10.5 STRUCTURAL DESIGN

10.5.1 General

(1) Objective

In order to estimate the preliminary project cost, preliminary designs of structures (including Bridge and Box-culvert) were made followed by the calculation of quantities.

(2) Items Included in the Preliminary Designs

The preliminary design includes the following elements:

- Establishment of planning conditions and design criteria
- Establishment of cross sections
- Preliminary designs of bridges, which consist of bridge planning and determination of required structural sections
- Preparation of general drawings
- Calculation of quantities

(3) Summary of Preliminary Design Results

In order to estimate the preliminary project cost, preliminary designs of structures (including Bridge and Box-culvert) were made followed by the calculation of quantities.

TABLE 10.5-1 SUMMARY OF PRELIMINARY BRIDGE DESIGN RESULTS

No.	Section	Location (Sta.)	Number of Bridges (Bypass Road)					Number of Overpass Bridges
			Sum total of Bridges	RCDG	PSCG	PC-Box	St-Truss	
1	Section-I	0+0 to 11+700	10	0	9	1	0	2
2	Section-II	11+700 to 28+800	14	0	14	0	0	4
3	Section-III	28+800 to 44+570	21	0	20	1	0	6
4	Total	---	45	0	43	2	0	12

RCDG: Concrete I-girder, PSCG: Prestressed concrete I-girder,
PC-Box: Prestressed concrete box girder, St-Truss: Steel Truss

Source: JICA Study Team

TABLE 10.5-2 SUMMARY OF PRELIMINARY CULVERT DESIGN RESULTS

No.	Section	Location (Sta.)	Number of Culvert (Bypass Road)		
			Pipe Culvert for Drainage	Box Culvert for River/Waterway	Box Culvert for Crossing Road
1	Section-I	0+0 to 11+700	19	16	0
2	Section-II	11+700 to 28+800	39	16	3
3	Section-III	28+800 to 44+570	24	8	2
4	Total	---	82	40	5

Source: JICA Study Team

10.5.2 Planning Condition and Design Criteria

(1) Crossing Road and Water way

1) Crossing Road

In accordance with the alignment design, the crossing conditions related to the bridge planning were identified.

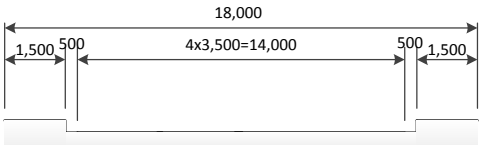
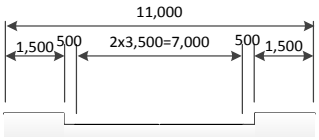
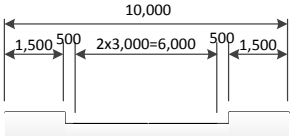
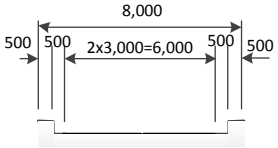
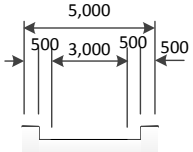
Table 10.5-3 shows the crossing condition and **Table 10.5-4** shows the cross sectional configuration of crossing road.

TABLE 10.5-3 LIST OF CROSSING ROAD (EXCEPT CROSSING AT GRADE)

No.	Section	Station	Crossing Road	Road Category		Skew Angles (deg.)	Type of Crossing
				Road Width (m)	Vertical Clearance (m)		
1	II	12+127	Davao-Bukidnon Rd.	18.0	5.2	85	Underpass
2	II	18+824	Barangay Rd.	5.0	4.0	90	Overpass
3	II	22+315	Barangay Rd.	5.0	4.0	90	Underpass
4	II	23+421	Barangay Rd.	5.0	4.0	65	Underpass
5	II	23+826	Mandug Rd.	8.0	4.9	90	Underpass
6	II	24+700	Subdivision Rd.	5.0	4.0	65	Overpass
7	II	25+470	Cabantian Rd.	10.0	4.9	90	Overpass
8	II	27+360	Barangay Rd.	5.0	4.0	90	Overpass
9	III	32+190	Barangay Rd.	5.0	4.0	85	Overpass
10	III	32+989	Acacia- Ilang Rd.	5.0	4.9	70	Overpass
11	III	33+465	Barangay Rd.	5.0	4.0	50	Overpass
12	III	33+965	Barangay Rd.	5.0	4.0	90	Overpass
13	III	34+390	Barangay Rd.	5.0	4.0	85	Overpass
14	III	38+425	Barangay Rd.	5.0	4.0	70	Overpass
15	III	39+355	Barangay Rd.	5.0	4.0	72	Underpass
16	III	44+097	Barangay Rd.	5.0	4.0	90	Underpass

Source: JICA Study Team

TABLE 10.5-4 CROSS SECTIONAL CONFIGURATION OF CROSSING ROAD

No.	Road Category	Road Width (m)	Cross Sectional Configuration	Vertical Clearance (m)
1	Davao-Bukidnon Road	18.0m		5.2m (4.9+0.3m)
2	National Road/ Provincial Road need not be widened	10.0m		5.2m (4.9+0.3m)
3	Municipality Road	10.0m		5.2m (4.9+0.3m)
4	Farm Road/Private Road/ Barangay Road (2-lane)	8.0m		4.0m (3.8+0.2m)
5	Farm Road/Private Road/ Barangay Road (1-lane)	5.0m		4.0m (3.8+0.2m)

2) Crossing River and Waterway

In accordance with the alignment design, the crossing conditions related to the bridge planning were identified. **Table 10.5.2-3** shows the crossing condition and **Table 10.5.2-4** and **10.5.2-5** shows the typical condition and allowance of free board.

TABLE 10.5-5 LIST OF CROSSING RIVER AND WATERWAY

No.	Section	Station	River Name	Discharge Volume (50years, m^3/s)	Require Free Board (m)
1	I	0+451	Macaring Creek	88.86	0.6
2	I	0+984	Creek 3	56.17	0.6
3	I	1+963	Creek 5	231.24	0.8
4	I	2+574	Bayabas Creek	643.93	1.0
5	I	2+804	Tributary of Bayabas Creek	176.47	0.6
6	I	5+130	Lubogan River	1,682.20	1.0
7	I	6+127	Lipadas River	984.67	0.8
8	I	10+764	Aclihan Creek	111.80	0.6
9	I	11+587	Talomo River Tributary	111.80	0.6
10	I	12+342	Talomo River-	2,390.07	1.2
11	II	17+753	Creek 22	69.08	0.6
12	II	18+580	Malogbok Creek	411.58	0.8
13	II	18+901	Balaag Creek (Matina)	352.52	0.8
14	II	22+953	Davao River	4,650.75	1.2
15	II	27+563	Panacan River	175.03	0.6
16	III	32+541	Communal River	199.24	0.6
17	III	40+235	Tagurot-Bunawan	859.82	1.0
18	III	41+531	Lacanon River	888.42	1.0
19	III	42+770	Creek 42	177.60	0.6
20	III	44+328	Maduao River	2,086.62	1.2

Source: JICA Study Team

TABLE 10.5-6 TYPICAL CONDITION OF CROSSING WATER WAY

Category of water way	Crossing condition	Structure
River	Discharge Volume (50years) <80m^3/s	RCBC with freeboard
	Discharge Volume (50years) >80m^3/s	Bridge with freeboard
	Existing Water Way Width >10m	Bridge with freeboard
Irrigation Canal	Keep the same or more cross section of existing canal	Varies with freeboard

Source: JICA Study Team

TABLE 10.5-7 FREEBOARD ALLOWANCE

No.	Design Discharge Q (m^3/s)	Freeboard (m)
1	Less than 200	0.6
2	200 to less than 500	0.8
3	500 to less than 2,000	1.0
4	2,000 to less than 5,000	1.2
5	5,000 to less than 10,000	1.5
6	More than 10,000	2.0

Source: JICA Study Team

10.5.3 Geometric Design

(1) Typical Cross Section

Typical cross sections employed in the Study are shown in **Figure 10.5.3-1**.

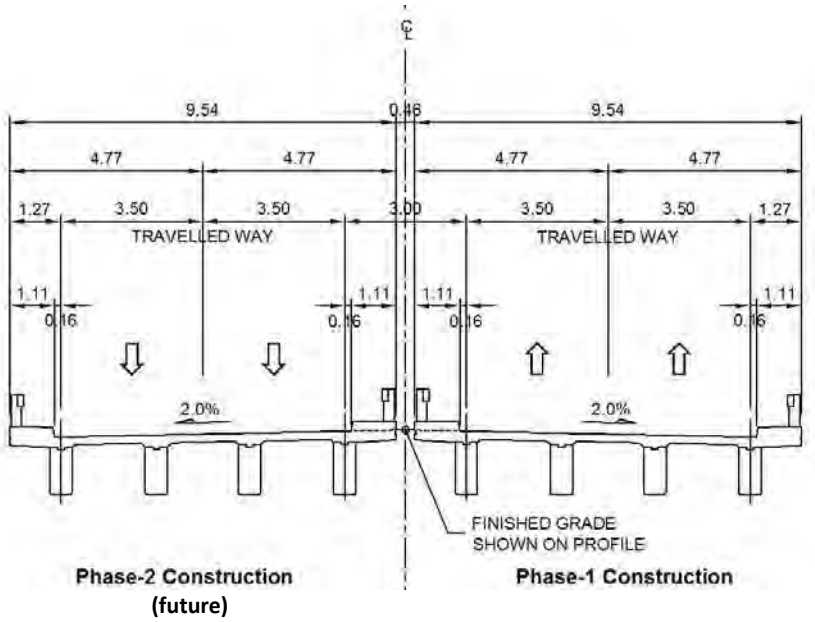
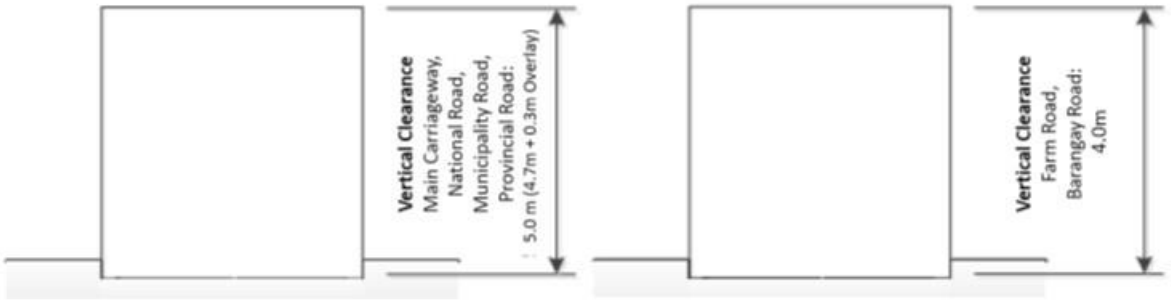


FIGURE 10.5-1 TYPICAL CROSS SECTION FOR BRIDGE

(2) Vertical Clearance

The vertical clearance of the main carriageway and crossing road shall be 4.0m (3.8m + overlay 0.2m) to 5.0m (4.7m + overlay 0.3m).



a) Main Carriageway and High priority crossing road

b) others

FIGURE 10.5-2 VERTICAL CLEARANCE

(3) Horizontal Clearance and Embedded Depth

The pier columns or walls for grade separation structures shall generally be located at a minimum of 9.0m from the edges of the through traffic lanes. Where the practical limits of structure cost, type of structure, volume and design speed of through traffic, span arrangement, skew and terrain make the 9.0m offset impractical, the pier or wall maybe placed closer than 9.0m and protected by the use of guardrail or other barrier devices. The guardrail or other devices shall be independently supported with the roadway face at least 0.60m from the face of pier or abutment.

The face of the guardrail or other device shall be at least 0.60m outside the normal shoulder line. Footings shall be embedded into the ground at least 1.0m from ground surface to the top of footing, and at least 2.0m from the river bed in the river. The effect of buoyancy on the structure shall be verified.

When using a spread footing type, bottom of footings shall be embedded at least 0.5m from the support layer. When using a pile type, bottom of pile shall be embedded at least 1.0 times diameter from the support layer.

10.5.4 Preliminary Design of Bridge Structures

(1) List of Bridges

Table 10.5-8 listed up the number of bridges for preliminary design.

