24.3 PRELIMINARY DESIGN AND COST ESTIMATE

24.3.1 Rehabilitation Design

(1) Bridge Design

(a) Scope of Works for Rehabilitation

This preliminary design recommended scheme, "**Slanted Prestressing Cable Strengthening and Longitudinal External PS Cable** (Large Scale Rehabilitation)" mentioned in **Section 24.2** Comparative Study. The major improvement measures in this scheme are as follows:

- Partial replacement of deck slab over pier support.
- Rehabilitation of gerber hinge portion with slanted P/S cables.
- Reconstruction of diaphragm and slab at gerber hinge.
- Installations of external cables on each side of the girder for the cantilever span and drop span.
- Repair and sealing of concrete cracks, honeycomb and spalling.

Figure 24.3.1-1 shows the general view of the works.

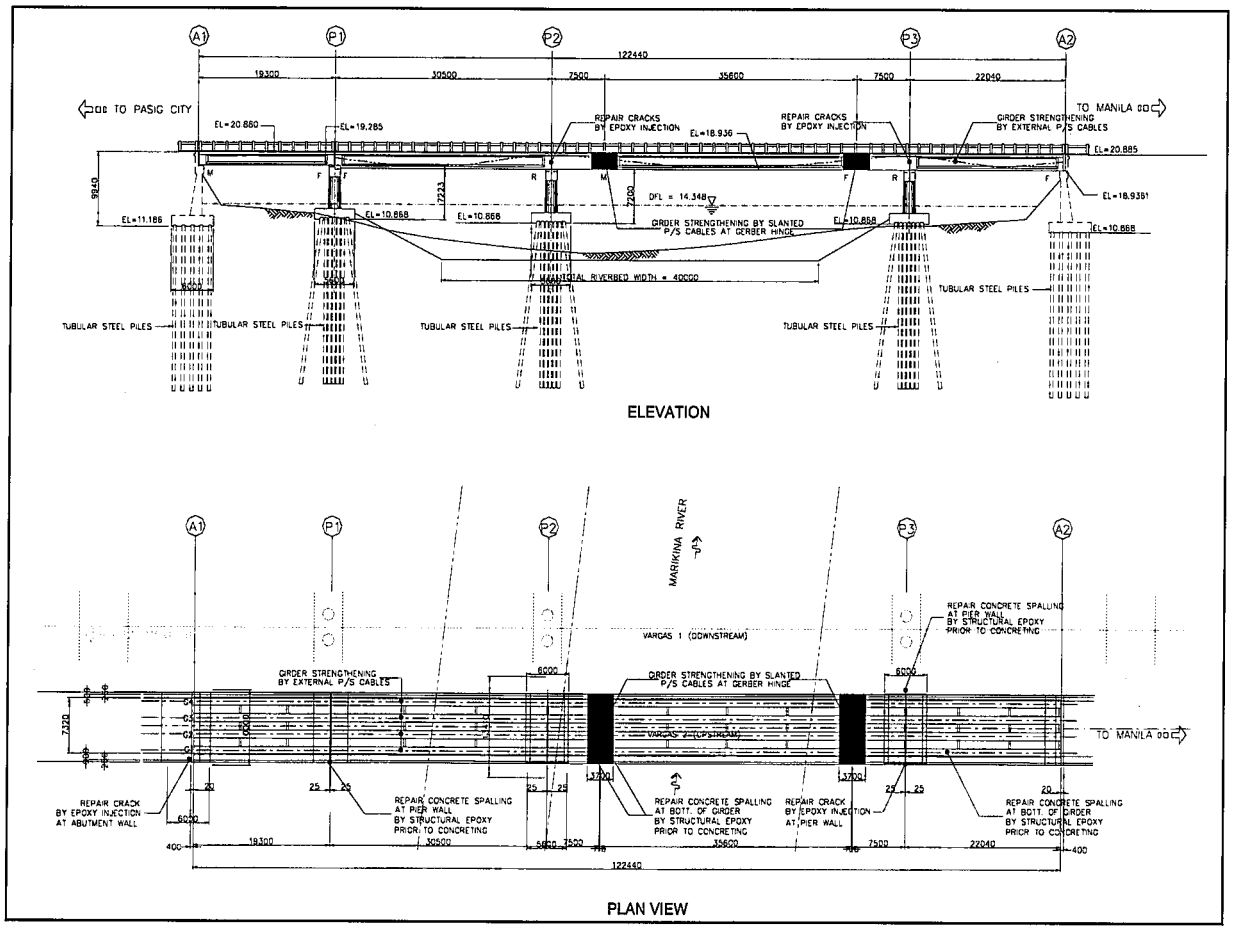


Figure 24.3.1-1 General View of Strengthening Works

(b) Design Criteria for Structure

Criteria for materials and loads are shown in **Table 24.3.1-1.**

Table 24.3.1-1 Design Criteria

I. SPECIFICATION	- AASHTO Standard Specification for Highway Bridges, 16th Edition 2000 including Division IA, Seismic Design - Specification for Highway Bridges, Japan Road Association, 1994
II. MATERIALS	-Prestressed Concrete, fc' = 39 MPa -Reinforced Concrete (New), fc' = 28 Mpa -Reinforcing Steel (New), fy = 415 MPa -Slanted Prestressing Cables (Type F70TS – JIS G 3536 Area of Strand = 383.80 mm^2 fpu = 1860 Mpa -External Prestressing Cables (12.70 mm HTS) Fpu = 1860 Mpa Area = 98.70 mm^2
III. LOADS	- Deadloads Reinforced Concrete = 24.50 kN/cu.m Steel = 77.00 kN/cu.m Earth Compacted = 19.00 kN/cu.m - Highway Loads AASHTO MS – 18 Loading - Impact Loads I = 15.24/L + 38, where L = Length in meters - Sidewalk Loads For Span more than 20m Sidewalk Loading shall be 2.50 KPa - Earthpressure Mononobe – Okabe Method

(c) Design of Superstructure

Sagging deformation of girder and cracks at gerber hinge are the major damage of this bridge. To recover these defects, the required measures are:

- To strengthen the damaged gerber hinge.
- To stop further deformation of girders.

The detail of the rehabilitation is shown in **Appendix 24.3.1-1**.

Strengthening of Gerber Hinge

For strengthening of gerber hinge, slanted prestressing cables are installed outside of the girder around the cracks at the hinge as shown in **Figure 24.3.1-2.**

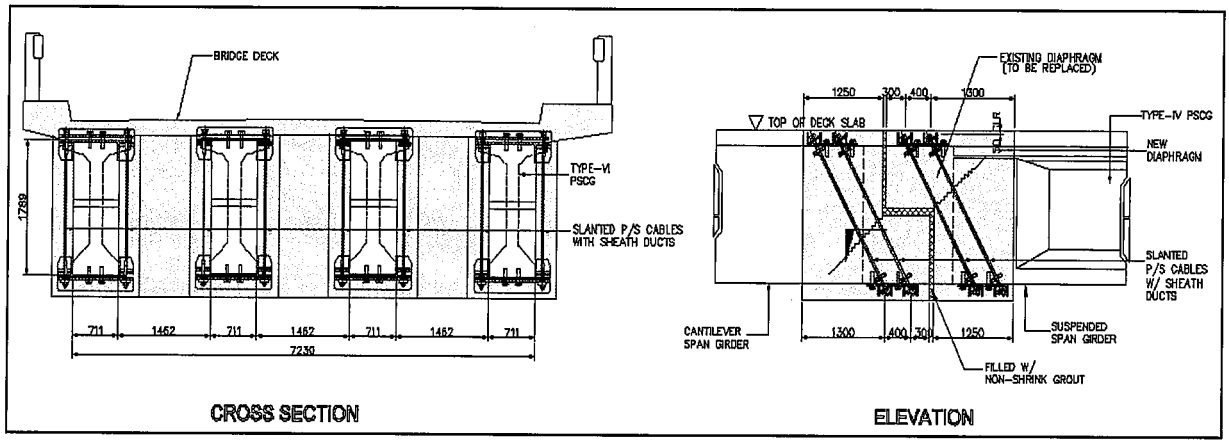
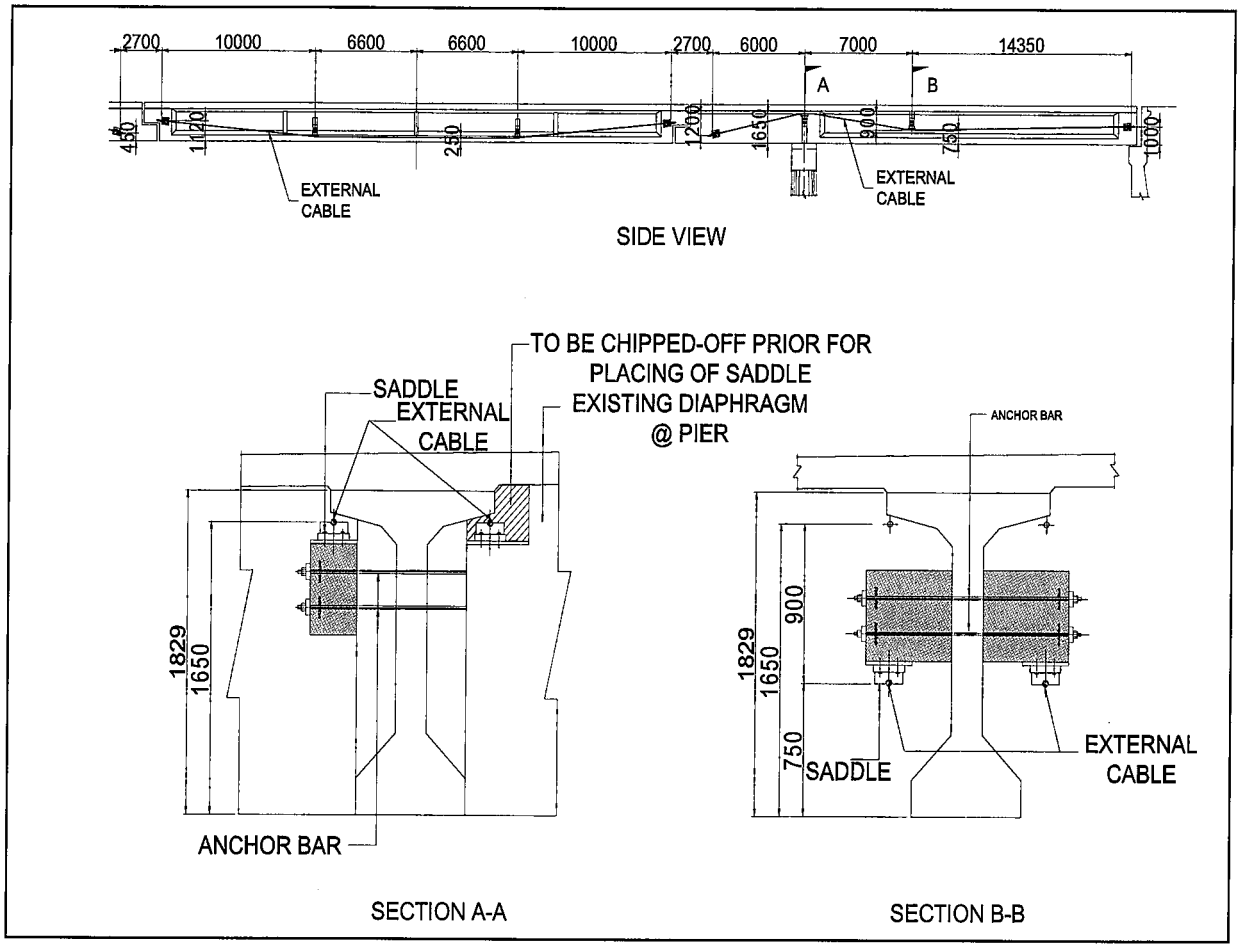


Figure 24.3.1-2 Strengthening of Gerber Hinge

Stopping Girder Deformation

For stopping girder deformation, external longitudinal prestressing cables are installed as shown in **Figure 24.3.1-3**.



