assistance						
1) Land users w/o title	-	-	-	-	-	None
4. Rehabilitation Assistance						
1) Severely affected land owners	-	-	-	-	-	None
	-	-	-	-	-	None
2) Agricultural lessees	-	-	-	-	-	None
3) Severely affected structural owners.						
5. Transportation Allowance						
1) Relocating PAPs	38	HH	3,000	38	114,000	
2) Shanty dwellers go back to province.	-	-	-	-	-	None
6. Transitional allowance						
1) Renters of affected structures	8	HH	3,000	8	24,000	
Subtotal					**483,000**	
TOTAL					**22,670,590**	
RAP Implementation					**1,011,950**	
GRAND TOTAL					**23,782,540**	

1) Impact on Land

The project is the construction of new two-lane bridge and access road with required standard right-of-way of 20m, except at the built-up area around Fernandez Street where ROW is narrowed to 12~14m.

Affected areas by land use are summarized as follows:

Land Use	Affected Lands (m^2)	Share (%)
Residential	6,688	35.5
Rice field	12,168	64.5
Total	**18,856**	**100.0**

2) Impact on Structures

A total of **41** structures, mostly residential houses, are identified along the proposed road alignment, as follows:

Structure Use	Number of Structures	Floor Area (m^2)
Residential	30	2,130
Residential cum Shop	2	220
Independent Shop	1	108
Sub-total	**33**	**2,458**
Fence	3	62 m
Signboard	2	-
Concrete Walls	3	625 m^2
Total	**86**	**-**

3) Impact on Residents

The impact on affected families is summarized as follows:

Type of PAF	Number	
Severely Affected PAFs	30.0	
- *Renters*	(*8.0*)	
- *Agricultural Tenants*	-	*not identified*
Marginally Affected PAFs	2.0	
Total	**32.0**	
Average Household Size	5.44	
Public Entities and Utility Companies	-	*not found*

The occupation of affected families varies widely, among which are farmers, shop owners, laborers, and employees. The average monthly household income of most of these families is ₱12,620.

No informal settlers or families along the proposed road alignment that need to be relocated were identified.

4) Impact on Trees and Perennials

Groves of fruit trees, mostly unproductive and with low commercial value, were observed around residential areas. A total of **153** various kinds of trees were identified along the project road.

13.10.5 Valuation of Losses

The sources of data and methods of valuation used to determine compensations for each type of loss are shown in **Section 12.10.5.**

13.10.6 Resettlement Site

There are no informal settlers and urban poor found along the project road, hence, provision of a resettlement site is not necessary. However, Cagayan de Oro City has a number of resettlement sites, as discussed in **Section 12.10.6**, that can accommodate residents who could possibly be displaced.

13.10.7 Income Restoration Program

An income restoration training will be given to PAPs who will be obliged to shift from their present occupation or income generating activity due to relocation. The details of this are discussed in **Section 12.10.6**.

13.10.8 Institutional Arrangements

The DPWH, through an appropriate Project Management Office (PMO), shall be the lead agency responsible for the implementation of the project and the compliance requirement of this RAP. This arrangement is discussed in detail below.

1) Department of Public Works and Highways (DPWH)

A PMO shall be designated by the DPWH as its overall responsible unit in the implementation of the 7th Bridge and Access Road Project. It will manage and supervise the project, including its resettlement activities and land acquisition requirements, in coordination with concerned agencies. To ensure smooth implementation the PMO shall facilitate the availability of funds, including those required for RAP implementation, in a timely manner.

Regional and District Engineering Offices of the DPWH

The City District Engineering Office (DEO) of the DPWH based in Cagayan de Oro City shall be the lead implementing arm for the Resettlement Action Plan (RAP) for project affected persons within the territorial boundary of Cagayan de Oro City.

The District Engineers (DEs), upon receipt of the appropriate Department Order (DO) for the RAP's implementation, shall appoint an adequate number of staff to perform the necessary activities under the plan. Should the number fall short of that required, the DE shall seek assistance from the DPWH Regional Office.

2) Local Government Unit (LGU)

The resettlement requirements of the project shall be coordinated by the DPWH and its regional and district engineering offices with the LGU concerned. This is especially critical insofar as implementation of the provisions of Republic Act 7279 (the Urban Development and Housing Act of 1992) and its implementing rules and regulations are concerned to ensure the observance of proper and humane relocation and resettlement.

3) RAP Implementation Committee (RIC)

The DEO RAP Staff shall be assisted in the implementation by a City Resettlement Implementation Committee (CRIC) which, consistent with the Resettlement Policy, shall be composed of the following:

RAP Implementation Committee (RIC)

Chairman and Convenor	:	District Engineer (DPWH), Cagayan de Oro City
Co-Chairman	:	City Mayor of Cagayan de Oro (or his designated representative)
Members	:	

Barangay Captain – Barangay Carmen
Barangay Captain – Barangay Nazareth
Barangay Captain – Barangay 1

Representative of PAPs – Barangay Carmen, Cagayan de Oro City
Representative of PAPs – Barangay Nazareth, Cagayan de Oro City
Representative of PAPs – Barangay 1, Cagayan de Oro City

Representative(s) from a Non-Government Organization (NGO) or People's Organization (PO) active in all the traversed barangays

The NGO(s) or PO(s) in the Resettlement Implementation Committee (RIC) should be active in the communities traversed by the alignment and registered organization(s) with the Securities and Exchange Commission (SEC). In addition, it should be duly recognized by the LGU through a process of accreditation and recognition by the Sangguniang Panlungsod (SP) of Cagayan de Oro.

The functions of the RIC shall be as follows:

a) Assist the DPWH DEO in validating the list of PAPs, the assets of PAPs that will be affected by the project (using a prepared compensation form), and in implementing the RAP;
b) Assist the DPWH DEO in public information campaign, public participation and consultation;
c) Assist the DEO in the payment of compensation to PAPs;

d) Receive complaints and grievances from PAPs and other stakeholders and act on them accordingly;
e) Maintain record of all public meetings, complaints, and actions taken to address complaints and grievances;
f) In coordination with concerned government authorities, assist in the enforcement of laws/ordinances regarding encroachment into the project road corridor.

4) Internal Monitoring and Evaluation Requirement

The Environmental Social Service Office (ESSO) of the DPWH shall be responsible for the internal monitoring and evaluation requirement of the RAP. Prior to the RAP implementation, however, the ESSO shall provide the DEO RAP Implementation Staff with the proper orientation in the implementation of the RAP and the DPWH Resettlement Policy.

5) External Monitoring and Evaluation Requirement

An external monitoring agency (EMA) or institution shall be engaged by the DPWH upon the donor agency's concurrence of this RAP. The EMA shall perform independent third party monitoring of DPWH's compliance to its own Resettlement Policy and the implementation of the provisions of this Resettlement Action Plan. Selection of this institution shall be in accordance with DPWH's selection process, which shall be concurred by the donor agency before its eventual engagement.

The scope of services of the EMA shall be governed by a Terms of Reference which shall spell out in detail the indicators to be measured among other important aspects of the external monitoring work. The main objectives of conducting an independent external monitoring and evaluation for each of the RAPs implemented are the following:
a) To determine whether or not the implementation of the RAP is carried out according to the Department's Resettlement Policy, and
b) To determine whether or not the main objectives of the RAP (i.e. to improve or at least restore the living standards, income-earning capacity and production levels of affected people) have been achieved.

6) Control of Land Speculation and Illegal Encroachment

To deter the proliferation of project affected persons (PAPs) that have not been censused or inventoried during the socio-economic survey as well as the inventory of affected assets, the RAP implementation team shall be guided during the validation work of the "**Cut-off Date**" as **June 29, 2004** (conclusion of the socio-economic survey for affected persons). Any PAPs identified during the validation work, except those which have not been interviewed but who had already been earlier identified, may not be entitled for compensation. The same restriction shall apply for additional assets built and/or improvements made on existing assets of identified PAPs after the cut-off date. Photographs earlier taken of these assets shall be used to validate any variances made after the cut-off date.

13.10.9 Grievance Redress Measures

Grievance redressal is one of the main functions of the RIC. The Resettlement Policy provides that grievances related to any aspect of the project will be handled through negotiations aimed at achieving consensus following the procedures discussed in **Section 12.10.8.**

13.10.10 Monitoring and Evaluation

The procedures for monitoring and evaluation of RAP implementation during the project implementation stage are discussed in **Section 12.10.9.**

13.10.11 RAP Implementation

1) Preparation of Final RAP

The social impacts identified in this study shall be verified and validated during the detailed design stage after establishing the exact extent of construction limits and the corresponding ROW limits required. The RAP updating surveys shown in **Table 13.10-4** shall be carried out to update the preliminary RAP prepared under this study after fixing the final ROW limits.

TABLE 13.10-4 RAP UPDATING SURVEYS TO BE UNDERTAKEN

Impact Item	Surveys to be Undertaken
Land	- **Parcellary survey** shall be carried out to identify the names of lot owners and the area to be acquired from each lot owner.
Structure	- **Tagging and picture taking** must be carried to identify the PAPs eligible for compensation. - **Cut-off**-Date must be set and informed to the residents prior to tagging.
Perennials	- **Validation survey** shall be carried out to identify name of owner of perennials with commercial values.
Tenants/Renters, Informal Settlers	- **Socio-economic survey** shall be carried out to identify the presence of agricultural tenants, renters of structures, and informal settlers who need special consideration by providing relocation site, financial assistance, and other assistance.

2) RAP Approval

The final RAP will have to be presented to the DPWH for approval and for concurrence by the donor agency by the scheduled period in 2007. The salient points of the final RAP will have to be reiterated with concerned officials of Cagayan de Oro City upon its approval prior to implementation. The RIC that will be organized for the purpose shall provide the necessary assistance to the DPWH DEOs during the implementation

process. Any technical assistance, when required by the RIC, will be extended by the DPWH Regional Office upon request.

3) MOU with LGU and the Establishment of the RIC

Within a reasonable period of time from the approval of this RAP, a Memorandum of Understanding (MOU) will be executed between the DPWH and the LGU (Cagayan de Oro City). The MOU will provide the mandate for the formation of the RIC and will likewise spell out the required cooperation and commitment of the LGU in ensuring that the right-of-way is sustainably free from encroachments and illegal squatting even after project completion.

4) Orientation and Training of the RIC

The members of the RIC will be given orientation on the scope and coverage of their work under the final RAP. In addition, the same RIC members will be trained on the implementation requirements of the RAP, including the scope and coverage of the DPWH policy framework that will be embodied in that RAP.

5) Stake-out

During the validation period, the RIC shall conduct a stakeout of the project corridor to determine the extent of the area required by the road project. The results of the alignment survey used during the detailed engineering design and the latest parcellary survey conducted in the area will be used as basis for this activity.

6) PAP Validation and Establishment of Detailed Compensation Rates

The RIC members will validate the census of PAPs and inventory of affected assets and review and update, where necessary, the compensation entitlements payable to these PAPs. This will be done at a pre-agreed period prior to the conclusion of the orientation training.

7) Conduct of Public Information Campaign

While the PAPs have already been informed about the project during the series of barangay consultations, perception survey, and socio-economic survey conducted during the preparation of the preliminary RAP, the RIC will again call for public meetings to explain further the details of the RAP upon its implementation. The RIC can, upon public information, improve materials prepared during the formulation of the RAP. The PAPs will be informed of the schedule of the RIC's validation work and will be requested to keep documents that would attest ownership of their affected assets as these may be requested by the RIC.

8) Finalization of Compensation and Other Entitlements of PAPs

The RIC shall finalize the entitlements and the total amount of compensation payable to each PAP following the updating of the unit prices that will be used, and after confirmation visit to each PAP to validate the inventory of affected assets. This shall be

consistent with the entitlement matrix of the RAP. The possibility of additional PAPs who have not bee identified during the preparation of the RAP due to potential minor re-alignment remains high and the validated list is expected to reflect these changes. Those that are within the ROW but who came in after the cut-off period established for the RAP are excluded.

An "Inventory of Affected Fixed Assets Form" will have to be accomplished and signed by each PAP or his duly authorized representative to indicate concurrence with the estimates of the affected assets, entitlements, and total compensation amounts. A copy of the acknowledged form will be given to each of the PAPs for their reference.

9) Public Meetings

Public meetings will be held during the disclosure of compensation to the PAPs in the barangays traversed by the road project. These meetings will be conducted in a public place following conclusion of the finalization of the compensation entitlements to inform them of the results of the validation of impacts and computation of compensation and other entitlements, other resettlement activities, and the schedule of payment to PAPs.

During this activity the PAPs are expected to register any disagreement on the validated results through the grievance redressal mechanism established in the policy framework that will be reiterated in the final RAP. The PAPs will be advised on the options that may be taken following the grievance redressal procedures of the same policy and the Policy Framework on Public Participation and Consultation of the DPWH. The result of the disclosure meetings shall be the basis for the preparation of payment vouchers and subsequent payments to the PAPs.

10) Payment of Compensation and Other Entitlements

The place, date, and time of the payment activity will be communicated to the Mayor of Cagayan de Oro City with a request that this be announced in advance to the barangay officials/RIC members. The announcement will likewise be posted by the barangay officials in a place accessible to the public to ensure that all PAPs within their administrative jurisdiction are informed. All payments of compensation will be also done in public.

The activity will be highlighted with the signing of a Pledge of Undertaking (POU) by the PAP, which states among others the demolition, removal or relocation of structures from the ROW within a specified period of time, the failure of which provides corresponding recourse of the DPWH to either carry out the stipulation at the PAPs expense or filing of criminal case in a court of law. In addition, the POU prohibits the rebuilding of such structures by the PAPs or their heirs within the DPWH's road right-of-way (RROW).

11) Reorganization and Relocation

The DPWH will not cause any demolition, reorganization or relocation along the ROW until all the PAPs are duly paid their compensation and other entitlements as disclosed during the public meetings.

12) Hand-over of the Site for Construction

The site may be handed over for the civil works construction at least a month following the conclusion of the RAP implementation and after the issuance of a "No Objection Letter" from the donor agency.

13) Monitoring and Supervision of RAP Implementation

The implementation of the RAP will be supervised by the Project Implementing Office in coordination with the ESSO. The ESSO will also carryout internal monitoring of the RAP implementation and will provide periodic progress reports to the donor agency. Supervision and monitoring of the RAP implementation will be done through the ESSO counterpart staff at the regional level.

An independent agency will be contracted to carry out external monitoring and post-evaluation study.

13.11 PROJECT EVALUATION

13.11.1 Economic Evaluation

1) Traffic Demand Forecast

Future traffic demand forecasted in a form of OD matrix (years 2010, 2016 and 2022) was assigned on the road network to estimate traffic volume on the 7th Bridge and its Access Road. The estimated traffic volume on the 7th Bridge and its Access Road for the case of "with" the project is summarized in **Table 13.11-1**.

TABLE 13.11-1 TRAFFIC VOLUME ON 7TH BRIDGE AND ITS ACCESS ROAD

Unit: PCU / day

	2010	2016	2022	AAGR (%)	
				'10 – '16	'16 – '22
7th Bridge	26,891	34,854	41,654	4.4	4.4
East Approach	22,462	30,777	33,670	5.4	5.4
North Approach	23,099	27,573	39,363	6.1	6.1

The estimated vehicle kilometers and vehicle hours in Metro CDO are shown in **Tables 13.11-2** and **13.11-3**, respectively. These tables are based on the benefit calculation.

TABLE 13.11-2 TOTAL VEHICLE KILOMETERS IN METRO CDO WITH AND WITHOUT 7TH BRIDGE AND ITS ACCESS ROAD

Unit: PCU Km / day

	W/O Project	W/ Project	W/O - W/
2010	2,448,266	2,443,015	5,251
2016	3,277,959	3,270,928	7,031
2022	4,470,549	4,458,197	12,352

TABLE 13.11-3 TOTAL VEHICLE HOURS IN METRO ILOILO WITH AND WITHOUT 7TH BRIDGE AND ITS ACCESS ROAD

Unit: PCU Hour / day

	W/O Project	W/ Project	W/O - W/
2010	102,010	100,580	1,430
2016	147,330	145,270	2,060
2022	226,190	222,970	3,220

2) Economic Evaluation

Evaluation Period

The evaluation period is assumed to be 20 years from 2011 to 2030 taking into account the service life of the 7th Bridge and its Access Road.

Implementation Schedule

The implementation schedule is assumed as follows:

- 2007 Detailed design
- 2008 Land acquisition
- 2009 – '10 Construction of 7th Bridge and its Access Road
- 2011 Open to the public

Economic Indicators

The economic evaluation method is principally employed benefit cost analysis. The economic indicators used in this study re as follows:

– Net Present Value (NPV)
– Benefit Cost Ratio, (BCR), and
– Economic Internal Rate of Return (EIRR)

Estimation of Benefit

Basic Vehicle Operating Cost

The basic vehicle operating cost (BVOC) is estimated annually by PMO-FS Office in DPWH. The latest BVOC was estimated in April 2002. In this study, this VBOC with some modification by inflation between April 2002 and April 2003 is utilized in this study (See Table 13.11-4).

TABLE 13.11-4 BASIC VEHICLE OPERATING COST (EXCLUDING TAX)

Vehicle Type	Running [P/1000km]	Fixed [P/Min]	Time [P/Min]
Car / Taxi / Jeep	4,441	0.245	0.991
Jeepney	2,991	1.181	1.468
Bus	7,453	1.794	5.561
Truck	9,622	2.107	0

Source: PMO-FIS, DPWH
Note: BVOC prepared by PMO-FIS is modified with inflation rate.
All costs are expressed as 2003 prices.

The vehicle operating cost by surface type and travel speed was set up since it varies by these factors as shown in Appendix Table **13.11-1.**

Estimation of Benefits

The saving in vehicle operating costs and travel time cost were estimated and are shown in **Table 13.11-5.**

TABLE 13.11-5 ESTIMATION OF BENEFITS

Unit: '000 Pesos/Year

Year	Saving in VRC	Saving in VFC	Saving in VOC	Saving in TCC	Total Saving
2010	19,355	24,421	43,776	33,013	746,789
2016	25,935	35,273	61,208	47,682	108,889
2022	39,270	55,118	94,388	74,509	168,896

Economic Cost

The project cost, which was already calculated in the previous section, is expressed as the financial cost. It is therefore to convert from financial cost to economic cost. In this study the economic cost was estimated to deduct from financial cost to government taxes and shadow prices of unskilled labor is shown in **Table 13.11-6**.

TABLE 13.11-6 ECONOMIC COST ESTIMATE

Unit: '000 Pesos

Description		Economic Cost	Financial Cost
1	Construction Cost	164,000	193,500
2	ROW Acquisition / Resettlement	21,300	23,700
3	Consultancy	20,800	23,200
3-1	Detailed Design	6,900	7,700
3-2	Construction Supervision	13,900	15,500
	Total	206,100	240,400

Maintenance Cost

According to the maintenance study in this study, the present maintenance cost for the road has estimated on the basis of the EMK method. In this study, therefore, the maintenance cost of the 7th Bridge and its Access Road is estimated on the basis of the same EMK method.

Benefit Cost Analysis

Based on the above mentioned benefits and cost estimations, the economic analysis of the Project was made. **Table 13.11-7** show the benefit – cost analysis of the 7th Bridge and its Access Road Construction Project during project life period of 20 years and **Table 13.11-8** shows the benefit cost stream. The results of the economic analysis show that a Net Present Value (NPV) of ₱ 218 million and BCR of 3.18 over 20 years life of the Bridge using discount date of 15% which is designated by the NEDA. The Economic Internal Rte of Return (EIRR) was compiled at 36.4%.

TABLE 13.11-7 ECONOMIC INDICATIONS OF BENEFIT COST ANALYSIS

Net Present Value	218 million pesos
BCR	3.18
EIRR	36.35%

Note: 1) Project life is assumed to be 20 years
2) Discount rate is 15%

TABLE 13.11-8 BENEFIT - COST STREAM OF 7th BRIDGE AND ITS ACCESS ROAD PROJECT

Undiccounted BenefiT Cost Stream

000 Pesos

Sq	Year	Construction Cost	O & M Cost	Cost Total	Benefit	Cost-Benefit
1	2004	0.0	0.0	0.0	0.0	0.0
2	2005	0.0	0.0	0.0	0.0	0.0
3	2006	0.0	0.0	0.0	0.0	0.0
4	2007	6,900.0	0.0	6,900.0	0.0	-6,900.0
5	2008	21,300.0	0.0	21,300.0	0.0	-21,300.0
6	2009	88,950.0	0.0	88,950.0	0.0	-88,950.0
7	2010	88,950.0	0.0	88,950.0	0.0	-88,950.0
8	2011	0.0	260.0	260.0	81,386.2	81,126.2
9	2012	0.0	261.0	261.0	86,260.6	85,999.6
10	2013	0.0	261.0	261.0	91,429.6	91,168.6
11	2014	0.0	262.0	262.0	96,911.2	96,649.2
12	2015	0.0	262.0	262.0	102,724.4	102,462.4
13	2016	0.0	263.0	263.0	108,889.4	108,626.4
14	2017	0.0	263.0	263.0	115,121.9	114,858.9
15	2018	0.0	263.0	263.0	121,713.8	121,450.8
16	2019	0.0	262.0	262.0	128,685.9	128,423.9
17	2020	0.0	262.0	262.0	153,856.5	153,594.5
18	2021	0.0	262.0	262.0	164,301.2	164,039.2
19	2022	0.0	262.0	262.0	168,896.3	168,634.3
20	2023	0.0	262.0	262.0	174,545.6	174,283.6
21	2024	0.0	262.0	262.0	180,387.5	180,125.5
22	2025	0.0	262.0	262.0	186,428.7	186,166.7
23	2026	0.0	262.0	262.0	192,676.0	192,414.0
24	2027	0.0	262.0	262.0	199,136.6	198,874.6
25	2028	0.0	262.0	262.0	205,817.9	205,555.9
26	2029	0.0	262.0	262.0	212,727.7	212,465.7
27	2030	0.0	262.0	262.0	219,873.8	219,611.8

Diccounted BenefiT Cost Stream

000 Pesos

Sq	Year	Discounted	Construction Cost	O & M Cost	Cost Total	Benefit	Cost-Benefit
1	2004	1.000	0.0	0.0	0.0	0.0	0.0
2	2005	1.150	0.0	0.0	0.0	0.0	0.0
3	2006	1.323	0.0	0.0	0.0	0.0	0.0
4	2007	1.521	4,536.9	0.0	4,536.9	0.0	-4,536.9
5	2008	1.749	12,178.3	0.0	12,178.3	0.0	-12,178.3
6	2009	2.011	44,223.9	0.0	44,223.9	0.0	-44,223.9
7	2010	2.313	38,455.5	0.0	38,455.5	0.0	-38,455.5
8	2011	2.660	0.0	97.7	97.7	30,596.1	30,498.4
9	2012	3.059	0.0	85.3	85.3	28,198.7	28,113.4
10	2013	3.518	0.0	74.2	74.2	25,990.0	25,915.8
11	2014	4.046	0.0	64.8	64.8	23,955.0	23,890.2
12	2015	4.652	0.0	56.3	56.3	22,079.9	22,023.6
13	2016	5.350	0.0	49.2	49.2	20,352.2	20,303.0
14	2017	6.153	0.0	42.7	42.7	18,710.5	18,667.8
15	2018	7.076	0.0	37.2	37.2	17,201.6	17,164.4
16	2019	8.137	0.0	32.2	32.2	15,814.8	15,782.6
17	2020	9.358	0.0	28.0	28.0	16,441.8	16,413.8
18	2021	10.761	0.0	24.3	24.3	15,267.8	15,243.5
19	2022	12.375	0.0	21.2	21.2	13,647.7	13,626.5
20	2023	14.232	0.0	18.4	18.4	12,264.5	12,246.1
21	2024	16.367	0.0	16.0	16.0	11,021.7	11,005.7
22	2025	18.822	0.0	13.9	13.9	9,905.1	9,891.2
23	2026	21.645	0.0	12.1	12.1	8,901.7	8,889.6
24	2027	24.891	0.0	10.5	10.5	8,000.2	7,989.7
25	2028	28.625	0.0	9.2	9.2	7,190.1	7,180.9
26	2029	32.919	0.0	8.0	8.0	6,462.2	6,454.2
27	2030	37.857	0.0	6.9	6.9	5,808.0	5,801.1
		Total	99,394.6	708.1	100,102.7	317,809.6	217,706.9

Net Present Value	**217,707**
B/C Ratio	**3.175**
EIRR	**36.35**

(2) Sensitivity Analysis

The sensitivity analysis is conducted under a worse case scenario incorporating increase and/or decrease of the estimation of costs and benefits. **Table 13.11-9** show the results of the sensitivity analysis.