TABLE 10.5-8 LIST OF BRIDGES

PKG	No.	Beginning Sta.	End Sta.	Bridge Length (m)	Nos. of Span	Girder Type	Angle (deg.)	Span Arrangement (m)	Type of Foundation	Apply BH. No.	Crossing Object
I	I-1	0 + 430	0 + 470	40	2	PSCG	90	40	C.I.P pile(ϕ 1200,L=10m)	BH1	
	I-2	0 + 940	1 + 28	88	3	PSCG	90	24 + 40 + 24	C.I.P pile(ϕ 1200,L=10m)		
	I-3	1 + 860	2 + 60	200	5	PSCG	90	40 + 40 + 40 + 40 + 40	C.I.P pile(ϕ 1200,L=10m)	BH2	
	I-4	2 + 505	2 + 635	130	4	PSCG	90	30 + 40 + 30 + 30	C.I.P pile(ϕ 1200,L=10m)	BH3	Bayabas Creak
	I-5	2 + 725	2 + 865	140	4	PSCG	90	30 + 40 + 40 + 30	C.I.P pile(ϕ 1200,L=10m)		
	I-6	3 + 196	3 + 304	108	4	PSCG	90	24 + 30 + 30 + 24	C.I.P pile(ϕ 1200,L=10m)	BH4	
	I-7	4 + 960	5 + 100	140	2	PC-Box	90	70 + 70	C.I.P pile(ϕ 1200,L=10m)	BH5	Lubogan River
	I-8	5 + 100	5 + 260	160	4	PSCG	90	40 + 40 + 40 + 40	Spread F.		Bato River
	I-9	6 + 27	6 + 227	200	5	PSCG	90	40 + 40 + 40 + 40 + 40	C.I.P pile(ϕ 1200,L=10m)	BH6	Lipadas River
	I-10	11 + 570	11 + 610	40	1	PSCG	90	40	C.I.P pile(ϕ 1200,L=10m)	BH8	
II	II-1	12 + 113	12 + 208	95	3	PSCG	90	30 + 35 + 30	C.I.P pile(ϕ 1200,L=10m)	BH8	Davao-Bukdnon Rd.
	II-2	12 + 310	12 + 430	120	3	PSCG	90	40 + 40 + 40	C.I.P pile(ϕ 1200,L=10m)		Talomo River
	II-3	14 + 900	14 + 940	40	1	PSCG	90	40	C.I.P pile(ϕ 1200,L=10m)	BH9	
	II-4	16 + 311	16 + 405	94	3	PSCG	90	24 + 35 + 35	C.I.P pile(ϕ 1200,L=10m)	BH10	
	II-5	16 + 982	17 + 172	190	5	PSCG	90	35 + 40 + 40 + 40 + 35	C.I.P pile(ϕ 1200,L=10m)		
	II-6	17 + 684	17 + 822	138	5	PSCG	90	24 + 30 + 30 + 30 + 24	C.I.P pile(ϕ 1200,L=10m)		
	II-7	18 + 429	18 + 724	295	8	PSCG	90	5 x 40 + 35 + 30 + 30	C.I.P pile(ϕ 1200,L=10m)	BH11	Malogbok Creak
	II-8	18 + 837	18 + 961	124	4	PSCG	90	24 + 40 + 30 + 30	C.I.P pile(ϕ 1200,L=10m)		Matina River
	II-9	22 + 840	23 + 40	200	5	PSCG	90	40 + 40 + 40 + 40 + 40	C.I.P pile(ϕ 1200,L=20m)	BH13	Davao River
	II-10	25 + 60	25 + 270	210	6	PSCG	90	40 + 40 + 40 + 30 + 30 + 30	C.I.P pile(ϕ 1200,L=10m)		
	II-11	26 + 57	26 + 137	80	2	PSCG	70	40 + 40	C.I.P pile(ϕ 1200,L=10m)		
	II-12	26 + 477	26 + 537	60	2	PSCG	90	30 + 30	C.I.P pile(ϕ 1200,L=10m)	BH15	
	II-13	27 + 510	27 + 630	120	3	PSCG	90	40 + 40 + 40	C.I.P pile(ϕ 1200,L=10m)		
	II-14	27 + 865	27 + 905	40	1	PSCG	90	40	C.I.P pile(ϕ 1200,L=10m)		
III	III-1	28 + 938	29 + 168	230	7	PSCG	90	30 + 30 + 35 + 40 + 35 + 30 + 30	C.I.P pile(ϕ 1200,L=10m)	BH16	
	III-2	29 + 195	29 + 250	55	2	PSCG	90	25 + 30	C.I.P pile(ϕ 1200,L=10m)		
	III-3	30 + 50	30 + 144	94	3	PSCG	90	35 + 35 + 24	C.I.P pile(ϕ 1200,L=10m)		
	III-4	30 + 702	30 + 867	165	5	PSCG	90	30 + 35 + 40 + 30 + 30	C.I.P pile(ϕ 1200,L=10m)		
	III-5	31 + 161	31 + 401	240	6	PSCG	90	40 + 40 + 40 + 40 + 40 + 40	C.I.P pile(ϕ 1200,L=12m)	BH17	
	III-6	31 + 512	31 + 687	175	5	PSCG	90	35 + 35 + 35 + 35 + 35	C.I.P pile(ϕ 1200,L=12m)		
	III-7	31 + 828	31 + 918	90	3	PSCG	90	30 + 30 + 30	C.I.P pile(ϕ 1200,L=12m)		
	III-8	32 + 75	32 + 110	35	1	PSCG	90	35	C.I.P pile(ϕ 1200,L=12m)		
	III-9	32 + 386	32 + 666	280	7	PC-Box	90	35 + 60 + 60 + 35 + 30 + 30 + 30	C.I.P pile(ϕ 1200,L=12m)		
	III-10	33 + 579	33 + 657	78	3	PSCG	90	24 + 30 + 24	C.I.P pile(ϕ 1200,L=12m)		
	III-11	33 + 784	33 + 862	78	3	PSCG	90	24 + 30 + 24	C.I.P pile(ϕ 1200,L=12m)		
	III-12	34 + 617	34 + 641	24	1	RCDG	90	24	C.I.P pile(ϕ 1200,L=12m)		
	III-13	34 + 862	34 + 902	40	1	PSCG	90	40	C.I.P pile(ϕ 1200,L=12m)		
	III-14	34 + 968	35 + 48	80	2	PSCG	90	40 + 40	C.I.P pile(ϕ 1200,L=12m)		
	III-15	35 + 355	35 + 390	35	1	PSCG	90	35	C.I.P pile(ϕ 1200,L=12m)		
	III-16	35 + 455	35 + 495	40	1	PSCG	90	40	C.I.P pile(ϕ 1200,L=12m)		
	III-17	36 + 378	36 + 488	110	3	PSCG	90	40 + 40 + 30	C.I.P pile(ϕ 1200,L=12m)		
	III-18	40 + 215	40 + 255	40	1	PSDG	90	40	C.I.P pile(ϕ 1200,L=35m)	BH18	
	III-19	41 + 490	41 + 580	90	3	PSCG	90	30 + 30 + 30	C.I.P pile(ϕ 1200,L=40m)	BH19	Lacanon River
	III-20	42 + 760	42 + 800	40	1	PSCG	90	40	C.I.P pile(ϕ 1200,L=60m)	BH20	
	III-21	44 + 278	44 + 378	100	3	PSCG	90	30 + 40 + 30	C.I.P pile(ϕ 1200,L=60m)		Maduao River

Source: JICA Study Team

(2) Superstructure

The following bridge types shall be adopted depending on the span length, economy and site condition.

Figure 10.5-3 shows the recommended type of superstructure depending on the different span length in the Philippines.

In this study, the commonly used type of superstructure are RCDG, PSCG and special bridge type is choose such as PC box girder and Steel Truss.

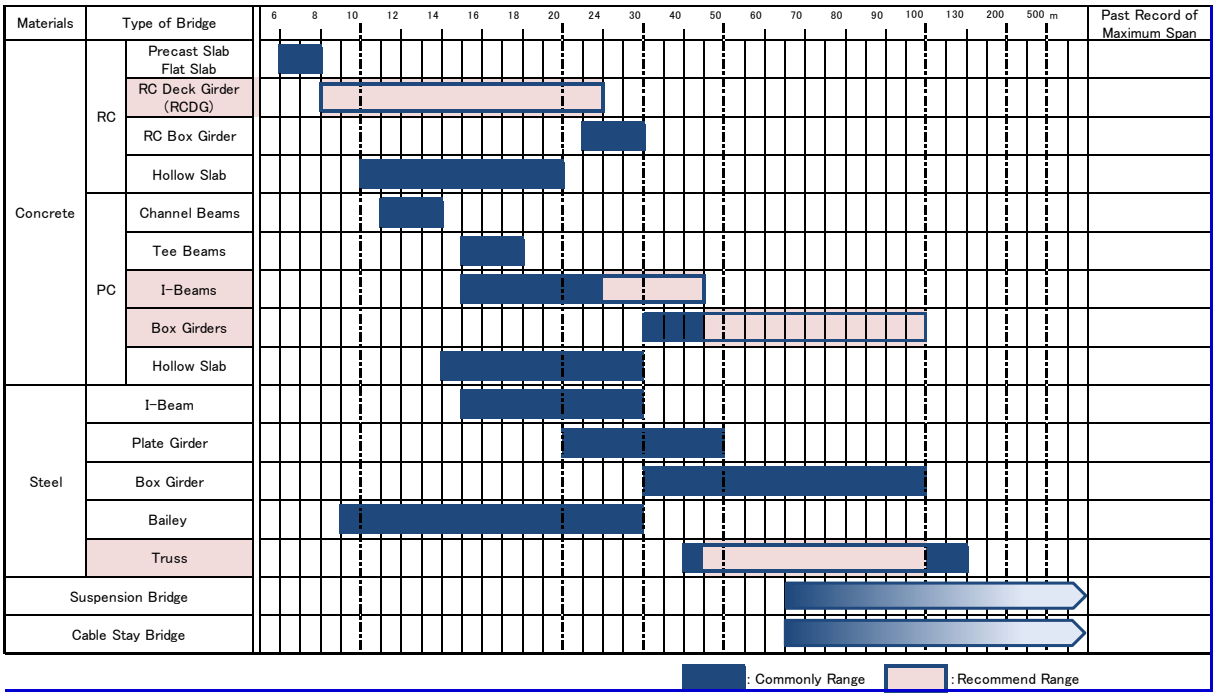


FIGURE 10.5-3 RECOMMENDED SUPERSTRUCTURE TYPE AT EACH SPAN LENGTH

(3) Substructure

The following type of pier shall be adopted in accordance to the site conditions and restrictions.

a) RC column with pier-head type pier.
b) RC hammerhead type pier.

Pile bent type shall not be allowed for improvement of seismic performance.

(4) Foundation

In accordance to the result of the sub-surface soil investigation, constraints factors during construction and others if any, the following types of foundation shall be selected;

a) Spread footing type
b) Cast in place concrete pile (1.2m diameter of piles will be adopted).

Driven pile type shall not be allowed for improvement of seismic performance.

Considering the effect of scour by the flow of river, the selected arrangement of pier type of foundation is the cast in place concrete pile.

(5) Span Arrangement

1) Bridge Length

In case the bridge is located on the deep river valleys and in mountainous areas, it is determined economically, including the many factors such as the stability of the ground, the effect of excavation, slope restoration and road construction. Therefore, it is necessary to locate the most appropriate abutment arrangement.

The following location of abutment shall be adopted in accordance to the site conditions.

a) Maximum height of abutment is 15.0m
b) Especially when abutment is located on a slope, as shown in **Figure 10.5-4.** Distance of toe footing to ground surface of horizontal direction (S: Space of horizontal) shall be keep more than footing length (B).

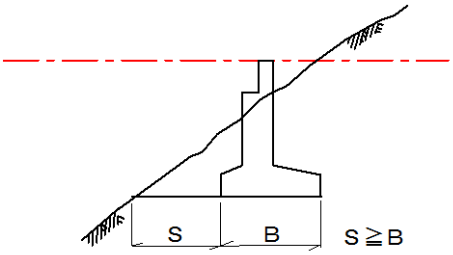


FIGURE 10.5-4 SPACE OF HORIZONTAL ON THE SLOPE ABUTMENT

2) Span Arrangement

There are 3 type bridges that will be utilize in this Study, such as Bridge for Road, Bridge for River/Waterway and Viaduct.

(a) Bridge for Road

Span arrangement of bridge for road shall utilize **Section 10.5.3** geometric design and basically these bridges are arranged as single span.

Especially, through the Davao-Bukidnon Road (No. I-10) is not only keep to existing road width but also keep the ROW (30m) and it is arranged 3 span bridge for advance to the seismic performance

(b) Bridge for River/Waterway

Span arrangement of bridge for river/waterway shall utilize **Section 10.5.3** geometric design. Basically, pier is not arranged in the river flow.

Span arrangement of major river bridge features is utilized.

- **[Sta. 4+960 – 5+260] Bridge of through the Lubogan River (No. I-7,I-8)**

Lubogan river width is approximately 50m. Based on the study result, best of girder type and span arrangement is 2-span PC box girder (70+70m, I-7) and 5-span PSCG (AASHTO girder type, 4@40m, I-8).Based on the geotechnical survey result, foundation type is spread footing. But PC box girder is near water flow, therefore Bridge I-7 cast-in-place pile (1.2m diameter) is selected.

- **[Sta. 12+290 – 12+375] Bridge of through the Talomo River (No. I-12)**

Talomo River width is approximately 30m. Based on the location of abutment, bridge length is 85m. Therefore, girder type and span arrangement is 3-span PSCG (AASHTO girder type, 40+40+40m). Based on geotechnical survey result, foundation type is Cast-in-place pile (1.2m diameter).

- **[Sta. 22+840 – 23+40] Bridge of through the Davao River (No. II-9)**

Davao River width is approximately 120m. This bridge is located from about 200m downstream from the existing “Waan Bridge” which has 100m bridge length (4-span x 25m, PSCG). On the other hand, both dike behaved erosion shown **Photo 10.5-1**. Therefore abutment disengaged dike from 1-span and bridge length is 200m. Based on the study result, the best appropriate girder type and span arrangement is 5-span PSCG (AASHTO girder type V, 5@40m). Based on geotechnical survey result, the foundation type is cast-in-place pile (1.2m diameter).

PHOTO 10.5-1 EROSION BEAVER ON DAVAO RIVER DIKE

- **[Sta. 41+490 – 41+580, 44+278 – 44+378] Bridge of through the Lacanon River (No. III-19) and Bridge of through the Maduao River (No. III-21)**

Lacanon River and Maduao river width is approximately 20m and 30m respectively. However, based on the hydraulic analysis during flood, these rivers overflow. Therefore, these bridges need an opening length enough than the current river bank state. These bridges would be arranged as 3-span bridges (30+30+30m and 30+40+30m respectively). Based on the geotechnical survey result, the foundation type is cast-in-place pile (1.2m diameter).

- **[Sta. 40+215 – 40+255, 42+760 – 42+800] Bridge through the Small River (No. III-18,20)**

These small river width is approximately less than 20m. According to the hydraulic analysis, during flood, this river may overflow. Therefore, this bridge need an opening length enough than the current state river bank. This bridge is arrange as a single-span bridge (40m). Based on the geotechnical survey result, the foundation type d is cast-in-place pile (1.2m diameter).

(c) Viaduct

"Viaduct" shall be defined that low effect by crossing object then long length bridge by deep valley.

Span arrangement of viaduct shall utilize **section 10.5.3** geometric design. And basically, pier is not arranged in the river flow. Span arrangement of major viaduct features are the following;

- **[Sta. 18+425 – 18+720] Bridge through the Malogbok Creek (No. II-7)**

Malogbok Creek is about more than 30m in depth. Bridge length is 295m best girder type and span arrangement is 8-span PSCG (AASHTO girder type V, 5@ 40+35+30+30m). Based on geotechnical survey result, foundation type is cast-in-place pile (1.2m diameter).