Result of Structural Analysis

Result of structural analysis are shown in **Table 24.3.1-2**.

Table 24.3.1-2 Result of Structural Analysis

SLANT SHEAR CABLE			
DEMAND		CAPACITY	
		EXISTING	REHABILITATION
809.96 kN		719.7 kN	1411 kN
REMARKS		5 - 28 mm dia bar spacing: 150mm c to c	28.2 mm dia cable qty : 8 pcs / girder @ gerber hinge
EXTERNAL CABLE			
SECTION STRESSES @ TOP OF PIER		COUNTER STRESSES (18 – 12mmø cable)	
F (top)	-3.11 MPa	3.49 MPa Compression	
F (bottom)	11.56 MPa	- 1.29 MPa (Tension)	
SECTION STRESS @ MIDSPAN OF DROP BEAM		COUNTER STRESSES (18 – 12mmø cable)	
F (top)	15.21 MPa	3.49 MPa (Tension)	
F (bottom)	-2.07 MPa	- 1.29 MPa Compression	

Summary of structural analysis is shown in **Appendix 24.3.1-2**.

Major Quantity

Major quantity for this rehabilitation work is shown in **Table 24.3.1-3**.

Table 24.3.1-3 Major Quantity for Rehabilitation

Description		Unit	Quantity
A. Repair / Sealing of Concrete Cracks			
SPL	Epoxy Bonding	l. s.	1.00
SPL	Concrete Grouting	l. s.	1.00
B. New Diaphragm / Concrete Slab			
101 (3)	Removal of Concrete Slab	sq. m.	600.00
101 (3) b	Removal of Asphalt	sq. m	600.00
301 (1)	Tack Coat	ton	1.00
310	Asphalt	ton	46.00
405 (1) a	Structural Concrete Slab	cu. m.	123.00
	Structural Concrete for New Diaphragm	cu. m.	68.00
	Formworks	sq. m	76.00
	Reinforcing Steel Bars	kgs	17,900.00
	External Cables	kgs	7,681.87
	Slanted Prestressing Cables	kgs	3,278.00
	Saddle Assembly	each	128.00
	Structural Steel	each	
	Anchor Bolts	each	
C. Guard Rail Post			
	Removal of Concrete Railing / Post	l. m.	22.00
	Removal of Concrete Sidewalk	sq. m	13.50
	New Concrete Railing / Post	l. m.	22.00
	New Concrete Sidewalk	sq. m	13.50

(2) Highway Design

(a) Scope of Works

The highway works includes following items:

- Approach roads of the bridge
- Improvement of two (2) intersections

(b) Design Criteria for Highway

The highway design was carried out based on the following criteria and standards:

- Design Guidelines and Standards for Public Works and Highways, Volume – II
- A policy on Geometric Design of Highways and Streets, 1996 (AASHT0)
- Highway Capacity Manual, Special Report, Transportation Research Board, 1999
- Road Structure Ordinance, Japan Road Association, 1983 (JRA)

(c) Intersections

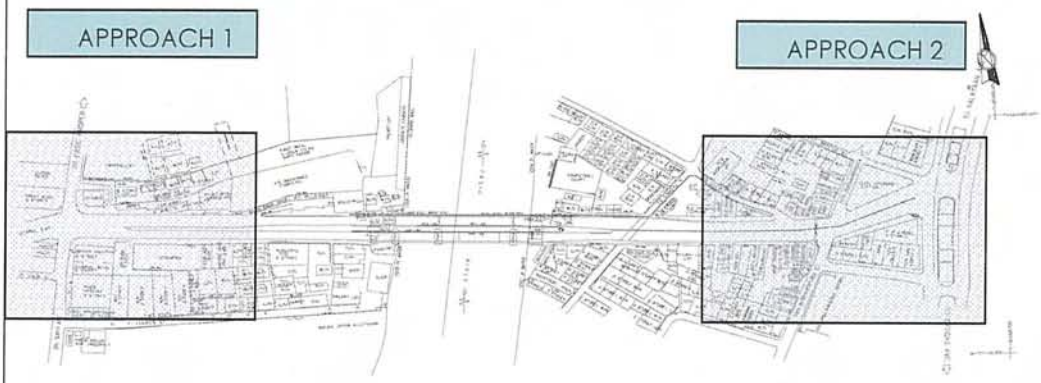
Vargas Bridge approach intersection (Approach 1) poses the problem of an excessive wide area along Shaw Blvd. Ext. This situation has the tendency to cause traffic confusion and

pedestrian safety problems. The other approach (Approach 2) intersection at C-5 present good intersection layout and does not need improvement at this stage.

Table 24.3.1-4 shows the existing condition of approaches/ intersections of Vargas Bridge.

Figure 24.3.1-4 to **Figure 24.3.1-5** present before and after improvement of the Approach 1 intersection of Vargas Bridge.

Table 24.3.1-4 Existing Conditions of Approaches /Intersections of the Vargas Bridge

PLAN		
	APPROACH 1	**APPROACH 2**
Traffic	• Traffic coming from the bridge is heavy due to several vehicles turning left and going through. • **Jeepney stops near the intersection in all legs of the intersection contributes to the greater traffic congestion.**	• **Vehicles making right turn to the bridge are speeding greater than normal which present risk to pedestrian.** • Traffic coming from the north of C-5 going to Vargas Bridge are to use U-Turn underneath the C-5 Flyover.
Pedestrian	• **Uncontrolled pedestrian crossing although pedestrian markings are in placed.**	• Pedestrian crossing markings are in placed and it is properly enforced.
Geometric and Pavement	• Sight distances are very limited due to commercial buildings adjacent to the road. • **Lane width is not maximized, many vehicles are out of lane especially those making right turns and left turns.** • Sidewalks are in placed but hardly inaccessible due to sidewalk vendors. • Pavement is quite in good condition with several patches.	• **Left turn prohibition from the service road and U-turning poses a greater speed entering the approach of the bridge.** • Pavement is in good condition.
Traffic Signal, Markings and Signs	• Unsignalized intersection. • Pavement markings are worn out. • **Insufficient traffic signs.**	• Unsignalized intersection. • Pavement markings are in place. • **Insufficient traffic signs.**
Recommnen-dation	• Major improvement is necessary by providing median and divisional island. • To provide signalization for all traffic direction.	• No improvement is necessary, however right turn movement should be regulated.

The existing intersection as shown in **Figure 24.3.1-4** shows a wide intersection area and it is without median or divisional barrier at some section that will control movements of vehicular traffic and at the same time control pedestrian where to properly cross the road. The existing lanes are two (2) lanes in each direction at Shaw Blvd. with provision for left turn coming from the bridge.

One way road are implemented due to heavy traffic going to Pasig proper along Dr. Sixto Antonio Ave. while the other leg is a two-way, two-lane road.

The proposed improvement of Shaw Blvd. / Dr. Sixto Antonio Ave intersection shall be to reduce the wide area of the road to control vehicular traffic movements.

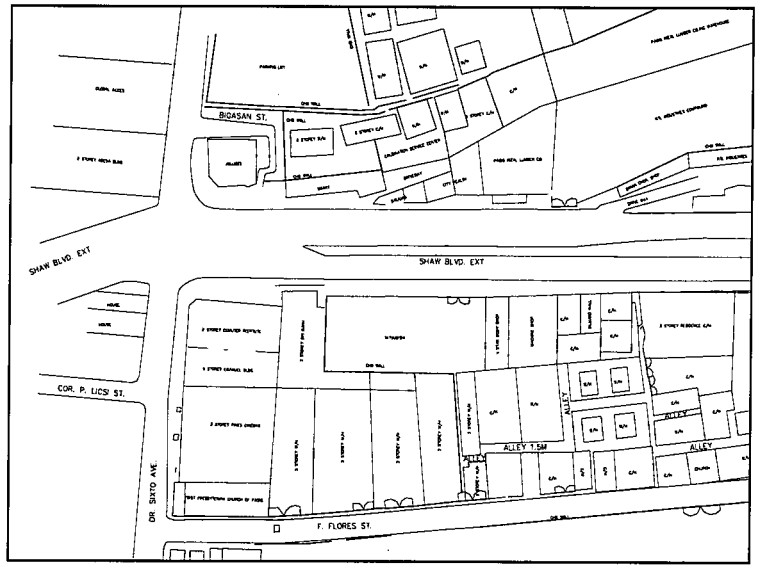


Figure 24.3.1-4 Existing Approach 1 Intersection before Improvement

Median and divisional island shall be done to improve the through road leading to the bridge and also the right turn and left turn movements.

Traffic signal shall be installed to properly direct traffic flow along this intersection.

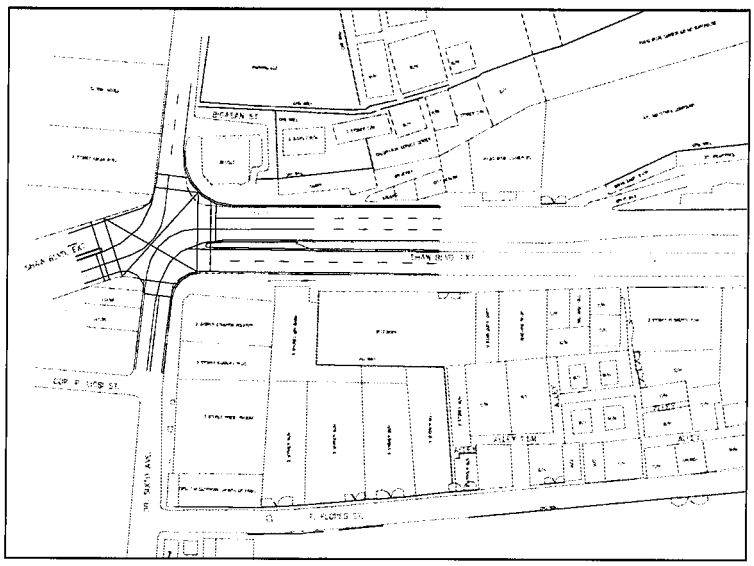


Figure 24.3.1-5 Proposed Approach 1 Intersection after Improvement

Improvement of the approach road intersection will include overlaying of the existing pavement along Shaw Blvd. Ext. and some section of Dr. Sixto Antonio Ave.

Pavement markings, traffic signs and guide signs shall be installed.

(d) Approach Road and Access Road

The existing alignment dictates the alignment of improvement design; the horizontal and vertical alignment of the center line of the bridge will be maintained.

Access Roads or driveways of nearby buildings should be discouraged to place entrances along the major road since this will obstruct efficient traffic flow especially along approach ramps of the bridge.

The existing site ocular inspections of both approaches are shown in **Appendix 24.3.1-3.**

(3) Design of Protection to Vessel Collision

There are two kinds of vessel collision: collision to superstructure and collision to substructure.

(a) Safety Measure for Superstructure

For collision to superstructure, the vessel collision avoidance system is not required as the bridge has sufficient vertical clearance.

(b) Safety Measure for Substructure

There is safety measure for substructure at upstream side of the bridge, but no measure at downstream side of the steel bridge. The downstream side of the bridge shall have safety measure on pier 2 and pier 3 as shown in **Figure 24.3.1-6**.