TABLE 13.11-9 SENSITIVITY ANALYSIS REGARDING COSTS AND BENEFITS OF 7TH BRIDGE AND ITS ACCESS ROAD CONSTRUCTION PROJECT (EIRR)

Unit: %

		Indicator	Benefits		
			20% down	Base Case	20% up
Costs	20% down	NPV (P million)	174	238	301
		B/C Ratio	3.18	3.97	4.76
		EIRR (%)	36.4	42.5	48.1
	Base Case	NPV (P million)	154	217	281
		B/C Ratio	2.54	3.18	3.81
		EIRR (%)	31.0	36.4	41.3
	20% up	NPV (P million)	134	198	261
		B/C Ratio	2.12	2.65	3.18
		EIRR (%)	27.2	31.9	36.4

Note: Project life is assumed to be 20 years

(3) Summary of Economic Analysis

The implementation of the 7th Bridge and its Access Road construction project can be justified from view of national economic point since the economic indicators of all cases more than the over cut-off level which can be considered as 15% of EIRR in the Philippines.

13.11.2 Technical Evaluation

The results of the technical analysis of the 7th Bridge show that the construction of the 7th Bridge is technically feasible. In general, there are a few technical problems to construct the 7th Bridge. However, the following technical notes shall be made:

- Due to existence of soft ground along the bank of Cagayan de Oro River, it is proposed to employ the soft ground treatment to replace from the soft soil to suitable soil to construct the bridge.

13.11.3 Other Impacts

1) On Traffic

Table 13.11-10 shows the transport efficiency of Metro Cagayan de Oro in cases of with and without the 7th Bridge Project.

Table 13.11-10 TRANSPORT EFFICIENCY IN METRO CAGAYAN DE ORO WITH AND WITHOUT 7TH BRIDGE CONSTRUCTION PROJECT

			2010	2016	2022
PCU Kilometers ('000)	Whole Area	W/O Project	2,448,270 (1.00)	3,277,960 (1.00)	4,470.550 (1.00)
		W/ Project	2,443,020 (1.00)	3,270,930 (1.00)	4,458,20 (0.99
PCU Hour ('000)	Whole Area	W/O Project	102,010 (1.00)	147,330 (1.00)	226,190 (1.00)
		W/ Project	100,580 (0.98)	145,270 (0.98	222,970 (0.98
Average Travel Speed (km/h)	Whole Area	W/O Project	24.00 (1.00)	22.25 (1.00)	19.76 (1.00)
		W/ Project	24.29 (1.01)	22.52 (1.01)	19.99 (1.01)
Vehicle Operating Cost (P '000/day)	Whole Area	W/O Project	12,288 (1.00)	16,695 (1.00)	23,272 (1.00)
		W/ Project	12,060 (0.98)	16,387 (0.98)	22,831 (0.98)

Table 13.11-11 TRAFFIC VOLUME WITH AND WITHOUT 7 TH BRIDGE CONSTRUCTION PROJECT

Unit: PCU/day

	2010			2016			2022		
	W/O 7th Bridge	W/ 7th Bridge	W/O-W/ W/O (%)	W/O 7th Bridge	W/ 7th Bridge	W/O-W/ W/O (%)	W/O 7th Bridge	W/ 7th Bridge	W/O-W/ W/O (%)
Marcos Bridge	69,400	63,800	8.1	83,300	757,000	9.1	96,700	91,800	5.1
Carmen Bridge	44,200	29,300	33.7	61,100	35,000	45.6	92,000	56,900	38.2
7th Bridge	-	26,900	-	-	34,900	-	-	41,700	-

2) On Urban Amenity

Traffic volume of the existing Carmen Bridge will be greatly reduced due to diverted to the 7th Bridge. Therefore, traffic congestion, noise level, air quality and vibration in the area within the city proper will be greatly improved. Thus, urban amenity will be improved.

3) On Regional Economy

With the improved and reliable transport facility, economic activities within the city proper will be stimulated. This project will contribute to economic growth of not only Metro Cagayan de Oro but also Reion X.

13.11.4 Overall Evaluation

As mentioned above, the implementation of the 7th Bridge construction project can be justified from view of economic, technical and social impact points.

CHAPTER 14
FEASIBILITY STUDY OF J.R. BORJA EXTENSION

14.1 Objectives of the Project

The eastern area of CDO City is topographically characterized as a narrow coastal flat plain with 0.3~1.5km in width followed by steep mountain slopes. Urbanization is being progressed in the narrow coastal plain. CDO-Butuan Road is the only trunk road serving for traffic in the eastern area.

The project is to extend the existing J.R. Borja Street running almost parallel to CDO-Butuan Road. The objectives of the project are as follows:

Objectives of the Project

- To reduce traffic congestion of CDO-Butuan Road.
- To form flexible road network which provides alternative route to road users.
- To enhance international / domestic investment in the Study Area.
- To realize expected investment effects of related projects such as Mindanao International Container Terminal and PHIVIDEC Industrial area.

14.2 Physical Features of the Project Site

Narrow coastal plain is crossed by four medium size rivers, namely Biga-an River, Cugman River, Umalag River and Agusan River. Three mountains are extended towards the coast where the flat plain becomes quite narrow (0.3~0.8km in width). These mountains are major obstacles for road construction.

Soils consist of sand with silt or gravel with relatively high N-value. Land use is the mixture of residential, commercial, warehouses and industrial area.

14.3 Engineering Surveys Conducted

The following three surveys were undertaken:

- Orthophoto Maping utilizing existing aerial photos
- Road Alignment Survey
- Geo-technical Survey and Soils/Materials Survey

1) Orthophoto Mapping
   - Existing aerial photos : Photo Scale = 1/15,000
   - Orthophoto Mapping : Scale = 1/5,000

2) Road Alignment Survey

- Control points survey
- Center line survey (50m interval)
- Profile survey (50m interval)
- Cross-section survey (50m interval, width=60m)
- River profile / cross section survey (Iponan River)

3) Geo-technical Survey and Soils/Material Source Survey

- Bridge site geo-technical survey (depth=19~35m)
- Soils / material sources survey (3 locations)

14.4 Selection of Route Alignment

14.4.1 Control Points for Selecting Route Alignment

Control points for selecting route alignment are as follows (see Figure 14.4-1):

- Existing J.R. Borja Extension is further extended towards the east.
- Residential areas, warehouses and factories have been developed in a narrow coastal plain.
- Three mountains with the height of 40m to 65m extend towards the coastal line where flat area becomes very narrow ranging from 300m to 700m in width.
- An alignment is planned to end at Syre Highway Parallel Road (city road), however, it is blocked by high mountain (Mountain-3 in Figure 14.4-1). As a temporary solution, it is merged with CDO-Butuan Road before this mountain.

14.4.2 Alternative Alignments

An alignment was divided into 4 sections. Alternative alignments were developed for Sections 2 and 4. An alignment of Section 1 and 3 was selected along the foot of mountain slopes. Alternative alignments are shown in Figure 14.4-1. Vertical alignments of alternatives in Section-2 and in Section-4 are shown in Figure 14.4-2 and 14.4-3, respectively.

14.4.3 Evaluation of Alternative Alignments and Selection of Best Alignment

Alternative alignments in each section were evaluated and selected as shown in Table 14.4-1.

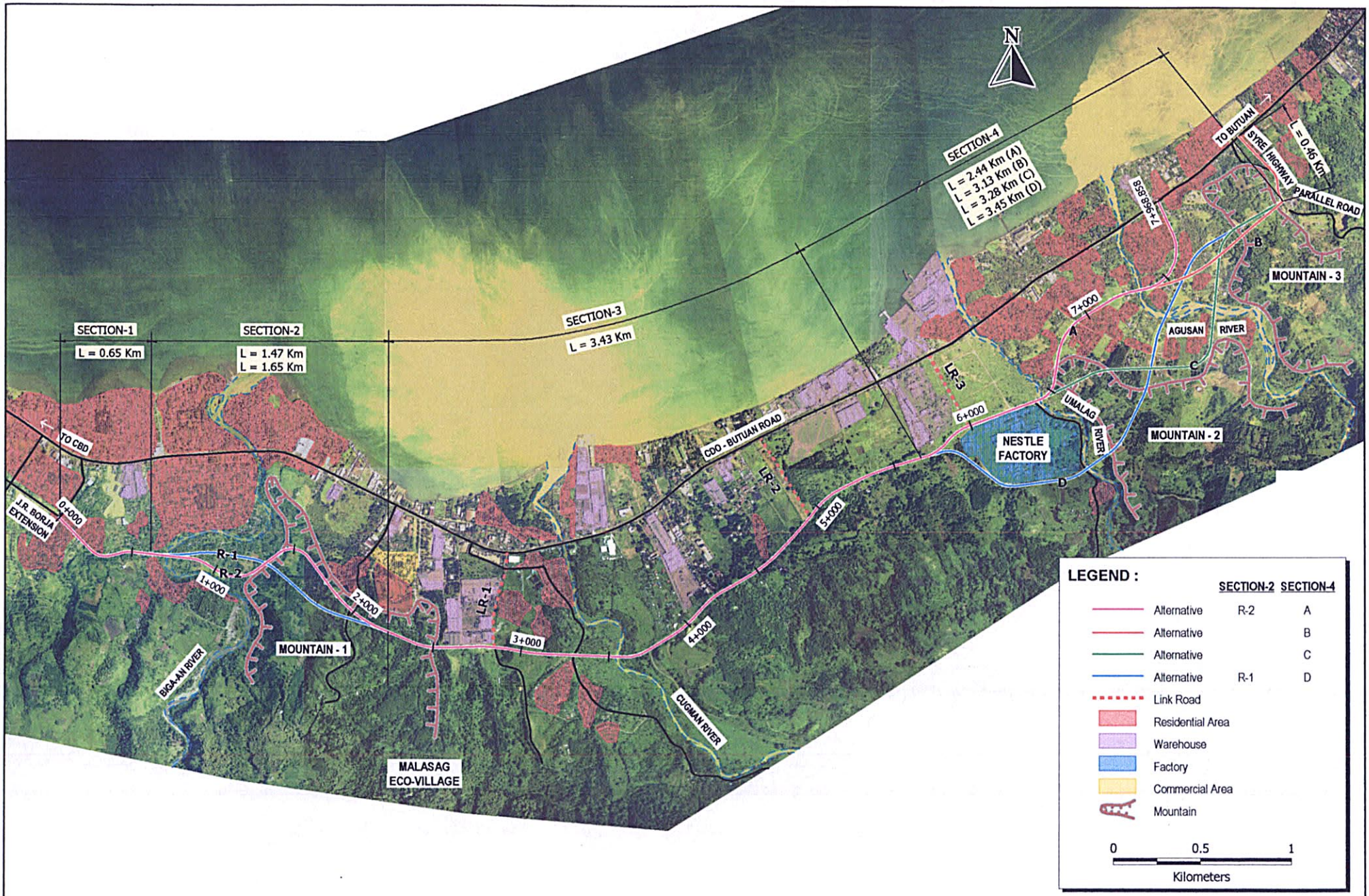


FIGURE 14.4-1 ALTERNATIVE ALIGNMENTS OF J. R. BORJA EXTENSION

TABLE 14.4-1 (1/2) EVALUATION OF ALTERNATIVE ALIGNMENTS : J.R. BORJA EXTENSION

		SECTION - 2		
		R-1		R-2
		R-1A	R-1B	
1) Site Conditions and Issues		• After Biga-an River, relatively high mountain with elevation difference of 65m (Mountain-1) exists. • How to cross this mountain is the key issue. • An alignment crosses the road going to Eco-Village. How to cross this existing road is another issue.		
2) Planning Concept		• Smooth horizontal alignment is to be selected, though encounters high cut section.	• Same as R-1A, but to avoid high cut section, a tunnel is planned.	• An alignment is to be selected following contour line as much as possible and smooth horizontal alignment is sacrificed.
3) Scope of Civil Work	Road Length (km)	1.46	0.91+1.85(T)	1.61
	Bridge Length (km)	0.36	0.06	0.41
	Total (km)	1.82	1.82	2.02
4) Construction Cost (Million P)	Road	212.7	1,722.4	138.8
	Bridge	307.2	52.2	347.2
	Total	519.9	1,774.6	486.0
5) ROW / Relocation Cost (Million P)	ROW	16.1	3.1	16.5
	Relocation	5.8	3.4	5.8
	Total	21.9	6.5	22.3
6) Evaluation	a) Horizontal Alignment	Rmin.=400m	Rmin.=400m	Rmin.=120m
	b) Vertical Alignment	i = 8% Cut height = 38m	i = 3.9% (Tunnel)	i = 8% Cut height = 18m
	c) Construction Cost	+33.9 (1.07)	+1,288.6 (3.65)	- (1.00)
	d) ROW / Relocation Cost	-0.4 (0.98)	-15.8 (0.29)	- (1.00)
	e) Social Impact (No.of Affected Structures)	29	17	29
	f) Advantages / Disadvantages	• High negative impact on natural environment. • Steep gradient. • Expensive.	• Very high construction cost. • Less impact on natural environment and social aspect.	• Requires sharp curve. • Relatively high cut, affecting natural environment. • Steep gradient. • Most economical.
7) Recommendation		X	X	◎ Recommended

TABLE 14.4-1 (2/2) EVALUATION OF ALTERNATIVE ALIGNMENTS : J.R. BORJA EXTENSION

		SECTION - 4						
		Alternative-A	Alternative-B		Alternative-C		Alternative-D	
			B-1	B-2	C-1	C-2	D-1	D-2
1) Site Conditions and Issues		• Coastal flat plain is narrow where residential houses, warehouses and factories were developed. • There is a relatively high mountain of 40m (Mountain-2) between Umajag River and Agusan River. • After Umajag River, coastal flat area is relatively dense residential area. Inland of this residential area is relatively high mountain. • Between Agusan River and Syre Highway Parallel Road, relatively high mountain of 50m (Mountain-3) exists.						
2) Planning Concept		• To utilize the existing road in front of NESTLE Factory. • To select alignment in the coastal residential area to avoid high cut of mountain slope.	• Route-A is extended and cross Mountain-3. • High cut is expected.	• Same as Route-B1, but to avoid high cut, a tunnel is planned.	• After NESTLE Factory, an alignment passes through two mountains and connected with Syre Highway Parallel Road.	• Same as Route C-1, but to avoid high cut, tunnels are planned.	• An alignment passes through the back side of NESTLE Factory and passes through two mountains to connect with Syre Highway Parallel Road.	• Same as Route D-1, but to avoid high cut, tunnels are planned.
3) Scope of Civil Work	Road Length (km)	2.29	2.98	2.68+030(T)	3.13	2.58+0.55(T)	3.30	2.47+0.83(T)
	Bridge Length (km)	0.15	0.15	0.15	0.15	0.15	0.15	0.15
	Total (km)	2.44	3.13	3.13	3.28	3.28	3.45	3.45
4) Construction Cost (Million P)	Road	136.3	330.3	639.5	400.9	1,033.5	430.3	1,467.3
	Bridge	135.0	135.0	135.0	135.0	135.0	135.0	135.0
	Total	271.3	465.3	774.5	535.9	1,168.5	565.3	1,602.3
5) ROW / Relocation Cost (Million P)	ROW	163.0	195.4	189.9	190.8	181.7	180.6	168.9
	Relocation	6.0	7.2	7.2	7.4	7.4	9.2	8.8
	Total	169.0	202.6	197.1	198.2	189.1	189.8	177.7
6) Evaluation	a) Horizontal Alignment	Rmin.=150m	Rmin.=150m	Rmin.=150m	Rmin.=150m	Rmin.=150m	Rmin.=150m (2-locations)	Rmin.=150m (2-locations)
	b) Vertical Alignment	i = 0.5%	i = 2.5% Cut height = 42m	i = 2.5% (1 Tunnel)	i = 1.1% Cut height = 42m	i = 1.1% (2 Tunnels)	i = 2.3% Cut height = 42m	i = 2.3% (2 Tunnels)
	c) Construction Cost	—	-309.2 (0.60)	- (1.00)	-238.6 (0.69)	+394.0 (1.51)	-209.2 (0.73)	+827.8 (2.07)
	d) ROW / Relocation Cost	—	+5.5 (1.03)	- (1.00)	+1.1 (1.01)	-0.8 (0.96)	-7.3 (0.96)	-19.4 (0.90)
	e) Social Impact (No.of Affected Structures)	30	36	36	37	37	46	44
	f) Advantages / Disadvantages	—	• Natural environment of one mountain affected. • Cut slope stability must be attentioned.	• Among tunnel solutions, cheapest one.	• Natural environment of two mountains affected. • Cut slope stability must be attentioned.	• Second most expensive.	• Natural environment of two mountains affected. • Cut slope stability must be attentioned.	• Most expensive.
7) Recommendation		◎ Recommended for Initial Stage	X	◎ Recommended for Ultimate Stage	X	X	X	X

14.5 Traffic Forecast

Estimated traffic volume by section is shown in Table 14.5-1 and number of lanes required is shown in Figure 14.5-1.

Traffic volume will exceed traffic capacity of a 2-lane road in 2010, thus it is recommended that this road be constructed with a 4-lane divided road standard from the beginning.

TABLE 14.5-1 ESTIMATED TRAFFIC VOLUME BY SECTION

			West Section	Middle Section	East Section
Traffic Volume (100 PCU)	2010		37.3	27.7	23.2
	2016		42.9	31.9	26.7
	2022		49.5	36.8	30.8
V/C Ratio	2-lane	2010	1.49	1.11	0.93
		2016	1.72	1.28	1.07
		2022	1.98	1.47	1.23
	4-lane	2010	0.75	0.55	0.46
		2016	0.86	0.64	0.53
		2022	0.99	0.74	0.62

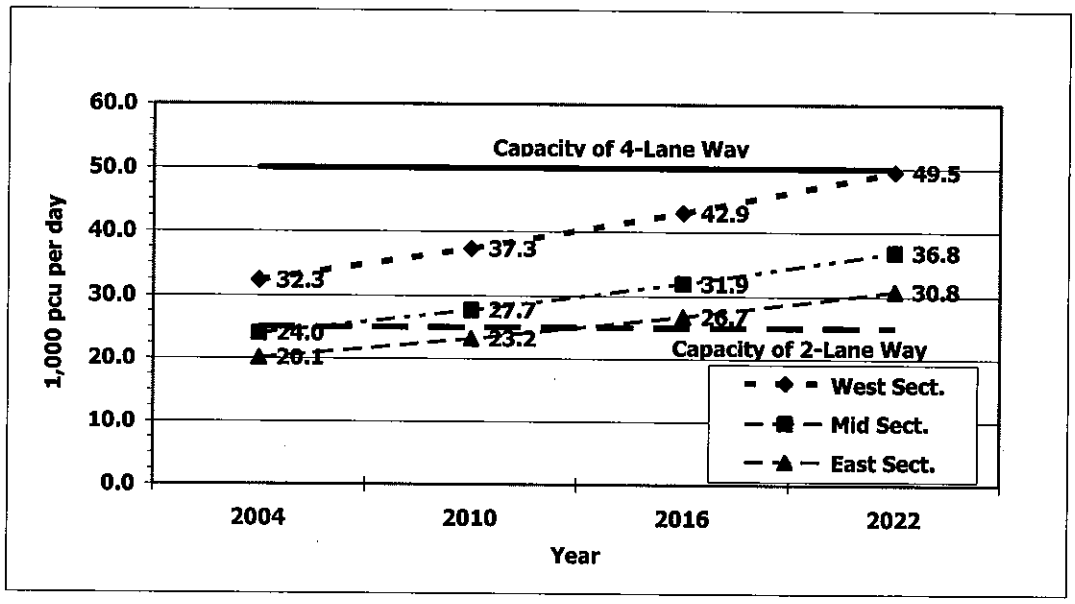


FIGURE 14.5-1 NO. OF LANES REQUIRED

14.6 Construction Phasing

Since this road is required to be constructed with a 4-lane divided road from the beginning, possible stage construction is by section.

In due consideration of financial constraints, following stage construction is recommended.

Phase – 1 : West Section
Phase – 2 : Middle and East Sections

To be noted is that Phase-2 should start soon after Phase-1 and there should be no time gap between Phase-1 and Phase-2.

14.7 Preliminary Design

14.7.1 Design Concepts and Criteria

1) Design Concepts

J.R. Borja Extension functions an alternative route of CDO-Butuan Road and strengthens the east-west transport axis.

It traverses the narrow coastal plain along the foot of mountain slopes and sometimes crosses mountains. It runs in the urbanized and planned urbanized areas as well as mountain areas. Major issue is to minimize adverse social and natural environment impacts. To achieve this objective, the design standards are not necessarily be so high.

In view of above, the design concepts were established as follows:

Design Concept

- Design speed of 50 km/hour is selected to minimize adverse social and natural environment impacts in determining horizontal and vertical alignments
- For socially critical areas, ROW width is narrowed as much as possible by applying structures such as retaining walls.
- Link roads to connect this road with CDO-Butuan Road are planned, so that both roads will be efficiently utilized.
- Intersections are so designed that a left-turn lane is provided.

2) Road and Intersection Design Criteria

Highway design criteria are shown in Table 14.7-1. Intersection design criteria were shown in Table 12.7-2.

Typical cross-sections are shown in Figure 14.7-1.

Typical cross-section of existing section of this road is shown in Figure 14.7-2. It is recommended that the existing section be revised in future to accommodate 1.5m loading / unloading lane.

Road right-of-way was established as follows:

Standard ROW (Open Area)	:	35m (Embankment height of 2.5m or less can be accommodated.)
ROW of Socially Critical Area (Residential Area)	:	25m (Retaining walls are provided to minimize ROW width.)
ROW of Cut Section	:	ROW width depends on cut height. To reduce ROW width, slope protection works shall be provided.