- **[Sta. 32+385 – Sta. 32+695] Bridge through deep creek (No. III-9)**

This Creek is about than 30m in depth . Bridge length is 310m., best girder type and span arrangement is 8-span PSCG (AASHTO girder type V, 5@ 40+35+30+30m). Based on geotechnical survey result, foundation type is cast-in-place pile (1.2m diameter).

(6) Study on alternative Bridge Types

To make a decision about the girder type and span arrangement of major bridges, an alternative study attention is focused on the following items;

- Economically (include construction cost, maintenance cost)
- Structurally (include commonality, seismic adequacy,)
- Constructability (include period, scale of temporary facility<equipment, access road>)
- Maintainability (include particularity of inspection and repair work)

To perform a comparative study about the bridges as shown below.

- Section I, I-7,I-8 (main feature; Long length river bridge)
- Section II, II-7 (main feature; Long length viaduct<deep valley>)
- Section II, II-9 (main feature; through the Davao river)
- Section III III-9 (main feature; Long length viaduct<deep valley>)

Bridge for comparison and results are as follows;

TABLE 10.5-9 RESULT OF COMPARISON STUDY SECTION-I BRIDGE I-7, 8

Alternative No.		Alternative-1	Alternative-2
Girder Type		PC-Box Girder + PSCG	PC-Box Girder + PSCG
Span arrangement		(70+70)+(20+30x4+20)=140+160m	(70+70)+(40x4)=140+160m
Structurally	Commonality	PC-Box girder is not commonality but had few bridges in Philippine. PSCG is most of commonality in Philippine. (★★)	PC-Box girder is not commonality but had few bridges in Philippine. PSCG is most of commonality in Philippine. (★★)
	Seismic adequacy	Continuous girder has excellent seismic performance. (★★★)	Continuous girder has excellent seismic performance. (★★★)
Constructability	Period	For 5-piers, the construction period is longer than the Alternative-2 (★★)	For 3-piers, the construction period is shorter than the Alternative-1 (★★★)
	Scale of temporary facility	For 5-piers, length of temporary road for construction is longer than the Alternative-2 (★★)	For 3-piers, length of temporary road for construction is shorter than the Alternative-1 (★★★)
Maintainability	Particularity of inspection and Repair works	PC box girder needs special inspection and repair works. But PSCG doesn't need special technic. (★★)	PC box girder needs special inspection and repair works. But PSCG doesn't need special technic. (★★)
Economically	Construction cost	PhP – 189,975,000 (1.16)	PhP – 163,496,000 (1.00)
Decision		---	Recommend

TABLE 10.5-10 RESULT OF COMPARISON STUDY SECTION-II BRIDGE II-7

Alternative No.		Alternative-1	Alternative-2	Alternative-3
Girder Type		PSCG	PSCG	PC-Box girder
Span arrangement		30x9+25=295m	40x5+35+30x2=295m	40+75x3+40=305m
Structurally	Commonality	PSCG is most of commonality in Philippine. (★★★)	PSCG is most of commonality in Philippine. (★★★)	PC-Box girder had few bridges in Philippine. (★★)
	Seismic adequacy	Continuous girder has excellent seismic performance. (★★★)	Continuous girder has excellent seismic performance. (★★★)	Continuous girder has excellent seismic performance. (★★★)
Constructability	Period	For 9-piers, the construction period is longer than the Alternative-2. (★★)	For 7-piers, the construction period is shorter than the Alternative-1. (★★★)	For cantilever method, the construction period is longer than PSCG. (★★)
	Scale of temporary facility	For 9-piers, length of temporary road for construction is longest. (★★)	For 7-piers, length of temporary road for construction is middle. (★★)	For 9-piers, length of temporary road for construction is shortest. (★★★)
Maintainability	Particularity of inspection and Repair works	For PSCG, Inspection and Repair works is easy. (★★★)	For PSCG, Inspection and Repair works is easy. (★★★)	For PC-Box girder, Inspection and Repair works is need to special technic. (★★)
Economically	Construction cost	PhP – 216,271,000 (1.20)	PhP – 180,012,000 (1.00)	PhP – 191,459,000 (1.06)
Decision		---	Recommend	---

TABLE 10.5-11 RESULT OF COMPARISON STUDY SECTION-II BRIDGE II-9

Alternative No.		Alternative-1	Alternative-2	Alternative-3
Girder Type		PSCG	PSCG	PC-Box girder
Span arrangement		25+30x5+25=200m	40x5=200m	40+60x2+40=200m
Structurally	Commonality	PSCG is most of commonality in Philippine. (★★★)	PSCG is most of commonality in Philippine. (★★★)	PC-Box girder had few bridges in Philippine. (★★)
	Seismic adequacy	Continuous girder has excellent seismic performance. (★★★)	Continuous girder has excellent seismic performance. (★★★)	Continuous girder has excellent seismic performance. (★★★)
Constructability	Period	For 6-piers, the construction period is longer than the Alternative-2. (★★)	For 4-piers, the construction period is shorter than the Alternative-1. (★★★)	For cantilever method, the construction period is longer than PSCG. (★★)
	Scale of temporary facility	For launching election, it needs special equipment. (★★)	For launching election, it needs special equipment. (★★)	For cantilever method, it doesn't need special equipment. (★★★)
Maintainability	Particularity of inspection and Repair works	For PSCG, Inspection and Repair works is easy. (★★★)	For PSCG, Inspection and Repair works is easy. (★★★)	For PC-Box girder, Inspection and Repair works is need to special technic. (★★)
Economically	Construction cost	PhP – 168,643,000 (1.04)	PhP – 162,266,000 (1.00)	PhP – 170,940,000 (1.05)
Decision		---	Recommend	---

TABLE 10.5-12 RESULT OF COMPARISON STUDY SECTION-III BRIDGE III-9

Alternative No.		Alternative-1	Alternative-2
Girder Type		PC-Box Girder + PSCG	PC-Box Girder
Span arrangement		(35+60x2+35)+(30x3)=190+90m	35+60x4+35=310m
Structurally	Commonality	PC-Box girder is not commonality but had few bridges in Philippine. PSCG is most of commonality in Philippine. (★★)	PC-Box girder is not commonality but had few bridges in Philippine. (★★)
	Seismic adequacy	Continuous girder has excellent seismic performance. (★★★)	Continuous girder has excellent seismic performance. (★★★)
Constructability	Period	Pier is many but cantilever method is shorten. Therefore, the construction period is shorter than Alternative-2 (★★★)	Pier is shorten but cantilever method is longer. Therefore, the construction period is longer than Alternative-2 (★★)
	Scale of temporary facility	For 6-piers, length of temporary road for construction is longer than the Alternative-2 (★★)	For 5-piers, length of temporary road for construction is shorter than the Alternative-1 (★★★)
Maintainability	Particularity of inspection and Repair works	PC box girder needs special inspection and repair works. But PSCG doesn't need special technic. (★★)	PC box girder needs special inspection and repair works. (★★)
Economically	Construction cost	PhP – 233,866,000 (1.00)	PhP – 251,387,000 (1.07)
Decision		Recommend	---

(7) Overpass Bridges

1) List of Overpass Bridges

TABLE 10.5-13 LIST OF OVERPASS BRIDGES

PKG	No.	Station	Crossing Object	Nos. of Span	Girder Type	Angle (deg.)	Span Arrangement (m)
I	IO-1	3 + 820	Brgy. Rd.	2	PSCG	90	25 + 25
	IO-2	9 + 80	Brgy. Rd.	2	PSCG	90	25 + 25
II	IIO-1	18 + 820	Brgy. Rd.	2	PSCG	80	25 + 20
	IIO-2	24 + 700	Subdivision Rd. (UC)	2	PSCG	90	25 + 30
	IIO-3	25 + 470	Cabantian Rd.	2	PSCG	65	25 + 25
	IIO-4	27 + 360	Brgy. Rd.	2	RCDG	90	20 + 20
III	IIIO-1	32 + 190	Brgy. Rd.	2	PSCG	90	30 + 25
	IIIO-2	32 + 990	Acacia-Ilang Rd.	2	PSCG	75	25 + 25
	IIIO-3	33 + 465	Brgy. Rd.	2	PSCG	90	25 + 20
	IIIO-4	33 + 965	Private Rd.	2	RCDG	90	20 + 20
	IIIO-5	34 + 390	Private Rd.	2	RCDG	90	20 + 20
	IIIO-6	38 + 425	National Rd.	2	PSCG	80	25 + 20

2) Span arrangement and girder type

Span arrangement of bridges for river/waterway will follow **Section 10.5.3** geometric design. Basically, pier is arranged in median strip. Therefore overpass bridges have 2-span bridges.

When crossing barangay road or private road, the rearrangement skew angle will be 90 degrees.

The type of girder depends on span length. Span length that is less than 20m will utilize a RCDG and that is more than 20m will utilize a PSCG.

10.5.5 Preliminary Design of Culvert Structures

(1) List of Culvert

Table 10.5-14 list up the RCBC for roads and **Table 10.5-15** list up the RCBC and RCPC for rivers and waterways.

TABLE 10.5-14 LIST OF RCBC FOR ROAD

PKG	Station	Crossing Object	Type	Dimensions		
				Nos. of Barrel	Inner Section	
					Width (m)	Height (m)
II	22 + 315	Barangay Road	RCBC	1	4.0	4.0
II	23 + 421	Barangay Road	RCBC	1	6.0	3.5
II	23 + 826	Mandug Rd.	RCBC	1	6.0	5.0
III	39 + 354	Barangay Road	RCBC	1	5.0	5.0
III	44 + 97	Barangay Road	RCBC	1	5.0	5.0

Source: JICA Study Team

TABLE 10.5-15 LIST OF RCBC AND RCPC FOR RIVER AND WATERWAY - SECTION 1

No.	PKG	Station			Crossing Object	Type	Dimensions		
							Nos. of Barrel	Inner Section	
								Width or Diameter (m)	Height (m)
1	I	0	+	15	Waterway	RCBC	1	1.20	0.90
2	I	0	+	83	Waterway near Lipadas River1	RCBC	3	3.00	2.50
3	I	1	+	182		rcpc	1	1.07	
4	I	1	+	350		rcpc	1	1.07	
5	I	1	+	450		rcpc	1	1.07	
6	I	1	+	549	Creek4	RCBC	1	5.00	5.00
7	I	1	+	753		rcpc	1	0.91	
8	I	1	+	784		rcpc	1	1.07	
9	I	3	+	600		rcpc	1	1.07	
10	I	2	+	297		rcpc	1	0.91	
11	I	2	+	968		RCBC	1	3.00	3.00
12	I	3	+	978	Creek10	RCBC	1	2.00	2.00
13	I	7	+	490	Creek11	RCBC	1	2.40	2.40
14	I	4	+	535		rcpc	1	1.07	
15	I	6	+	804		rcpc	1	1.52	
16	I	7	+	221		rcpc	1	1.07	
17	I	7	+	423	Waterway14	RCBC	1	4.00	4.00
18	I	8	+	61		RCBC	1	1.20	1.20
19	I	8	+	304		rcpc	1	1.07	
20	I	8	+	474		rcpc	1	1.52	
21	I	8	+	674		RCBC	1	3.00	3.00
22	I	8	+	910	Waterway15	RCBC	3	3.00	2.10
23	I	10	+	320		RCBC	3	2.00	1.80
24	I	9	+	562	Waterway16	RCBC	3	3.00	2.50
25	I	9	+	796		rcpc	1	0.91	
26	I	9	+	950		RCBC	1	0.90	0.90
27	I	9	+	961		RCBC	1	1.20	0.90
28	I	11	+	270		rcpc	1	0.91	
29	I	10	+	409		rcpc	1	1.07	
30	I	10	+	610		rcpc	1	1.07	
31	I	10	+	765	Aclihan Creek-R8	RCBC	3	3.00	3.00
32	I	10	+	896		rcpc	1	1.07	
33	I	11	+	159		rcpc	1	1.07	
34	I	11	+	387		RCBC	1	5.00	2.50
35	I	11	+	656		rcpc	1	1.52	

Source: JICA Study Team

TABLE 10.5-16 LIST OF RCBC AND RCPC FOR RIVER AND WATERWAY – SECTION 2

No.	PKG	Station			Crossing Object	Type	Dimensions		
							Nos. of Barrel	Inner Section	
								Width or Diameter (m)	Height (m)
36	II	11	+	792		rcpc	1	0.91	
37	II	11	+	883		rcpc	1	0.91	
38	II	11	+	925		rcpc	1	0.91	
39	II	12	+	73		rcpc	3	1.52	
40	II	13	+	403		rcpc	1	1.52	
41	II	13	+	650		rcpc	1	1.52	
42	II	13	+	858		RCBC	1	1.20	0.90
43	II	13	+	892		rcpc	1	0.91	
44	II	13	+	973		rcpc	1	1.52	
45	II	14	+	367	Creek18 & 19	RCBC	3	3.00	3.00
46	II	14	+	641	Waterway	RCBC	1	4.00	3.00
47	II	14	+	679		RCBC	1	4.00	3.00
48	II	15	+	363	Waterway	RCBC	3	3.00	3.00
49	II	15	+	732		rcpc	1	1.07	
50	II	15	+	958		rcpc	1	1.52	
51	II	16	+	69		rcpc	1	1.07	
52	II	16	+	418		rcpc	1	1.07	
53	II	16	+	585		rcpc	1	1.52	
54	II	17	+	607		rcpc	1	0.91	
55	II	17	+	860		rcpc	1	1.52	
56	II	18	+	21		rcpc	1	1.52	
57	II	18	+	83		rcpc	1	1.52	
58	II	21	+	397		rcpc	1	0.91	
59	II	21	+	454		rcpc	1	0.90	
60	II	21	+	539		rcpc	1	1.52	
61	II	21	+	650		rcpc	1	0.91	
62	II	21	+	819		rcpc	1	1.07	
63	II	21	+	913		rcpc	1	1.52	
64	II	22	+	188		rcpc	1	1.52	
65	II	22	+	385		rcpc	1	1.52	
66	II	22	+	483		RCBC	1	5.00	3.00
67	II	22	+	605		rcpc	1	1.52	
68	II	22	+	629		RCBC	1	5.00	5.00
69	II	22	+	792		RCBC	1	3.00	2.50
70	II	23	+	364		RCBC	1	5.00	3.00
71	II	23	+	439		rcpc	3	1.52	
72	II	23	+	529		rcpc	1	1.07	
73	II	23	+	721		rcpc	1	0.91	
74	II	23	+	937		rcpc	1	0.91	
75	II	24	+	453	Waterway	RCBC	3	2.40	2.10
76	II	24	+	815		rcpc	1	1.52	
77	II	25	+	836		rcpc	1	1.07	
78	II	25	+	411		rcpc	1	1.52	
79	II	25	+	832		rcpc	1	1.52	
80	II	25	+	899		rcpc	1	1.52	
81	II	25	+	971		rcpc	1	1.07	
82	II	26	+	186		rcpc	1	1.52	
83	II	26	+	520	Waterway29	RCBC	1	3.00	2.75
84	II	26	+	950		RCBC	1	1.20	0.90
85	II	27	+	276		rcpc	1	1.52	
86	II	27	+	401		rcpc	1	0.91	
87	II	28	+	517		RCBC	1	3.00	2.50
88	II	28	+	616		RCBC	1	2.00	2.00
89	II	28	+	705		RCBC	1	1.20	0.60
90	II	28	+	721		RCBC	1	1.20	0.60