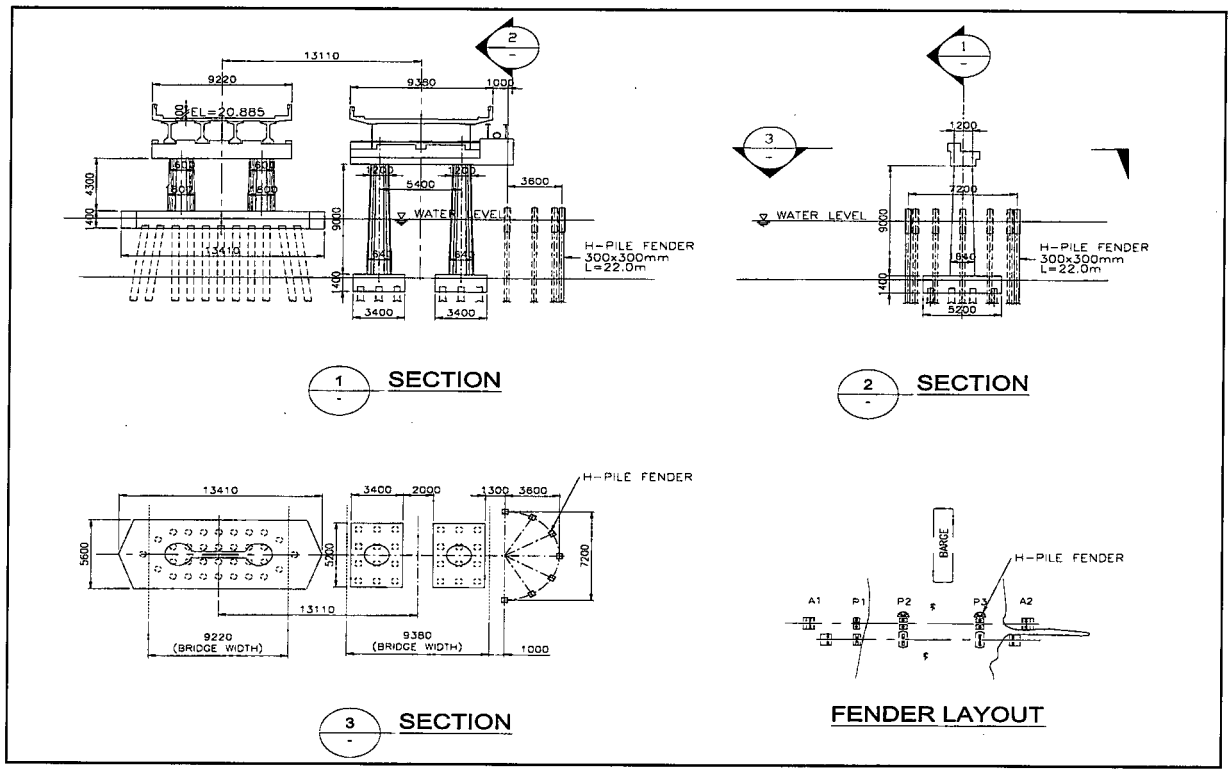


Figure 24.3.1-6 Layout of Vessel Collision Fenders

24.3.2 Construction Plan and Traffic Management

(1) Construction Method

This rehabilitation work is partial construction of the superstructure. All of the works will be carried out on the partially provided scaffolding and the construction materials/equipments

will be transferred by boom crane from bridge surface to the scaffolding as shown in **Figure 24.3.2-1**. The details of construction method are shown in **Appendix 24.3.2-1**.

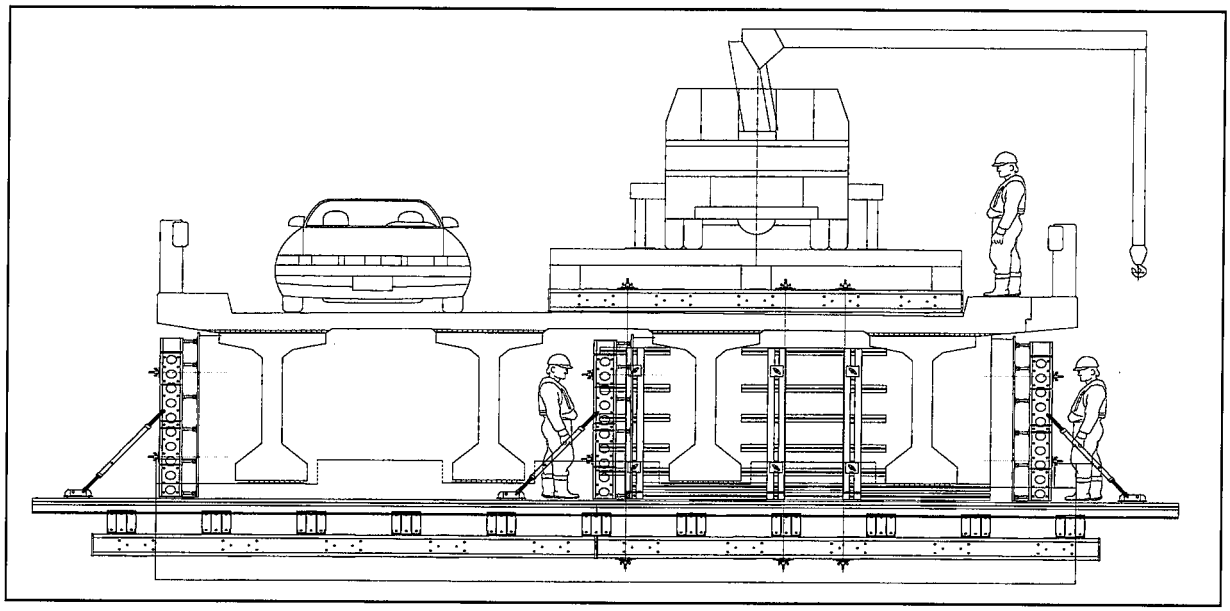


Figure 24.3.2-1 Construction Method

(2) Traffic Management

The construction will be carried out from upstream side to downstream side as shown in **Figure 24.3.2-2**.

In this construction method, the traffic constraints will be as follows:

- Partial closure of traffic is necessary during removal of existing diaphragm and partial removal of deck slab
- Temporary full closure of bridge is necessary during stressing operation and concreting works.
- Lane vehicle will be limited during removal and reconstruction of existing diaphragm and deck slab.
- Rerouting of traffic is necessary during removal and reconstruction of existing diaphragm and deck slab; and stressing operation.

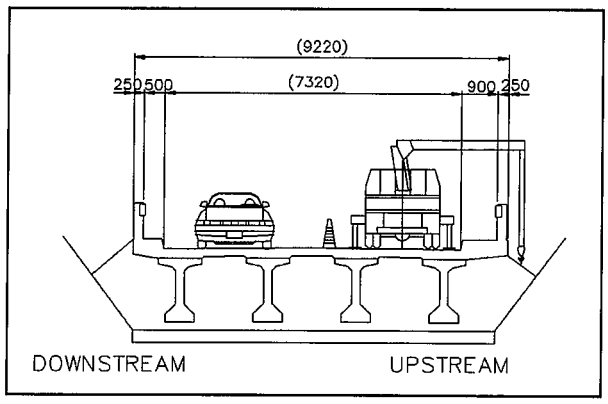


Figure 24.3.2-2 Traffic Control during Construction

24.3.3 Preliminary Cost Estimate

The total project costs consist of total construction cost and engineering service. The construction cost was estimated by accumulation of each work item which is the combination

of labor costs, material costs and equipment costs considering the construction method and procedure.

(1) Construction Cost

Construction cost was estimated by accumulating the cost of each work item which is the product of unit cost and quantity of each work. The unit costs of each item are estimated from the combination of the basic unit prices of the labor wages, material prices and equipment operation cost considering the construction method and procedure.

Unit costs were estimated from the previous similar practices in Manila. In order to cover the unforeseen works and conditions at this moment, and considering the allowance of some changes in the detailed design stage, a contingency of 5% was taken in account to the total construction cost.

The unit cost by construction item is shown in **Table 24.3.3-1**

Detailed computation is presented in **Appendix 24.3.3-1.**

Total Construction Cost

The total construction cost of the bridge rehabilitation estimated on the basis described above is shown in **Table 24.3.3-2.**

Table 24.3.3-2 Estimated Construction Cost

June, 2003 Prices

Items		Cost(x MP)
Superstructure	Foreign	16.50
	Local	4.50
	Tax	3.30
	Subtotal	24.30
Highway	Foreign	1.30
	Local	0.30
	Tax	0.20
	Subtotal	1.80
Total Construction Cost		**26.10 MP**

(2) Road Right-Of-Way Acquisition Cost

No acquisition of Right-of-way for this bridge.

Table 24.3.3-1 Unit Cost by Construction Items

June 2003 Prices

Item No.	Description	Unit	Unit Cost(PP)	Components (%)		
				Foreign	Local	Taxes
Annex I – CONSTRUCTION COST FOR REHABILITATION						
A. Repair/Sealing of Concrete Cracks						
SPL	Epoxy Bonding	l.s.	2,568,243.05	73%	15%	12%
SPL	Concrete Grouting	cu.m.	1,027,297.22	65%	25%	10%
B. New Diaphragm/Concrete Slab						
101(3)	Removal of Concrete Slab	sq.m.	500.00	65%	21%	14%
101(3)b	Removal of Asphalt	sq.m.	150.00	65%	21%	14%
301(1)	Tack Coat	ton	25,000.00	76%	10%	14%
310	Asphalt	ton	3,100.00	76%	10%	14%
405(1)a	Structural Concrete for Slab	cu.m.	4,500.00	65%	21%	14%
405(3)	Structural Concrete for New Diaphragm	cu.m.	6,000.00	65%	21%	14%
SPL 415	Formworks	sq.m.	810.00	65%	21%	14%
404	Reinforcing Steel Bars	kgs.	50.00	65%	21%	14%
416(1)b	External Cable	kgs.	1,087.69	65%	21%	14%
416(1)	Prestressing Bar	kgs.	604.27	65%	21%	14%
C. Guardrail Post						
101(4)	Removal of Concrete Railing/Post	l.m.	150.00	65%	21%	14%
101(4)a	Removal of Concrete Sidewalk	sq.m.	160.00	65%	21%	14%
401(1)	New Concrete Railing Post	l.m.	3,500.00	65%	21%	14%
601	New Concrete Sidewalk	sq.m.	350.00	65%	21%	14%
D. Gondola Falsework						
SPL	Gondola Falsework	l.s.	7,216,546.64	68%	18%	14%
E. Traffic Management						
SPL	Traffic Management	l.s.	2,000,000.00	71%	15%	14%
F. Contingencies						
xxx	Contingencies	l.s.	1,002,408.31	75%	15%	10%
G. Temporary Facilities						
SPL	Temporary Facilities	l.s.	2,659,826.40	65%	21%	14%
H. Mobilization/Demobilization						
xxx	Mobilization/demobilization	l.s.	601,44.99	75%	15%	10%
Annex II - ROADWAY IMPROVEMENT						
Earthworks						
101(3)b	Removal of Curb and Gutter	l.m.	85.62	65%	21%	14%
102(3)e	Removal of Parking Space	sq.m.	99.21	65%	21%	14%
Miscellaneous						
600(1)	Combination of Concrete Curb and Gutter	l.m.	1,100.00	65%	21%	14%
612(1)	Pavement Markings	sq.m.	862.13	65%	21%	14%
xxx	Contingencies	l.s.	11,570.22	75%	15%	10%
xxx	Traffic Signal (2 intersection)	l.s.	1,500,000.00	75%	15%	10%

(3) Engineering Cost

Engineering service cost consists of the engineering design services at the detailed design stage and the construction supervision at the construction stage. The engineering service cost varies depending on the scales of the project, tender processing and contract method.

Based on previous experiences, the engineering service costs for the project are estimated as 5% and 8% of the total construction cost for the detailed design and construction supervision respectively.