TABLE 14.7-1 HIGHWAY DESIGN CRITERIA

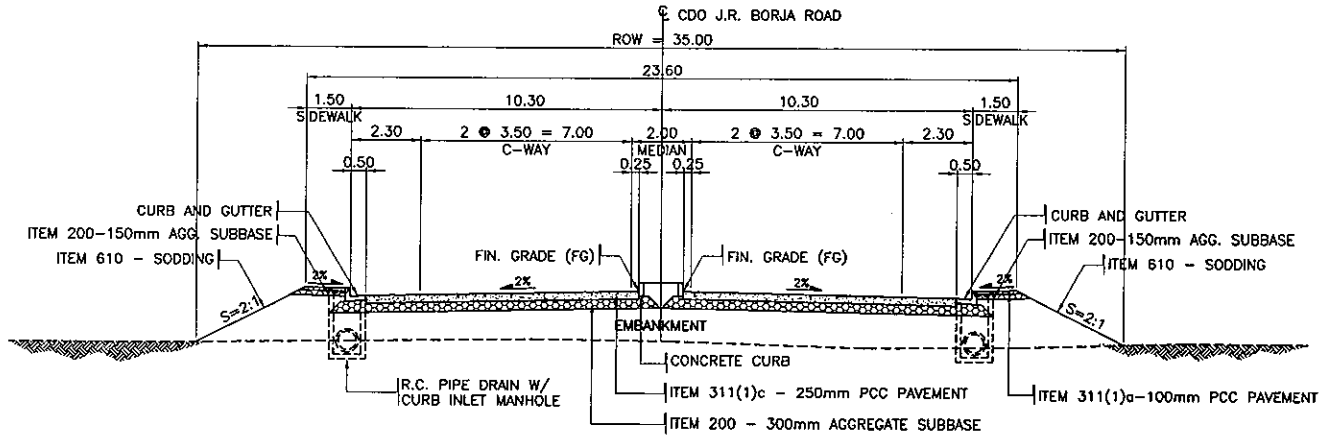
Element	Unit	Flat/Rolling/ Mountainous Terrain
Design Speed	Km/hr.	50
No. of Lanes	-	4
Type of Pavement	-	PCCP
Lane Width	m	3.5
PUV Loading / Unloading Lane	m	2.3
Median	m	2.0
Sidewalk	m	1.5~2.0
Stopping Sight Distance	m	65
Passing Sight Distance	m	340
Minimum Horizontal Radius	m	80
Minimum Horizontal Radius for Normal Cross Slope	m	1,200
Maximum Vertical Grade	%	8 10 (300^{m})
Minimum Length of Vertical Curve	m	60
Maximum Superelevation	%	6
Normal Cross Slope	%	2
Vertical Clearance	m	5

3) Bridge and Structures

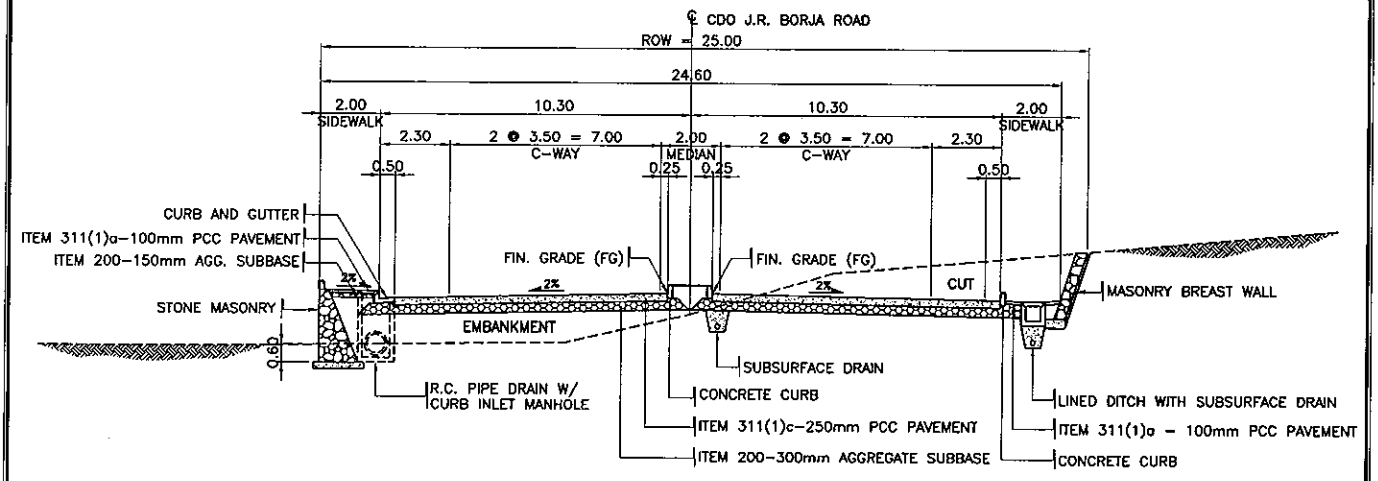
The same design criteria as shown in Section 12.7.1 were adopted.

4) Drainage and Cross Drainage Facilities

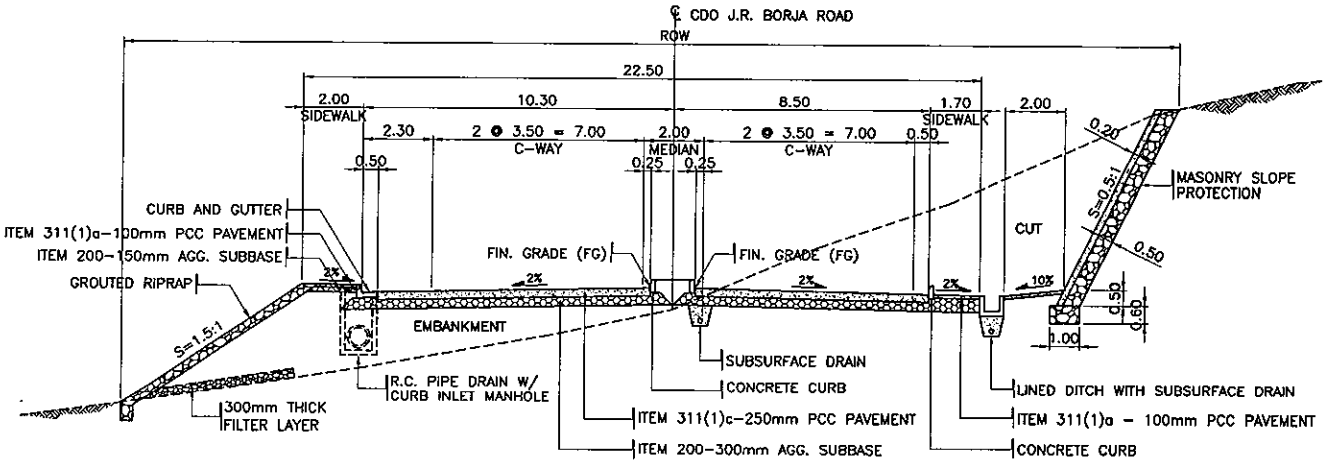
The same design criteria as shown in Section 12.7.1 were adopted.



NORMAL SECTION – EMBANKMENT (OPEN AREA)



NORMAL SECTION – EMBANKMENT & CUT (RESIDENTIAL AREA)



NORMAL SECTION – EMBANKMENT & CUT

FIGURE 14.7-1(1/2) TYPICAL CROSS-SECTION : J.R. BORJA EXTENSION

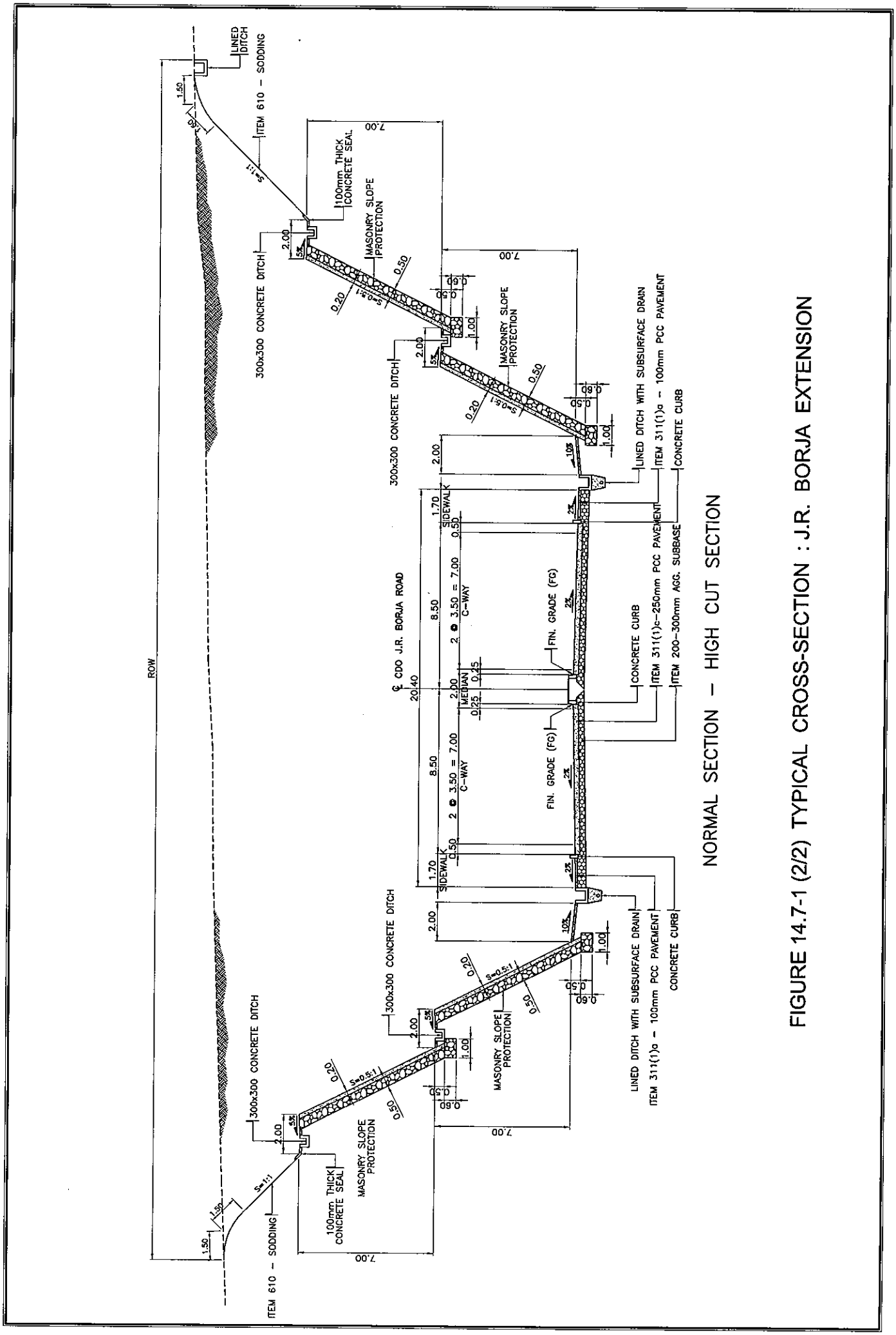
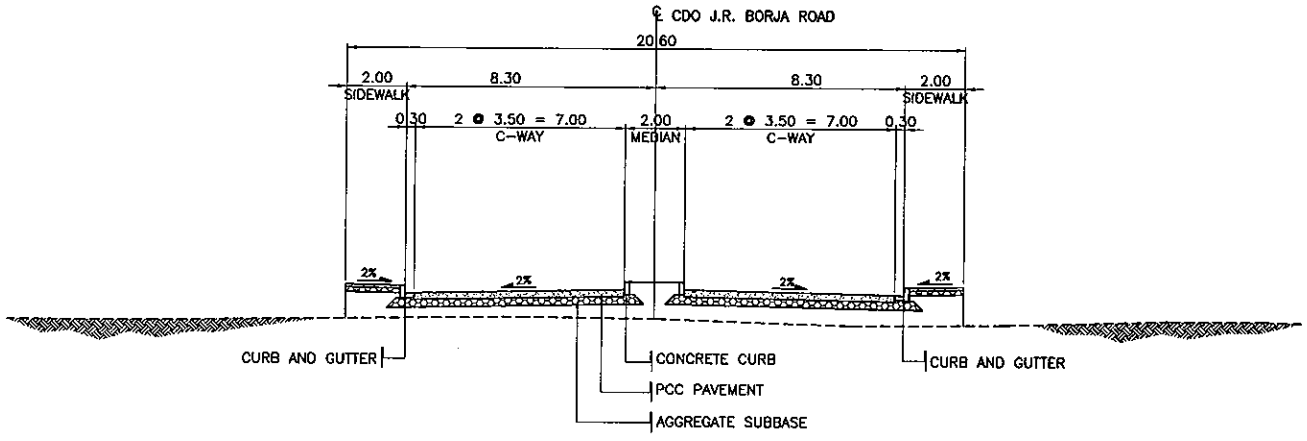
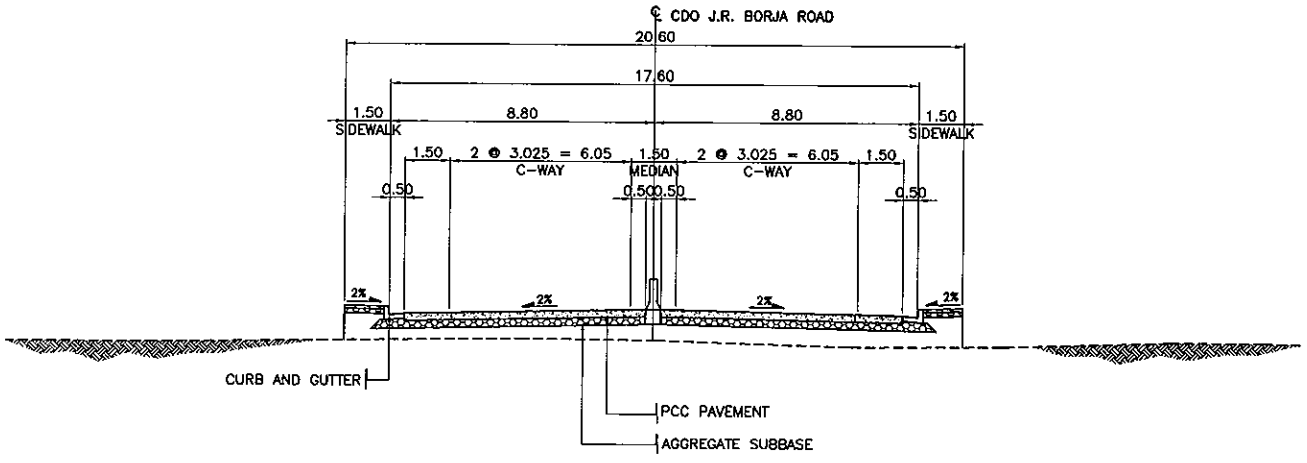


FIGURE 14.7-1 (2/2) TYPICAL CROSS-SECTION : J.R. BORJA EXTENSION



NORMAL SECTION – EXISTING ROAD



NORMAL SECTION – PROPOSED REVISION OF EXISTING ROAD

FIGURE 14.7-2 TYPICAL CROSS-SECTION :
EXISTING SECTION OF J.R. BORJA EXTENSION

14.7.2 Road and Intersection Design

1) Horizontal Alignment

Horizontal alignment was designed to satisfy the design speed of 50km/hour, and is shown in Figure 14.7-3. Among various horizontal curves, minimum is 120m in radius with super elevation of 6%.

2) Vertical Alignment

Control points for vertical alignment design were as follows:

- Elevation of existing intersecting road.
- Proposed bridge elevation.
- Reduction of cut height as much as possible.
- Introduction of viaduct for high embankment section.
- Minimum depth of 0.6m from road surface to the top of pipe culvert to avoid reinforcement of pipe culvert.

3) Typical Cross-sections Applied

Typical cross-sections were applied to the following sections:

Type of Typical Cross-Sections	Applied Section	Length
Embankment (Open Area)	Km 0+809-Km1+470	L = 0.661 km
	Km 1+590-Km 2+150	L = 0.560 km
	Km 2+350-Km 2+950	L = 0.600 km
	Km 3+250-Km 5++950	L = 2.700 km
	Km 6+350-Km 6+500	L = 0.150 km
Embankment (Residential Area)	Km 0+000-Km 0+809	L = 0.809 km
	Km 5+950-Km 6+350	L = 0.400 km
	Km 6+500-Km 7+969	L = 1.469 km
High Cut	Km 1+470-Km 1+590	L = 0.120 km
	Km 2+150-Km2+350	L = 0.200 km
	Km 2+950-Km 3+250	L = 0.300 km

4) Intersection Design

All major intersections were provided with left turn lanes. Major intersections are as follows:

- Intersection at the beginning point (Figure 14.7-4)
- Intersections with Link Roads
- Intersection with CDO-Butuan Road

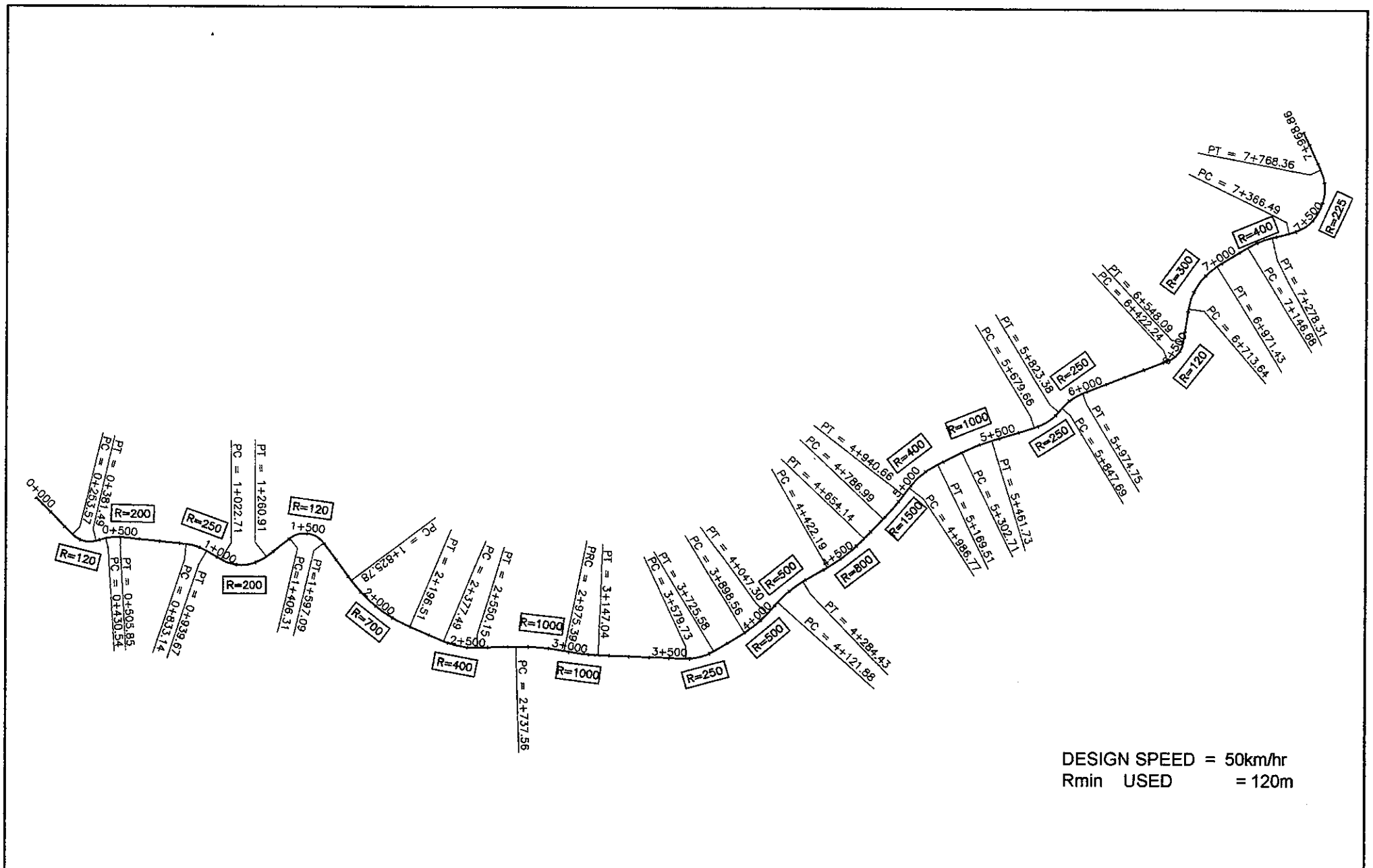


Figure 14.7-3 HORIZONTAL ALIGNMENT : J. R. BORJA EXTENSION ROAD

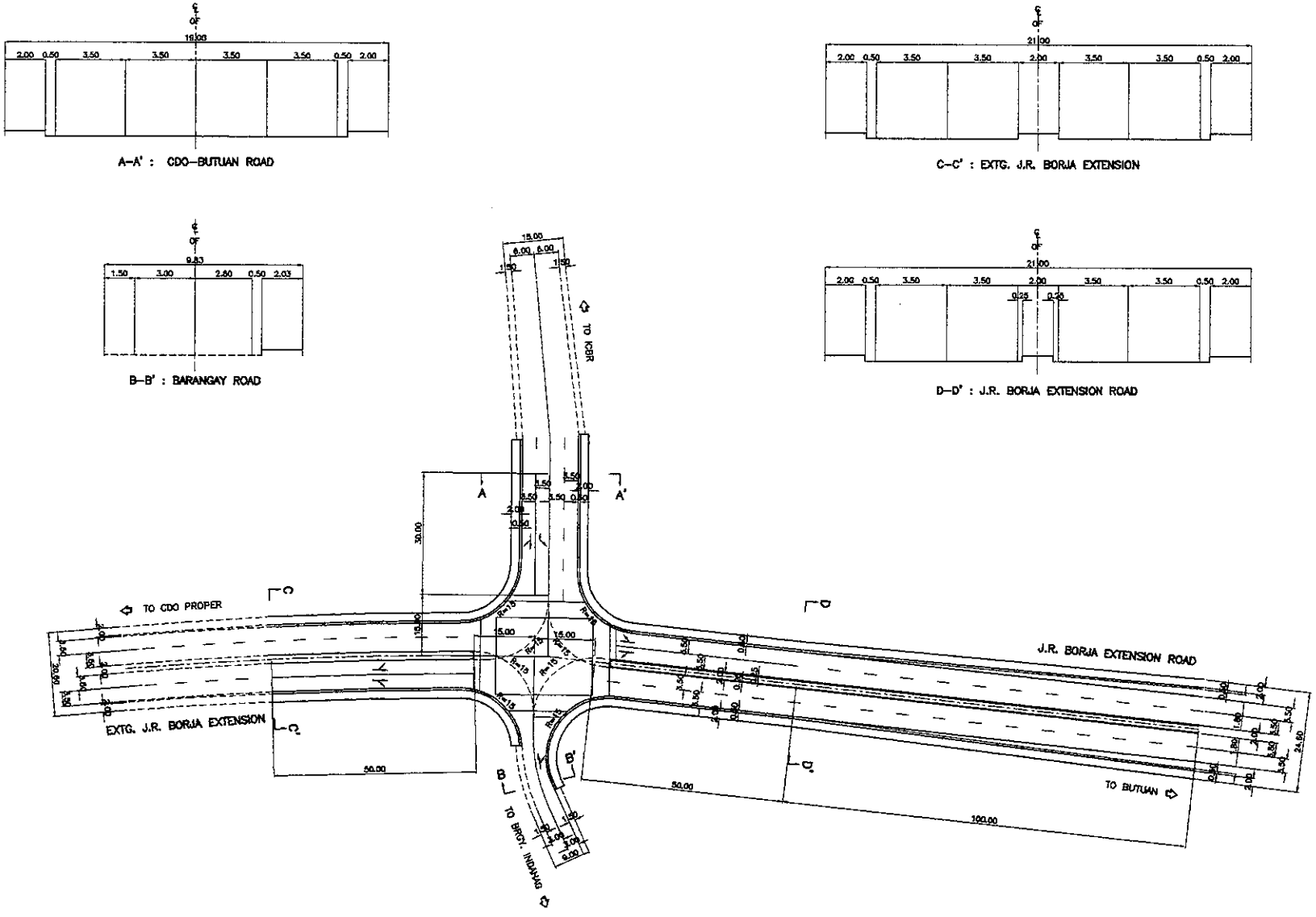


FIGURE 14.7-4 INTERSECTION WITH ICBR ACCESS ROAD
STA. 0+000.000, BEG. OF J.R. BORJA EXTENSION ROAD

14.7.3 Pavement Design

Pavement design was made in accordance with the AASHTO Guide for Design of Pavement Structures, 1993.