Source: JICA Study Team

TABLE 10.5-17 LIST OF RCBC AND RCPC FOR RIVER AND WATERWAY – SECTION 3

No.	PKG	Station			Crossing Object	Type	Dimensions		
							Nos. of Barrel	Inner Section	
								Width or Diameter (m)	Height (m)
91	III	29	+	400		rcpc	1	1.52	
92	III	29	+	464	Waterway33	RCBC	1	5.00	3.00
93	III	29	+	516		rcpc	1	1.52	
94	III	29	+	599		rcpc	1	1.52	
95	III	29	+	819	Waterway	RCBC	1	3.00	3.00
96	III	30	+	207		rcpc	1	0.91	
97	III	33	+	272		rcpc	1	1.07	
98	III	33	+	728		rcpc	1	1.52	
99	III	36	+	804		rcpc	1	0.91	
100	III	37	+	120		rcpc	1	1.52	
101	III	39	+	420		rcpc	3	1.52	
102	III	39	+	700		rcpc	1	0.91	
103	III	39	+	779		rcpc	1	1.52	
104	III	40	+	840		rcpc	3	1.07	
105	III	41	+	0		rcpc	1	0.91	
106	III	41	+	347		rcpc	1	1.07	
107	III	41	+	675		rcpc	1	0.91	
108	III	41	+	918		rcpc	1	0.91	
109	III	42	+	50		rcpc	1	1.52	
110	III	42	+	188		RCBC	1	5.00	2.50
111	III	42	+	341		rcpc	1	1.52	
112	III	42	+	443		rcpc	1	1.52	
113	III	42	+	570		rcpc	1	1.52	
114	III	42	+	667		rcpc	1	1.52	
115	III	43	+	70		rcpc	1	1.52	
116	III	43	+	444		rcpc	1	0.91	
117	III	43	+	535		rcpc	1	1.07	
118	III	43	+	656		RCBC	1	1.50	1.25
119	III	43	+	835		RCBC	3	1.50	1.50
120	III	43	+	943		RCBC	1	3.00	2.10
121	III	44	+	460		RCBC	3	1.50	1.00
122	III	44	+	553		RCBC	2	1.50	1.50

Source: JICA Study Team

(2) Type of Culvert

1) Pipe Culvert

Pipe culvert is utilized for valley of stream after rain and irrigation canal. The dimension of pipe culvert is at least 0.91m diameter.

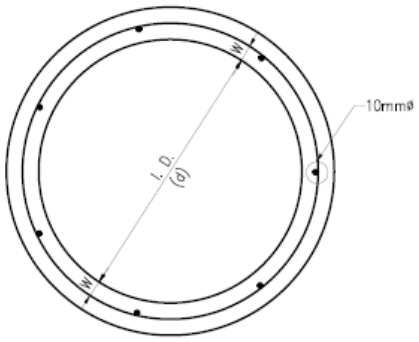


FIGURE 10.5-5 TYPICAL CROSS SECTION AT PIPE CULVERTBOX CULVERT FOR CROSSING ROAD

Box culvert is applied for less than 6m width of road crossing such as barangay road and farm road.

2) Box Culvert for Crossing River and Waterways

Box culvert is applied for less than 6m width of road crossing. Portal rigid frame type is applied less than 12m width and discharge volume more than 80m^3/s.

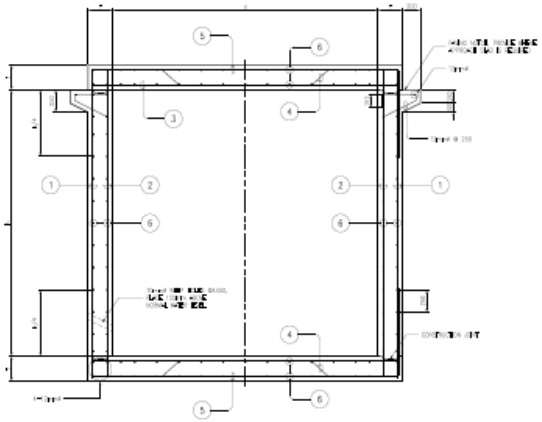


FIGURE 10.5-6 TYPICAL CROSS SECTION OF RCBC SINGLE BARREL

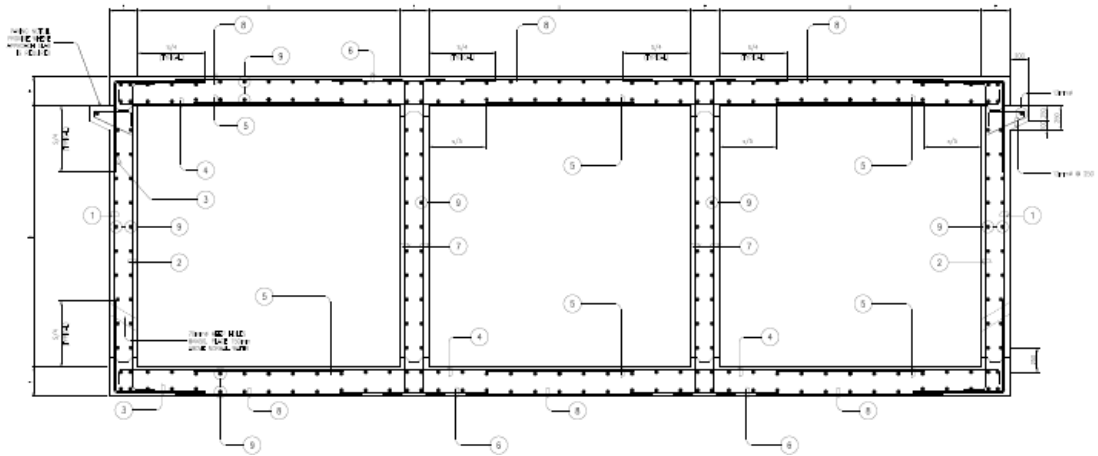


FIGURE 10.5-7 TYPICAL CROSS SECTION OF RCBC TRIPLE BARREL

10.5.6 Effects of seismically unstable ground

(1) General

The effects of the unstable ground shall be taken into account in the verification of seismic performance of a bridge when the ground is expected to be in an unstable state during an earthquake. Unstable ground is defined as an extremely soft soil layer in seismic design, or a sandy layer affecting the bridge due to the liquefaction and lateral spreading.

In addition to the verification of the seismic performance of a bridge with conditions indicated in soft soil layer and/or sandy layer above, the case in which the ground is assumed to be stable shall also be considered in order to ensure the seismic performance of the bridge for both stable and unstable ground conditions.

Verification of seismic performance, assessment of soil liquefaction, reduction of geotechnical parameters and verification of foundations for liquefaction-induced lateral spreading is refer to LRFD Bridge Seismic Design Specifications (DPWH guide specifications, 2013, 1st edition.

1) Assessment of Extremely Soft Soil Layer in Seismic Design

For a clayey layer or a silt layer located within three meters from the ground surface, and having a compressive strength of 20kPa (kN/mm^2) or less obtained from an unconfined compression test or an in-situ test, the layer shall be regarded as an extremely soft layer in seismic design.

2) Assessment of Soil Liquefaction and Countermeasure

(a) Sandy layer requiring liquefaction assessment

For an alluvial sandy layer having all of the following three conditions, liquefaction assessment shall be conducted in accordance with the provisions specified below and shown **Figure 10.5.6-1**, since liquefaction may affect the bridge performance during an earthquake.

a. Saturated soil layer with depth less than 20m below the ground surface and having ground water level higher than 10m below the ground surface.
b. Soil layer containing a fine contend (FC) of 35% or less, or soil layer having plasticity index, Ip less than 15, even if FC is larger than 35%.
c. Soil layer having a mean particle size (D_{50}) of less than 10mm and a particle size at 10% passing (D_{10}) (on the grading curve) is less than 1mm.

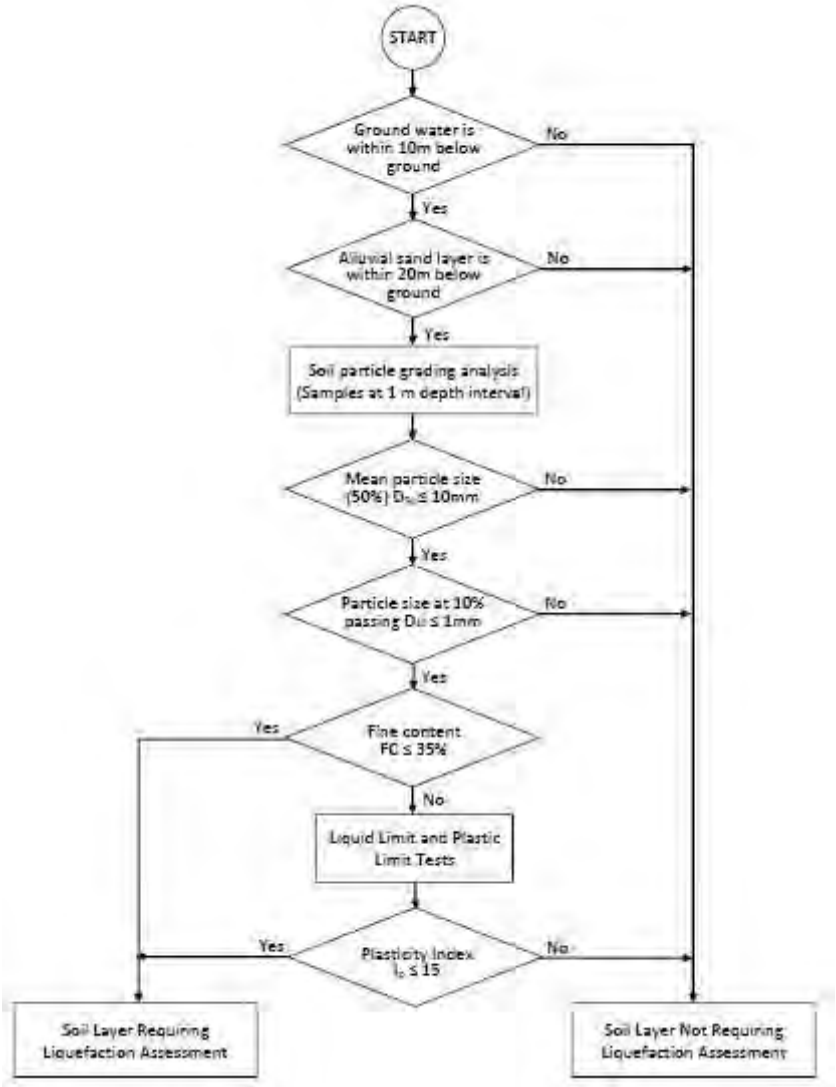


FIGURE 10.5-8 DETERMINATION OF NECESSITY FOR LIQUEFACTION ASSESSMENT OF SOIL LAYER

(b) Reduction of geotechnical parameters

When a soil layer is considered to be an extremely soft layer according to the provisions specified in (2), its geotechnical parameters (shear modulus and strength) shall be assumed to be zero in the seismic design.

For a sandy layer causing liquefaction and affecting the bridge shall be equal to the product of geotechnical parameters obtained without liquefaction and the coefficient D_E in **Table 10.5-18**. For the case when D_E=0, the geotechnical parameters (shear modulus and strength) shall be taken as 0 in seismic design.

The weight of a soil layer with reduced or zero geotechnical parameter in the seismic design shall be assumed to be acting as an overburden.

TABLE 10.5-18 REDUCTION FACTOR D_E FOR GEOTECHNICAL PARAMETERS

Range of F_L	Depth from Present Ground Surface x (m)	Dynamic Shear Strength Ratio, R	
		$R \leq 0.3$	$0.3 < R$
		Verification for Level 2 Earthquake Ground Motion	Verification for Level 2 Earthquake Ground Motion
$F_L \leq 1/3$	$0 \leq x \leq 10$	0	1/6
	$10 < x \leq 20$	1/3	1/3
$1/3 < F_L \leq 2/3$	$0 \leq x \leq 10$	1/3	2/3
	$10 < x \leq 20$	2/3	2/3
$2/3 < F_L \leq 1$	$0 \leq x \leq 10$	2/3	1
	$10 < x \leq 20$	1	1

(c) Recommended for liquefaction

According to geotechnical survey, it shall be consider to soil liquefaction to BH-17 to BH-20. When detailed design stage, it shall be more detailed geotechnical test and follow the specification for soil liquefaction.

3) For Lateral Spreading

(a) Ground with possible lateral movement

A ground with both of the following two conditions shall be treated as a ground with possible lateral movement affecting the bridge.

a. Ground within a distance of less than 100m from a water front in a shore area formed by a revetment with an elevation difference of 5m or more between the water bottom and the ground surface behind (see **Figure 10.5.6-2**).
b. Ground with a sandy layer thicker than 5m that is assessed as a liquefiable layer according to the provision in 10.5.6.(3) and is distributed somewhat widely in the area of the water front.