The estimated engineering cost is shown in **Table 24.3.3-3**

Table 24.3.3-3 Estimated Engineering Cost

June, 2003 Prices

Items		Cost (x MP)
Detailed Design	Foreign	0.70
	Local	0.50
	Tax	0.10
	Subtotal	1.30
Construction Supervision	Foreign	1.10
	Local	0.70
	Tax	0.20
	Subtotal	2.10
Total Engineering Cost	**Total**	**3.40**

(4) Project Cost

The total project cost consist of construction cost, land acquisition cost and engineering service cost. The summary of the estimated project cost is given in **Table 24.3.3-4**

Table 24.3.3-4 Summary of Estimated Project Cost

June, 2003 Prices

Items		Cost (x MP)
Construction Cost	Foreign	17.80
	Local	4.80
	Tax	3.50
	Subtotal	26.10
Engineering Cost	Foreign	1.90
	Local	1.20
	Tax	0.30
	Subtotal	3.40
Grand Total	Foreign	19.70
	Local	6.00
	Tax	3.80
Grand Total		**29.50**

24.4 TRAFFIC ANALYSIS AND ECONOMIC EVALUATION

24.4.1 Traffic Analysis

(1) Alternative Road Networks and Bridge Plans

There are several road network plans that can be considered in relation to Vargas Bridge. In this study, the following alternative cases of the road network for the traffic assignment are considered: (See **Table 24.4.1-1**)

Do Nothing Case (No rehabilitation Case)

2007 – 2012 Limitation of vehicle load on Vargas bridge

2013 afterward Full closure of Vargas Bridge

Do Something Case (Rehabilitation Case)

2007 – 2045 No limitation of vehicle use on Vargas Bridge

2045 afterward Replacement of Vargas Bridge

Table 24.4.1-1 Alternative Road Networks and Bridge Plans

Name of Bridge	Year	Do Nothing Case	Do Something Case
Vargas Bridge	2007 – 2012	* Vehicle load limitation on Vargas Bridge	* No limitation of vehicle load
	2013 -2045	* Full closure of Vargas Bridge	* No limitation of vehicle load
	2046 afterward	* Full closure of Vargas Bridge	* Replacement of Vargas Bridge

(2) Traffic Assignment Method

The traffic assignments to road networks with the Bridge Plans are made using STRADA highway – type assignment model as discussed in **Section 5.3** of Chapter 5.

(3) Results of Traffic Assignment

Table 24.4.1-2 shows the traffic demand forecast on bridges on Pasig River.

Table 24.4.1-2 Traffic Demand Forecast on Major Bridges of Marikina River by Alternative Cases

No.	Bridge Name	Do Nothing		Do Something	
		2010	2020	2010	2020
13	Vargas Bridge	34,200	54,500	54,700	60,200
14	Rosario Bridge	125,100	164,300	99,600	163,600
15	Marcos Bridge	95,600	145,000	95,600	145,000
16	Marikina Bridge	122,800	148,200	122,800	148,200
Total		383,5000	550,400	388,500	555,400

Table 24.4.1-3 shows the traffic demand and growth rate on the major bridges of Marikina River. The vehicle composition of the Vargas Bridge in 2010 is estimated in **Figure 24.4.1-1** and **Table 24.4.1-4**.

Table 24.4.1-3 Traffic Volume on Bridges of Marikina River

		2002	2010	2020	Growth Rate (%)	
					2002-'10	2002-'10
13	Vargas Bridge	53,599	54,700	60,200	0.3	1.0
14	Rosario Bridge	85,059	99,600	163,600	2.0	5.1
15	Marcos Bridge	75,983	95,600	145,000	2.9	4.3
16	Marikina Bridge	54,508	122,800	148,200	10.7	1.9
	Total	275,360	388,500	555,400	4.4	3.6

Table 24.4.1-4 Traffic Volume and its Composition on Vargas Bridge

	AADT	Composition (%)
P.Car	31,800	58.2
Jeepney	19,400	35.5
Bus	100	0.1
Truck	3,400	6.2
Total	54,700	100.0

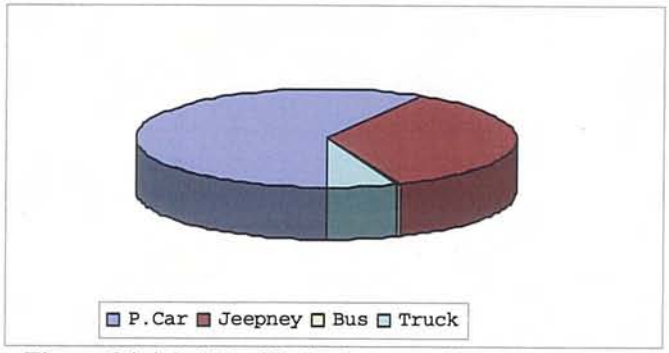


Figure 24.4.1-1 Traffic Volume and its Composition on Vargas Bridge

24.4.2 Economic Evaluation

(1) Presumptions

(a) Evaluation Period

The evaluation period is assumed to be 40 years from 2007 to 2047.

(b) Implementation Schedule of the Project

According to the implementation schedule mentioned in the previous sections, the project will be implemented as the following schedule:

- Detailed engineering 2006
- Implementation 12 months in 2007
- Open to traffic 2008

(c) Economic Indicator

The economic evaluation of the project principally employed the benefit cost analysis which is the evaluation of investment efficiency through comparison between benefits and costs derived from with and without the Vargas Bridge rehabilitation project.

It is expressed as the benefit cost stream during evaluation period with the following economic indicators used in this study:

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

(d) Discount Rate

The discount rate is assumed to be 15 %.

(2) Project Cost

(a) Project Cost

The project cost, which is already calculated in the previous section, is expressed as the financial cost. It is therefore necessary to convert from financial cost to economic cost using conversion factor.

Taking into account the master plan stage, in this study, the economic cost is estimated by deducting from the financial cost to government taxes and is shown in **Table 24.4.2-1**.

Table 24.4.2-1 Economic Cost Estimate

'000 Pesos

Description		Economic Cost	Financial Cost
1	Rehabilitation Cost		
1-1	Superstructure	21,000	24,200
1-2	Substructure	0	0
2	Consultancy		
2-1	Detailed Design	1,200	1,300
2-2	Construction Supervision	1,900	2,100
	Total	25,700	29,500

(b) Maintenance Cost

According to the maintenance review conducted in this study the present maintenance cost for the bridges in the Metro Manila are estimated to about 1.0% of the construction cost. In this study, therefore, the maintenance cost of the Vargas Bridge is assumed to be 1.0% of the construction cost.

(3) Economic Benefits

(a) Type of Benefit

The most significant benefit of the bridge rehabilitation project is reduction of traffic cost which consists of the vehicle operating cost (VOC) and the travel time cost (TTC). The VOC

can be further sub-divided into the two (2) types: vehicle running cost (VRC) and vehicle fixed cost (VFC):

The benefit is estimated through "with and without" comparison of the traffic costs derived from the following situations:

Name of Bridge	Year	Do Nothing Case	Do Something Case
Vargas Bridge	2008 – 2011	* No Vehicle load limitation on Vargas Bridge	* No limitation of vehicle load
	2012 - 2037	* Full closure of Vargas Bridge	* No limitation of vehicle load

(b) Basic Vehicle Operating Cost

The basic vehicle operating cost (BVOC) is estimated annually by PMO-FS Office in DPWH as shown in **Table 24.4.2-2**. 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.

Table 24.4.2-2 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-FS, DPWH
Note: BVOC prepared by PMO-FS is modified with inflation rate.

(c) Benefit Calculation

Saving in vehicle operating costs and travel time cost were estimated and are shown in **Table 24.4.2-3**.

Table 24.4.2-3 Estimation of Benefits

Unit: '000 Pesos/Day

Year	Saving in VOC	Saving in Fixed Cost	Saving in Time Cost	Total Saving
2010	7,280	2,644	6,992	16,915
2020	8,015	2,909	7,695	18,619

(3) Economic Evaluation

(a) Benefit Cost Analysis

Based on the above mentioned benefits and cost estimations, the economic analysis of the Project was made. **Table 24.4.2-4** shows the benefit – cost analysis of the Vargas Bridge

Rehabilitation Project during project life period and **Table 24.4.2-5** shows the benefit cost stream. The results of the economic analysis show that a Net Present Value (NPV) of P 22 million and BCR of 1.97 over 30 years life of the Bridge using a discount date of 15% which is designated by the NEDA. The Economic Internal Rate of Return (EIRR) was computed at 24.1 %.

Table 24.4.2-4 Economic Indications of Benefit Cost Analysis

Net Present Value	₱22 million Pesos
BCR	1.97
EIRR	24.1 %

Notes: 1) Project life is assumed to be 30 years
2) Discount rate ids 15%

Table 24.4.2-5 Benefit-Cost Stream of Vargas Bridge Large Scale Rehabilitation Scheme

Undiscounted 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
2	2005	0	0.0	0.0	0.0	0.0
3	2006	1,200	0.0	1,200.0	0.0	-1200.00
4	2007	24,500	0.0	24,500.0	0.0	-24500.00
5	2008	0	1,260.0	1,260.0	0.0	-1260.00
6	2009	0	1,260.0	1,260.0	0.0	-1260.00
7	2010	0	1,260.0	1,260.0	0.0	-1260.00
8	2011	0	1,260.0	1,260.0	0.0	-1260.00
9	2012	0	1,260.0	1,260.0	17,242.9	15,982.9
10	2013	0	1,260.0	1,260.0	17,409.2	16,149.2
11	2014	0	1,260.0	1,260.0	17,577.1	16,317.1
12	2015	0	1,260.0	1,260.0	17,746.6	16,486.6
13	2016	0	1,260.0	1,260.0	17,917.7	16,657.7
14	2017	0	1,260.0	1,260.0	18,090.5	16,830.5
15	2018	0	1,260.0	1,260.0	18,265.0	17,005.0
16	2019	0	1,260.0	1,260.0	18,441.1	17,181.1
17	2020	0	1,260.0	1,260.0	18,618.9	17,358.9
18	2021	0	1,260.0	1,260.0	18,708.7	17,448.7
19	2022	0	1,260.0	1,260.0	18,798.9	17,538.9
20	2023	0	1,260.0	1,260.0	18,889.6	17,629.6
21	2024	0	1,260.0	1,260.0	18,980.6	17,720.6
22	2025	0	1,260.0	1,260.0	19,072.2	17,812.2
23	2026	0	1,260.0	1,260.0	19,164.1	17,904.1
24	2027	0	1,260.0	1,260.0	19,256.5	17,996.5
25	2028	0	1,260.0	1,260.0	19,349.4	18,089.4
26	2029	0	1,260.0	1,260.0	19,442.7	18,182.7
27	2030	0	1,260.0	1,260.0	19,536.4	18,276.4
28	2031	0	1,260.0	1,260.0	19,583.5	18,323.5
29	2032	0	1,260.0	1,260.0	19,630.7	18,370.7
30	2033	0	1,260.0	1,260.0	19,678.0	18,418.0
31	2034	0	1,260.0	1,260.0	19,725.5	18,465.5
32	2035	0	1,260.0	1,260.0	19,773.0	18,513.0
33	2036	0	1,260.0	1,260.0	19,820.7	18,560.7
34	2037	0	1,260.0	1,260.0	19,868.5	18,608.5