Table 14.7.3-1 shows the design requirements. Bus and truck factors were determined with reference to the axle load survey results undertaken along Mindanao Section of Pan-Philippine Highway in 1998.

Bus factor (number of ESAL per bus) : 0.9
Truck factor (number of ESAL per truck) : 1.5

PCC pavement was selected for the pavement type, as soft ground is not expected.

Table 14.7.3-2 shows traffic loading. Cummulative ESAL is 17.6 Million for 20 years.

Required pavement thickness is as follows:

Subbase course : 30cm
PCC pavement : 25cm

TABLE 14.7.3-1 DESIGN REQUIREMENT (J. R. Borja)

Category	Description
a. Design Variable	
a.1 Time Constraints • Initial Performance Period	PCCP : 20 years
a.2 Traffic Loading	Directional Distribution Factor : 0.5 Lane Distribution Factor : 0.6
a.3 Bus and Truck Factor	Bus : 0.9 Truck : 1.5
a.4 Reliability	Z_R = 1.037 for 85% Reliability So = 0.35 (Rigid)
b. Performance Criteria	
b.1 Serviceability	(Rigid) PSI = Po - Pt = 4.5 - 2.5 = 2.0
c. Material Properties for Structural Design	
c.1 Effective Modulus of Subgrade Reaction	K-Value (pci) ; 450pci (CBR : 5%, Subbase : 30cm)
c.2 Pavement Layer Materials Characterization	E_C = Modulus of Elasticity of PCC (4.20×10^6 psi)
c.3 PCC Modulus of Rupture (Rigid) (Flexural Strength)	S'c = 797 psi , Sc = 690 psi
d. Pavement Structural Characteristics	
d.1 Drainage	Rigid CD = Drainage Coefficient ; 1.0
d.2 Load Transfer (Rigid)	J = 3.8 (Plane jointed, Untied Shoulder)
e. Required Pavement Thickness	
e1. Subbase Course	t = 30cm
e2. PCC Pavement	t = 25cm

TABLE 14.7.3-2 TRAFFIC LOADING (J. R. Borja)

Year	AADT (Both Direction) Bus	Track	Cumulative ESAL
2016	182	4,438	746,878
2017	188	4,544	1,511,733
2018	193	4,653	2,295,000
2019	199	4,764	3,097,122
2020	206	4,878	3,918,554
2021	212	4,994	4,759,763
2022	219	5,113	5,621,155
2023	221	5,164	6,491,162
2024	223	5,216	7,369,869
2025	226	5,268	8,257,362
2026	228	5,321	9,153,731
2027	230	5,374	10,059,063
2028	232	5,428	10,973,449
2029	235	5,482	11,896,979
2030	237	5,537	12,829,744
2031	240	5,592	13,771,836
2032	242	5,648	14,723,349
2033	244	5,704	15,684,378
2034	247	5,761	16,655,017
2035	249	5,819	17,635,362
TOTAL	**4,454**	**104,697**	**17,635,362**

14.7.4 Structure Design

The Proposed J. R. Borja Extension is a new road construction 7.97kms long. Along the alignment, four (4) bridge crossings are identified to cross streams and rivers. Since the proposed alignment will traverse the mountainside, two (2) bridge viaducts are proposed in areas where the alignment crosses ravines/valleys to minimize deep cut and reduce road slope grade. Where the alignment underpasses the existing road to Malasag (Eco-Tourism Village), a bridge replacement is proposed to provide continuous access to either side of the alignment.

This section discusses the preliminary design aspects of the proposed bridge structures along the alignment.

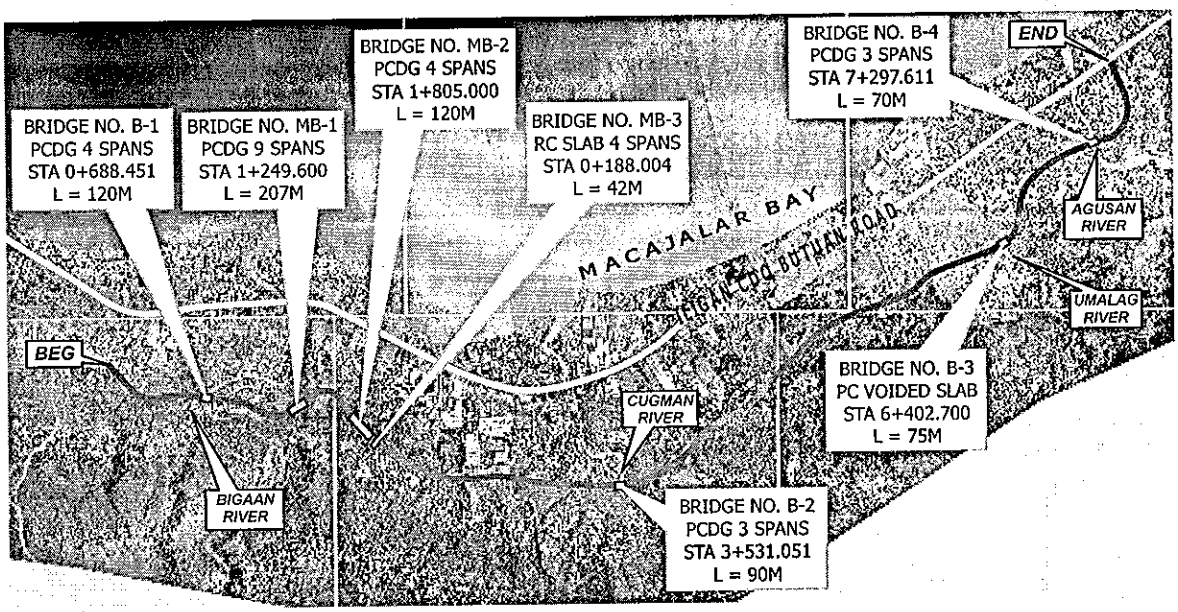


FIGURE 14.7.4-1 BRIDGE LOCATION MAP

14.7.4.1 Present Condition of the Proposed Bridge Site

Site investigations were carried-out to verify the conditions of waterway and valleys along the alignment and determine the appropriate type and span of bridge suitable for the proposed site. Figure 14.7.4-1 presents the locations of the proposed bridges while Figure 14.7.4-2 presents the conditions of the streams/rivers along the proposed J.R. Borja Extension.

The following features describe briefly the proposed bridge sites:

Topography

- The proposed alignment passes over mostly rolling and mountainous terrain at 700m south of the Iligan-CDO-Butuan Road.
- The beginning of the alignment connects with the existing 4-lane J.R. Borja Ave. and crossing Bigaan River at relatively flat terrain.

- The alignment then crosses two valleys at Malasag area where bridge viaducts are to be provided to minimize deep cuts in the mountain.
- In the Malasag area, the alignment will cross under a local road leading to the Eco-Tourism park and Sitio Malasag with grades of 12% and 14%. The local road traversed will be replaced by an overcrossing bridge with 10% grade.
- Other areas of the alignment traverse rolling as well as flat topography at the foot of the mountains.

Rivers/Streams

- The proposed alignment crosses streams and rivers that meander on both the upstream and down stream side of the bridge location.
- River bed materials on most rivers consist of sand and gravel with small boulders less than 200mm in diameter.
- The proposed bridge site distance to the sea varies from 0.8km to 1.2kms.
- In some areas, trees and vegetations line up the banks but on areas where there is no vegetation, scouring is observed on the banks with exposed sand-silt soil mixture.
- Since the river originates from the mountain, medium to large debris are observed and expected including small trees and small bamboos.
- The major rivers traversed by the alignment are crossed by the Iligan-CDO-Butuan Road at a distance of about 500m to 800m downstream of the proposed bridge sites. The existing bridges along the existing road are PCDG and RCDG bridges with bridge lengths from 40m to 76m and spans from 20m to 25m.

The river discharges for a 50-year return period are calculated for the proposed bridge sites and presented in Table 14.7.4-1.

TABLE 14.7.4-1 RIVER DISCHARGE FOR PROPOSED BRIDGE SITE

BRIDGE NO.	RIVER NAME	50-YEAR DISCHARGE (cu.m/sec)	DFWL (EL. +m)	VELOCITY (m/s)	BRIDGE SPAN (m)	
					Minimum	Provided
B-1	Bigaan River	277.0	8.00	1.24	21.4	30
B-2	Cugman River	316.0	4.8	3.36	21.6	30
B-3	Umalag River	125.0	4.00	1.64	-	25
B-4	Agusan River	301.0	3.80	2.80	21.5	22/26

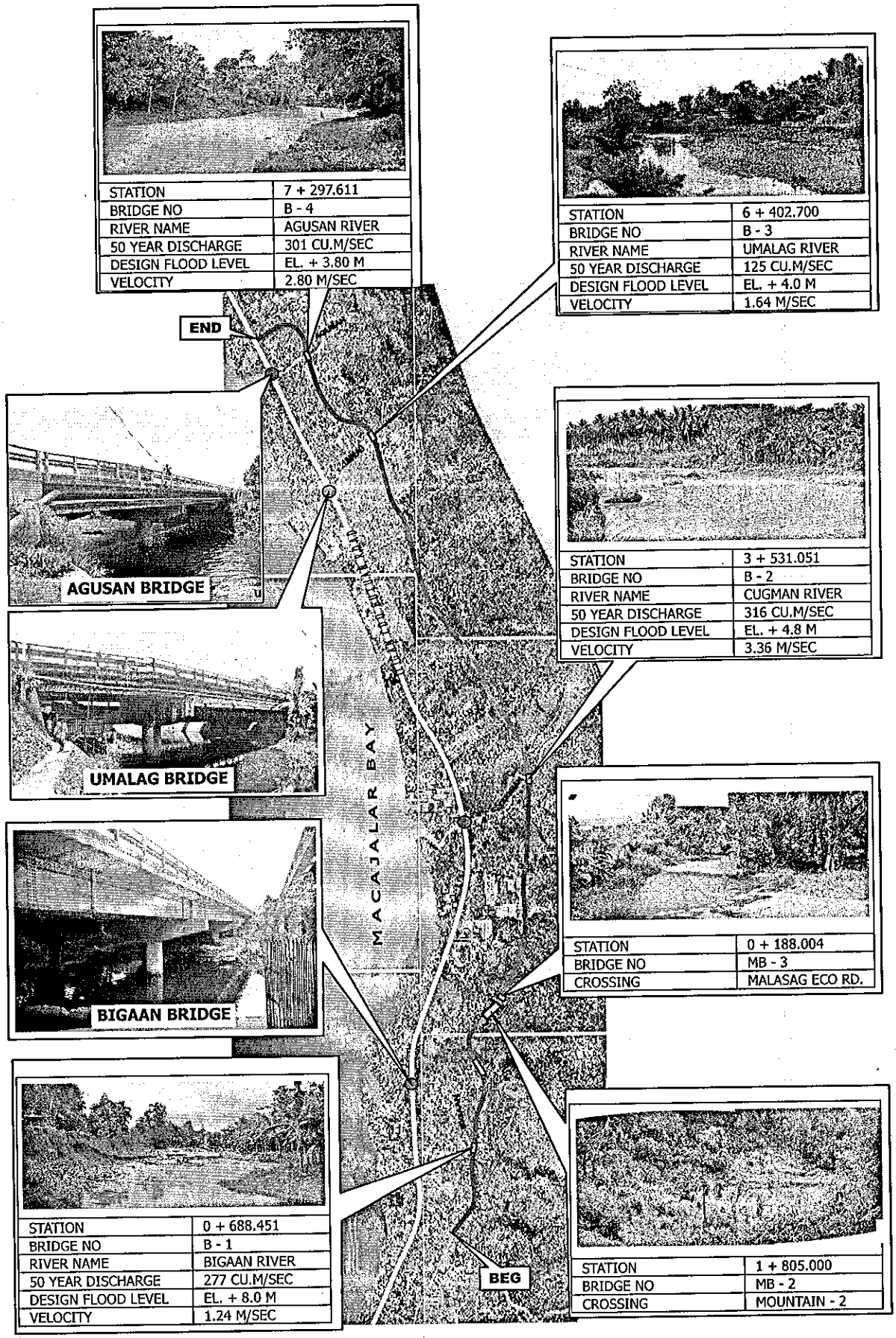


FIGURE 14.7.4-2 RIVER CONDITION AT PROPOSED BRIDGE SITE

Geotechnical

- Geotechnical investigations carried-out for the proposed bridge sites revealed the presence of different materials below:

BOREHOLE NO.	RIVER / LOCATION	DESCRIPTION
BH - 7	Bigaan River	♦ Site underlain by thick granular deposit consisting of gravel with sand interbed ♦ N-values in upper 10m ranges from 10 to 31 but 3m below this ranges from 4 to 7 and increased again from 10 to 31 until refusal at 25m depth where plastic silt was encountered
BH - 8	Mt. Bridge No.2	♦ Subsoil condition consists of silt/clay, sand and gravel/boulders interbeds. ♦ Upper 4m to 10m is medium dense (10<N<30) with subsequent depths down to 30m hitting practical refusal (N>50)
BH - 9	Cugman River	♦ Similar to Borehole No. 8
BH - 10	Umalag River	♦ Subsoil consists of relatively thick sand formation persisting to end of borehole at 35.5m with grain sizes of medium to fine (<2mm diameter)
BH - 11	Agusan River	♦ Similar to Borehole No. 8
BH - 12	Malasag Eco-Tourism Rd	♦ Similar to Borehole No. 8

- The river crossing sites (BH-7, BH-9, BH-10, BH-11) can be considered susceptible to liquefaction phenomena due to:
  - Non-plastic loose sand/silty sand of medium to fine grain size distribution,
  - Generally high ground water table, and
  - Loose relative density.

- Further study under soil liquefaction is recommended during detailed design for these bridge sites.

14.7.4.2 Design Concept for Structures

(1) Superstructure

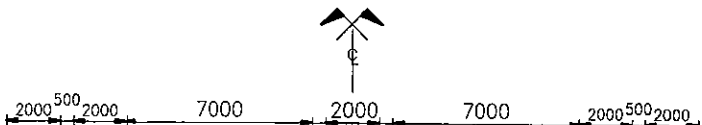
The superstructure preliminary design basically adheres to the following concepts:

Bridge Deck Section

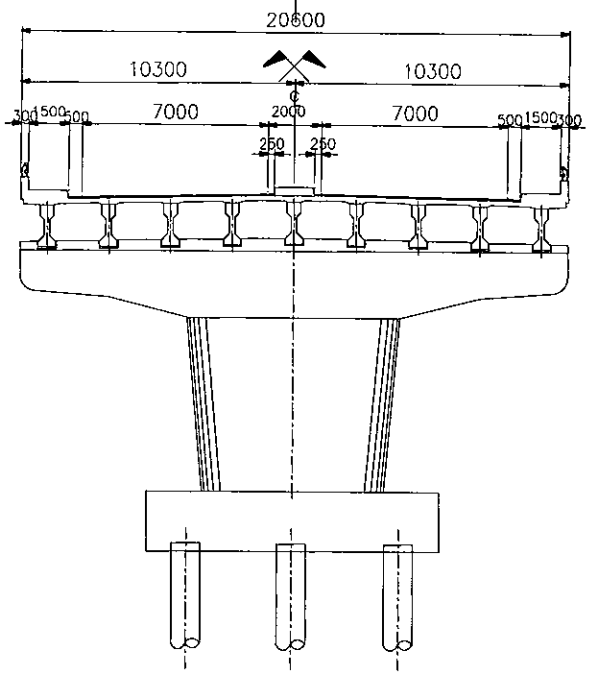
- The bridge deck section should conform with the travelway/carriageway width of the highway. Typical bridge section is illustrated in Figure 14.7.4-3. Since the Proposed J.R. Extension is to be implemented with four lanes of travelway, the bridge deck section will be provided with four lanes of carriageway and median in the same configuration as the highway.

- A 1.5m wide sidewalk is provided at both sides of the deck since the proposed road is located near urbanized areas.

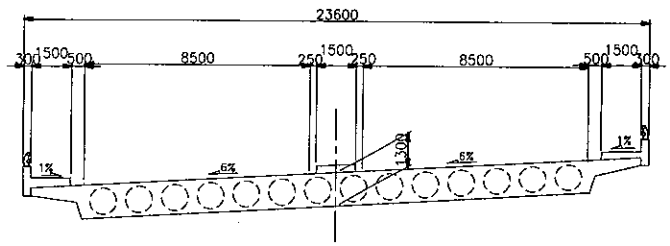
- In areas where bridges are located in curve section of the alignment, deck widening is provided as a function of the design speed. Widening (1.5m each way) for Umalag River Bridge and Mountain Bridge No.1 are provided since both bridges are in the curve section of the alignment.



TYPICAL ROAD SECTION



TYPICAL BRIDGE SECTION



DECK WIDENING AT CURVE SECTION
(UMALAG BRIDGE PC VOIDED SLAB)

FIGURE 14.7.4-3 TYPICAL BRIDGE SECTION

Span and Bridge Length Consideration

- The span length taken in planning the bridge is based on:
  - Design discharge (requiring minimum spans as presented in Table 14.7.4-1),
  - Pier encroachment to be ≤ 5% of river section,
  - Existing bridge spans (upstream bridges have spans of 20m and 25m),
  - Bridge spans on mountain areas are decided by economy and construction difficulty.
- The bridge length taken in planning the bridge is based on:
  - Design Flood Water Level as indicated in Table 14.7.4-1,
  - Bank distance to be covered by the bridge without river encroachment,
  - Embankment height at abutment to be no more than 5m,
  - In case of mountain bridges, the bridge has to cover sufficient length to locate the abutments at stable areas.

Girder Types

- The Precast/Prestressed Concrete Deck Girder (PCDG, AASHTO Girders) is basically proposed for the bridge superstructure since this type is the cheapest and most cost-effective. The girders will be fabricated elsewhere and erected on site by cranes.
- To enhance seismic performance, PCDG are made continuous over the intermediate piers allowing transfer of superstructure horizontal forces directly to the substructure.
- Since the application of precast AASHTO Girders is quite difficult for bridge decks on curves, prestressed (cast-in-place) voided slab is proposed for the Umalag curve bridge river crossing (radius of curvature at 120m). For spans of 25m, voided slab are more cost-effective and structurally stable for curve alignment. Furthermore, the deck is proposed to be cast-in-place and simply supported to simplify the deck geometry complicated by widening and superelevation.
- On the other hand, the bridge deck proposed for the Umalag Eco-Tourism road bridge is the flat slab type deck since the bridge is also on curve (radius of curvature is 40m) but with a shorter span of 12m. This deck type is the cheapest and structurally stable for the conditions given on site.

Vertical Clearance

- A minimum vertical clear height of 1.5m is provided for river crossings since debris is expected at maximum design flood level.
- Clearance below the Malasag Eco-Tourism bridge is provided at 5m.

(2) Substructures

Piers

- Preliminary design for substructures considers the seismic design requirements based on the AASHTO Div. I-A Seismic Design recommendations.

- Plastic hinges are expected to form at pier substructures so that design forces of foundations will utilize the said forces.

- Single column piers are proposed for the PCDG and voided slab substructures (oval shape). The reason for single oval shape pier is similar to the bridge for Western Coastal Road.

- Wall type pier continuous with the flat slab is proposed for the Malasag Eco-Tourism bridge since the pier width is limited to 0.70m at the median of the proposed J.R. Borja Extension.

Pile Foundation

- Since the soil condition is relatively soft in this area, deep foundations can be utilized to support the bridge structures. Candidate types of foundations include driven piles (RC and steel) and bored piles.

- The bored pile foundation is preferred over the other types due to:

    - The seismic requirement (plastic forces of pier columns) for driven piles will result in relatively large number of driven piles as compared to bored piles.

    - Pile cap size can be reduced by utilizing lesser number of piles.

    - Since the site has potential for liquefaction, bored piles have more moment resisting capacity than driven piles and will perform more efficiently than driven piles in the event of a very large earthquake.

    - Since the bearing layer tends to be deep at more than 20m, pile splicing is eliminated if bored piles are utilized.

- Likewise, foundation for the abutment utilizes bored pile foundation.

Abutments

- Abutment type is the inverted T cantilever wall seat type abutment. This type, being a closed type abutment is more reliable since it is difficult to guarantee the stability of slope in front of the abutment. Existing soil condition tends to be soft in the upper 5m in some areas with potential for liquefaction. In this case, a close-type abutment is preferred.

- Abutment preliminary design basically follows the AASHTO Div. I-A recommendations using Mononobe-Okabe formulation to calculate seismic forces due to retained earth.

- Retained earth at the back of the abutment is limited to 5m above the existing ground to minimize settlement and soil improvement of the upper soil layer.
- Expansion joints for the superstructures are provided at abutment locations.

14.7.4.3 Proposed Bridges

Details of the proposed bridges crossing J.R. Borja Extension rivers and valleys with a total length of 724m are presented in Table 14.7.4-2 below.