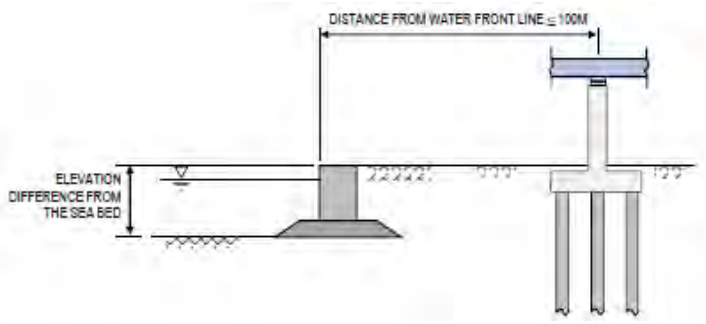


FIGURE 10.5-9 ELEVATION DIFFERENCE FROM THE SEA BED AND DISTANCE FROM THE WATER FRONT LINE

(b) Verification of seismic performance of a bridge for liquefaction-induced lateral spreading

A pier foundation situated on a ground specified in 1) above shall be verified against possible liquefaction-induced lateral spreading. In the verification, lateral movement force specified 3) shall act on the pier foundation. However, the lateral movement force and the inertia force not to be considered simultaneously.

(c) Recommended for Lateral Spreading

According to geotechnical survey, it shall be consider to soil liquefaction to BH-18 to BH-20. When detailed design stage, it shall be more detailed geotechnical test and follow the specification for soil liquefaction.

Remediation objectives include increasing the soils liquefaction resistance through densification, increasing its strength, and/or improving its drainage. The most common remediation measures bellow.

Surcharge - The weight of a surcharge/buttress increases the liquefaction resistance by increasing the effective confining pressures in the foundation.

Drains - Relief of excess pore water pressure to prevent liquefaction. (Wick drains have comparable permeability to sand drains). Primarily gravel drains; sand/wick may supplement gravel drain or relieve existing excess pore water pressure. Permanent dewatering with pumps.

Compaction Piles - Densification by displacement of pile volume and by vibration during driving, increase in lateral effective earth pressure.

Deep soil-cement mixing methods - The in situ injection and mixing of cement into weak soils is becoming more common. Recent applications include liquefaction mitigation and the strengthening of weak cohesive soils adjacent to embankments, levees and bridge abutments.

10.6 PAVEMENT DESIGN

10.6.1 General

This section describes pavement design for the bypass project. The pavement design is based on the following;

1) The results and findings of the subgrade characteristics over which the road is to be built;
2) The traffic load anticipated to traverse the proposed road alignments over the selected design life; and
3) The type of pavement to be adopted based on the technical and economical advantages.

10.6.2 Technical Approach

The design parameters used in the pavement design includes time constraints, traffic, design serviceability loss, reliability, subgrade and material properties for pavement structure design. The following are the major design conditions;

(1) Design Period

10 years
It is assumed that the design life of pavement consummates the 10-year design period before rehabilitation is performed.

(2) Traffic

The structural design of the pavement is based on fatigue loads. Fatigue loading is taken as the cumulative number of passes of an Equivalent Standard Axle Load (ESAL) of 8,300 kgs (18kips) per axle, to which the pavement structure will be subjected throughout its design life.

10.6.3 Recommended Pavement Structures

The recommended pavement structures for the bypass main carriageway is below;

Portland Cement Concrete Pavement (PCCP)		
No.	Thickness	Pavement
1	300 mm	Portland Cement Concrete Pavement
2	300 mm	Crushed Aggregate Base Course

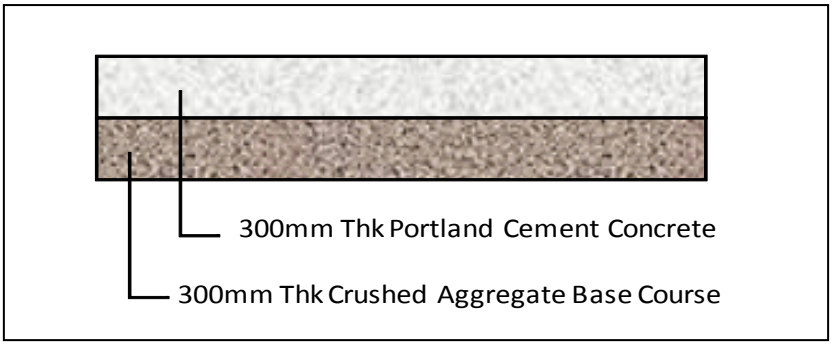


FIGURE 10.6-1 PAVEMENT STRUCTURE OF MAIN CARRIAGEWAY

10.7 DRAINAGE DESIGN

10.7.1 General

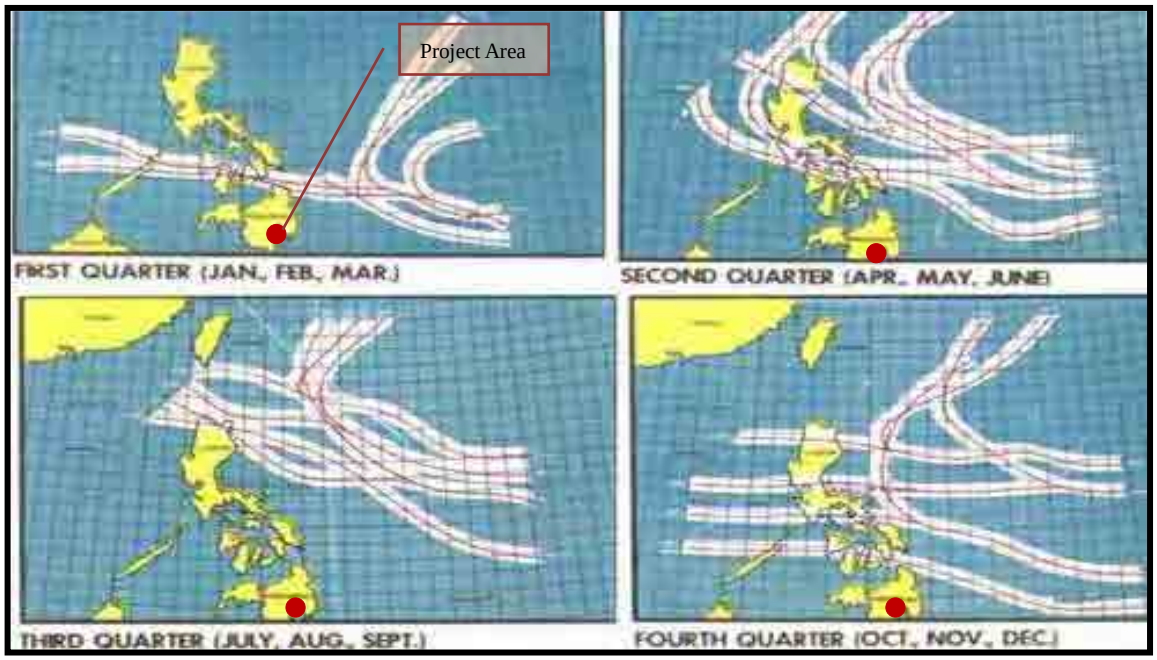
The elimination of floods and the protection against Inundation of a roadway / its facilities forms one of the major problems in road design. Adequate flood controls and drainage measures will invariably reduce damage to a roadway and its facilities, thus minimizing maintenance and operational cost and even reconstruction cost as the case may be.

The hydrological conditions / studies concerning the drainage of proposed bypass road are assessed as follows.

10.7.2 Meteorological Conditions

Davao City is outside the typhoon belt and lacks major seasonal variations as shown in **Figure 10.7-1**. The city belongs to Type IV Climate that has mild tropical rainforest climate where rainfall is more or less evenly distributed throughout the year with no dry season as shown in **Figure 10.7-2**.

There is a synoptic observation station of climatic data in and around Davao city, which installed and have been operated by Philippine Atmospheric, Geophysical & Astronomical Services Administration (PAGASA) as shown in **Table 10.7-1** and **Figure 10.7-3**.



Source: _____

FIGURE 10.7-1 ANNUAL TRACKS OF TROPICAL CYCLONE

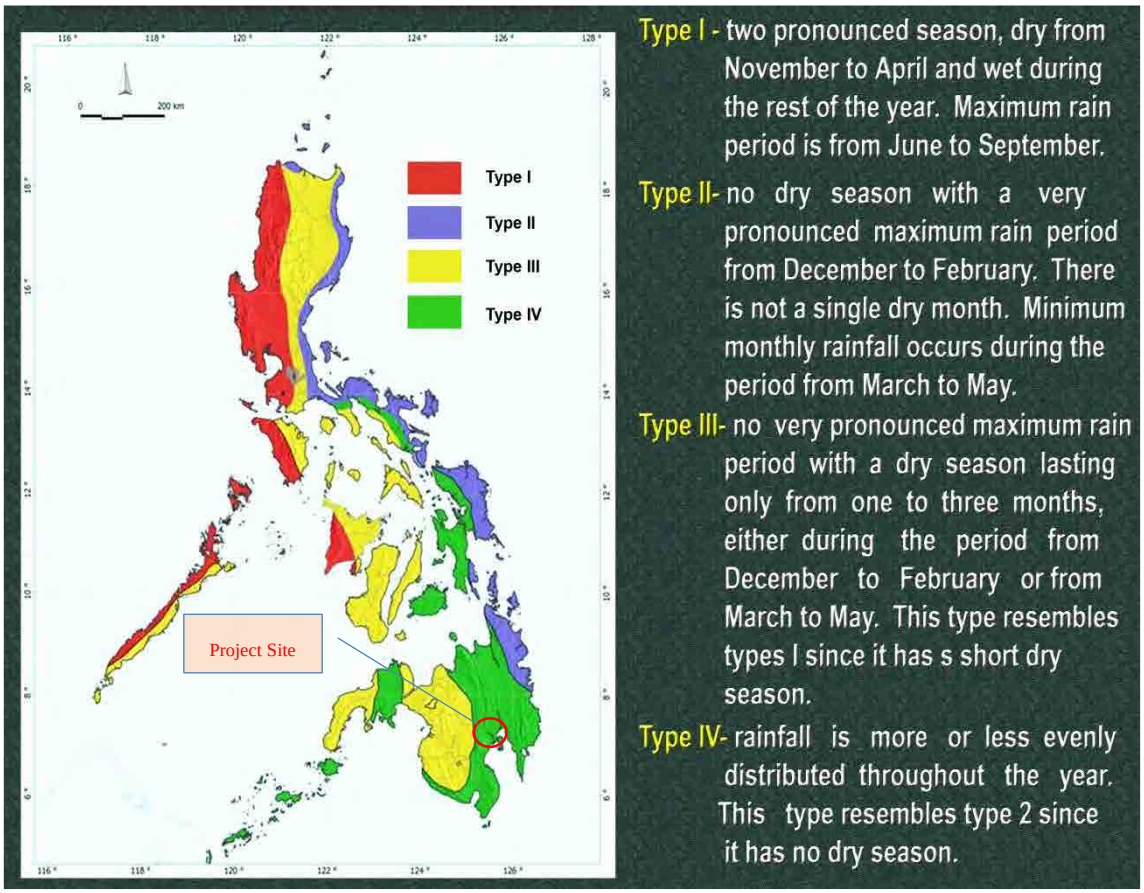


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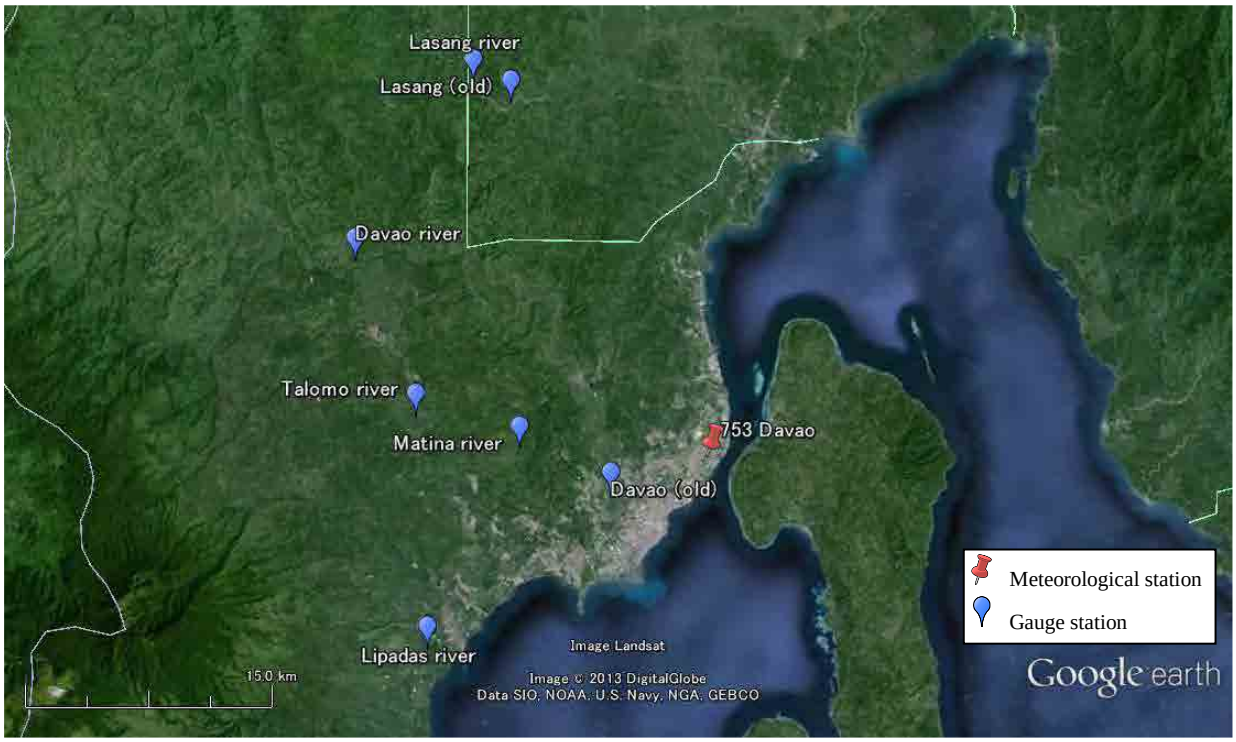
FIGURE 10.7-2 CLIMATE MAP OF THE PHILIPPINES