Discounted Benefit Cost Stream

000 Pesos

Sq	Sq	Year	Discounted	Construction Cost	O & M Cost	Cost Total	Benefit	Cost-Benefit
1	1	2004	1.000	0.0	0.0	0.0	0.0	0.0
2	2	2005	1.150	0.0	0.0	0.0	0.0	0.0
3	3	2006	1.323	907.4	0.0	907.4	0.0	-907.40
4	4	2007	1.521	16,109.1	0.0	16,109.1	0.0	-16109.10
5	5	2008	1.749	0.0	720.4	720.4	0.0	-720.40
6	6	2009	2.011	0.0	626.4	626.4	0.0	-626.40
7	7	2010	2.313	0.0	544.7	544.7	0.0	-544.70
8	8	2011	2.660	0.0	473.7	473.7	0.0	-473.70
9	9	2012	3.059	0.0	411.9	411.9	5,636.7	5,224.8
10	10	2013	3.518	0.0	358.2	358.2	4,948.8	4,590.6
11	11	2014	4.046	0.0	311.5	311.5	4,344.8	4,033.3
12	12	2015	4.652	0.0	270.8	270.8	3,814.5	3,543.7
13	13	2016	5.350	0.0	235.5	235.5	3,349.0	3,113.5
14	14	2017	6.153	0.0	204.8	204.8	2,940.2	2,735.4
15	15	2018	7.076	0.0	178.1	178.1	2,581.4	2,403.3
16	16	2019	8.137	0.0	154.8	154.8	2,266.3	2,111.5
17	17	2020	9.358	0.0	134.6	134.6	1,989.7	1,855.1
18	18	2021	10.761	0.0	117.1	117.1	1,738.5	1,621.4
19	19	2022	12.375	0.0	101.8	101.8	1,519.0	1,417.2
20	20	2023	14.232	0.0	88.5	88.5	1,327.3	1,238.8
21	21	2024	16.367	0.0	77.0	77.0	1,159.7	1,082.7
22	22	2025	18.822	0.0	66.9	66.9	1,013.3	946.4
23	23	2026	21.645	0.0	58.2	58.2	885.4	827.2
24	24	2027	24.891	0.0	50.6	50.6	773.6	723.0
25	25	2028	28.625	0.0	44.0	44.0	676.0	632.0
26	26	2029	32.919	0.0	38.3	38.3	590.6	552.3
27	27	2030	37.857	0.0	33.3	33.3	516.1	482.8
28	28	2031	43.535	0.0	28.9	28.9	449.8	420.9
29	29	2032	50.066	0.0	25.2	25.2	392.1	366.9
30	30	2033	57.575	0.0	21.9	21.9	341.8	319.9
31	31	2034	66.212	0.0	19.0	19.0	297.9	278.9
32	32	2035	76.144	0.0	16.5	16.5	259.7	243.2
33	33	2036	87.565	0.0	14.4	14.4	226.4	212.0
34	34	2037	100.700	0.0	12.5	12.5	197.3	184.8
			Total	17,016.5	5,439.5	22,456.0	44,235.9	21,779.9

Net Present Value	21,780
B/C Ratio	1.970
EIRR	24.1%

(b) 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 24.4.2-6** shows the results of the sensitivity analysis.

Table 24.4.2-6 Sensitivity Analysis regarding Costs and Benefits of Vargas Bridge Rehabilitation Project (EIRR)

Unit: %

		Benefits				
		20% down	10% down	Base Case	10% up	20% up
Costs	20% down	24.1	25.8	27.5	29.0	30.4
	10% down	22.4	24.1	25.7	27.1	28.5
	Base Case	20.9	22.5	24.1	25.5	26.8
	10% up	19.6	21.2	22.7	24.1	25.4
	20% up	18.4	20.0	21.5	22.8	24.1

Note: Project life of the project is assumed to be 30 years

(c) Summary of Economic Analysis

The implementation of the Vargas Bridge Rehabilitation project can be justified from the national economic point of view since the economic indicators of all cases are more than the cut-off level of 15% of EIRR in the Philippines.

24.5 ENVIRONMENTAL IMPACT ASSESSMENT

The general approach adopted in the present study is based on the procedural flow of the Environmental Impact Statement (EIS) System prescribed under Article III of the DENR Administrative Order No. 96-37. The EIA Team followed the Participatory Impact Assessment Method (PIAM) wherein the stakeholders were involved in the conduct of the EIA through project briefings and public consultation meetings.

24.5.1 Methodology

The EIA study covered the following modules:

- Physico-Chemical Environment
  - Physiography and Geomorphology
  - Meteorology
  - Hydrology
  - Water Quality
  - Air Quality
  - Noise Level
- Terrestrial Biology
- Socio-Economics

(1) Physico-Chemical Environment

(a) Physiography and Geomorphology

The physiographical and geomorphological study for the proposed project was done through field verification of available secondary data. The information used in the preparation of this report were obtained mostly from various government offices/entities among others, the Mines and Geosciences Bureau (MGB), Philippine Institute of Volcanology and Seismology (PHIVOLCS), Bureau of Soils and Water Management (BSWM), Pasig River Rehabilitation Commission (PRRC).

(b) Water Quality

Water quality assessment of Marikina River, Vargas Bridge Section Pasig City was conducted to determine the present condition of the waterway that may possibly be affected by the proposed Improvement of Vargas Bridge. The sampling was performed on November 24,

2003. After taking field measurements of temperature and pH, water samples were then collected and immediately brought to the laboratory for analyses. The samples were assessed pollution indicators such as Chemical Oxygen Demand (COD), Biological Oxygen Demand, Total Suspended Solids (TSS), Dissolved Oxygen (DO), Oil & Grease, and Fecal and Total Coliform.

(c) River Sediments

River sediment sampling was also undertaken by the EIA Team to determine the amount of trace metals in Pasig River. Sediments were collected from the River and then brought to the laboratory for assessment.

(d) Air Quality

The conduct of air quality sampling followed the standard procedure according to the prescribed methodology in the Department of Environment and Natural Resources Department Order 2000-81 (DAO). Sampling was performed within a specified time and flow rate. Total suspended particulate matter and carbon monoxide were sampled on a 1-hour averaging time, whereas, NO_2 and SO_2 were evaluated within a 30-minute time period. TSP, CO, CO_2, and NO_2 sampling was done on November 27, 2003, while SO_2 sampling was performed on December 12, 2003.

(e) Noise Level

Noise level monitoring along Vargas Bridge was carried out on December 18, 2003. Noise level was directly measured using a standard sound level meter. Sampling location was the same as that of the air quality. Monitoring was done during the morning time, daytime, evening time, and nighttime. Three (3) readings were recorded within a 5-minute averaging time.

(2) Biological Environment

(a) Flora

Identification of the flora species encountered in the project area was done through gross morphology. This is a type of plant identification that relies greatly on the external features of both vegetative and reproductive parts, since these are easily observable. Flora guidebooks and other related reference materials were used during the conduct of the study for verification.

(b) Terrestrial Fauna

Since the project area is situated within a city, terrestrial wildlife identification, particularly birds, was done through actual observation.

(3) Socio-Economic

(a) Public Consultation Meeting (PCM)

The EIA Team organized consultation meetings with the LGUs and families to be directly affected by the proposed rehabilitation of Vargas Bridge. The Team ensured that all stakeholders and concerned sectors are well informed of the scheduled meetings.

(b) Consultation Meetings with the LGUs

The proposed Improvement of Vargas Bridge was briefly presented to Brgy. Capt. Ferdinand A. Avis on December 02, 2003. An informal forum was also conducted at Brgy. Caniogan, Pasig City on December 02, 2003. The EIA Team met with Brgy. Kagawad Jovito Añonuevo.

(c) Public Consultation Meetings

A consultation meeting with the affected informal settlers under the Vargas Bridge in Brgy. Bagong Ilog, Pasig City was organized on December 02, 2003. The forum was attended by the affected residents as well as some barangay tanods in the area. In the same manner, a consultation meeting with the affected informal settlers under the Vargas Bridge in Brgy. Caniogan, Pasig City was undertaken on the same day. It was attended by affected residents and some barangay officials of the community. After a brief presentation of the proposed Improvement of Vargas Bridge, the participants were allowed to air out their issues and concerns about the project. (Please see **Photo 24.5.1-1 to 24.5.1-4**).

Photo 24.5.1-1 Consultation meeting with *Brgy. Captain* Ferdinand A. Avis 2003 of Brgy. Bagong Ilog on December 02, 2003

Photo 24.5.1-2 Consultation meeting with the community leaders of Brgy. Caniogan, held on December 2, 2003.

Photo No. 24.5.1-3 Public Consultation Meeting At Brgy. Bagong Ilog held on December 02, 2003.

Photo 24.5.1-4 Public Consultation Meeting At Brgy. Caniogan held on December 02, 2003.

24.5.2 Brief Description of Data Gathering

Baseline information for the preparation of the report was established through primary and secondary data gathering procedures. Series of field investigations, verifications, validations of information obtained from the concerned government offices/agencies visited by the EIA Team were carried out. The offices/entities include the City Government of Manila, Philippine Atmospheric Geophysical and Astronomical Services Administration (PAGASA), Mines and Geosciences Bureau (MGB), Bureau of Soils and Water Management (BSWM), and Philippine Institute of Volcanology and Seismology (PHIVOLCS). The Team also coordinated with the Pasig River Rehabilitation Project Commission (PRRC).

With respect to the **ambient air quality, water quality, noise level,** and **socio-economic** aspects, actual samplings and perception surveys within the study area were performed to generate baseline data.

24.5.3 Brief Description of Project Environment

The areas to be directly affected by the project are Brgy. Caniogan and Barangay Bagong Ilog. These are located below the eastern and western foot of the bridge, respectively. Motorists crossing the Bridge, both private and public, as well as passengers are also considered to be indirectly affected in terms of possible increase in traffic congestion, and thus were included in the survey.

(1) Physico-Chemical Environment

(a) Physiography and Geomorphology

In general, there are two broad geomorphologic units in the MMA, namely, the north-south trending plateau and the flat-lying alluvial (Marikina Flood Plain) and deltaic sediments

(Pasig River Delta Plain) which are situated on either sides of the said central elevated portion (Besana and Daligdig, 1993). The Pasig and Marikina Rivers are two major river systems that drain off the area with several tributaries feeding it from the north and east of the MMA. The plateau or the central elevated portion averages about 10 to 30 meters above mean sea level with highest elevation of 70 meters located in Quezon City. While the Pasig River delta plain has an average elevation of less than 5 meters, which is roughly of concave shape, poor drainage and gently sloping towards Manila Bay.

(b) Geological Setting

According to Gervacio (1968), the Marikina Valley Alluvial Plain is the wide, longitudinal and nearly rectangular North-South trending alluviated graben valley east of the tuff highland from Novaliches to Guadalupe, Makati City. The limits of alluviation are well defined on the west side by the tuff escarpment and on the east side by a well aligned, fault truncated ridge nose of Cretaceous metavolcanics. He further explained that northward, the valley looses it physiographic identity as it merges with the rolling foothills of the Sierra Madre range while southward it widens and extends to Laguna de Bay. The thickness of the alluvial deposits within the valley varies erratically from about 117 meters in the northern portion in Montalban to around 15 meters or more towards Marikina and between 30 to 40 meters towards Pasig proper. Farther south, the deposit thickens again to more than 130 meters, while eastward, it is about 30 meters. The greater part of the deposit rests on the down faulted portion of the Guadalupe Formation. A thin section rests on the down faulted, truncated basement volcanic rock sequence in Parang, Marikina.

(c) Seismicity

There are five seismic source zones that have been identified as the loci of major earthquakes that affected the MMA in the past, namely: a) the Marikina Valley Fault System; b) Philippine Fault Zone; c) Lubang Fault; d) Casiguran Fault; and, e) the Manila Trench (Punongbayan and others, 1990). Of the five types of seismic hazards, the MMA is only susceptible to ground shaking, liquefaction and surface rupturing. The other two, landslides and tsunami, may occur but these may not seriously affect the region.

Earthquakes originating from any of the aforesaid five major seismic source zones could affect ground shaking in the MMA. But whenever earthquakes would be coming from the Marikina Valley Fault System (MVFS) and the Philippine Fault Zone (PFZ) stronger levels of ground shaking would most likely be generated and be felt due to Metro Manila's proximity

to said seismic source zone. Most probable levels of ground shaking are estimated at 0.15g for a return period of 79 years and at 0.2g for a return period of 250 years (Punongbayan, et. al., 1990).