TABLE 14.7.4-2 PROPOSED BRIDGES FOR J.R. BORJA EXTENSION

BRIDGE NO.	RIVER NAME	STATION		BRIDGE LENGTH (m)	SUPERSTRUCTURE			SUBSTRUCTURE			
								PIER		ABUTMENT	
		BEG.	END		TYPE	SPAN	SKEW (deg)	COLUMN TYPE	FOUNDATION	TYPE	FOUNDATION
B-1	Bigaan River	Sta. 0+688.451	Sta. 0+809.251	120	PCDG AASHTO Type V	4 @ 30m	-	Wall Type 1.8mx6.0m	ϕ1200 Bored Pile N=8 ; L=21-23m	Closed Inverted-T Cantilever	ϕ1000 Bored Pile N=10; L=24m
B-2	Cugman River	Sta. 3+531.051	Sta. 3+621.851	90	PCDG AASHTO Type V	3 @ 30m	-	Wall Type 1.8mx6.0m	ϕ1200 Bored Pile N=8 ; L=17m	Closed Inverted-T Cantilever	ϕ1000 Bored Pile N=10; L=16m
B-3	Umalag River	Sta. 6+402.70	Sta. 6+478.50	75	PC Voided Slab	3 @ 25m	10°	Wall Type 1.6mx6.0m	ϕ1200 Bored Pile N=8 ; L=18-20m	Closed Inverted-T Cantilever	ϕ1000 Bored Pile N=12; L=21m
B-4	Agusan River	Sta. 7+297.611	Sta. 7+368.411	70	PCDG AASHTO Type IV-B	22+26+22	-	Wall Type 1.6mx6.0m	ϕ1200 Bored Pile N=6 ; L=15m	Closed Inverted-T Cantilever	ϕ1000 Bored Pile N=10; L=17m
MB-1	(Valley Crossing)	Sta. 1+249.6	Sta. 1+457.4	207	PCDG AASHTO Type IV-B & IV	2-3@25+ 3@19	-	Wall Type 2.0mx6.0m	ϕ1200 Bored Pile N=9,8 ; L=15-18m	Closed Inverted-T Cantilever	ϕ1000 Bored Pile N=10; L=18-22m
MB-2	(Valley Crossing)	Sta. 1+805.00	Sta. 1+925.80	120	PCDG AASHTO Type V	4 @ 30m	-	Wall Type 2.3mx6.0m	ϕ1200 Bored Pile N=12 ; L=15-17m	Closed Inverted-T Cantilever	ϕ1000 Bored Pile N=12; L=23m
MB-3	(Eco-Village Road)	Sta. (0+188.004)	Sta. (0+230.664)	42	RC Flat Slab	9+12+12+9	-	Wall Type 0.7mx3.0m	ϕ1200 Bored Pile N=2 ; L=8m	Closed Inverted-T Cantilever	ϕ1000 Bored Pile N=2; L=8m,10m

TOTAL BRIDGE LENGTH : 724 m

14.7.5 DRAINAGE DESIGN

14.7.5.1 Principle and Methodology

Refer to Sub section 12.7.5.1 for the principle and methodology

14.7.5.2 Hydrological and Hydraulic Analyses

Refer to Sub section12.7.5.2 for the hydrological and hydraulic analyses

14.7.5.3 Results of Hydrological Analyses

The hydrological analyses reveal that there are thirty two (32) catchment areas for this proposed road .See Fig. 14.7.5-1 for the catchment areas map of J.R. Borja Extension. The analyses also reveal that there are four (4) locations where the area is greater than twenty (20) sq km. More over there are four (4) areas where the design discharge is more than forty (40) cu m per sec. The result of the hydrological analyses is shown in Table 14.7.5-1.

14.7.5.4 Results of the Hydraulic Analyses

The hydraulic analyses reveal that there are four (4) bridges and thirty one (31) culverts needed for the road. The bridge schedule is shown in Section 14.7.4 and the list of proposed culverts is shown in Table 14.7.5-2.

14.7.5.5 Flood Flow Analysis

The flood flow analysis is conducted for four (4) catchment areas where the discharge is more than forty (40) cu m per sec. The results of the analysis are shown in Table 14.7.5-3

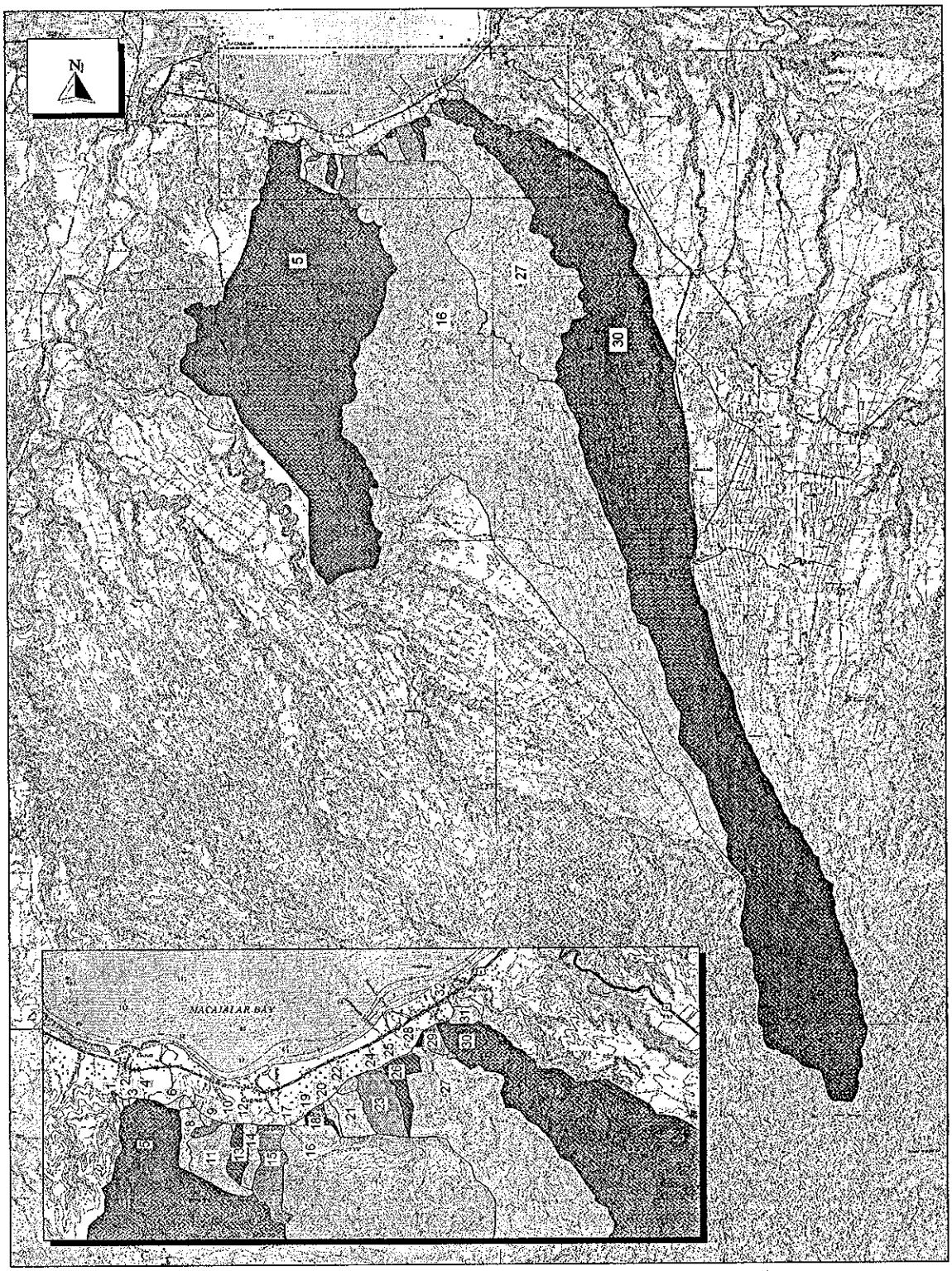


FIGURE 14.7.5 – 1 J.R. BORJA EXTENSION CATCHMENT AREAS MAP

TABLE 14.7.5-1
HYDROLOGICAL ANALYSIS

Road Section: J.R. BORJA EXTENSION

Basin Number	STATION		DISCHARGE			
	BEGINNING	END	2 year $m^3/sec.$	10 year $m^3/sec.$	25 year $m^3/sec.$	50 year $m^3/sec.$
1	0 + 000.00	0 + 110.00	0.27	0.44	0.52	0.58
2	0 + 110.00	0 + 220.00	0.66	1.06	1.26	1.42
3	0 + 220.00	0 + 320.00	0.15	0.24	0.28	0.31
4	0 + 320.00	0 + 470.00	0.27	0.44	0.52	0.58
5	0 + 470.00	0 + 970.00	166.59	265.50	315.29	352.20
6	0 + 970.00	1 + 500.00	0.89	1.43	1.71	1.91
7	1 + 500.00	1 + 750.00	0.97	1.56	1.85	2.08
8	1 + 750.00	1 + 970.00	5.46	8.65	10.25	11.46
9	1 + 970.00	2 + 210.00	0.73	1.18	1.41	1.58
10	2 + 210.00	2 + 430.00	1.88	3.02	3.60	4.04
11	2 + 430.00	2 + 580.00	12.94	20.34	24.05	26.82
12	2 + 580.00	2 + 720.00	0.25	0.40	0.48	0.54
13	2 + 720.00	2 + 820.00	5.97	9.55	11.36	12.73
14	2 + 820.00	3 + 060.00	4.33	6.80	8.04	8.97
15	3 + 060.00	3 + 490.00	14.68	23.19	27.46	30.66
16	3 + 490.00	3 + 770.00	190.04	306.97	365.96	409.75
17	3 + 770.00	3 + 960.00	0.54	0.87	1.04	1.17
18	3 + 960.00	4 + 160.00	2.01	3.21	3.82	4.27
19	4 + 160.00	4 + 370.00	1.04	1.68	2.00	2.25
20	4 + 370.00	4 + 530.00	1.92	3.07	3.66	4.10
21	4 + 530.00	4 + 820.00	8.53	13.54	16.06	17.95
22	4 + 820.00	5 + 300.00	1.64	2.65	3.15	3.54
23	5 + 300.00	5 + 640.00	13.48	21.27	25.20	28.12
24	5 + 640.00	5 + 830.00	0.24	0.38	0.46	0.51
25	OUTLET @ UMALAG (NESTLE)		7.17	11.32	13.40	14.96
26	5 + 830.00	6 + 280.00	0.38	0.60	0.72	0.80
27	6 + 280.00	6 + 585.00	93.76	147.36	174.30	194.23
28	6 + 585.00	6 + 890.00	0.43	0.68	0.82	0.92
29	6 + 890.00	7 + 230.00	3.71	5.91	7.02	7.86
30	7 + 230.00	7 + 430.00	223.69	360.49	429.47	480.67
31	7 + 430.00	7 + 780.00	3.54	5.70	6.79	7.62
32	7 + 780.00	7 + 969.00	2.19	3.50	4.16	4.66

TABLE 14.7.5-2
HYDRAULIC ANALYSIS

J.R. BORJA EXTENSION

BASIN NUMBER	STATION (km)	SIZE		LENGTH	REMARKS / RECOMMENDATION
		RCPC	RCBC		
		mmØ	SPAN X HEIGHT		
1	0 + 020.00	1-910		24	
2	0 + 110.00	1-910		24	
3	0 + 265.00	1-910		25	
4	0 + 455.00	1-910		23	
5	0 + 748.85				BIGAAN RIVER
6	1 + 160.00	1-910		32	
	1 + 330.00				VIADUCT
7	1 + 645.00	1-1220		40	
8	1 + 860.00				VIADUCT
9	2 + 035.00	1-1220		36	
10	2 + 400.00	2-1220		24	
11	2 + 520.00		2- 2.40 X 2.40	27	
12					DIVERT TO SIDE DITCH
13					DIVERT TO SIDE DITCH
14	2 + 903.00		2- 2.40 X 2.40	23	
15	3 + 400.00		3- 3.00 X 3.00	30	
16	3 + 576.45				CUGMAN RIVER
17	3 + 860.00	1-910		25	
18	4 + 010.00	1-910		24	
	4 + 125.00	2-1070		25	
19	4 + 285.00	2-910		31	
20	4 + 390.00	2-1220		29	
21	4 + 700.00		2- 2.40 X 2.40	26	
22	4 + 900.00	1-910		27	
	5 + 130.00	2-910		30	
23	5 + 490.00		3- 2.40 X 2.40	26	
24	5 + 790.00	1-910		29	
25					OUTLET @ NESTLE TO UMALAG RIVER
26	5 + 920.00	1-1070		31	
27	6 + 420.00				UMALAG RIVER
28	6 + 730.00	1-910		23	
29	7 + 170.00		1- 2.40 X 2.40	25	
30	7 + 335.00				AGUSAN RIVER
31	7 + 480.00	2-910		25	
	7 + 760.00	2-1220		25	
32	7 + 930.00	2-1220		25	
	0 + 210.00	1-910		17	ACCESS ROAD 1
	0 + 440.00	1-910		17	ACCESS ROAD 1
	0 + 300.00	1-910		17	ACCESS ROAD 2
	0 + 520.00	1-910		17	ACCESS ROAD 2

TABLE 14.7.5-3 FLOOD FLOW ANALYSIS

J.R. BORJA EXTENSION , METRO CAGAYAN DE ORO

HIGHWAY STATION (km)	BRIDGE NUMBER	BRIDGE NAME	CATCHMENT AREA (km2)	DISCHARGE 50 YEARS (cms)	VELOCITY (mps)	DFL (m)	M.F.L. FROM FIELD SURVEY (m)	WATER WIDTH (m)	REMARKS
0+749	B-1	Bigaan	61.33	277.43	1.24	8.00	7.97	120.00	
3+576	B-2	Cugman	94.18	315.69	3.36	4.80	5.10	80.00	
6+446	B-3	Umalag	24.30	125.44	1.64	4.00	4.21	45.00	
7+333	B-4	Agusan	101.20	301.01	2.80	3.80	4.00	65.00	
1+354	MB-1								207 m viaduct
0+209	MB-3								42 m overpass
1+865	MB-2								120 m viaduct

14.8 COST ESTIMATES

14.8.1 Construction Cost

(1) Unit Cost Analysis

The project cost was estimated based on the July 2004 prices with breakdown of foreign and local currency components and a tax component.

The foreign exchange rates used were as follows:

1 US $ = 56.04 P = 109.64 Yen (July, 2004)

A market price survey was conducted to obtain information on market or prevailing prices of construction materials, labor cost and equipment cost. Based on these prices, a unit cost analysis was conducted to develop unit costs for construction items. Unit prices of major construction items are presented in Tables 14.8-1, 2, 3 and 4, respectively.

(2) Construction Cost

Estimated construction cost is presented in Table 14.8-5. The construction cost of J.R. Borja Extension was estimated at 1,179.8 Million pesos, composing of 46.0% a foreign currency component (or 543.2 Million pesos), 38.5% of a local currency component (or 453.8 Million pesos) and 15.5 % of a tax component (or 182.8 Million pesos). Detailed breakdown of construction cost is presented in Appendix 14.8-1.

TABLE 14.8-5 CONSTRUCTION COST

(Million Pesos)

	Foreign	Local	Tax	Total
Amount	543.2	453.8	182.8	1,179.8
%	46.0%	38.5%	15.5%	100%

TABLE 14.8-1 MARKET PRICE OF CONSRUCTION MATERIALS IN CAGAYAN DE ORO

(July 2004 Prices)

Price No.	Description	Unit	Unit Price (P)
1	Portland Cement	bag	143.00
2	Reinforcing Steel Bar, Gr. 40	kg.	28.00
3	Reinforcing Steel Bar, Gr. 60	kg.	34.00
4	Gasoline, Premium	lit.	26.68
5	Gasoline, Regular	lit.	26.13
6	Diesel	lit.	20.56
7	Lumber	bd.ft.	29.00
8	Ordinary Plywood 1/2"	pc	380.00
9	Emulsified Asphalt SS-1	drum	4,823.16
10	Asphalt Cement Pen. 85-100	drum	5,023.16
11	Thinner	gal.	130.00
12	Tie Wire #16	kg.	45.00

SOURCE:

- *Study Team Survey*

TABLE 14.8-2 LABOR COST

(July 2004 Prices)

Labor Category	Hourly Rate (Pesos)	Daily Rate (Pesos)
Foreman	34.66	277.30
Operator	26.24	209.90
Driver	26.24	209.90
Carpenter	26.24	209.90
Re-Bar Worker	26.24	209.90
Masonry	26.24	209.90
Blaster	31.25	250.00
Welder	26.24	209.90
Painter	26.24	209.90
Mechanic	26.24	209.90
Electrician	26.24	209.90
Skilled Labor	26.24	209.90
Unskilled Labor	25.00	200.00

SOURCE:

- *DPWH*
- *National Health Insurance Program*
- *Social Security System*

TABLE 14.8-3 HOURLY (OR DAILY) COST OF CONSTRUCTION EQUIPMENT

(July 2004 Prices)

	Construction Equipment	Unit	Cost (P)
1	Tractor, crawler w/dozer (Bulldozer, 15t)	hr	2,243.00
2	Tractor, crawler w/dozer (Bulldozer, 21t)	hr	3,623.00
3	Backhoe, hydraulic, crawler, 0.61m3	hr	1,295.00
4	Backhoe, hydraulic, crawler, 0.80m3	hr	1,766.00
5	Dump Truck, 6.0-9.0 cu-yds (4.6-6.9m3)	hr	807.00
6	Motor Grader, 3.71m	hr	1,748.00
7	Vibratory Tandem Smooth Drum 10.6t	hr	1,622.00
8	Four Tamping Foot Wheels (Tire Roller) 16t	hr	1,583.00
9	Water Wagon/Pump Truck 500-1000 gal	hr	968.00
10	Asphalt Paver/Finisher, 4.7m	hr	1,974.00
11	Truck Mixer 5.0-6.0 cu-yds	hr	1,066.00
12	Concrete Batch Plant 40m3/hr with silo	hr	1,990.00
13	Crawler Drill	hr	428.00
14	Concrete Vibrator *(operator not included)*	day	456.00
15	Concrete Cutter *(operator not included)*	day	1,080.00
16	Concrete Paver/Finisher	hr	870.00
17	Truck Crane, Hydraulic 21-25t	hr	1,297.00
18	Concrete Pump Vehicle 100cu-yds/hr (76.5m3/hr)	hr	1,668.00
19	Air Compressor 456-500 cfm	hr	876.00
20	Aggregate Crusher 100t/hr *(operator not included)*	hr	2,730.00
21	Trailer 20t	hr	1,588.00
22	Welding Machine 250A	hr	300.00
23	Generator 51-100 kW *(operator not included)*	day	3,310.00
24	Bar Bender *(operator not included)*	day	1,310.00
25	Electric Bar Cutter	day	1,310.00

SOURCE: Associated Construction Equipment Lessors (ACEL)

TABLE 14.8-4 UNIT COST OF MAJOR CONSTRUCTION ITEM (1/2)

Item No.	Description	Unit	Unit Cost	Component(%)		
				Foreign	Local	Tax
	PART C - EARTHWORK					
100(1)	Clearing and Grubbing	ha.	53,000.00	57	27	16
102(1)	Unsuitable Excavation	m3	179.00	59	17	24
102(2)a	Surplus Common Excavation	m3	179.00	60	24	15
102(2)b	Surplus Common Excavation with Big Boulders	m3	210.00	60	24	15
103(2)a	Bridge Excavation, Common (AWL)	m3	200.00	53	31	16
103(2)b	Bridge Excavation, Common (BWL)	m3	750.00	51	34	15
104(1)a	Embankment from Excavation	m3	195.00	54	20	26
104(1)b	Embankment from Borrow	m3	390.00	56	30	15
104(1)c	Selected Borrow for Backfilling	m3	550.00	54	20	26
105(1)	Subgrade Preparation (Common Material)	m2	17.00	57	27	16
	PART D - SUBBASE AND BASE COURSE					
200	Aggregate Subbase Course	m3	550.00	54	32	14
	Sub Total					
	PART E - SURFACE COURSE					
311(1)a	PCC Pavement(Plain) (t=0.10m)	m2	420.00	62	23	15
311(1)b	PCC Pavement(Plain) (t=0.20m)	m2	620.00	62	23	15
311(1)d	PCC Pavement(Plain) (t=0.25m)	m2	770.00	62	23	15
311(1)e	PCC Pavement(Plain) (t=0.28m)	m2	850.00	62	23	15
311(2)	PCC Pavement(Reinforced) for Approach Slab, t=300mm	m2	4,450.00	62	23	15
	PART F - BRIDGE CONSTRUCTION					
400(4)	Precast Concrete Piles (0.45m×0.45m), Furnished and Driven	m	3,200.00	52	28	20
400(15)	Test Piles (0.45m×0.45m)	m	370.00	52	35	13
400(16)a	Cast-in-Place Concrete Bored Piles, φ1000mm	m	23,800.00	38	45	17
400(16)b	Cast-in-Place Concrete Bored Piles, φ1200mm	m	32,500.00	38	45	17
400(16)c	Cast-in-Place Concrete Bored Piles, φ1500mm	m	47,000.00	38	45	17
400(19)	Piles Shoes for 0.45m×0.45m Piles	ea	1,750.00	55	30	15
401	Concrete Railings	m	2,240.00	38	49	13
404(1)	Reinforcing Steel, Grade 40 (Fy=275Mpa)	kg	39.00	50	37	13
404(2)	Reinforcing Steel, Grade 60 (Fy=415Mpa)	kg	40.00	50	37	13
404(3)	Prestressing Steel, Grade 270 (Fu=1860Mpa)	kg	255.00	50	37	13
405(1)	Structural Concrete Class"A1" for Substructure (f'c=24Mpa)	m3	3,200.00	34	50	16
405(2)	Structural Concrete Class"A2" for Superstructure (f'c=24Mpa)	m3	5,040.00	34	50	16
405(3)	Structural Concrete Class"A3" for Others (f'c=21Mpa)	m3	4,130.00	34	50	16
405(4)	Structural Concrete Class"A4" for Others (f'c=41Mpa)	m3	7,180.00	34	50	16
405(5)	Seal Concrete	m3	420.00	34	50	16
405(6)	Structural Concrete "Lean Concrete" (f'c=17 Mpa)	m3	2,480.00	43	37	20
406(1)a	Prestressed Concrete Girder, AASHTO Type IV-B, L=20m	ea	308,910.00	22	62	16
406(1)b	Prestressed Concrete Girder, AASHTO Type IV-B, L=22m	ea	331,400.00	22	62	16
406(1)c	Prestressed Concrete Girder, AASHTO Type IV-B, L=25m	ea	391,250.00	25	59	16
406(1)d	Prestressed Concrete Girder, AASHTO Type IV-B, L=26m	ea	405,480.00	22	62	16
406(1)e	Prestressed Concrete Girder, AASHTO Type IV-B, L=27m	ea	419,645.00	22	62	16
406(1)f	Prestressed Concrete Girder, AASHTO Type IV-B, L=28m	ea	441,755.00	20	65	15
406(1)g	Prestressed Concrete Girder, AASHTO Type V, L=30m	ea	505,185.00	20	65	15
406(1)h	Prestressed Concrete Girder, AASHTO Type V, L=31m	ea	520,815.00	20	65	15
406(1)i	Prestressed Concrete Girder, AASHTO Type V, L=35m	ea	647,400.00	17	69	14
406(1)j	Prestressed Concrete Girder, AASHTO Type VI, L=36m	ea	672,500.00	19	67	14
406(1)k	Prestressed Concrete Girder, AASHTO Type VI, L=40m	ea	815,870.00	17	69	14
406(1)l	Prestressed Concrete Girder, AASHTO Type IV-A, L=36m	ea	598,500.00	17	69	14
406(1)m	Prestressed Concrete Girder, AASHTO Type IV-B, L=19m	ea	293,500.00	22	62	16
407(1)a	Elastomeric Bearing Pad, 400×350×60 (Duro 60)	ea	18,100.00	55	30	15
407(1)b	Elastomeric Bearing Pad, 500×350×60 (Duro 60)	ea	21,100.00	55	30	15
407(1)c	Elastomeric Bearing Pad, 625×400×60 (Duro 60)	ea	30,100.00	55	30	15
407(2)	Expansion Joint, 50mm Gap	m	46,300.00	55	30	15
407(4)	Metal Drain (φ150mm G.I. Drain Pipe)	m	985.00	55	30	15
408	Chain Link Railing	m	1,570.00	55	30	15
	PART G - DRAINAGE AND SLOPE PROTECTION STRUCTURES					
500(1)a	Reinforced Concrete Pipe Culvert, 610mmφ (Extra. Str.)	m	4,451.00	57	28	15
500(1)b	Reinforced Concrete Pipe Culvert, 910mmφ (Extra. Str.)	m	6,600.00	57	28	15
500(1)c	Reinforced Concrete Pipe Culvert, 1070mmφ (Extra. Str.)	m	10,000.00	57	28	15
500(1)d	Reinforced Concrete Pipe Culvert, 1220mmφ (Extra. Str.)	m	10,600.00	57	28	15
500(1)e	Reinforced Concrete Pipe Culvert, 1520mmφ (Extra. Str.)	m	18,700.00	57	28	15
500(3)a1	Reinforced Concrete Box Culvert 1-1.5m x 1.5m	m	16,200.00	42	43	15
500(3)a2	Reinforced Concrete Box Culvert 2-1.5m x 1.5m	m	25,600.00	42	43	15
500(3)a3	Reinforced Concrete Box Culvert 3-1.5m x 1.5m	m	35,800.00	42	43	15
500(3)b1	Reinforced Concrete Box Culvert 1-2.4m x 2.4m	m	27,300.00	42	43	15
500(3)b2	Reinforced Concrete Box Culvert 2-2.4m x 2.4m	m	46,100.00	42	43	15
500(3)b3	Reinforced Concrete Box Culvert 3-2.4m x 2.4m	m	65,400.00	42	43	15
500(3)c1	Reinforced Concrete Box Culvert 1-3.0m x 3.0m	m	37,300.00	42	43	15
500(3)c2	Reinforced Concrete Box Culvert 2-3.0m x 3.0m	m	65,300.00	42	43	15
500(3)c3	Reinforced Concrete Box Culvert 3-3.0m x 3.0m	m	92,000.00	42	43	15
500(3)d1	Reinforced Concrete Box Culvert 2-4.0m x 2.5m	m	2.00	42	43	15
501(4)	Subsurface Drain, Type SSD(G/P)-B	m	490.00	42	43	15
501(5)	Filter Layer	m3	800.00	42	43	15
502(2)b1	Reinforced Concrete Headwall, 1-910mmφ RCPC	ea.	18,800.00	28	57	15
502(2)b2	Reinforced Concrete Headwall, 2-910mmφ RCPC	ea.	25,200.00	28	57	15
502(2)c1	Reinforced Concrete Headwall, 1-1070mmφ RCPC	ea.	21,500.00	30	55	15
502(2)c2	Reinforced Concrete Headwall, 2-1070mmφ RCPC	ea.	31,300.00	30	55	15
502(2)d1	Reinforced Concrete Headwall, 1-1220mmφ RCPC	ea.	26,700.00	31	54	15
502(2)d2	Reinforced Concrete Headwall, 2-1220mmφ RCPC	ea.	37,500.00	31	54	15
502(2)f1	Reinforced Concrete Headwall, 1-1520mmφ RCPC	ea.	36,200.00	33	52	15
502(2)f2	Reinforced Concrete Headwall, 2-1520mmφ RCPC	ea.	51,700.00	33	52	15