TABLE 10.7-1 INVENTORY OF METEOROLOGICAL STATION

Meteorological Station	Code (WMO)	Coordinates		Height (m)	Period of Records				Remarks
		Latitude	Longitude		Temperature	Relative Humidity	Rainfall	Wind	
1. Davao (synoptic station)	98753	07-07'N	125-39' E	18	1951-	1951-	1951-	1951-	

Source: PAGASA



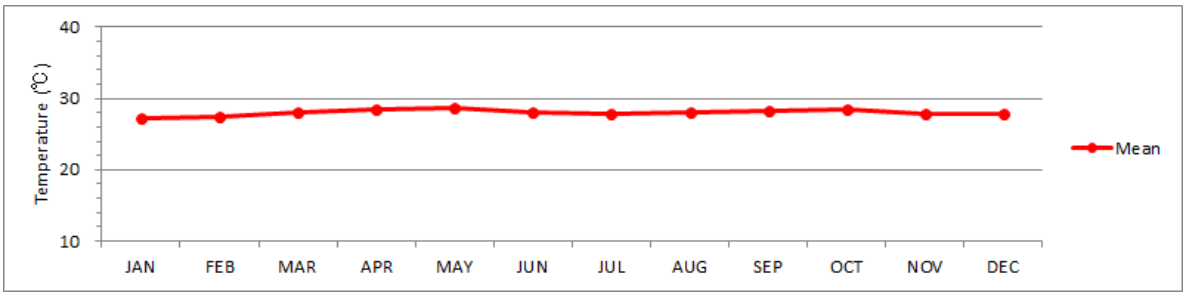
Source: JICA Study Team based on the image of Google earth

FIGURE 10.7-3 LOCATION MAP OF METEOROLOGICAL AND HYDROLOGICAL STATIONS

(1) General weather conditions

1) Temperature

The monthly mean temperature has a range between 28.6℃ and 27.3℃ in Davao city. According to collected data, the mean monthly maximum temperature 29.1℃ (May 2010) and the mean minimum temperature 27.0℃ (January 2011) at Davao city were recorded respectively during the recent 5 years. The monthly mean temperature is substantially constant throughout the year, and its fluctuation range is very small. The daily mean temperature typically varies from 24℃ to 33℃, and is rarely below 23℃ or above 34℃.

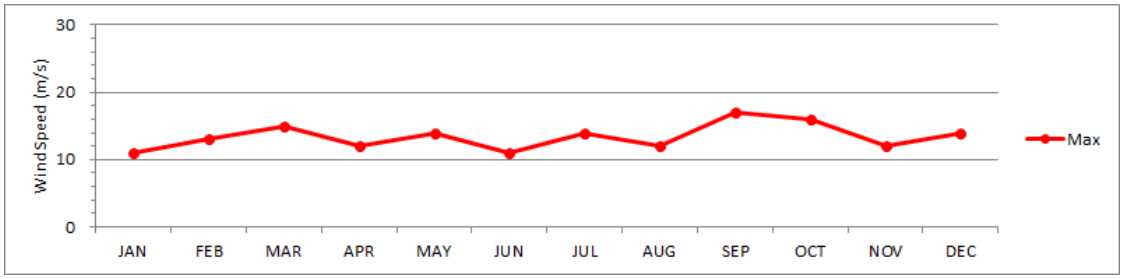


Source: JICA Study Team based on the data from PAGASA

FIGURE 10.7-4 MONTHLY MEAN TEMPERATURE AT DAVAO STATION (2008-2012)

2) Wind Speed and Direction

Over the course of the year, typical wind speeds varies from 0 m/s to 5 m/s, and it rarely exceeds 8 m/s. However, the maximum wind speed was recorded at range between 8 and 17 m/s during months of past 5 years. (The city is outside the typhoon belt.)
The typical wind is mostly the direction of the north (17% of the time) and south (14% of the time).

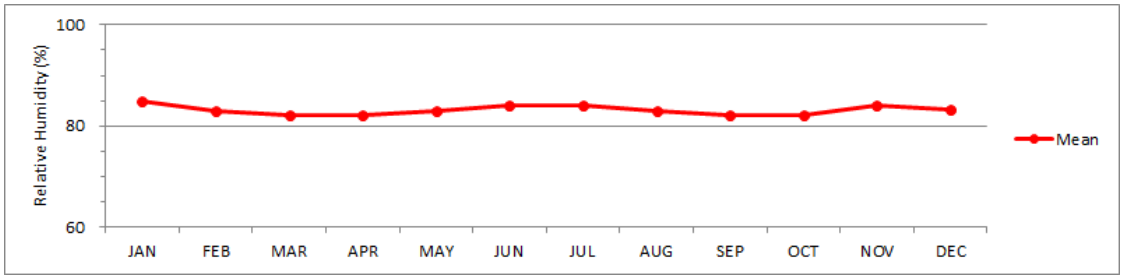


Source: JICA Study Team based on the data from PAGASA

FIGURE 10.7-5 MONTHLY MAXIMUM WIND SPEED AT DAVAO STATION (2008-2012)

3) Relative Humidity

The mean monthly relative humidity in Davao City is ranging between 78% and 86% during months of past 5 years. And the daily mean high / low relative humidity typically ranges from 61% to 95% over the course of the year.



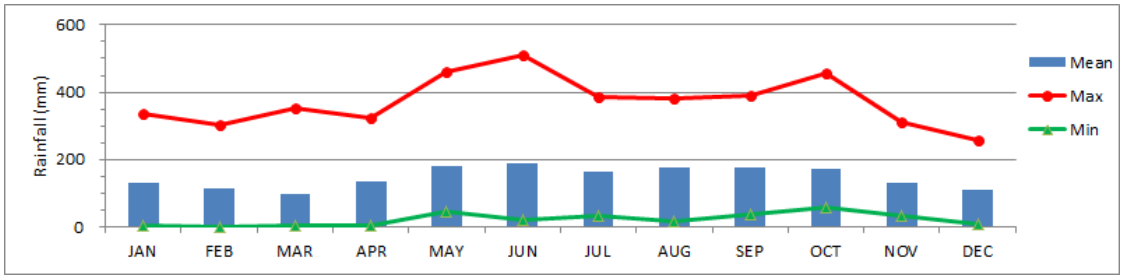
Source: JICA Study Team based on the data from PAGASA

FIGURE 10.7-6 MEAN MONTHLY RELATIVE HUMIDITY AT DAVAO STATION (2008-2012)

(2) Rainfall

1) Annual Rainfall and Seasonal Fluctuation

The monthly mean rainfall of past 52 years is no characteristic seasonal fluctuation, but the precipitation is slightly greater during May to October which the thunderstorms are easy to occur, as shown in **Figure 10.7-7**. However, its fluctuation range (max/min) of each month of past 52 years is relatively big. The monthly mean rainfall for each month varies from 191mm to 98mm, the annual mean rainfall is 1786mm. (1128 - 2358mm).

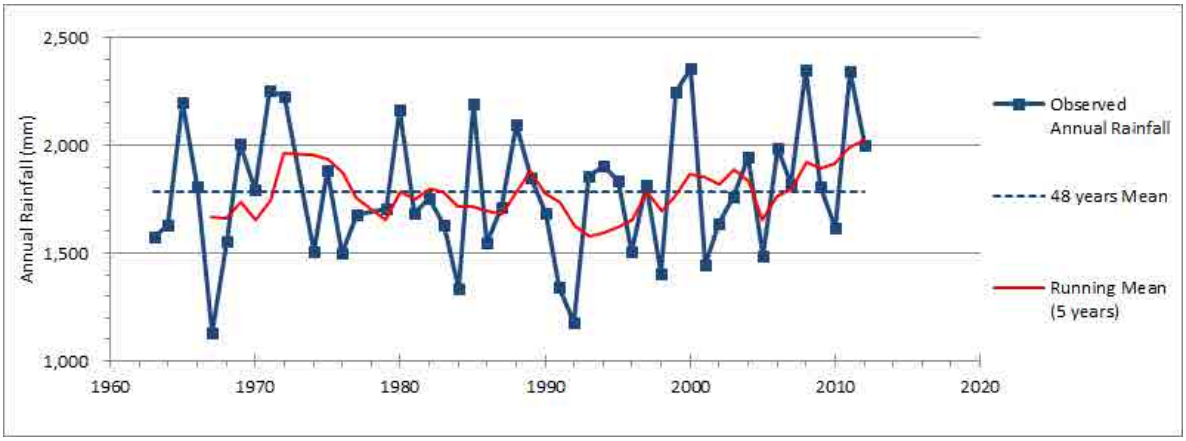


Source: JICA Study Team based on the data from PAGASA

FIGURE 10.7-7 MONTHLY MEAN (MAXIMUM, MINIMUM) RAINFALL AT DAVAO STATION (1961-2012)

2) Long-term Fluctuation of Annual Rainfall

According to the data of 48 years in the past, the annual rainfall varies from 1128mm to 2358mm as shown in **Figure 10.7-8**. (Average is 1786mm.) Also, this Figure is shown the long-term fluctuation of annual rainfall by using 5 year running mean at Davao. The cycle of wet and droughty periods is not clear, but it is indicated that limited rise trend of annual rainfall is going on in recent years.



Source: JICA Study Team based on the data from PAGASA

FIGURE 10.7-8 5-YEAR RUNNING MEAN RAINFALL AT DAVAO (1963-2012)

3) Exceedance Probability and Intensity Curve of Rainfall

The annual maximum daily rainfall data (extreme value) over 50 years or more in Davao meteorological station was collected. The 24 hour rainfalls of 2-100 year probabilities are calculated by using these extreme values of Davao station. On the other hand, the PAGASA had also estimated the probable rainfall each duration time, by using 62 year's records of Davao station. Both results of probability calculation are shown in **Table 10.7-2**.

TABLE 10.7-2 PROBABLE RAINFALL EACH RAINFALL DURATION AT DAVAO STATION

Return Period (Probability) (year, %)		Probable Rainfall each rainfall duration (mm) by PAGASA									Probable Rainfall by JICA study team	Remarks
		0.167	0.333	0.5	1	2	3	6	12	24hr		
		10	20	30	60	120	180	360	720	1440min		
2	50%	19.5	30.0	38.2	53.2	65.2	71.6	80.3	85.8	91.4	96.0	
5	20%	25.1	39.3	51.0	73.2	88.8	96.4	108.7	114.9	121.1	125.4	
10	10%	28.8	45.4	59.4	86.5	104.5	112.8	127.5	134.1	140.7	144.8	
15	6.667%	30.9	48.9	64.2	94.0	113.3	122.1	138.1	145.0	151.8	155.8	
20	5%	32.4	51.3	67.6	99.3	119.5	128.6	145.5	152.6	159.5	163.5	
25	4%	33.5	53.2	70.1	103.3	124.2	133.6	151.2	158.5	165.5	169.4	
50	2%	37.0	59.0	78.1	115.8	138.9	149.0	168.8	176.5	183.9	187.7	
100	1%	40.5	64.7	85.9	128.1	153.5	164.2	186.3	194.4	202.1	205.8	

Note: Probable rainfall by PAGASA was estimated based on past 61 year's record, and values of JICA Study Team are the estimation by past 52 year's record.

Source: PAGASA, JICA Study Team

As a result, the both probable rainfalls in case of 24 hour rainfall are nearly same, and hence, the value of PAGASA will be used in this study. The rainfall intensity calculated from the given probable rainfall is shown in **Table 10.7-3**.

TABLE 10.7-3 RAINFALL INTENSITY EACH RAINFALL DURATION AT DAVAO STATION

Return Period (Probability) (year, %)		Rainfall intensity each rainfall duration (mm/hr) by PAGASA									Remarks
		0.167	0.333	0.5	1	2	3	6	12	24hr	
		10	20	30	60	120	180	360	720	1440min	
2	50%	116.9	90.1	76.4	53.2	32.6	23.9	13.4	7.2	3.8	
5	20%	150.7	117.9	102.0	73.2	44.4	32.1	18.1	9.6	5.0	
10	10%	173.0	136.3	118.9	86.5	52.2	37.6	21.2	11.2	5.9	
15	6.667%	185.6	146.7	128.4	94.0	56.7	40.7	23.0	12.1	6.3	
20	5%	194.5	154.0	135.1	99.3	59.7	42.9	24.2	12.7	6.6	
25	4%	201.3	159.6	140.3	103.3	62.1	44.5	25.2	13.2	6.9	
50	2%	222.2	176.9	156.1	115.8	69.5	49.7	28.1	14.7	7.7	
100	1%	243.0	194.0	171.9	128.1	76.7	54.7	31.0	16.2	8.4	