(d) Water Quality

The degree of acidity or alkalinity of the sample is within the standard as per DENR DAO 34 for Class C waters. Sunlight penetration that sustains biological activities is still sufficient as indicated by the minimal amount of suspended solids found in the sample. The COD and the oil and grease content of the River are also well within the permissible limit. However, the BOD exceeded the maximum limit suggesting that presence of organic wastes in the river is significant. This also substantiates the very low amount of dissolved oxygen in Marikina River, which is the end result of the discharge of effluent with high BOD levels. The considerable quantity of fecal coliform detected from the water sample is expected, since it is very apparent that sewage lines of the inhabitants in the periphery are directly tapped into the River (Please refer to **Table 24.5.3-1**).

In general, results of the sampling validated that Marikina River has been a recipient, along its course from upstream to downstream, of all sorts of loadings from point and non-point sources among others, residential, commercial, industrial and even agricultural.

Table 24.5.3-1 Physical Properties of the Marikina River, Vargas Bridge Section Pasig City

	Sampling Results	DENR Effluent Standard For Class "C" Water (DAO 34)
Sampling Station Location	• In the Middle of Marikina River below Vargas Bridge, Pasig City	
Date and Time of Sampling	1310–1320 HRS 24 November 2003 (LOW TIDE)	
Parameters		
Temperature C	29.8	Max. 3 degrees increase
Ph	7.8	6.5 - 8.5
DO, mg/L	1.9 mg/L	Min. 4–5 mg/L
COD mg/L	35.6 mg/L	100 mg/L
BOD, mg/L (5 days, 20°C)	12.7 mg/L	10 mg/L
TSS, mg/L	12.8 mg/L	Max. 30 mg/L increase
Oil and Grease, mg/L	ND	5.0 mg/L
Total Coliform, MPN/mL	170,000 MPN/100 mL	5,000 MPN/1000 mL
Fecal Coliform, MPN/mL	50,000 MPN/ 100 mL	

(e) River Sediments

Levels of most of the toxic and deleterious substances particularly lead, exceeded the DENR standard. This may be explained by the continuous increase in loadings (industrial waste, chemical and infectious wastes, liquid and solid domestic wastes) contributed by various factories and human settlements, not only those along the main Marikina River, but by its tributaries as well (Please refer to **Table 24.5.3-2**).

Table 24.5.3-2 Marikina River Sediment Test Result, Vargas Bridge Section Pasig City

Trace Metal/Element	Result Value	DENR Standard
Chromium Hexavalent (Cr+6)	0.19 ppm	0.05 mg/L
Cyanide (CN-)	0.19 ppm	0.05 mg/L
Cadmium (Cd)	ND	0.01 mg/L
Lead (Pb)	19.10 ppm	0.05 mg/L
Arsenic (As)	ND	0.05 mg/L
Mercury (Hg)	0.47 ppm	0.002 mg/L
Polychlorinated Biphenyls (AROCLOR 1254)	ND	–

Note: "–" Means the standard of the substance is not considered necessary for the present time, considering the stage of the country's development and DENR capabilities, equipment and resources (DENR Administrative Order No. 34, Series of 1990)
ND - Not Detected

(f) Meteorology

The Port Area (MCO) in Manila is the nearest synoptic meteorological station to the Vargas Bridge. Based on the Modified Corona's Classification, the climate in Manila City belongs to Type I, which is characterized by the wet and the dry seasons. From December to April, the project area experiences a relatively dry period. The rainy season concurs with the Southwest Monsoon from July to September. The recorded annual rainfall in the area is almost close to **2205.4 mm**. The month of August receives the highest amount of precipitation of **486.0 mm**. As well, this month has the longest number of rainy days with **22**. From a low of **26.5ºC** in January, the mean monthly temperature in Port Area could heat up to a very high of **33.5ºC** during the month of May. The annual average mean temperature is **28.2°C**. The highest relative humidity of **81%** is felt in August, while a low of **65%** is experienced from March to April. The warmest months are from March to June.

(g) Ambient Air Quality

The observed levels of the air pollutants in both stations are well within the permissible limits based on the DAO 2000-81, except for TSP (**338 μg/Ncm**) which exceeded the DENR maximum permissible limit of **230 μg/Ncm**. High concentrations of TSP may have been due

to emissions from diesel-powered vehicles plying the route at the time of sampling. The rest remain way below the set standards (Please see **Table 24.5.3-3**).

Table 24.5.3-3 Observed Ambient Air Quality Along Vargas Bridge

Parameters	Date & Time of Sampling	Averaging Time	Concentration in µg/Ncm	
			Sampling Results	*DENR Standards*
TSP	05 December 2003 1030–1130 HRS	1 hr	338 µg/Ncm	***230***
SO_2	12 December 2003 1030–1100 HRS	30 min	6.9 µg/Ncm	***180***
NO_2	05 December 2003 1030–1130 HRS	30 min	39.9 µg/Ncm	***150***
CO	05 December 2003 1030–1130 HRS		< 0.10 ppm	***30 PPM***
CO_2	05 December 2003 1030–1130 HRS	1 hr	559 ppm	-

Note: "–" Means the standard of the substance is not considered necessary for the present time, considering the stage of the country's development and DENR capabilities, equipment and resources (DAO 34, Series of 1990)

(h) Noise Level

The recorded noise level along the bridge in all the sampling periods exceeded the permissible limit set by the DENR. The relatively high noise values obtained maybe be due to the to the instantaneous peaks generated by the vehicles crossing the bridge at the time of sampling, particularly the diesel-powered vehicles (Please refer to **Table 24.5.3-4**).

Table 24.5.3-4 Observed Noise Level Along Vargas Bridge

		Noise Levels in dB (A)	
Time	*DENR Standards*	Date & Time of Monitoring	Monitoring Results
	B		
Morning (0500–0900 HRS)	60	06 January 2004 0801–0808 HRS	94.96
Daytime (0900–1800 HRS)	65	06 January 2004 1003–1008 HRS	86.91
Evening (1800–2200 HRS)	60	06 January 2004 1928–1933 HRS	89.26
Nighttime (2200–0500 HRS)	55	06 January 2004 2220–2225 HRS	90.16

SOURCE: Rules and Regulations of the National Pollution Control Commission (NPCC), 1978

(2) Biological Environment

(a) Terrestrial Flora

There is no significant vegetation cover observed in the project area within the vicinity of Vargas Bridge. The proposed improvement of Vargas Bridge is not expected to have any significant impact to the flora environment.

(b) Terrestrial Fauna

The commonly observed species in the project area is *Collocalia esculenta* (glossy swiftlet), which is endemic to the Philippines. Other species noted are *Lanius cristatus* (brown shrike), *Sterna sumatrana* (black-naped tern), and *Passer montanus* (urasian tree sparrow). The proposed improvement of Vargas Bridge is not expected to have any significant impact to the faunal environment.

(3) Socio-Economic Environment

Results of field investigation and interview surveys conducted are discussed in this section. Based on field investigation, a total of **35** Project-Affected Families (PAFs) were identified. These PAFs belong to two (2) barangays, namely Barangay Caniogan, and Barangay Bagong Ilog. Out of the **35**, **31** or **88.6%** were interviewed

Aside from the PAFs that will be directly affected as a result of the rehabilitation of Vargas Bridge, other stakeholders were identified and included in the survey. They are the users of the bridge, which include the drivers and passengers of (i) public utility jeepneys, (ii) private vehicles, (iii) trucks, and (iv) Mega taxis, commonly known as "FX". As such, two (2) sets of questionnaires were prepared, one for PAFs and the other for motorists. A total of **100** respondents (**31** PAFs and **69** motorists) were interviewed.. **Table 24.5.3-5** shows the number of PAFs and motorists interviewed.

Table 24.5.3-5 Number of Stakeholders Interviewed

	Number	Interviewed	%
Brgy. Caniogan	15	15	100.0
Brgy. Bagong Ilog	20	16	80.0
Motorists	69	69	100.0
TOTAL	**104**	**100**	**96.1**

(a) Project Affected Familes (PAFs)

Number and Type of Dwelling

As observed during the field investigation and interview surveys, there are two (2) main types of dwellings/structures occupied by the PAFs. These are consist of apartments and shanties. The apartments are structures made of wood and light materials, have common roofing, and are composed of several units. The shanties are made of light materials such as second hand roofing with worn materials piled on top used for holding the roof in place, old plywood, and other small pieces of used lumber. Please see Plate Nos. 1 and 2 (Please see **Photo 24.5.3-1 and Photo 24.5.3-2**).

Photo 24.5.3-1 Sample of apartment-type dwelling in Brgy. Caniogan.

Photo 24.5.3-2 Sample of shanty-type dwellings in Brgy. Bagong Ilog

The number and type of dwellings of PAFs are presented in **Table 24.5.3-6** and graphically shown in **Figure 24.5.3-1**. As seen from the table, all the PAFs from Brgy. Caniogan occupy apartments, whereas in Brgy. Bagong Ilog, families occupy apartments and shanties.

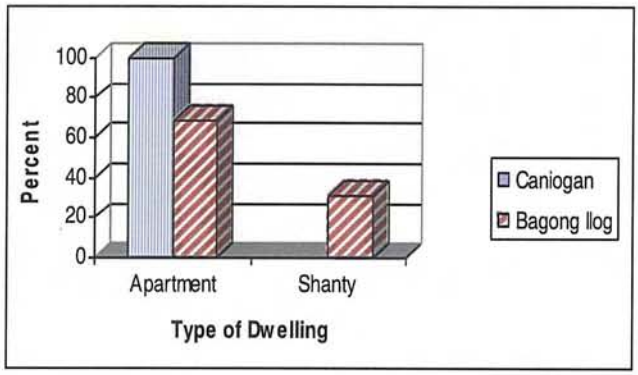


Figure 24.5.3-1 PAFs' Type of Dwelling

Table 24.5.3-6 Number and Type of Dwelling of Project-Affected Persons

Barangay	Apartment		Shanty		Total	
	No.	%	No.	%	No.	%
Caniogan	15	100.0	-	-	15	100.0
Bagong Ilog	11	68.8	5	31.3	16	100.0
Total	26	83.9	5	16.1	31	100.0

Household Size

Majority of the PAFs from both barangays have a household size of 1 to 4; 87.5% for Brgy. Bagong Ilog, and 66.7% for Brgy. Caniogan. The rest have 5 to 7; 20.0% for Brgy. Caniogan and 12.5% for Brgy. Bagong Ilog, and only a few (13.3% from Brgy. Caniogan) have 8 to 10 members. This trend is quite different from other urban areas where informal settlers abound,

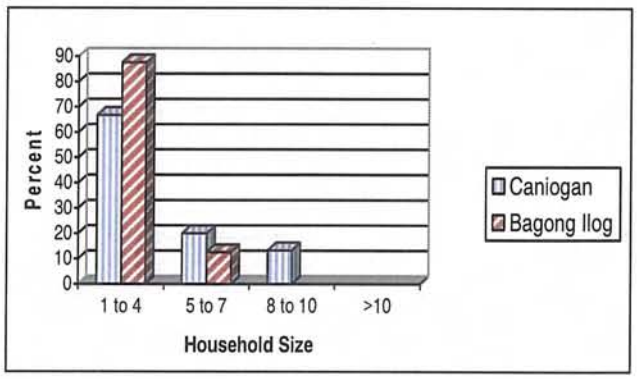


Figure 24.5.3-2 Household Size of PAFs'

wherein most of the families have a minimum of 5 to 7 members. (Please see **Table 24.5.3-7** and **Figure 24.5.3-2**).