TABLE 14.8-4 UNIT COST OF MAJOR CONSTRUCTION ITEM (2/2)

Item No.	Description	Unit	Unit Cost	Component(%)		
				Foreign	Local	Tax
502(10)a1	Reinforced Concrete Headwall, Box Culvert 1-1.5m x 1.5m	ea.	49,900.00	44	41	15
502(10)a2	Reinforced Concrete Headwall, Box Culvert 2-1.5m x 1.5m	ea.	59,800.00	45	40	15
502(10)a3	Reinforced Concrete Headwall, Box Culvert 3-1.5m x 1.5m	ea.	70,700.00	45	40	15
502(10)b1	Reinforced Concrete Headwall, Box Culvert 1-2.4m x 2.4m	ea.	102,000.00	44	41	15
502(10)b2	Reinforced Concrete Headwall, Box Culvert 2-2.4m x 2.4m	ea.	122,000.00	45	40	15
502(10)b3	Reinforced Concrete Headwall, Box Culvert 3-2.4m x 2.4m	ea.	141,000.00	45	40	15
502(10)c1	Reinforced Concrete Headwall, Box Culvert 1-3.0m x 3.0m	ea.	148,000.00	44	41	15
502(10)c2	Reinforced Concrete Headwall, Box Culvert 2-3.0m x 3.0m	ea.	178,000.00	45	40	15
502(10)c3	Reinforced Concrete Headwall, Box Culvert 3-3.0m x 3.0m	ea.	201,000.00	45	40	15
502(3)a1	Catch Basin for RCPC 1-φ610	ea.	16,800.00	45	40	15
502(3)b1	Catch Basin for RCPC 1-φ910	ea.	24,300.00	38	47	15
502(3)b2	Catch Basin for RCPC 2-φ910	ea.	37,900.00	39	46	15
502(3)c1	Catch Basin for RCPC 1-φ1070	ea.	28,400.00	38	47	15
502(3)c2	Catch Basin for RCPC 2-φ1070	ea.	45,500.00	39	46	15
502(3)d1	Catch Basin for RCPC 1-φ1220	ea.	37,100.00	38	47	15
502(3)d2	Catch Basin for RCPC 2-φ1220	ea.	60,900.00	39	46	15
502(3)e1	Catch Basin for RCPC 1-φ1520	ea.	47,500.00	38	47	15
502(3)e2	Catch Basin for RCPC 2-φ1520	ea.	80,300.00	39	46	15
504(5)	Grouted Riprap, Class "A"	m3	2,120.00	49	36	15
505(1)	Stone Masonry	m3	2,200.00	55	30	15
505(2)	Gravity Type Retaining Wall(H=1.0～1.5m)	m3	5,220.00	44	41	15
505(3)	Gravity Type Retaining Wall(H=1.0～3.0m)	m	4,200.00	44	41	15
506	Loose Boulder Apron 300mm ϕ min.,S.G=2.65	m3	2,250.00	44	41	15
507	Steel Sheet Pile (85×400×8mm), Furnished and Driven	m	1,430.00	55	30	15
509	Gabions	m3	3,620.00	51	34	15
510	Rubble Concrete Slope Protection, t = 350mm	m3	1,940.00	51	34	15
511(a)	Concrete Side Dicth (0.5 x 0.5)	m	2,230.00	38	47	15
511(b)	Concrete Side Dicth (1.0 x 0.5)	m	3,100.00	38	47	15
511(c)	Concrete Side Dicth (2.0 x 1.5)	m	8,400.00	38	47	15
SPL512(1)	Slope Protection for Cut	m2	4,500.00	44	41	15
SPL512(2)	RC L-Type Retaining Wall(H=3.0～5.0m)	m	12,500.00	44	41	15
	PART H - MISCELLANEOUS STRUCTURES					
600(1)a	Concrete Curb, Type A (200x450mm)	m	629.00	58	27	15
600(1)c	Concrete Curb for Edge of Sidewalk(200*500)	m	741.00	58	27	15
600(3)a	Combination Concrete Curb & Gutter/Side Strip, Type A (675x364mm)	m	1,050.00	58	27	15
603(3)a	Metal Guardrail	m	2,300.00	58	27	15
610	Sodding	m2	200.00	58	27	15
SPL620(1)	Traffic Signal (3-leg intersection)	ea.	2,082,000.00	20	65	15
SPL620(2)	Traffic Signal (4-leg intersection)	ea.	2,268,500.00	20	65	15
	Other Miscellaneous (Road Signs,Pavement Stud,etc)	km	1,500,000.00	70	20	10
	PART A,B- ENGINEER'S FACILITY AND MOBILIZATION / DEMOBILIZATION					
	(5% of PART C to H)					
	CONTINGENCY					
	(5% of PART A to H)					

14.8.2 ROW Acquisition and Compensation Cost (J.R. Borja Extension)

1) Unit Price

Unit prices for road right-of-way acquisition and compensation are obtained from respective municipality/city Assessor's Offices and regional office of BIR. The Republic Act 8974 provides that compensation cost for land shall be BIR zonal value that is normally far lower than prevailing market prices. Since the agricultural land around the study area has strong potential demand for residential use, price of the land currently transacted around area is fairly higher than zonal value. For the purpose of obtaining practical cost estimate for the project, prevailing market prices are adopted in this study.

Prices of structures are determined based on schedule of prices available in the Assessor's Office. The unit prices of structures are determined without any depreciation to obtain replacement cost of structures.

Unit prices are summarized in Table 14.8-6.

TABLE 14.8-6 UNIT PRICES OF LAND ACQUISITION AND COMPENSATION

Item	Zonal Value Assessed Value (P/m^2)	Prevailing Market Price (P/m^2)
Land Acquisition	Zonal Value	
Residential	150 – 80	800-1,000
Rice Field	20 – 100	100-500
Factory	800 – 100	1,500
Mountain	15 – 30	50
Factory / Warehouse	800 - 1000	1,200
Structures (floor area in m^2)	Assessed Value	
Concrete House	6,000 – 6,300	
Semi Concrete House	4,800 – 5,000	
Light Material House	3,000 – 3,500	

2) Compensation Cost

Land area to be acquired by present land uses are computed based on aerial-photo map and verified by field survey. Number of houses is tentatively obtained from aerial-photo map and will be verified by field investigation during social impact survey. Summary of compensation is presented in Table 14.8-7. Detail is presented in Appendix 14.8-2.

TABLE 14.8-7 ESTIMATED LAND ACQUISITION AND COMPENSATION COST

Item	Quantity	Amount (Million ₱)
Land Acquisition	285,300 m^2	113.1
Residential	62,399	46.9
Rice Field	136,035	13.6
Factory	35,433	50.0
Mountain / Forest	51,434	2.6
Structures	235 structures	54.8
Other Compensation		8.0
Total		**175.9**

14.8.3 Detailed Engineering and Construction Supervision Cost

Engineering services cost for a detailed design ranges from 3 to 5% of construction cost, and a construction supervision from 5 to 9%. An average of 4% of construction cost was adopted for the detailed design and 8% for the construction supervision for this project.

TABLE 14.8-8 ENGINEERING SERVICE COST

(Unit: Million Pesos

	Component			TOTAL
	Foreign	Local	Tax	
Detailed Design	26.0 (55%)	16.5 (35%)	4.7 (10%)	47.2 (100%)
Construction Supervision	51.9 (55%)	33.1 (35%)	9.4 (10%)	94.4 (100%)
Total	**77.9** **(55%)**	**49.6** **(35%)**	**14.1** **(10%)**	**141.6** **(100%)**

14.8.4 Summary of Project Cost

Summary of project cost is shown in Table 14.8-9.

TABLE 14.8-9 SUMMARY OF PROJECT COST

Unit: Million Pesos

	Component			TOTAL
	Foreign	Local	Tax	
Detailed Design	26.0	16.5	4.7	47.2
ROW/Resettlement	-	158.3	17.6	175.9
Construction	543.2	453.8	182.8	1,179.8
Construction Supervision	51.9	33.1	9.4	94.4
Total	**621.1**	**661.7**	**214.5**	**1,497.3**

14.8.5 Maintenance Cost for J.R. Borja Extension

(1) Road and Bridge Conditions

Road and bridge conditions and EMK factors are determined as follows.

Item	Conditions	EMK Factor
Road Length (km)	7.5	-
Traveled Way Width (m)	4-lane: 15m~175m	1.6
Bridge Length (total) (l.m)	150	0.01
AADT (2016)		1.20
Opening Year	2014	-

Note: AADT is estimated by PCU divided by 1.3. EMK factor is limited at 1.38 for 2-lane and 1.48 for 4-lane road. Total EMK=Road Length (km) x (Width F. x Surface Type F.) + Bridge Length x (Bridge F.)

(2) Base Cost

See Chapter 14.8.5 OF Part B.

(3) Maintenance Cost Estimate

Maintenance cost is estimated based on EMK and base costs of routine and periodic maintenance, and shown in Table 14.8-10.

TABLE 14.8-10 MAINTENANCE COST OF J.R. BORJA EXTENSION

	Calendar Factors		EMK			Financial Cost (x1000Peso)			Economic Cost (x1000Peso)		
	Year	AADT	Lane	Bridge	(km)	Routine	Periodic	Total	Routine	Periodic	Total
1	2014	1.12	1.60	1.50	14.93	1,262	0	1,262	954	0	954
2	2015	1.13	1.60	1.50	15.05	1,271	0	1,271	961	0	961
3	2016	1.14	1.60	1.50	15.17	1,281	0	1,281	969	0	969
4	2017	1.15	1.60	1.50	15.28	1,291	0	1,291	976	0	976
5	2018	1.16	1.60	1.50	15.40	1,301	0	1,301	984	0	984
6	2019	1.17	1.60	1.50	15.52	1,311	0	1,311	991	0	991
7	2020	1.18	1.60	1.50	15.63	1,321	0	1,321	998	0	998
8	2021	1.19	1.60	1.50	15.75	1,331	0	1,331	1,006	0	1,006
9	2022	1.20	1.60	1.50	15.87	1,340	0	1,340	1,013	0	1,013
10	2023	1.21	1.60	1.50	15.98	1,350	0	1,350	1,021	0	1,021
11	2024	1.22	1.60	1.50	16.10	1,360	0	1,360	1,028	0	1,028
12	2025	1.23	1.60	1.50	16.22	1,370	0	1,370	1,036	0	1,036
13	2026	1.24	1.60	1.50	16.33	1,380	0	1,380	1,043	0	1,043
14	2027	1.25	1.60	1.50	16.45	1,390	0	1,390	1,051	0	1,051
15	2028	1.26	1.60	1.50	16.56	1,399	0	1,399	1,058	0	1,058
16	2029	1.27	1.60	1.50	16.68	1,409	0	1,409	1,065	0	1,065
17	2030	1.27	1.60	1.50	16.80	1,419	0	1,419	1,073	0	1,073
18	2031	1.28	1.60	1.50	16.91	1,429	0	1,429	1,080	0	1,080
19	2032	1.29	1.60	1.50	17.03	1,439	0	1,439	1,088	0	1,088
20	2033	1.30	1.60	1.50	17.15	1,449	0	1,449	1,095	0	1,095

14.9 ENVIRONMENTAL IMPACT ASSESSMENT

14.9.1 General Characteristics of the Project Road

The J.R. Borja Extension Road Project (EW-2) is a proposed new road about 8.0km long traversing four (4) barangays of Cagayan de Oro City, namely: Gusa, Cugman, Tablon, and Agusan. It will be a 4-lane road with a 35-m right-of-way (ROW) and will be provided with six (6) new 4-lane bridges with a total length of 664.5m.

The alignment, which further extends J.R. Borja Extension starts at the end of the newly constructed road in Barangay Gusa and runs parallel to the Iligan City-Cagayan de Oro City-Butuan City Road (ICBR) until it joins the ICBR at Barangay Agusan (the terminus of the project). This road will be provided with three (3) access roads strategically stationed at different locations of the alignment to the ICBR.

The Initial Environmental Examination conducted in June 2004 reported that there is one environmentally critical spot along the project road. Eco-Tourism Village owned by the Philippine Tourism Authority to provide a preserved forest scenery to tourists is located at a mountain slope in Barangay Malasay. The proposed road alignment is selected by avoiding such critical spot, hence, no significant negative impact is expected. No other environmentally critical spots are observed along the road but required ROW along the entire stretch of the road shall be acquired since the road is newly constructed.

14.9.2 Social Acceptability

The criterion provided by the DENR DAO 96-37[1] for evaluating the social acceptability of a project has been considered during the course of the study to a certain extent. **Table 14.9-1** shows the action taken to ascertain social acceptability at the feasibility study level.

TABLE 14.9-1 ACTION TAKEN BY THE STUDY TEAM TO ASCERTAIN SOCIAL ACCEPTABILITY

Criteria	Action Taken
1) Consistency with land use plan	. Provincial and municipal land use plans and infrastructure development plan are obtained and examined. The proposed widening project is confirmed with the local infrastructure development plan.
2) Public Participation	. Officials from regional offices of national government (NEDA, DENR, DOTC), local government units and private sector were consulted during selection the project road and its improvement level. • Public consultation meeting involving the communities along the project road were held by barangay level.
3) Promotion of Social Equity	. Preferential hiring of local labor and provision of alternative means of livelihood are considered as mitigating and enhancement measures to address adverse socio-economic impacts.
4) Mitigating and Enhancement Measures	• Included in **Table 14.9-5**
5) Involve Women and Vulnerable Groups	• Active participation of women and vulnerable groups, such as informal settlers and tenants/renters are included in this report as mitigating and enhancement measures to address adverse socio-economic impacts.
6) Environmental Monitoring and Evaluation	• Included in **Table 14.9-6**

[1] Department of Environment and Natural Resources, Administrative Order No. 37, Series 1996. This Administrative Order provides detailed procedures of the EIA System.

14.9.3 Data Gathering for Baseline Information

The parameters of baseline data needed to establish historical trends and present condition of the physical, biological and socio-economic environment of project area were agreed during Level I Scoping Meeting (Technical Scoping) with EMB[2]. Based on the agreed parameters, the collection of baseline information has been carried out in July 2004. The result of baseline survey is discussed in the next section.

14.9.4 Description of Existing Environmental Condition

1) Physical Environment

Climate

The nearest synoptic meteorological station in the project area is located in Cagayan de Oro City. The climatic characteristics of the project road are identical to the New West Diversion Road as discussed in **Section 12.9.4**.

Terrain

Terrain of the project road is generally flat to rolling except at the section that passes through the perimeter of the Eco-Tourism Village where terrain is mountainous with maximum slope of 7%. The elevation of the ground along the proposed alignment is 10m at the beginning and goes up to 45m sharply at Barangay Lungnam (Sta 2+200) near the Eco-Tourism Village then gradually goes down and ends with 6m at the end of the project road in Barangay Agusan. Four (4) major rivers originate from highland plateaus that require the construction of bridges are observed. Two (2) more bridges are proposed to be constructed over deep ravines to maintain vertical alignment of the road with required design standard.

Air Quality

One (1) hour ambient air quality measurements for total suspended particulates (TSP) was conducted at Barangay Tablon, Cagayan de Oro City. Results of the sampling activity indicate that the concentration recorded for the project alignment ranges from 12.26 micrograms per normal cubic meter (μ/Ncm) to 30.10 (μ/Ncm). This concentration is way below the standard established by the Department of Environment and Natural Resources at 230.0 micrograms per normal cubic meter.

Water Quality

Water quality measurements were made at Umalag River in Barangay Tablon. Result of water quality measurements is shown in **Table 14.9-2**.

TABLE 14.9-2 WATER QUALITY MEASUREMENTS

Location	Temperature	Ph	Dissolved Oxygen (DO), mg/L	Total Dissolved Solids, mg/L	Salinity	Conductivity
Umalag River Upstream	30.1°C	8.16	3.86	131.1	0.1	302
Umalag River Downstream	30.7°C	8.06	3.16	133.1	0.1	307

[2] EMB: Environmental Management Bureau of DENR

Noise Level

Noise level measurements were made at Barangay Tablon, Cagayan de Oro City, adjacent the project roads.

The average readings taken at the time of sampling are shown in **Table 14.9-3**. By comparing with the standards established for the purpose, average readings for the project alignment ~~are~~ more or less same as standard values, meaning that the ambient noise level reaches critical level.

TABLE 14.9-3 NOISE LEVEL MEASUREMENTS

Trial Readings	Morning	Daytime	Evening	Nighttime
	5 AM - 9 AM	9 AM - 6 PM	6 PM - 10 PM	10 PM - 5 AM
1	48.8	51.5	51.0	49.3
2	48.0	58.2	50.6	48.8
3	47.9	49.0	51.7	48.4
4	49.9	50.8	51.2	49.8
5	49.8	52.1	52.1	47.4
6	49.2	49.7	50.0	48.5
7	49.9	49.7	50.9	48.4
Minimum	48.0	49.0	50.0	47.4
Maximum	49.9	58.2	52.1	49.3
Average	49.1	51.6	51.1	48.7
Standard	50.0	55.0	50.0	45.0

Land Use

Land use along the project road varies a lot from residential/industrial to ricefields and mountains. Composition of land use is as follows:

Residential	52,199 m^2	(18.3%)
Industrial (Factory)	35,433 m^2	(12.4%)
Ricefields	146,234 m^2	(51.3%)
Mountain	51,434 m^2	(18.0%)
	285,300 m^2	(100.0%)

Ricefields share more than 50% of the project road while built-up areas (residential and industrial) also accounts more than 30%.

Beginning portion of the project road at Barangay Gusa is residential then goes to mountain after passing through ricefields. The road goes back to ricefields and ends at residential areas. Several factories and warehouses are observed along the road.

2) Biological Environment

Vegetation and Wildlife

Three (3) sampling stations were established for the road alignment. These sites are located in the Malasag, Baloy, and Agusan, Cagayan de Oro City.

SUBSTATION 1 - MALASAG, CAGAYAN DE ORO CITY: Thirty-four (34) species under 17 families were identified. Fruit bearing trees such as *Mangifera indica* (mango), *Spondias purpuria* (seneguelas) and *Cocos nucifera* (coconut) were identified. Other vegetations include grasses, shrubs and herbs.

SUBSTATION 2 - BALOY, CAGAYAN DE ORO CITY: Plants identified are common grasses, shrubs and herbs and few trees. Thirty-one (31) species under 15 families were identified.

SUBSTATION 3 - AGUSAN, CAGAYAN DE ORO CITY: Vegetation identified were common. It included grasses, shrubs and trees. Twenty-five (25) species in 16 families were identified.

Aquatic Fresh/Marine Environment

There are no local account of freshwater fish present in the rivers sampled during the water quality measurements, but it has to be established preferably before the start of construction. It is likely that there could be endemic species in these rivers but that had not been noticed during the field survey.

3) Socio-Economic Environment

The socio-economic characteristics of the project area are identical to the New West Diversion Road as discussed in **Section 12.9.4**, since the two project roads are located close to each other.

14.9.5 Perception Survey

The Perception Survey was conducted in the four (4) barangays traversed by the proposed road. The respondents were disaggregated into two major identification (unless specified otherwise in the rest of the tables): (1) respondents within the barangays traversed by the alignment that are directly affected, and (2) respondents within the barangays that are not directly affected by the alignment.

A total of 356 respondents were identified during the survey. Less than half (49.7%) of these respondents were randomly selected within the barangays while a little more than half (50.3%) were directly selected within the barangays since they are most likely along the project alignment.

TABLE 14.9-4 DISTRIBUTION OF RESPONDENTS BY BARANGAY

City/Barangay	Directly Affected		Indirectly affected		Total	
	Number	%	Number	%	Number	%
Cagayan de Oro City						
Gusa	67	37.4	83	46.9	150	42.1
Cugman	55	30.7	44	24.8	99	27.8
Agusan	26	14.5	20	11.3	46	12.9
Tablon	31	17.3	30	16.9	61	17.1
Total	**179**	**100**	**177**	**100**	**356**	**100**
% Distribution		50.3		49.7	100	

1) Awareness about the Project

More than four-fifths (83.7%) of the respondents have already heard of the plans for construction of the project. The percentage of directly affected respondents who have already heard of the project is relatively higher (83.2%) and the highest can be found in Barangay Gusa.

Nearly half (47.2%) of the respondents heard of the project only recently. A fourth (25%) heard about it 1 or 2 years ago. More than a fifth (21.3%) on the other hand heard of it more than two years ago.

Those who heard about the project said that it is about the construction of a new road/highway (62.6%) while the remainder believed it is about other projects.

2) Agreement for the Project

Most (90.4%) of the respondents are in favor of the implementation of the project. More than two-fifths (45.8%) said that the project will give way to development of the area and the province as a whole. A fifth (20.2%) also indicated that the project offers safe and efficient transport of people, goods and services. More than a tenth (14.0%) did not provide any response.

3) Effect on Source of Income

Three-fourths (75.6%) of the respondents said that their livelihood will not be affected and that includes more than four-fifths (83.2%) of the directly affected respondents. More than a fifth (23.0%) said that there will be loss of livelihood, employment and property. More than three-fourths (76.1%) did not provide any response.