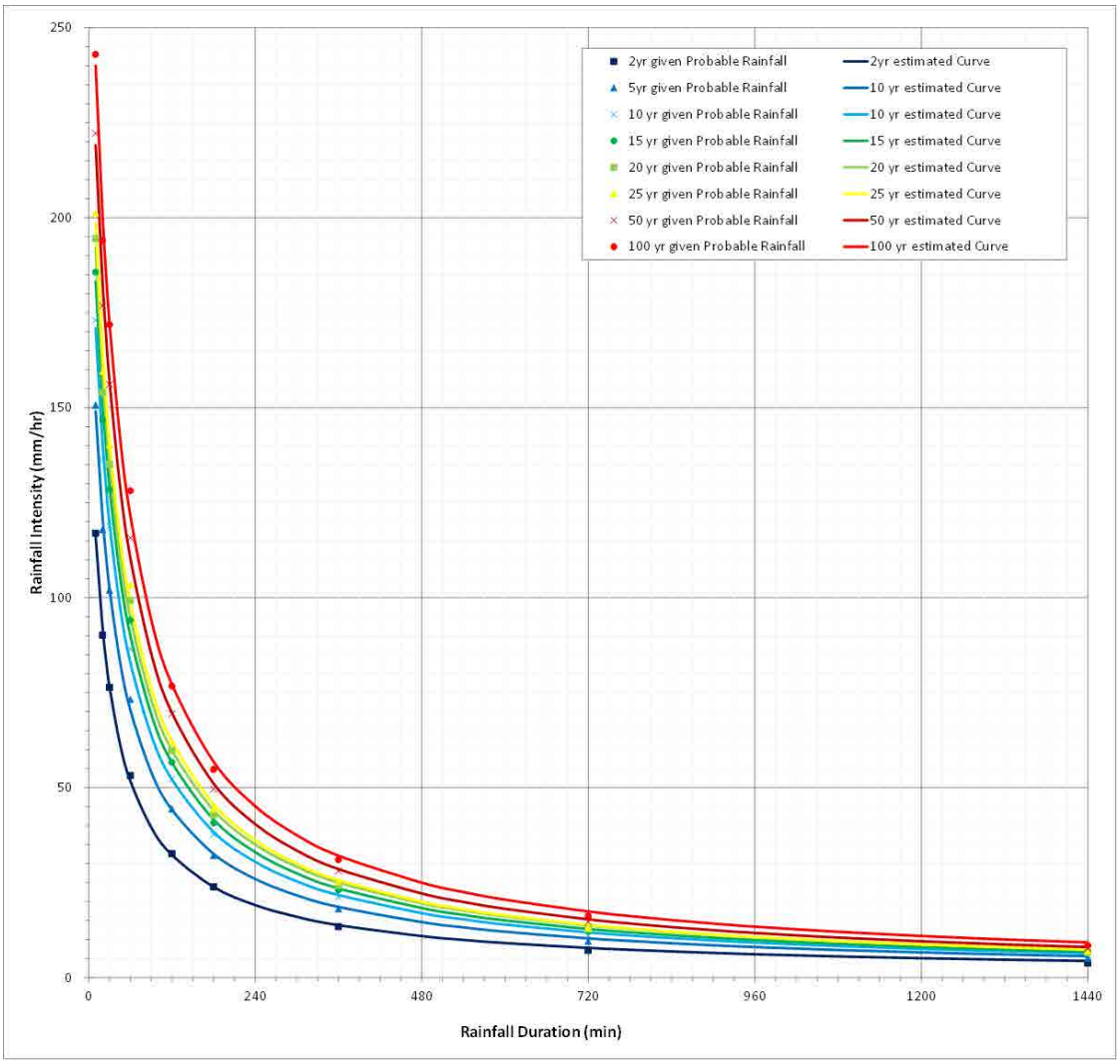
Source: PAGASA

The application for the rainfall intensity formula from the rainfall intensity, are estimated by solver function (least square method) of Microsoft Excel. Although there are many methods for rainfall intensity equation, the equation of Horner type is adopted in accordance with the DPWH's guideline in this Study. The rainfall intensity curve and the parameter of equation are shown in **Table 10.7-4** and **Figure 10.7-9**.

TABLE 10.7-4 COEFFICIENTS FOR RAINFALL INTENSITY FORMULA AND APPLIED PERIODS

Return Period (year, %)		Coefficient of Intensity Curve $I = A / (t+b)^n$			Design Criteria					Remarks
		A	b	n	Ditches and Road Surface	Embank-ment	Pipe Culverts Drainage Pipes	Rivers ($A<40km^2$) Box Culverts	Rivers ($A \geq 40km^2$)	
2	50%	2262.7	21.90	0.858	○					
5	20%	3949.3	28.33	0.899						
10	10%	5413.3	32.05	0.924		○				
15	6.667%	6325.7	33.89	0.936			○			
20	5%	6325.8	33.51	0.926						
25	4%	7553.9	35.98	0.951			△	○		
50	2%	9340.3	38.45	0.967				△	○	
100	1%	9340.3	37.59	0.948					△	

Note: "○" shows the design period applied, and "△" shows the design period for check.
Source: JICA Study Team based on the data from PAGASA



Source: JICA Study Team based on the data from BRS of DPWH

FIGURE 10.7-9 RAINFALL INTENSITY CURVE AT DAVAO STATION

10.7.3 Hydrological / Hydraulic Conditions

In order to predict the flow rate / water level in flood season, it is necessary to collect and correlate the hydrological and hydraulic conditions of the related rivers surrounding proposed bypass road.

In this study area, there are the past hydrological records of 5 gauge stations (for Davao, Lasang, Talomo, Lipadas and Matina rivers). The gauge station (for observing water level/discharge) is managed by the Bureau of Research and Standards (BRS) of DPWH. Of these stations, the 4 stations has been operating even now, but only Matina station was abolished already. Also, the location of Davao and Lasang stations were respectively changed one time in the past.

Inventory of river gauge stations is shown in **Table 10.7-5**. (Also, the location of them is shown in **Figure 10.7-1**.)

TABLE 10.7-5 INVENTORY OF RIVER GAUGE STATIONS

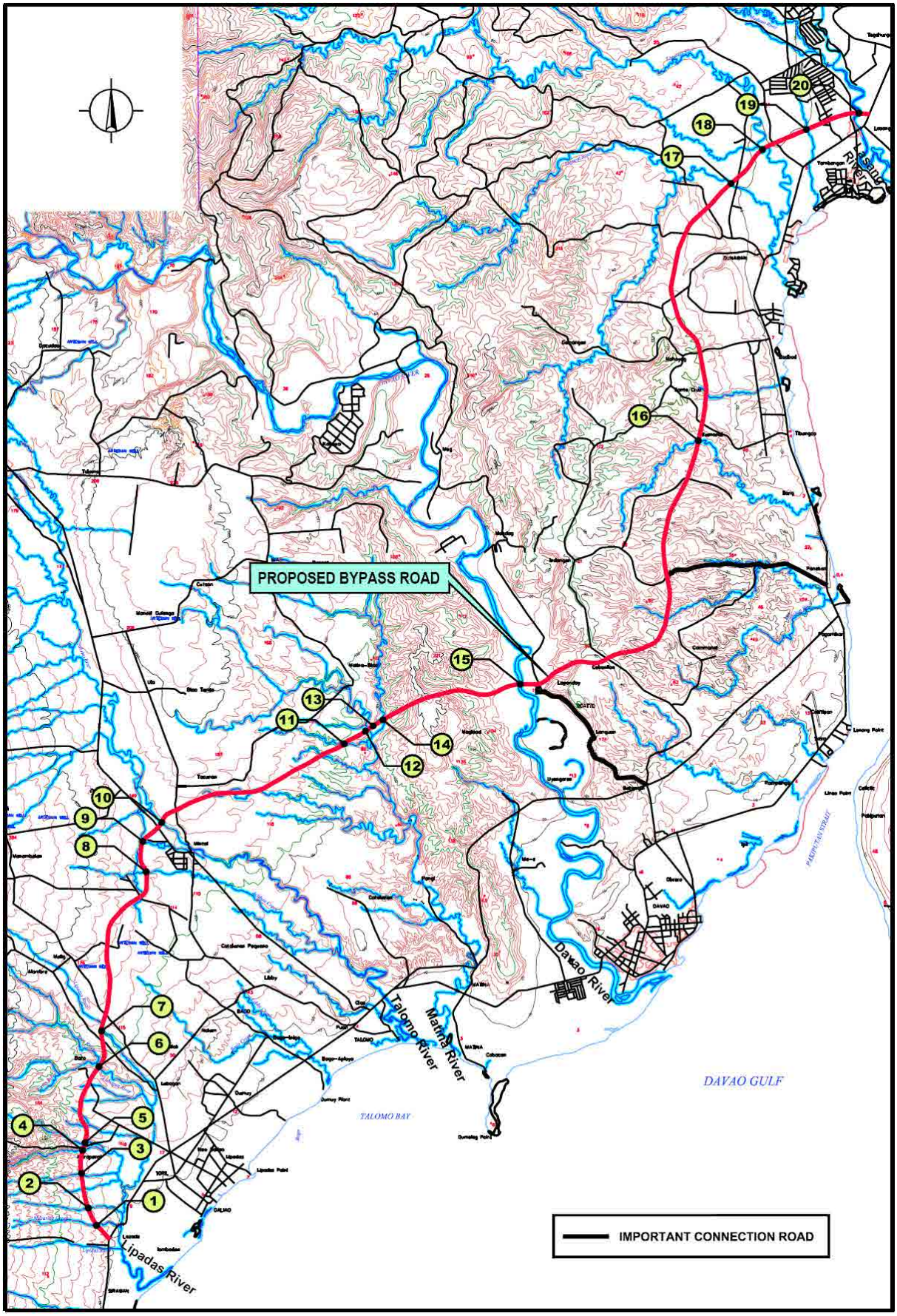
River / Gauging Station	Coordinates		Catchment Area (km2)	Height (m)	Type of Gauge	Period of Record	Water (Tide) level	Discharge	Observed by	Remarks
	Latitude	Longitude								
1. Davao River / Lacson	07-13'-53"	125-26'-32"	1,469	10.502	Staff Gauge	2001-	○	○	BRS	
1. Davao River / Tigatto	07-5'-38"	125-35'-35"	1,683	20	Staff Gauge	1984-1999	○	○	BRS	old station
2. Lasang River / Brgy	7-20'-12"	125-30'-42"	344	15.718	Staff Gauge	2002-	○	○	BRS	
2. Lasang River / Mabuhay	7-19'-28"	125-32'-2"	354	17.155	Staff Gauge	1985-1989	○	○	BRS	old station
3. Talomo River / Angalan II	7-8'-25"	125-28'-40"	165	13.235	Staff Gauge	1986-	○	○	BRS	
4. Lipadas River / Barangay	7-0'-12"	125-29'-4"	149	10	Staff Gauge	1986-	○	○	BRS	
5. Matina River / Pangi	7-7'-16"	125-32'-21"	48	5.89	Staff Gauge	1959-1970	○	○	BRS	old station

Source: BRS of DPWH

(1) Major Rivers and the Characteristics of River Flow

A substantial part of the Davao City is mountainous, characterized by extensive mountain ranges with uneven distribution of plateaus and lowlands. The mountain range at the western boundary extends as far down as South Cotabato and it nestles the Mountain Apo (the highest mountain peak in the Philippines at elevation 3,144 meters). Mountain Apo is considered as semi-active volcano. The large and contiguous lowland areas of the city are coastal plains and valleys extending inland as gently rising valleys. The entire land area of the city is drained by the above 5 rivers towards the Davao Gulf and the largest is Davao River. These rivers and their numerous tributaries are the main natural drainage systems in the area. Davao River originates from Davao del Norte, flows in a southward meandering along the central part of the City.

As rivers with a large catchment basin of the other, there are Lasang, Talomo, Lipadas and Matina Rivers. The location of major rivers in Davao city is shown in **Figure 10.7-10**.



Source: JICA Study Team based on the data from NAMRIA

FIGURE 10.7-10 LOCATION OF MAJOR RIVERS IN DAVAO CITY

1) Characteristics of River Flow

(a) Flow Characteristics of Related Rivers

The discharge-duration curve which is often used in Japan is examined in order to understand the potential surface water characteristics of the river through the year. The flow regime shows the annual flow condition using the daily discharge at each hydrological station, and is indicated by the daily discharge and the number of exceeded days. The annual flow regime shows as follows;

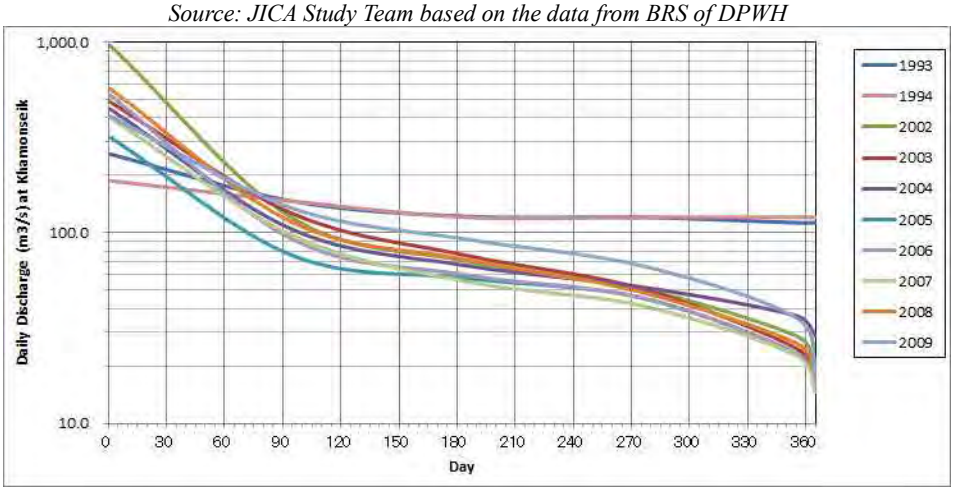
- High Discharge (95th daily discharge from the greatest)
- Normal Discharge (185th daily discharge from the greatest)
- Low Discharge (275th daily discharge from the greatest)
- Drought Discharge (355th daily discharge from the greatest)

The flow regime which was computed at 4 river gauge stations except the Matina River for recent 10 years period, is summarized in **Table 10.7-6 - Table 10.7-9** and **Figure 10.7-11 - Figure 10.7-14** The coefficient of river regime is the ratio of the minimum flow and the maximum flow rate at optional point of the river, and shows the stability of the river flow quantitatively. For example, in the Europe, 18 - Basel of the Rhine River, 4 - Vienna of the Danube river, 34 - the Seine River. In Japan, 930 - the Tone River, 870 - the Kiso River, 5060 - the Yoshino River.) As seeing in these Table and Figure, the coefficient of river regime differs by rivers. Also, the magnitude of coefficient of river regime indicates that the flow fluctuation is large, and if it is large, it indicates that the full year water intake is difficult and the flood damage is easy to occur.