Table 24.5.3-7 Household Size of Project-Affected Persons Interviewed

Barangay	1 to 4		5 to 7		8 to 10		>10		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Caniogan	10	66.7	3	20.0	2	13.3	0	0	15	100.0
Bagong Ilog	14	87.5	2	12.5	-	-	0	0	16	100.0
Total	24	77.4	5	16.1	2	6.5	0	0	31	100.0

Household Income

In terms of household income, results show that majority of the PAFs in both barangays have annual household incomes below the poverty threshold set by NEDA, which is equivalent to P55,292 for a family of four (4). (Please **Table 24.5.3-8** and **Figure 24.5.3-3**).

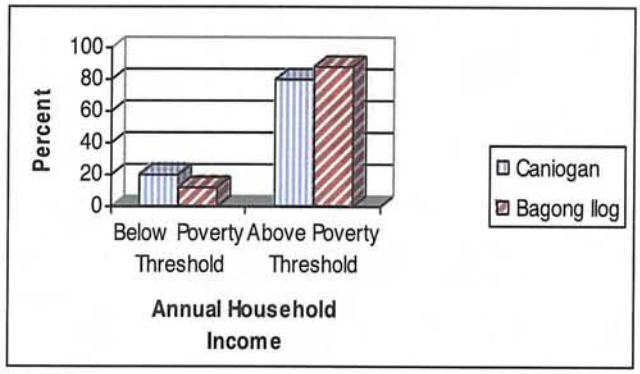


Figure 24.5.3-3 PAFs' Annual Household Income

Table 24.5.3-8 Annual Household Income of Project-Affected Persons

Barangay	Below Poverty Threshold*		Above Poverty Threshold*		Total	
	No.	%	No.	%	No.	%
Caniogan	3	20.0	12	80.0	15	100.0
Bagong Ilog	2	12.5	14	87.5	16	100.0
Total	5	16.1	26	83.9	31	100.0

Note: * - Based on the NEDA annual per capita poverty threshold as of year 2000 for a family of four (4), which is equivalent to P55,292.00

History of Residency

Results of the survey shows that among the informal settlers at the Vargas Bridge, majority occupied the area in the 1990s (Please refer to **Table 24.5.3-9** and **Figure 24.5.3-4**). Similar to the other bridges under the present study, this trend seems ironic because it was during this decade,

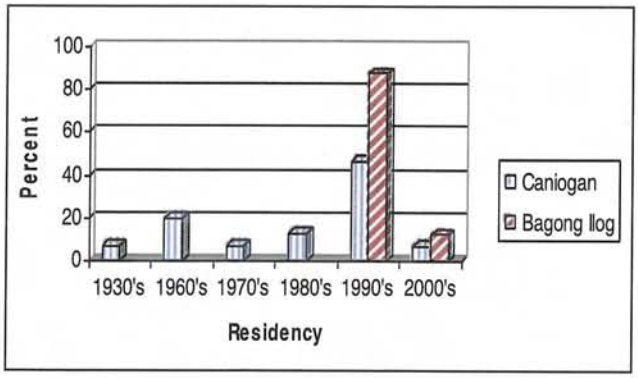


Figure 24.5.3-4 PAFs' History of Residency

specifically in the year 1992 when the law (R. A. 7279) prohibiting illegal settling in danger areas such as river banks, was enacted.

Table 24.5.3-9 Residency of Project-Affected Persons

Barangay	1930's		1960's		1970's		1980's		1990's		2000's		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Caniogan	1	6.7	3	20.0	1	6.7	2	13.3	7	46.7	1	6.7	15	100.0
Bagong Ilog	-	-	-	-	-	-	-	-	14	87.5	2	12.5	16	100.0
Total	1	3.2	3	9.7	1	3.2	2	6.5	21	67.7	3	9.7	31	100.0

Availability of Basic Social Services

As shown in **Table 24.5.3-10** and **Figure 24.5.3-5**, majority of PAFs from both barangays obtain their drinking water supply purchase their water supply for a certain amount per container of water. Some even have piped connections.

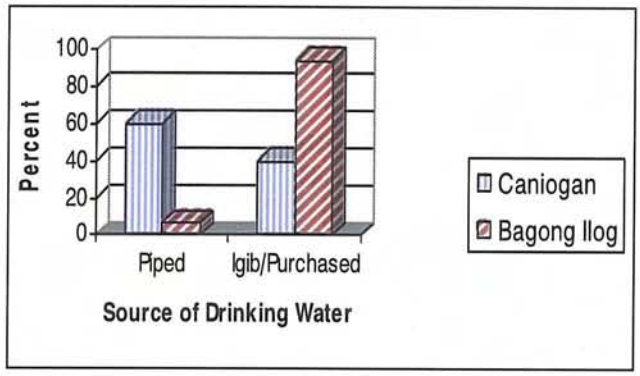


Figure 24.5.3-5 PAFs' History of Residency

Table 24.5.3-10 Source of Drinking Water of Project-Affected Persons

Barangay	Piped		Igib/Purchased		Total	
	No.	%	No.	%	No.	%
Caniogan	9	60.0	6	40.0	15	100.0
Bagong Ilog	1	6.3	15	93.8	16	100.0
Total	10	32.3	21	67.7	31	100.0

Source of Electricity

Results of the survey indicate that the PAFs from Brgy. Caniogan are apparently better off than those in Brgy. Bagong Ilog. Aside from being able to purchase water, **100%** of the PAFs in Caniogan have legal source of power supply, i.e., from MERALCO. On the other hand, majority of the PAFs from Bagong Ilog (**75.0%**) obtain power supply through illegal connections (Please refer to **Table 24.5.3-11** and **Figure 24.5.3-6**).

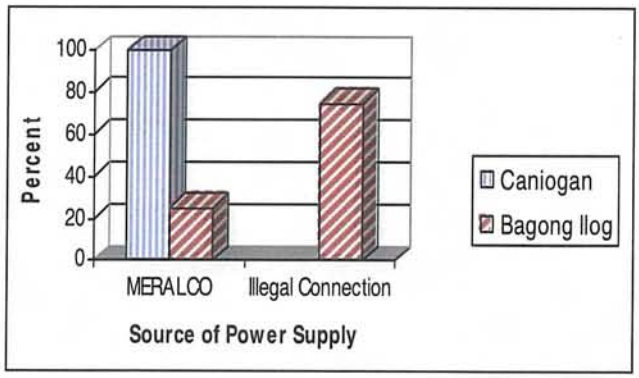


Figure 24.5.3-6 PAFs' Source of Power Supply

Table 24.5.3-11 Source of Power Supply of Project-Affected Persons

Barangay	MERALCO		Illegal Connection		Total	
	No.	%	No.	%	No.	%
Caniogan	15	100.0	-	-	15	100.0
Bagong Ilog	4	25.0	12	75.0	16	100.0
Total	19	61.3	12	38.7	31	100.0

Type of Toilet Facility

In terms of sanitation facilities, it can be observed from **Table 24.5.3-12** and **Figure 24.5.3-7** that majority have semi-flush type of toilet facility. Some make use of the public toilet. Quite a few declared that they don't have any toilet facility, and even worse are some families who admitted that they use the river to dispose of their domestic wastes.

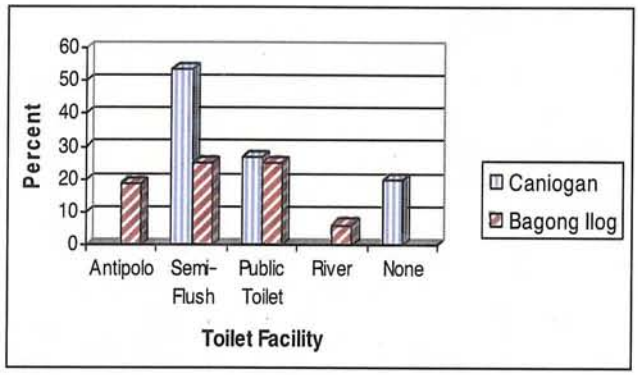


Figure 24.5.3-7 PAFs' Toilet Facilities

Table 24.5.3-12 Toilet Facilities of Project-Affected Persons

Barangay	Antipolo		Semi-flush		Public Toilet Semi-flush		River		None		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Caniogan	-	-	8	53.3	4	26.7	-	-	3	20.0	15	100.0
Bagong Ilog	3	18.8	4	25.0	4	25.0	1	6.3	4	25.0	16	100.0
Total	3	9.7	12	38.7	8	25.8	1	3.2	7	22.6	31	100.0

In terms of health and educational facility, all PAFs have access to all types of health facilities such as health centers, private clinics, and hospitals. This is because they are located within the City of Pasig. In terms of waste disposal practices, majority of the PAFs dispose of their solid wastes through the City Garbage Collector.

(b) Motorists

Perceived Causes of Traffic Congestion and Condition of Vargas Bridge

When asked about the traffic situation along Vargas Bridge, the respondents cited their perception regarding the various causes of congestion. The answers are shown in **Table 24.5.3-13** and **Figure 24.5.3-8.**

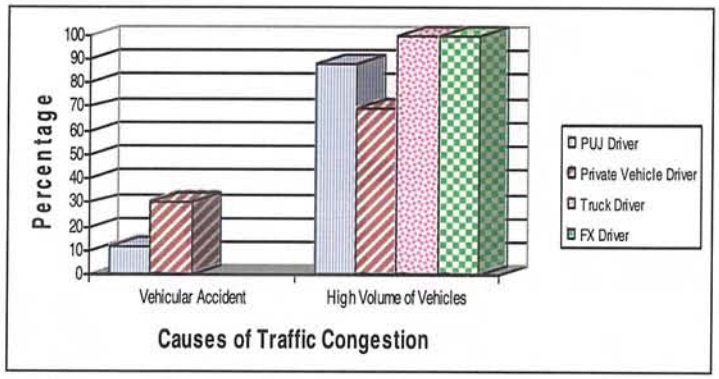


Figure 24.5.3-8 Perceived Causes of Traffic Congestion

Table 24.5.3-13 Perceived Causes of Traffic Congestion Along Vargas Bridge

Type of Respondent	Vehicular accident		High volume of vehicles		Total	
	No.	%	No.	%	No.	%
PUJ-Driver	6	12.2	43	87.8	49	100.0
PV-Driver	4	30.8	9	69.2	13	100.0
Freight Truck Driver	-	-	1	100.0	1	100.0
FX Driver	-	-	5	100.0	5	100.0
Total	10	14.7	58	85.3	68	100.0

Perceived Condition of the Vargas Bridge

When asked about their observation regarding the condition of the Vargas Bridge, the motorists gave the following: Please see **Table 24.5.3-14 and Figure 24.5.3-9**. As seen from the table, the only observation they gave was "strong vibration"; some even said "None".

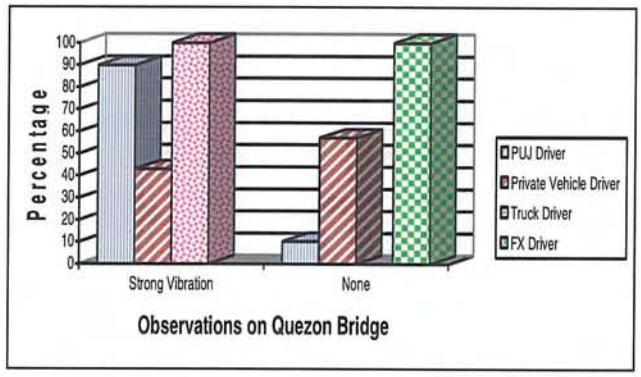


Figure 24.5.3-9 Perceived Condition of Vargas Bridge

Table 24.5.3-14 Perceived Condition of Vargas Bridge

Type of Respondent	Strong vibration		None		Total	
	No.	%	No.	%	No.	%
PUJ-Driver	44	89.8	5	10.2	49	100.0
PV-Driver	6	42.9	8	57.1	14	100.0
Freight Truck Driver	1	100.0	-	-	1	100.0
FX Driver	-	-	5	100.0	5	100.0
Total	51	73.9	18	26.1	69	100.0

(b) Social Acceptability

Based on the interview surveys, a high **93.3%** (from Brgy. Caniogan) and 68.8% (from Brgy. Bagong Ilog) of the PAFs, and almost **100%** of all the motorists interviewed expressed full support to the proposed improvement of the Vargas Bridge. (Please see **Table 24.5.3-15** and **Figure 24.5.3-10**).