4) Good Things Seen about the Project

About almost the same percentages of the respondents believed that with the project, there will be less traffic in the main highway (29.2%), and that it will benefit the majority and opening of new business (29.8%). More than a tenth (15.4%) added that the city or barangay will improve or develop while about a fifth (19.4%) said that there will be easy and fast access to the region.

5) Benefits Expected from the Project

More than two-fifths (44.9%) of the total number of respondents said that travel time will become shorter (including faster and convenient transport of people and goods) while according to nearly two-fifths (38.5%) of the respondents, there will also be opening of new industries along the alignment and consequent offer of employment. The rest said that the project will provide housing/improvement of barangay (9.0%); increased aesthetic value of areas along the proposed road (1.7%); or did not provide any response or comment or do not know at all what to expect from the project.

6) Bad Things about the Project

Nearly a third (28.4%) of the total number of respondents believe that no bad things can be attributed to the project. Almost the same percentage (29.5%) said that there will be increase in noise and air pollution level. Also nearly a fourth (23.0%) said that there will be loss of livelihood/relocation of affected families. The rest are spread over to other responses such as disruption of regular activities of barangay residents (7.3%); fast moving vehicles causing accidents (5.9%); strangers will be coming into the barangays (1.1%); and increased crime rate (1.4%), among others.

7) Problems Foreseen for the Community as a Whole

Close to a third (27.0%) of the respondents believe that the project will not bring any problems to the community as a whole, but nearly a fourth (24.7%) indicated that there will be loss or properties/livelihood problems (lack of job). More than a fifth (21.1%) said that there will be accidents/increased crime rates, drug-related incidents, robbery/hold-up cases while about a fifth (19.9%) said there will increased pollution/problem of flooding/heavy erosion and landslide.

14.9.6 Identified Impacts and Mitigation Measures

The predicted environmental impacts, along with the mitigation (for negative impacts) and enhancement (for positive impacts) measures are presented in **Table 14.9-5**, Impacts and Mitigation/Enhancement Matrix.

14.9.7 Environmental Management and Monitoring Plan

The Environmental Management and Monitoring Plan is presented in **Table 14.9-6**.

14.9.8 Resettlement Plan for Affected People

The survey on Resettlement Plan for affected people is currently being undertaken. Status of survey is discussed in **Section 12.10**.

TABLE 14.9-5 SUMMARY MATRIX OF IMPACTS AND MITIGATION AND ENHANCEMENT MEASURES (1/3)

Impacts	Type		Mitigation/Enhancement Measures
	Negative	Positive	
CONSTRUCTION PHASE			
Physical Environment			
Air Quality and Noise Levels			
Increase in levels of Total Suspended Particulates (TSP) such as dust, dirt, and oil soot.	Low		Use of water trucks equipped with horizontal spray jets located on the aft end and perpendicular to the direction of travel.
Increase in exhaust gas emission levels due to the operation of various heavy equipment and vehicles.	Low		Regular maintenance of heavy equipment and other smoke emitting machinery must be strictly complied with.
Increase in noise levels and vibration due to the operation of heavy equipment and vehicles.	Low		Use of mufflers and appropriate noise suppressors for heavy equipment and machinery.
			Scheduling of high noise generating activities during the daytime.
Temporary stockpiles of excavated and surplus materials as well as fill and embankment materials may also add to the present TSP levels.	Low		Excavate unsuitable materials and contraction spoils will be regularly hauled and disposed to DENR approved disposal site.
			Temporary stockpiles of fill and embankment materials will be covered with tarpaulin canvass or sack materials to prevent re-suspension of particulate matters.
Water Quality			
Increase in the amount of suspended solids of receiving natural water ways due to the deposition of high volumes of exposed, loose sediments transported by surface run-off.	Low		Since wetlands have the natural ability to filter and purify water, some areas, particularly those which have low agricultural productivity can be used as natural treatment facilities.
Possible contamination of surface and ground water due to borrow pits and quarries and other excavation activities.	Low		Contamination of surface and ground water due to borrow pits and quarries and other excavation activities may be minimized by carefully studying the substances profiles before any disturbance is started.
Increase in the bacteriological content of local surface water bodies due to domestic wastewater generated by construction personnel. This may eventually transmit diseases.	Low		Sanitation facilities should be provided by the Contractor to ensure that local water bodies are not polluted.
Washing of construction vehicles and other mobile equipment such as cement mixers, chutes, and related equipment will pollute the surface waters.	Low		Washing of construction vehicles and other mobile equipment along the waterways should be prohibited.
Improper storage and handling of chemicals such as lubricants, fuel, paint, and other solutions for routine vehicular operation may contaminate local surface and ground water.	Low		Chemicals such as lubricants, fuel, paint, and other solutions for routine vehicular operation must be handled with care and properly stored.
Biological			
As a result of an increase in noise levels and vibration, natural wildlife activates such as mating, nesting, and migratory patterns, particularly of birds will be disrupted/disturbed.	Low		Disruption/disturbance to natural wildlife activities such as mating, nesting, and migratory patterns is inevitable but reversible.
As a result of an increased turbidity of surface waters, the sediments will block light penetration into the rivers and creeks and inhibit both natural and algal photosynthesis and visibility of aquatic fauna required for location of food.	Low		Increased turbidity of surface waters is a short term and reversible type of adverse impact.

TABLE 14.9-5 SUMMARY MATRIX OF IMPACTS AND MITIGATION AND ENHANCEMENT MEASURES (2/3)

Impacts	Type		Mitigation/Enhancement Measures
	Negative	Positive	
Socio-Economic Environment			
Loss of Structure			
Number structures affected: 235	High		Government must ensure that the affected structures are properly compensated based on 'Replacement Cost" method as provided by laws and regulations.
Loss of Land			
Residential 52,199 m^2 Industrial 35,433 Ricefield 146,235 Mountain 51,434 **Total 285,301 m^2**	High		The affected land shall be compensated with fair market value.
Loss of Other Improvement			
- Trees and other perennials - Other structures	Moderate		Trees and other perennials with commercial values shall be compensated based on schedule of prices available in municipal/city assessor's office. Other structures shall be compensated based on "Replacement Cost" method.
Agricultural Tenants			
Agricultural tenants residing within the proposed ROW will be displaced.	Moderate		Government must relocate tenant-farmers at a resettlement site or area they prefer where they can access to their agricultural land.
			Government must implement a sound Social Development Program (SDP) that will ensure that affected agricultural tenants get compensated for the disturbance.
Limited Accessibility to Farmlands			
During the construction phase, farmers may experience temporal difficulty in terms of accessibility to the land they are cultivating.	Low		Contractors must provide a safe alternative route to farmers who need to cross the land they are cultivating (during and after construction phase).
Generation of temporary employment opportunities.		Moderate	Contractor must give priority to available local labor.

TABLE 14.9-5 SUMMARY MATRIX OF IMPACTS AND MITIGATION AND ENHANCEMENT MEASURES (3/3)

Impacts	Type		Mitigation/Enhancement Measures
	Negative	Positive	
OPERATIONAL PHASE			
Physical Environment			
Increase in vehicular gaseous emissions and noise level along the highway as a result of increase in vehicles due to increase in number of lanes.	Moderate		To improve air quality and noise level along the highway, LTO shall regulate operation of vehicles that emit smokes and make noise beyond limit provided by law. LGUs shall enforce strict traffic regulations to regulate speeding vehicles.
Socio-Economic Environment			
Means of livelihood of the dislocated people may not be restored properly as planned in Resettlement Plan.	Low		External and internal monitoring shall be regularly conducted to verify status of income restoration of dislocated people.
Improved accessibility to basic social services such as schools, hospitals, markets, churches, and communication facilities.		Moderate	DPWH must regularly maintain the bypass sections.
			DPWH must improve/construct access roads to the road so that more people can have better access to basic social services.
Reduction of transport costs due to improved traffic flow.		Moderate	DPWH must regularly maintain the road.
Better flow of industrial, commercial, and agricultural commodities.		Moderate	DPWH must regularly maintain the road to ensure continuous, undisrupted flow of agricultural products.
Urbanization and commercial development of non-agricultural and non-prime agricultural areas.		Moderate	Concerned LGUs must work hard towards achieving the development plans.
Increase in land values of areas traversed by and in the vicinity of the bypass sections.		Moderate	Landowners will benefit from increase of land values in areas traversed by or near the bypass sections.
Increase in employment opportunities as a result of commercial development.		Moderate	Government must ensure that qualified measures of the host community are given priority in the hiring of local labor force.

TABLE 14.9-6 ENVIRONMENTAL MANAGEMENT AND MONITORING MATRIX (CAGAYAN DE ORO, EW-2)

Parameters to be Monitored	Stations to be Monitored	Frequency of Monitoring	Methods of Analysis/Execution	DENR Standard	Implementor
CONSTRUCTION PHASE					
PHYSICAL					
Water quality BOD, TSS, and oil and grease of surface water	All m ajor bridges and RCBC sites	Quarterly during construction	Standard EMPASS-EQD water quality analysis	Class "C" BOD - <10 mg/L TSS - <30 mg/L increase Oil & Grease - <3mg/L	DENR-Region 10
Air quality TSP, NO_2, and SO_2	Barangay Tablon in Cagayan de Oro City	Quarterly during construction	Standard EMPASS-WQD air quality analysis	TSP: 430, NO_2: 470, SO_2: 375	DENR-Region 10
BIOLOGICAL					
Tree cutting	Entire alignment where there are trees to be cut	Daily	Monitoring team must ensure that tree cutting is limited within the required ROW only	N. A.	MMT
Waste management and disposal	All portions with excavation and fill activities	Weekly during construction	Site inspection	Based on EMP	DENR-Region 10
SOCIAL					
Relocation of project affected families	All stretch of the project road and relocation site	Monthly	Monitoring team must ensure that affected families are properly compensated and their means of livelihood is maintained or restored	Based on RAP	MRIC External Monitoring Agent
Compliance of Contractor to occupational health and safety rules and regulation	All construction areas	Weekly	Site inspection of work areas including sanitation facilities	Based on EMP	MMT
Road safety	Signalized intersections, merging lanes	Quarterly	Site inspection	Based on DPWH Standard Operating Procedures	DPWH
OPERATIONAL PHASE					
BIOLOGICAL					
Tree planting and its maintenance on both sides of the highway	Designated environmental belts/zones	Monthly	Site inspection	Based on EMP	DENR-Region 10 MMT
SOCIAL					
Livelihood restoration	Resettlement site	Monthly	Interview with relocated families	Based on RAP	External Monitoring Agent
Informal settling/squatting/encroaching	Acquired ROW	Weekly	Site inspection	Based on EMP	LGUs, MMT
Illegal conversion of prime agricultural land	Areas adjacent to the bypass	Weekly	Site inspection	Based on EMP	LGUs, MMT
Road condition	Pavement and bridge, including drainage system and embankments	Based on standard DPWH maintenance procedures	Standard DPWH road and bridges maintenance works	Based on DPWH Standard Operating Procedures	DPWH

MMT : Multi-Partite Monitoring Team
MRIC : Municipal RAP Implementation Committee

14.10 SOCIAL IMPACT ASSESSMENT AND RESTTLEMENT ACTION PLAN

14.10.1 Measures Taken to Mitigate Negative Impacts

Four (4) alternative alignments were studied to determine the most feasible route, that which has the least impact on land and structures and which is the most technically and economically viable. The detailed process of alternative selection is discussed in **Section 14.4**. The alternative which avoids built-up areas and other major establishments was finally selected.

14.10.2 Barangays Affected by the Project

The following barangays of Cagayan de Oro City are affected by the project:

1. Gusa
2. Cugman
3. Agusan
4. Tablon

14.10.3 Community Consultation and Participation

Series of community consultation meetings have been held since the beginning of the study. The topics discussed in these meetings are presented below.

1) Workshops

The JICA Study Team has conducted workshops, whenever major study outputs are made, to present the process of the master plan and feasibility study to all concerned agencies and residents. The location of the final alignment and the extent of land acquisition and social impacts are also presented to the public and their comments and suggestions are incorporated in the study.

SUMMARY OF WORKSHOPS

	1st Workshop	2nd Workshop	3rd Workshop	4th Workshop
Date	November 2003	March 2004	July 2004	September 2004
Venue/Location	Cagayan de Oro City	Cagayan de Oro City	Cagayan de Oro City	Cagayan de Oro City
Topics Discussed	1. Outline of the study 2. Projects proposed by LGUs	1. Proposed road network plans	1. Selected road alignments 2. Social Impact Survey results	1. Presentation of Draft Final Report

Details of the workshops are presented in **Section 12.10.3**.

2) Meetings with City Officials

Prior to the Social Impact Survey, the Study Team visited the office of the Mayor of Cagayan de Oro City and the City Planning and Development Office, as discussed in **Section 12.10.3.**

3) Meetings with Barangay Captains

Meetings with the Barangay Captains of each of the affected barangays were held after coordination with their respective officials.

The dates of meetings with the Barangay Captains and the date of "**Barangay Endorsement**" in acceptance of the proposed project is summarized in **Table 14.10-1.**

TABLE 14.10-1 SUMMARY OF MEETINGS WITH BARANGAY CAPTAINS AND DATE OF ISSUANCE OF BARANGAY ENDORSEMENT

City	Date of Meeting	Venue / Location	Date of Issuance of Barangay Endorsement	
Cagayan de Oro City	17 June 2004	Brgy. Session Hall	Gusa	22 June 2004
			Cugman	19 June 2004
			Agusan	23 June 2004
			Tablon	21 June 2004

4) Barangay Consultation Meetings

Consultation meetings with residents that could be possibly affected were held in each barangay as summarized below.

TABLE 14.10-2 SUMMARY OF BARANGAY CONSULTATION MEETINGS

Barangay	Location/Venue	Date and Time of Meeting	
Cagayan de Oro City			
Gusa	Purok 3A Multipurpose Hall	20 June 2004	10:00 AM
Cugman	Cugman Barangay Hall	19 June 2004	2:00 PM
Agusan	Basketball Court, Barangay Hall	20 June 2004	9:00 AM
Tablon	Barangay Hall (Stage)	21 June 2004	3:00 PM

14.10.4 Identified Impacts

Identified impacts and corresponding compensation costs are summarized **Table 14.10-3.**

TABLE 14.10-3 SUMMARY OF IMPACT AND COMPENSATION COST

J.B. Borja Extension Road (EW-2)

Description	No. of HHs	Unit	Rate/Unit	Quantity	Amount (Php)	Remarks
Compensation for Land and Other Assets						
1. Land						
1) Residential – 1	-	m^2	1,000	13,605	13,605,000	Name of land owners to be identified by parcellary survey.
2) Residential – 2	-	m^2	800	29,619	23,695,200	
3) Residential –3	-	m^2	500	19,175	9,587,500	
4) Industrial –1	-	m^2	1,500	24,825	37,237,500	
5) Industrial –2	-	m^2	1,200	10,608	12,729,000	
6) Agricultural (Rice Field)	-	m^2	100	136,035	13,603,450	
7) Forest	-	m^2	50	51,433	2,571,665	
Subtotal				**285,300**	**113,029,315**	
2. Structures						
1) Shanty (Bamboo & Nipa)	12	m^2	1,000	199.00	199,000	
2) Wood with GI sheet	110	m^2	1,140	3,570.50	4,070,370	
3) Concrete with wood	46	m^2	6,000	2,228.00	13,368,000	
4) Concrete	67	m^2	7,800	4,758.25	37,114,350	
Subtotal	**235**			**10,755.75**	**54,751,720**	
3. Other Fixed Structures						
1) Wooden Fence	4	m	100	182.00	18,200	
2) Concrete/Steel Fence	12	m	200	576.00	115,200	
	16			**758.00**	**133,400**	
4. Repair Cost	-	-	-	-	-	None
5. Electric Post Relocation	-	-	-	-	-	None
6. Perennials						
Various types	-	Nos.	various	2,004	701,400	
Subtotal					**168,615,835**	
Other Compensations						
1. Disturbance Allowance						
1) Severely affected land owners	-	-	-	-	-	None
2) Agricultural lessees	-	-	-	-	-	None
3) Temporary land users	-	-	-	-	-	None
4) Severely affected structural owners	201	HH	10,000	201	2,010,000	
2. Subsistence Allowance						
(1) Income loss for shop owners	38	HH	15,000	38	570,000	
2. Financial Assistance						
1) Land users w/o title	-	-	-	-	-	None
3. Rehabilitation Assistance						
1) Severely affected land owners	-	-	-	-	-	None
2) Agricultural lessees	-	-	-	-	-	None
3) Severely affected structural owners.	-	-	-	-	-	None
4. Transportation Allowance						
1) Relocating PAPs	212	HH	3,000	212	636,000	
2) Shanty dwellers go back to province.	-	-	-	-	-	None
5. Transitional allowance						
1) Renters of affected structures	11	HH	3,000	11	33,000	
Subtotal					**3,049,000**	
TOTAL					**171,664,835**	
RAP Implementation					**4,265,150**	
GRAND TOTAL					**175,928,985**	

1) Impact on Land

The project is the construction of new four-lane highway with required standard right-of-way of 35m, except at some built-up areas along the road where ROW is narrowed to 25m to reduce the number of affected families.

Affected areas by land use are summarized as follows:

Land Use	Land Area (m^2)	Share (%)
Residential	62,399	21.9
Industrial (factories)	35,433	12.4
Rice fields	136,035	47.7
Forest	51,433	18.0
Total	**285,299**	**100.0**

2) Impact on Structures

A total of **251** structures, mostly residential houses, are identified along proposed road alignment as follows:

Structure Use	Number of Structures	Floor Area (m^2)
Residential	186	8,887.75
Residential cum Shop	18	1,028.00
Independent Shops	22	543.00
Farmhouses	2	35.00
Waiting Sheds	2	21.00
Other Buildings	7	241.00
Sub-total	**235**	**10,755.75**
Fence	16	758.00 m
Total	**251**	**-**

3) Impact on Residents

The impact on affected families is summarized as follows:

Type of PAF	Number	
Severely Affected PAFs	201.0	
- *Renters*	(*10.0*)	
- *Agricultural Tenants*	-	*not identified*
Marginally Affected PAFs		
Renters	(*1.0*)	
Total	**215.0**	
Average Household Size	5.11	
Public Entities and Utility Companies	2.0	

The occupation of affected families varies widely, among which are farmers, shop owners, laborers, and employees. The average monthly household income of most of these families is below ₱6,000.

No informal settlers or families along the proposed road alignment that need to be relocated were identified.

4) Impact on Trees and Perennials

Groves of fruit trees, mostly unproductive and with low commercial value, were observed around residential areas. A total of **2,004** various kinds of trees were identified along the project road.

14.10.5 Valuation of Losses

The sources of data and methods of valuation used to determine compensations for each type of loss are shown in **Section 12.10.5.**

14.10.6 Resettlement Site

There are no informal settlers and urban poor found along the project road, hence, provision of a resettlement site is not necessary. However, Cagayan de Oro City has a number of resettlement sites, as discussed in **Section 12.10.6**, that can accommodate residents who could possibly be displaced.

14.10.7 Income Restoration Program

An income restoration training will be given to PAPs who will be obliged to shift from their present occupation or income generating activity due to relocation. The details of this are discussed in **Section 12.10.6.**

14.10.8 Institutional Arrangements

The DPWH, through an appropriate Project Management Office (PMO), shall be the lead agency responsible for the implementation of the project and the compliance requirement of this RAP. This arrangement is discussed in detail below.

1) Department of Public Works and Highways (DPWH)

A PMO shall be designated by the DPWH as its overall responsible unit in the implementation of the New J.R. Borja Road Extension Project. It will manage and supervise the project, including its resettlement activities and land acquisition requirements, in coordination with concerned agencies. To ensure smooth implementation the PMO shall facilitate the availability of funds, including those required for RAP implementation, in a timely manner.

Regional and District Engineering Offices of the DPWH

The City District Engineering Office (DEO) of the DPWH based in Cagayan de Oro City shall be the lead implementing arm for the Resettlement Action Plan (RAP) for project affected persons within the territorial boundary of Cagayan de Oro City.

The District Engineers (DEs), upon receipt of the appropriate Department Order (DO) for the RAP's implementation, shall appoint an adequate number of staff to perform the necessary activities under the plan. Should the number fall short of that required, the DE shall seek assistance from the DPWH Regional Office.

2) Local Government Unit (LGU)

The resettlement requirements of the project shall be coordinated by the DPWH and its regional and district engineering offices with the LGU concerned. This is especially critical insofar as implementation of the provisions of Republic Act 7279 (the Urban Development and Housing Act of 1992) and its implementing rules and regulations are concerned to ensure the observance of proper and humane relocation and resettlement.

3) RAP Implementation Committee (RIC)

The DEO RAP Staff shall be assisted in the implementation by a City Resettlement Implementation Committee (CRIC) which, consistent with the Resettlement Policy, shall be composed of the following:

RAP Implementation Committee (RIC)

Chairman and Convenor : District Engineer (DPWH), Cagayan de Oro City
Co-Chairman : City Mayor of Cagayan de Oro (or his designated representative)
Members :

Barangay Captain – Barangay Gusa, Cagayan de Oro City
Barangay Captain – Barangay Cugman, Cagayan de Oro City
Barangay Captain – Barangay Tablon, Cagayan de Oro City
Barangay Captain – Barangay Agusan, Cagayan de Oro City

Representative of PAPs – Barangay Gusa, Cagayan de Oro City
Representative of PAPs – Barangay Cugman, Cagayan de Oro City
Representative of PAPs – Barangay Tablon, Cagayan de Oro City
Representative of PAPs – Barangay Agusan, Cagayan de Oro City

Representative(s) from a Non-Government Organization (NGO) or People's Organization (PO) active in all the traversed barangays

The NGO(s) or PO(s) in the Resettlement Implementation Committee (RIC) should be active in the communities traversed by the alignment and registered organization(s) with the Securities and Exchange Commission (SEC). In addition, it should be duly recognized by the LGU through a process of accreditation and recognition by the Sangguniang Panlungsod (SP) of Cagayan de Oro.

The functions of the RIC shall be as follows:

a) Assist the DPWH DEO in validating the list of PAPs, the assets of PAPs that will be affected by the project (using a prepared compensation form), and in implementing the RAP;

b) Assist the DPWH DEO in public information campaign, public participation and consultation;

c) Assist the DEO in the payment of compensation to PAPs;

d) Receive complaints and grievances from PAPs and other stakeholders and act on them accordingly;

e) Maintain record of all public meetings, complaints, and actions taken to address complaints and grievances;

f) In coordination with concerned government authorities, assist in the enforcement of laws/ordinances regarding encroachment into the project road corridor.

4) Internal Monitoring and Evaluation Requirement

The Environmental Social Service Office (ESSO) of the DPWH shall be responsible for the internal monitoring and evaluation requirement of the RAP. Prior to the RAP implementation, however, the ESSO shall provide the DEO RAP Implementation Staff with the proper orientation in the implementation of the RAP and the DPWH Resettlement Policy.

5) External Monitoring and Evaluation Requirement

An external monitoring agency (EMA) or institution shall be engaged by the DPWH upon the donor agency's concurrence of this RAP. The EMA shall perform independent third party monitoring of DPWH's compliance to its own Resettlement Policy and the implementation of the provisions of this Resettlement Action Plan. Selection of this institution shall be in accordance with DPWH's selection process, which shall be concurred by the donor agency before its eventual engagement.