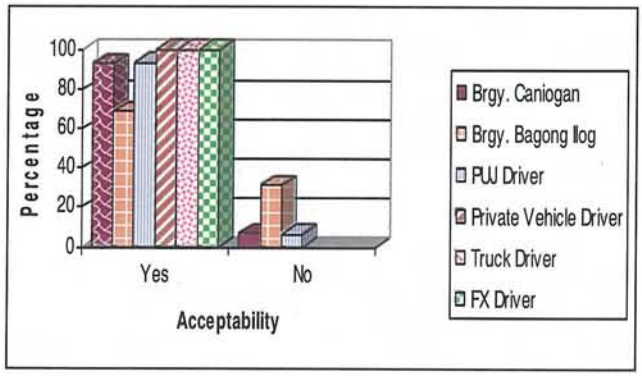


Figure 24.5.3-10 Acceptability Among PAFs and Motorist

Table 24.5.3-15 Social Acceptability Among PAFs and Motorists

Barangay	Yes		No		Total	
	No.	%	No.	%	No.	%
PAFs						
Brgy. Caniogan	14	93.3	1	6.7	15	100.0
Brgy. Bagong Ilog	11	68.8	5	31.3	16	100.0
Motorists						
PUJ-Driver	46	93.9	3	6.1	49	100.0
PV-Driver	14	100.0	-	-	14	100.0
Freight Truck Driver	5	100.0	-	-	5	100.0
FX Driver	5	100.0	-	-	5	100.0
Total	**95**	**91.3**	**9**	**8.7**	**104**	**100.0**

(c) PAFs' Willingness to Relocate

Based on the interviews conducted, majority of the PAFs (**73.3%** from Brgy. Caniogan and **93.8%** from Brgy. Bagong Ilog) expressed willingness to be relocated from their present dwelling areas (Please refer to **Table 24.5.3-16** and **Figure 24.5.3-11**).

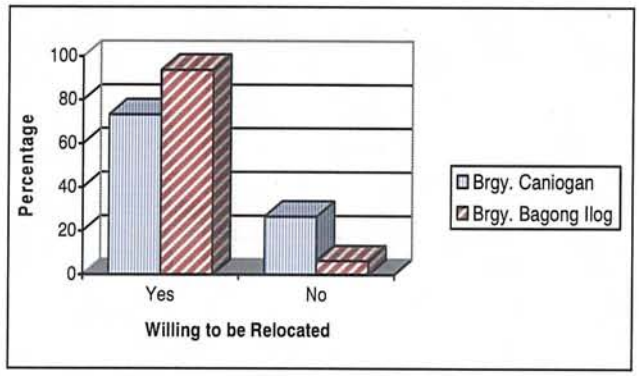


Figure 24.5.3-11 PAPs' Willingness to Relocate

Table 24.5.3-16 Project-Affected Persons Willingness to Relocate

Barangay	Yes		No		Total	
	No.	%	No.	%	No.	%
Caniogan	11	73.3	4	26.7	15	100.0
Bagong Ilog	15	93.8	1	6.3	16	100.0
Total	26	83.9	5	16.1	31	100.0

(d) PAFs' Preferred Relocation Site.

When asked about their preferences regarding the relocation site, a very high percentage of the PAFs (**90.9%** from Brgy. Caniogan and **86.7%** from Brgy. Bagong Ilog) responded that they would prefer a relocation site within the City of Pasig. Only a few favored any other relocation site (Please refer to **Table 24.5.3-17** and **Figure 24.5.3-12**).

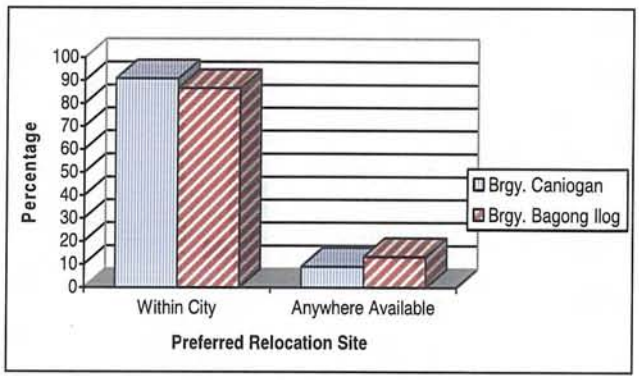


Figure 24.5.3-12 PAPs' Preferred Relocation Site

Table 24.5.17 Preferred Relocation Site

Barangay	Relocation site w/ in the city		Anywhere available relocation site		Total	
	No.	%	No.	%	No.	%
Caniogan	10	90.9	1	9.1	11	100.0
Bagong Ilog	13	86.7	2	13.3	15	100.0
Total	23	88.5	3	11.5	26	100.0

(e) Resettlement Requirements

The rehabilitation works along Vargas Bridge would entail displacement of **35** informal settlers occupying the portions under and along the sides of the said bridge. Although the work involved would be mainly the strengthening of the structure, it is important to ensure the safety of these people once the construction activities commence.

To accomplish this, a comprehensive and workable Resettlement Action Plan (RAP) has to be prepared and implemented for the Project-Affected Families residing at various sections of the bridge. In accordance with Section 29 of R.A. 7279, the LGUs, such as the City Government of Pasig are the entities responsible for providing socialized housing to underprivileged and homeless citizens residing in danger areas, including riverbanks and other public places such as sidewalks and roads within their respective jurisdictions.

However, under the Implementing Rules and Regulations (IRR) of Section 28 of the same Act (R.A. 7279), it is not only the LGUs' responsibility to relocate project affected persons or families. Section 2 of the said IRR states that one of the conditions for demolition to be allowed is when government infrastructure projects with available funding are about to be implemented. Section 3 of the same IRR states that relocation operations shall be the responsibility of the LGU concerned or the government agency authorized to demolish. In any case, coordination between the DPWH and the City Government of Pasig would be extremely necessary for the resettlement plan to be successfully carried out.

24.5.4 Impacts and Mitigation Measures

The predicted impacts and corresponding mitigation measures are presented in **Table 24.5.4-1**. The Environmental Management and Monitoring Program is shown on **Table 24.5.4-2**.

Table 24.5.4-1 Impacts and Mitigation Matrix

Parameters to be Monitored	Impacts	Duration and Degree of Impacts	Mitigating/Enhancement Measures
PRE-CONSTRUCTION AND CONSTRUCTION PHASES PHYSICAL ENVIRONMENT			
Hydrology & Water Quality	Possible increase in the turbidity due to the movement and positioning of construction barges that will create eddies thus disturbing river sediments at the shallow portion of the Pasig River	Short-term, negative	• The impact is unavoidable but temporary in nature. Condition of the Pasig River is expected to return to normal as soon as the rehabilitation works are completed
	Possible impediment of river flow due to indiscriminate disposal of replaced steel structures	Short-term, negative	• Replaced steel structures must be properly stockpiled and regularly hauled to the designated disposal site to avoid impediment of river flow
	Possible increase in the level of oil and grease and other waste contaminants in the river	Long-term, negative	• Contractors will be required to conduct daily routine check up of heavy equipment and machinery to ensure these are in good working condition to avoid spillage of oil and grease into the river.
	Possible increase in level of chemical pollutants due to the painting and cleaning of corroded steel floor systems	Long-term, negative	• Safety nets or tarpaulin materials must be installed below the Vargas Bridge during painting and cleaning of corroded steel floor systems to prevent spillage of paints and other chemicals into the River that may further pollute the waterway
Air Quality & Noise Level	Possible increase in exhaust gas emission levels	Short-term, negative	• Contractors will be required to conduct daily routine equipment and machinery check-ups to ensure that these are in the optimum working conditions; and • Regular tune-up and maintenance of construction equipment and machinery will be complied with to minimize exhaust gas emissions
	Possible increase in existing noise level along Vargas Bridge and its immediate vicinity	Short-term, negative	• Noise suppressors, such as mufflers will be installed whenever deemed necessary to maintain the noise generated by the various heavy equipment and other construction machinery to permissible limits; and High noise generating construction activities will be scheduled during daytime to minimize disturbance to the residents surrounding the area
SOCIO-ECONOMIC ENVIRONMENT			
Human Settlement	Displacement of informal settlers on the side and under the northeast approach of Vargas Bridge	Long-Term, negative	• Relocation of affected informal settlers in close coordination with the City Government of Manila
	Opportunity for **59** Project-Affected Families (PAFs) to be resettled and thus enjoy security of tenure and access to basic social services	Long-Term, positive	• Ensure that relocation and resettlement procedures are in accordance with international (World Bank and JBIC) and local policies and thus protect the interest of these PAFs, and ensure that their lives are not worsened off by the proposed project.
Income of Drivers	Possible decrease in the earnings of public transport drivers due to traffic congestion	Short-Term, negative	• This impact is unavoidable but temporary in nature. A sound traffic management re-routing plan duly-approved by the Metro Manila Development Authority (MMDA) will be implemented.
Safety	Hazard to motorists using Vargas Bridge and vessels navigating along Pasig River underneath the Bridge	Short-Term, negative	• Traffic enforcers and flagmen will be designated at critical construction sites to ensure safety of motorists; • Illuminated warning signs, lighting, and barricades will be installed along the entire stretch of Vargas Bridge;
Employment	Generation of temporary employment for qualified laborers within the affected areas during the construction	Short-Term, positive	• Qualified workers and laborers from the affected barangays will be given priority in hiring during the construction stage of the project
OPERATION PHASE SOCIO-ECONOMIC ENVIRONMENT			
Safety	Improved safety of motorists crossing Vargas Bridge	Long-Term, positive	• Inspection and maintenance of the newly rehabilitated bridge will be done on a regular basis to ensure optimum level service to road users

Table 24.5.4-2 Environmental Monitoring Program Matrix: Rehabilitation Stage

Parameters to be Monitored	Stations to be Monitored	Frequency of Monitoring	Methods of Analysis/Execution	DENR Standards	Implementor
PHYSICAL					
Water Quality BOD, TSS, Oil & Grease	Pasig River	Twice a year during construction period	Standard DENR EMPASS-EQD water quality analysis.	Class "C" **BOD - <10 mg/L** **TSS- <30 mg/L increase** **Oil & Grease - <3mg/L**	DENR-NCR
Air Quality TSP, NO_2, and SO_2	Vargas Bridge	Twice a year during construction period	Standard EMPASS-EQD water quality analysis.	TSP – 300 µg/Ncm^3 NO_2 – 470 µg/Ncm^3 SO_2 – 375 µg/Ncm^3	DENR-NCR
Noise Level	Vargas Bridge	Twice a year during construction period	Standard EMPASS-EQD water quality analysis.	Morning – 65 dB(A) Daytime – 70 dB(A) Evening – 65 dB(A) Nighttime – 60 dB(A)	DENR-NCR
SOCIAL					
Compliance of Contractor to occupational health and safety rules and regulation	Within the construction site	Daily	Site inspection of work areas including sanitation facilities	Based on EMP	DENR-NCR
Safety of motorists using Vargas Bridge	Vargas Bridge	Daily	Regular site inspection within the construction area	Based on DPWH and PCG Standard Operating Procedures	DPWH
Structural Integrity of the Vargas Bridge	Vargas Bridge	Based on standard DPWH maintenance procedures	Standard DPWH bridge maintenance works	Based on DPWH Standard Operating Procedures	DPWH