The scope of services of the EMA shall be governed by a Terms of Reference which shall spell out in detail the indicators to be measured among other important aspects of the external monitoring work. The main objectives of conducting an independent external monitoring and evaluation for each of the RAPs implemented are the following:

a) To determine whether or not the implementation of the RAP is carried out according to the Department's Resettlement Policy, and

b) To determine whether or not the main objectives of the RAP (i.e. to improve or at least restore the living standards, income-earning capacity and production levels of affected people) have been achieved.

6) Control of Land Speculation and Illegal Encroachment

To deter the proliferation of project affected persons (PAPs) that have not been censused or inventoried during the socio-economic survey as well as the inventory of affected assets, the RAP implementation team shall be guided during the validation work of the "**Cut-off Date**" as **June 25, 2004** (conclusion of the socio-economic survey for affected persons). Any PAPs identified during the validation work, except those which have not been interviewed but who had already been earlier identified, may not be entitled for compensation. The same restriction shall apply for additional assets built and/or improvements made on existing assets of identified PAPs after the cut-off date. Photographs earlier taken of these assets shall be used to validate any variances made after the cut-off date.

14.10.9 Grievance Redress Measures

Grievance redressal is one of the main functions of the RIC. The Resettlement Policy provides that grievances related to any aspect of the project will be handled through negotiations aimed at achieving consensus following the procedures discussed in **Section 12.10.8**.

14.10.10 Monitoring and Evaluation

The procedures for monitoring and evaluation of RAP implementation during the project implementation stage are discussed in **Section 12.10.9**.

14.10.11 RAP Implementation

1) Preparation of Final RAP

The social impacts identified in this study shall be verified and validated during the detailed design stage after establishing the exact extent of construction limits and the corresponding ROW limits required. The RAP updating surveys shown in **Table 14.10-4** shall be carried out to update the preliminary RAP prepared under this study after fixing the final ROW limits.

TABLE 14.10-4 RAP UPDATING SURVEYS TO BE UNDERTAKEN

Impact Item	Surveys to be Undertaken
Land	- **Parcellary survey** shall be carried out to identify the names of lot owners and the area to be acquired from each lot owner.
Structure	- **Tagging and picture taking** must be carried to identify the PAPs eligible for compensation. - **Cut-off-Date** must be set and informed to the residents prior to tagging.
Perennials	- **Validation survey** shall be carried out to identify name of owner of perennials with commercial values.
Tenants/Renters, Informal Settlers	- **Socio-economic survey** shall be carried out to identify the presence of agricultural tenants, renters of structures, and informal settlers who need special consideration by providing relocation site, financial assistance, and other assistance.

A final RAP shall be prepared based on the preliminary RAP and the RAP update surveys.

2) RAP Approval

The final RAP will have to be presented to the DPWH for approval and for concurrence by the donor agency by the scheduled period in 2007. The salient points of the final RAP will have to be reiterated with concerned officials of Cagayan de Oro City upon its approval prior to implementation. The RIC that will be organized for the purpose shall provide the necessary assistance to the DPWH DEOs during the implementation process. Any technical assistance, when required by the RIC, will be extended by the DPWH Regional Office upon request.

3) MOU with LGU and the Establishment of the RIC

Within a reasonable period of time from the approval of this RAP, a Memorandum of Understanding (MOU) will be executed between the DPWH and the LGU (Cagayan de Oro City). The MOU will provide the mandate for the formation of the RIC and will likewise spell out the required cooperation and commitment of the LGU in ensuring that the right-of-way is sustainably free from encroachments and illegal squatting even after project completion.

4) Orientation and Training of the RIC

The members of the RIC will be given orientation on the scope and coverage of their work under the final RAP. In addition, the same RIC members will be trained on the

implementation requirements of the RAP, including the scope and coverage of the DPWH policy framework that will be embodied in that RAP.

5) Stake-out

During the validation period, the RIC shall conduct a stakeout of the project corridor to determine the extent of the area required by the road project. The results of the alignment survey used during the detailed engineering design and the latest parcellary survey conducted in the area will be used as basis for this activity.

6) PAP Validation and Establishment of Detailed Compensation Rates

The RIC members will validate the census of PAPs and inventory of affected assets and review and update, where necessary, the compensation entitlements payable to these PAPs. This will be done at a pre-agreed period prior to the conclusion of the orientation training.

7) Conduct of Public Information Campaign

While the PAPs have already been informed about the project during the series of barangay consultations, perception survey, and socio-economic survey conducted during the preparation of the preliminary RAP, the RIC will again call for public meetings to explain further the details of the RAP upon its implementation. The RIC can, upon public information, improve materials prepared during the formulation of the RAP. The PAPs will be informed of the schedule of the RIC's validation work and will be requested to keep documents that would attest ownership of their affected assets as these may be requested by the RIC.

8) Finalization of Compensation and Other Entitlements of PAPs

The RIC shall finalize the entitlements and the total amount of compensation payable to each PAP following the updating of the unit prices that will be used, and after confirmation visit to each PAP to validate the inventory of affected assets. This shall be consistent with the entitlement matrix of the RAP. The possibility of additional PAPs who have not bee identified during the preparation of the RAP due to potential minor re-alignment remains high and the validated list is expected to reflect these changes. Those that are within the ROW but who came in after the cut-off period established for the RAP are excluded.

An "Inventory of Affected Fixed Assets Form" will have to be accomplished and signed by each PAP or his duly authorized representative to indicate concurrence with the estimates of the affected assets, entitlements, and total compensation amounts. A copy of the acknowledged form will be given to each of the PAPs for their reference.

9) Public Meetings

Public meetings will be held during the disclosure of compensation to the PAPs in the barangays traversed by the road project. These meetings will be conducted in a public place following conclusion of the finalization of the compensation entitlements to inform them of the results of the validation of impacts and computation of compensation and other entitlements, other resettlement activities, and the schedule of payment to PAPs.

During this activity the PAPs are expected to register any disagreement on the validated results through the grievance redressal mechanism established in the policy framework that will be reiterated in the final RAP. The PAPs will be advised on the options that may be taken following the grievance redressal procedures of the same policy and the Policy Framework on Public Participation and Consultation of the DPWH. The result of the disclosure meetings shall be the basis for the preparation of payment vouchers and subsequent payments to the PAPs.

10) Payment of Compensation and Other Entitlements

The place, date, and time of the payment activity will be communicated to the Mayor of Cagayan de Oro City with a request that this be announced in advance to the barangay officials/RIC members. The announcement will likewise be posted by the barangay officials in a place accessible to the public to ensure that all PAPs within their administrative jurisdiction are informed. All payments of compensation will be also done in public.

The activity will be highlighted with the signing of a Pledge of Undertaking (POU) by the PAP, which states among others the demolition, removal or relocation of structures from the ROW within a specified period of time, the failure of which provides corresponding recourse of the DPWH to either carry out the stipulation at the PAPs expense or filing of criminal case in a court of law. In addition, the POU prohibits the rebuilding of such structures by the PAPs or their heirs within the DPWH's road right-of-way (RROW).

11) Reorganization and Relocation

The DPWH will not cause any demolition, reorganization or relocation along the ROW until all the PAPs are duly paid their compensation and other entitlements as disclosed during the public meetings.

12) Hand-over of the Site for Construction

The site may be handed over for the civil works construction at least a month following the conclusion of the RAP implementation and after the issuance of a "No Objection Letter" from the donor agency.

13) Monitoring and Supervision of RAP Implementation

The implementation of the RAP will be supervised by the Project Implementing Office in coordination with the ESSO. The ESSO will also carryout internal monitoring of the RAP implementation and will provide periodic progress reports to the donor agency. Supervision and monitoring of the RAP implementation will be done through the ESSO counterpart staff at the regional level.

An independent agency will be contracted to carry out external monitoring and post-evaluation study.

14.11 PROJECT EVALUATION

14.11.1 Economic Evaluation

1) Traffic Demand Forecast

Future traffic demand forecasted in a form of OD matrix (years 2010, 2016 and 2022) was assigned on the road network to estimate traffic volume on the New J.B. Borja Extension Road. The estimated traffic volume on the Borja Extension Road for the case of "with" the project is summarized in **Table 14.11-1**.

TABLE 14.11-1 TRAFFIC VOLUME ON J.R. BORJA EXTENSION ROAD

Unit: PCU / day

	2010	2016	2022	AAGR (%)	
				'10 – '16	'16 – '22
West Section	14,590	26,868	49,478	10.7	10.7
Middle Section	8,777	17,962	36,758	12.7	12.7
East Section	4,166	11,326	30,794	18.1	18.1

The estimated vehicle kilometers and vehicle hours in Metro Cagayan de Oro are shown in **Tables 14.11-2** and **14.11-3**, respectively. These tables are based on the benefit calculation.

TABLE 14.11-2 TOTAL VEHICLE KILOMETERS IN METRO CDO WITH AND WITHOUT J.R. BORJA EXTENSION ROAD

Unit: PCU Km / day

	W/O Project	W/ Project	W/O – W/
2010	2,450,210	2,414,000	36,210
2016	3,282,160	3,224,080	58,080
2022	4,475,100	4,434,520	40,580

TABLE 14.11-3 TOTAL VEHICLE HOURS IN METRO CDO WITH AND WITHOUT J.R. BORJA EXTENSION ROAD

Unit: PCU Hour / day

	W/O Project	W/ Project	W/O – W/
2010	102,110	98,470	3,640
2016	148,470	142,750	5,720
2022	230,070	218,920	11,150

2) Economic Evaluation

Evaluation Period

The evaluation period is assumed to be 20 years from 2018 to 2037 taking into account the service life of the J.R. Borja Extension Road.

Implementation Schedule

The implementation schedule is assumed as follows:

- 2009 Detailed design
- 2010 – '12 Land acquisition
- 2013 – '17 Construction of J.R. Borja Extension Road

- 2015 Open to public for section 1
- 2018 Open to public for all section

Economic Indicators

The economic evaluation method is principally employed benefit cost analysis. The economic indicators used in this study re as follows:

– Net Present Value (NPV)
– Benefit Cost Ratio, (BCR), and
– Economic Internal Rate of Return (EIRR)

Estimation of Benefit

Basic Vehicle Operating Cost

The basic vehicle operating cost (BVOC)is estimated annually by PMO-FS Office in DPWH. The latest BVOC was estimated in April 2002. In this study, this VBOC with some modification by inflation between April 2002 and April 2003 is utilized in this study (See Table 14.11-4).

TABLE 14.11-4 BASIC VEHICLE OPERATING COST (EXCLUDING TAX)

Vehicle Type	Running [P/1000km]	Fixed [P/Min]	Time [P/Min]
Car / Taxi / Jeep	4,441	0.245	0.991
Jeepney	2,991	1.181	1.468
Bus	7,453	1.794	5.561
Track	9,622	2.107	0
Motor Cycle	822	0.082	0.586

Source: PMO-FIS, DPWH
Note: BVOC prepared by PMO-FIS is modified with inflation rate.
All costs are expressed as 2003 prices.

The vehicle operating cost by surface type and travel speed was set up since it varies by these factors.

Estimation of Benefits

The saving in vehicle operating costs and travel time cost were estimated and are shown in **Table 14.11-5**.

TABLE 14.11-5 ESTIMATION OF BENEFITS

Unit: '000 Pesos/Year

Year	Saving in VRC	Saving in VFC	Saving in VOC	Saving in TCC	Total Saving
2010	81,480	62,316	143,796	84,240	228,436
2016	127,120	97,888	225,008	132,326	357,333
2022	132,965	190,966	323,931	258,150	582,081

Economic Cost

The project cost, which was already calculated in the previous section, is expressed as the financial cost. It is therefore to convert from financial cost to economic cost. In this study the economic cost was estimated to deduct from financial cost to government taxes and shadow prices of unskilled labor is shown in **Table 14.11-6**.

TABLE 14.11-6 ECONOMIC COST ESTIMATE

Unit: '000 Pesos

Description		Economic Cost	Financial Cost
1	Construction Cost	997,000	1,179,800
2	ROW Acquisition / Resettlement	244,300	271,400
3	Consultancy	127,500	141,600
3-1	Detailed Design	42,500	47,200
3-2	Construction Supervision	85,000	94,400
	Total	1,368,800	1,592,800

Maintenance Cost

According to the maintenance study in this study, the present maintenance cost for the road has estimated on the basis of the EMK method. In this study, therefore, the maintenance cost of the J.R. Borja Extension Road is estimated on the basis of the same EMK method.

Benefit Cost Analysis

Based on the above mentioned benefits and cost estimations, the economic analysis of the Project was made. **Table 14.11-7** show the benefit – cost analysis of the J.R. Borja Extension Road Construction Project during project life period of 20 years and **Table 14.11-8** shows the benefit cost stream. The results of the economic analysis show that a Net Present Value (NPV) of ₱ 392 million and BCR of 2.20 over 20 years life of the Bridge using discount date of 15% which is designated by the NEDA. The Economic Internal Rte of Return (EIRR) was compiled at 25.6%.

TABLE 14.11-7 ECONOMIC INDICATIONS OF BENEFIT COST ANALYSIS

Net Present Value	392 million pesos
BCR	2.20
EIRR	25.55%

Note: 1) Project life is assumed to be 20 years
2) Discount rate is 15%

(2) Sensitivity Analysis

The sensitivity analysis is conducted under a worse case scenario incorporating increase and/or decrease of the estimation of costs and benefits. **Table 14.11-9** show the results of the sensitivity analysis.

TABLE 14.11-8 BENEFIT - COST STREAM OF J.R. BORJA EXTENSION PROJECT

Undiccounted BenefiT Cost Stream

000 Pesos

Sq	Year	Construction Cost	O & M Cost	Cost Total	Benefit	Cost-Benefit
1	2004	0.0	0.0	0.0	0.0	0.0
2	2005	0.0	0.0	0.0	0.0	0.0
3	2006	0.0	0.0	0.0	0.0	0.0
4	2007	0.0	0.0	0.0	0.0	0.0
5	2008	0.0	0.0	0.0	0.0	0.0
6	2009	42,500.0	0.0	42,500.0	0.0	-42,500.0
7	2010	81,433.3	0.0	81,433.3	0.0	-81,433.3
8	2011	81,433.3	0.0	81,433.3	0.0	-81,433.3
9	2012	81,433.3	0.0	81,433.3	0.0	-81,433.3
10	2013	216,400.0	0.0	216,400.0	0.0	-216,400.0
11	2014	216,400.0	0.0	216,400.0	0.0	-216,400.0
12	2015	216,400.0	627.0	217,027.0	153,189.9	-63,837.1
13	2016	216,400.0	627.0	217,027.0	162,479.0	-54,548.0
14	2017	216,400.0	627.0	217,027.0	173,809.2	-43,217.8
15	2018	0.0	1,254.0	1,254.0	416,695.0	415,441.0
16	2019	0.0	1,276.0	1,276.0	451,556.6	450,280.6
17	2020	0.0	1,299.0	1,299.0	490,418.6	489,119.6
18	2021	0.0	1,321.0	1,321.0	533,751.5	532,430.5
19	2022	0.0	1,344.0	1,344.0	582,081.1	580,737.1
20	2023	0.0	1,366.0	1,366.0	609,038.2	607,672.2
21	2024	0.0	1,389.0	1,389.0	637,555.8	636,166.8
22	2025	0.0	1,411.0	1,411.0	667,725.7	666,314.7
23	2026	0.0	1,411.0	1,411.0	699,645.0	698,234.0
24	2027	0.0	1,411.0	1,411.0	733,416.9	732,005.9
25	2028	0.0	1,411.0	1,411.0	769,150.2	767,739.2
26	2029	0.0	1,411.0	1,411.0	806,960.4	805,549.4
27	2030	0.0	1,411.0	1,411.0	846,969.8	845,558.8
28	2031	0.0	1,411.0	1,411.0	889,307.9	887,896.9
29	2032	0.0	1,411.0	1,411.0	934,111.6	932,700.6
30	2033	0.0	1,411.0	1,411.0	981,526.2	980,115.2
31	2034	0.0	1,411.0	1,411.0	1,031,705.3	1,030,294.3
32	2035	0.0	1,411.0	1,411.0	1,084,811.7	1,083,400.7
33	2036	0.0	1,411.0	1,411.0	1,141,017.7	1,139,606.7
34	2037	0.0	1,411.0	1,411.0	1,200,505.9	1,199,094.9

Diccounted BenefiT Cost Stream

000 Pesos

Sq	Year	Discounted	Construction Cost	O & M Cost	Cost Total	Benefit	Cost-Benefit
1	2004	1.000	0.0	0.0	0.0	0.0	0.0
2	2005	1.150	0.0	0.0	0.0	0.0	0.0
3	2006	1.323	0.0	0.0	0.0	0.0	0.0
4	2007	1.521	0.0	0.0	0.0	0.0	0.0
5	2008	1.749	0.0	0.0	0.0	0.0	0.0
6	2009	2.011	21,130.0	0.0	21,130.0	0.0	-21,130.0
7	2010	2.313	35,205.9	0.0	35,205.9	0.0	-35,205.9
8	2011	2.660	30,613.8	0.0	30,613.8	0.0	-30,613.8
9	2012	3.059	26,620.7	0.0	26,620.7	0.0	-26,620.7
10	2013	3.518	61,514.4	0.0	61,514.4	0.0	-61,514.4
11	2014	4.046	53,490.8	0.0	53,490.8	0.0	-53,490.8
12	2015	4.652	46,513.7	134.8	46,648.5	32,927.1	-13,721.4
13	2016	5.350	40,446.7	117.2	40,563.9	30,368.5	-10,195.4
14	2017	6.153	35,171.0	101.9	35,272.9	28,248.9	-7,024.0
15	2018	7.076	0.0	177.2	177.2	58,890.9	58,713.7
16	2019	8.137	0.0	156.8	156.8	55,493.8	55,337.0
17	2020	9.358	0.0	138.8	138.8	52,408.5	52,269.7
18	2021	10.761	0.0	122.8	122.8	49,599.3	49,476.5
19	2022	12.375	0.0	108.6	108.6	47,035.1	46,926.5
20	2023	14.232	0.0	96.0	96.0	42,794.3	42,698.3
21	2024	16.367	0.0	84.9	84.9	38,954.8	38,869.9
22	2025	18.822	0.0	75.0	75.0	35,476.7	35,401.7
23	2026	21.645	0.0	65.2	65.2	32,324.0	32,258.8
24	2027	24.891	0.0	56.7	56.7	29,464.6	29,407.9
25	2028	28.625	0.0	49.3	49.3	26,869.7	26,820.4
26	2029	32.919	0.0	42.9	42.9	24,513.6	24,470.7
27	2030	37.857	0.0	37.3	37.3	22,373.0	22,335.7
28	2031	43.535	0.0	32.4	32.4	20,427.3	20,394.9
29	2032	50.066	0.0	28.2	28.2	18,657.7	18,629.5
30	2033	57.575	0.0	24.5	24.5	17,047.7	17,023.2
31	2034	66.212	0.0	21.3	21.3	15,581.9	15,560.6
32	2035	76.144	0.0	18.5	18.5	14,246.9	14,228.4
33	2036	87.565	0.0	16.1	16.1	13,030.5	13,014.4
34	2037	100.700	0.0	14.0	14.0	11,921.6	11,907.6
		Total	350,707.0	1,720.4	352,427.4	718,656.4	366,229.0

Net Present Value	**366,229**
B/C Ratio	**2.039**
EIRR	**24.15**

TABLE 14.11-9 SENSITIVITY ANALYSIS REGARDING COSTS AND BENEFITS OF J.R. BORJA EXTENSION ROAD CONSTRUCTION PROJECT

		Indicator	Benefits		
			20% down	Base Case	20% up
Costs	20% down	NPV (P million)	293	437	580
		B/C Ratio	2.04	2.55	3.06
		EIRR (%)	24.2	27.6	30.6
	Base Case	NPV (P million)	222	366	606
		B/C Ratio	1.63	2.04	3.37
		EIRR (%)	21.0	24.2	32.0
	20% up	NPV (P million)	152	296	439
		B/C Ratio	1.36	1.70	2.04
		EIRR (%)	18.7	21.6	24.2

Note: Project life of the project is assumed to be 20 years

(3) Summary of Economic Analysis

The implementation of the J.R. Borja Extension Road construction project can be justified from view of national economic point since the economic indicators of all cases more than the over cut-off level which can be considered as 15% of EIRR in the Philippines.

14.11.2 Technical Evaluation

The results of the technical analysis of J.R. Borja Extension Road show that the construction of the said road is technically feasible. However, the following technical notes shall be made:

- Due to high embankment to be necessary in the section 1 of J.R. Borja Extension, it is proposed to employ viaduct at the high embankment section.
- Due to minimizing acquisition of ROW along residential areas in the section 2, it is proposed to employ the block masonry as retaining wall.

14.11.3 Other Impacts

1) On Traffic

Table 14.11-10 shows the transport efficiency of Metro Cagayan de Oro in case of without and with the J.R. Borja Road.

TABLE 14.11-10 TRANSPORT EFFICIENCY IN METRO CAGAYAN DE ORO WITH AND WITHOUT J.R. BORJA EXTENSION ROAD

			2010	2016	2022
PCU Kilometers ('000)	Whole Area	W/O Project	2,450,210 1.00	3,282,160 1.00	4,475,100 1.00
		W/ Project	2,414,000 0.98	3,224,080 0.98	4,434,520 0.99
PCU Hour ('000)	Whole Area	W/O Project	102,110 1.00	148,470 1.00	230,070 1.00
		W/ Project	98,470 0.96	142,750 0.96	218,920 0.95
Average Travel Speed (km/h)	Whole Area	W/O Project	24.00 1.00	22.11 1.00	19.45 1.00
		W/ Project	24.52 1.02	22.59 1.02	20.26 1.04
Vehicle Operating Cost (P '000/day)	Whole Area	W/O Project	12,298 1.00	16,736 1.00	23,361 1.00
		W/ Project	12,065 0.98	16,373 0.98	22,981 0.98

TABLE 14.11-11 TRAFFIC VOLUME WITH AND WITHOUT J.R. BORJA EXTENSION CONSTRUCTION PROJECT

Unit: PCU/day

	2016			2022		
	W/O Project	W/ Project		W/O Project	W/ Project	
	Existing Rd	Existing Rd	J.P. Borja	Existing Rd	Existing Rd	J.P. Borja
West Section	97,600	77,100	26,900	128,500	79,600	68,000
Middle Section	77,700	60,100	18,000	101,400	81,200	49,500
East Section	67,400	56,500	11,300	87,600	66,900	36,800

2) On Urban Amenity

Traffic volume of the existing Iligan - Cagayan de Oro – Butuan Road will be greatly reduced due to diverted to the J.R. Borja Extension Road. Therefore, noise level air quality and vibration in the area within the existing Iligan - Cagayan de Oro – Butuan Road will be greatly improved. Thus, urban amenity will be improved.

3) On Urbanization

Urbanization will be guided and supported by the J.R. Borja Extension Road. According to the Urban Index calculated in Section 11.2 of the Master Plan, urbanization index (RUa) along the J.R. Borja Extension Road corridor will be able to calculate to be almost 80%. With the existing road network within the road, sound urbanization will be achieved.

4) On Regional Economy

With the improved and reliable transport facility, economic activities within the influence area of the J.R. Borja Extension Road will be stimulated. This project will contribute to economic growth of not only Metro Cagayan de Oro but also Reion X.

14.11.4 Overall Evaluation

As mentioned above, the implementation of the J.R. Borja Extension Road construction project can be justified from view of economic, technical and social impact points.