TABLE 10.7-6 FLOW REGIME OF DAVAO RIVER DURING RECENT 10 YEARS

Year	Drainage Area (km^2)	Daily Discharge (m^3/s)							Coefficient of River Regime	Remarks
		Max.	High Dischage	Normal Discharge	Low Discharge	Drought Discharge	Min.	Mean		
			95th day	185th day	275th day	355th day				
1993	1,683	259	147	122	121	113	113	142	2.3	old station
1994	1,683	188	147	121	121	121	121	132	1.6	
2002	1,469	959	120	71	51	29	21	105	46.2	new station
2003	1,469	485	126	76	51	25	17	98	28.5	
2004	1,469	445	104	67	52	37	29	93	15.4	
2005	1,469	317	76	58	46	23	17	67	18.6	
2006	1,469	526	92	60	46	23	16	82	32.9	
2007	1,469	401	97	55	42	23	15	77	27.6	
2008	1,469	569	113	72	49	26	19	99	30.3	
2009	1,469	408	134	92	67	36	18	115	22.5	
Mean	-	456.0	116.0	79.0	64.0	46.0	38.0	101.0	12.0	

Source: JICA Study Team based on the data from BRS of DPWH



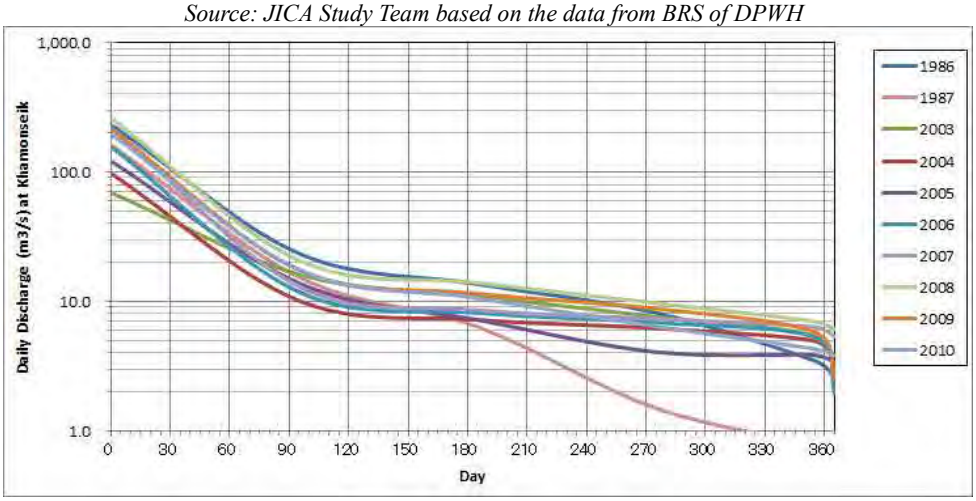
Source: JICA Study Team based on the data from BRS of DPWH

FIGURE 10.7-11 FLOW REGIME OF DAVAO RIVER DURING RECENT 10 YEARS

TABLE 10.7-7 FLOW REGIME OF LASANG RIVER DURING RECENT 10 YEARS

Year	Drainage Area (km^2)	Daily Discharge (m^3/s)							Coefficient of River Regime	Remarks
		Max.	High Dischage	Normal Discharge	Low Discharge	Drought Discharge	Min.	Mean		
			95th day	185th day	275th day	355th day				
1986	354	227	23	14	8	3	3	19	86.2	old station
1987	354	158	15	6	1	1	1	13	198.0	2 month- missing
2003	344	68	16	11	8	5	3	14	24.7	new station
2004	344	96	10	7	6	5	3	11	28.1	
2005	344	119	14	7	4	4	3	13	35.1	
2006	344	153	12	8	7	5	2	15	77.9	
2007	344	216	13	9	7	6	5	16	40.1	
2008	344	254	21	14	10	7	6	20	41.6	
2009	344	210	18	12	9	6	3	19	83.8	
2010	344	192	18	11	6	4	4	16	49.7	
Mean	-	169.0	16.0	10.0	7.0	5.0	3.0	16.0	56.3	

Source: JICA Study Team based on the data from BRS of DPWH



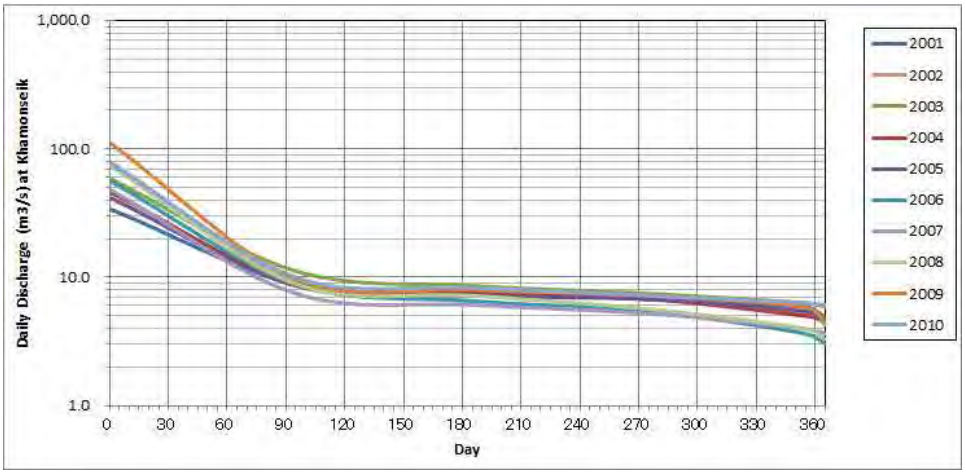
Source: JICA Study Team based on the data from BRS of DPWH

FIGURE 10.7-12 FLOW REGIME OF LASANG RIVER DURING RECENT 10 YEARS

TABLE 10.7-8 FLOW REGIME OF TALOMO RIVER DURING RECENT 10 YEARS

Year	Drainage Area (km^2)	Daily Discharge (m^3/s)							Coefficient of River Regime	Remarks
		Max.	High Dischage	Normal Discharge	Low Discharge	Drought Discharge	Min.	Mean		
			95th day	185th day	275th day	355th day				
2001	165	34	9	8	7	6	5	9	7.0	
2002	165	78	9	7	7	5	4	9	18.1	
2003	165	58	11	9	7	6	6	10	9.9	
2004	165	45	9	7	7	5	5	9	9.7	
2005	165	41	9	7	7	5	5	8	8.5	
2006	165	56	9	7	5	4	3	8	18.3	
2007	165	48	7	6	5	4	4	7	13.0	
2008	165	73	9	7	6	4	3	8	22.0	
2009	165	109	10	8	7	6	4	10	24.3	
2010	165	76	10	8	7	6	6	10	12.5	
Mean	-	62.0	9.0	7.0	7.0	5.0	5.0	9.0	12.4	

Source: JICA Study Team based on the data from BRS of DPWH



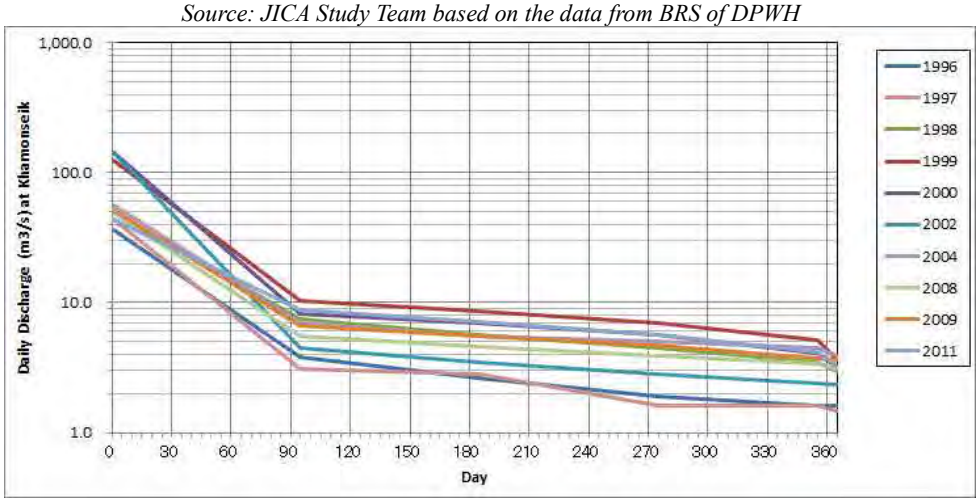
Source: JICA Study Team based on the data from BRS of DPWH

FIGURE 10.7-13 FLOW REGIME OF TALOMO RIVER DURING RECENT 10 YEARS

TABLE 10.7-9 FLOW REGIME OF LIPADAS RIVER DURING RECENT 10 YEARS

Year	Drainage Area (km^2)	Daily Discharge (m^3/s)							Coefficient of River Regime	Remarks
		Max.	High Dischage	Normal Discharge	Low Discharge	Drought Discharge	Min.	Mean		
			95th day	185th day	275th day	355th day				
1996	149	36	4	3	2	2	2	4	22.7	
1997	149	44	3	3	2	2	1	3	29.7	
1998	149	50	8	6	5	3	3	8	16.9	
1999	149	125	10	9	7	5	4	10	34.6	
2000	149	143	8	7	6	4	3	8	45.4	
2002	149	141	5	3	3	2	2	5	59.9	
2004	149	57	7	6	5	4	4	7	14.6	
2008	149	49	6	5	4	3	3	6	15.7	
2009	149	52	7	6	5	4	4	7	14.2	
2011	149	44	9	7	6	4	3	8	13.5	
Mean	-	74.0	7.0	5.0	4.0	3.0	3.0	7.0	24.7	

Source: JICA Study Team based on the data from BRS of DPWH



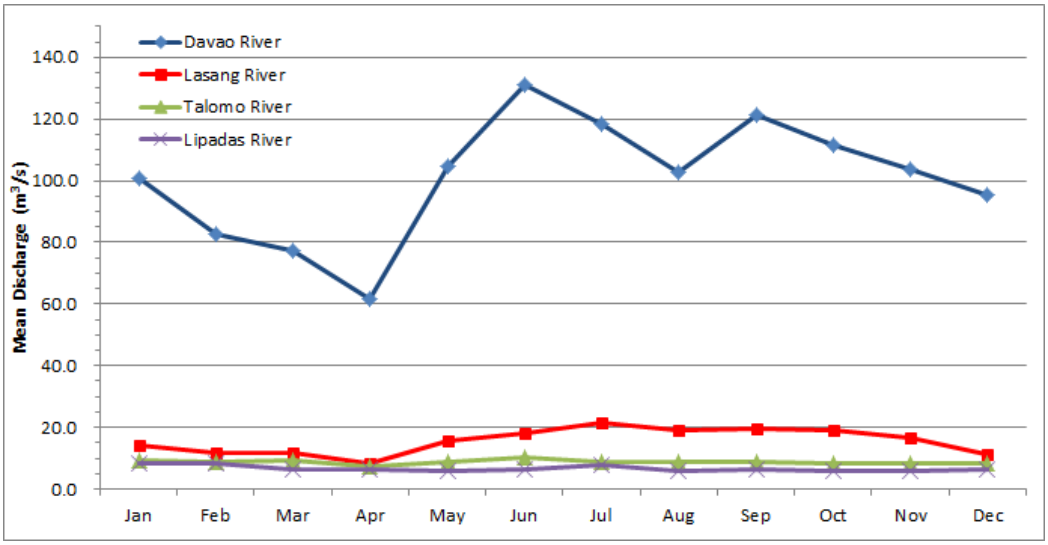
Source: JICA Study Team based on the data from BRS of DPWH

FIGURE 10.7-14 FLOW REGIME OF LIPADAS RIVER DURING RECENT 10 YEARS

(2) Monthly Flow Pattern of Major Rivers

The mean monthly flow pattern from the data of recent 10 years at 4 river gauging stations are shown in **Table 10.7-10** and **Figure 10.7-15**. Similar to the pattern of rainfall, the monthly flow

pattern is slightly greater during May to October which the thunderstorms are easy to occur. (See **Figure 10.7-15**.)



Source: JICA Study Team based on the data from BRS of DPWH

FIGURE 10.7-15 MEAN MONTHLY FLOW PATTERN AT RELATED RIVERS

TABLE 10.7-10 MEAN MONTHLY FLOW PATTERN AT RELATED RIVERS

River: Davao River
Station: Davao

Year	Drainage Area (km^2)	Monthly Mean Discharge (m^3/s)												Annual Mean Discharge
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
		1	2	3	4	5	6	7	8	9	10	11	12	
1986	1,683	155.3	142.9	135.0	127.4	126.9	148.4	157.6	149.6	183.1	123.0	125.7	129.7	1,704.7
1994	1,683	127.2	131.3	133.5	138.4	143.8	137.1	124.7	124.7	139.5	139.1	120.5	128.0	1,587.9
2002	1,469	134.6	63.8	81.8	31.9	144.4	191.5	79.5	134.2	104.0	128.4	108.8	57.8	1,260.8
2003	1,469	50.3	94.3	83.1	33.4	82.4	84.5	133.3	136.3	102.4	144.8	93.8	136.1	1,174.7
2004	1,469	64.5	64.1	63.5	60.6	104.4	129.8	161.1	68.9	178.9	73.6	49.4	91.8	1,110.5
2005	1,469	72.6	42.9	37.7	37.8	74.9	106.3	74.0	51.8	80.4	84.5	67.5	73.3	803.6
2006	1,469	59.6	66.5	86.3	29.0	55.4	102.0	55.0	87.5	136.5	161.8	87.5	50.3	977.3
2007	1,469	92.8	49.0	36.4	33.5	137.1	116.0	102.5	73.1	46.9	52.0	118.0	68.3	925.4
2008	1,469	79.0	64.3	48.1	36.8	59.7	144.4	135.3	78.8	182.7	130.2	112.7	121.3	1,193.2
2009	1,469	171.2	106.0	68.8	88.4	118.9	153.3	158.9	122.8	60.5	76.8	155.1	97.0	1,378.0
Mean	-	100.7	82.5	77.4	61.7	104.8	131.3	118.2	102.8	121.5	111.4	103.9	95.4	1,211.6

River: Lasang River
Station: Lasang

Year	Drainage Area (km^2)	Monthly Mean Discharge (m^3/s)												Annual Discharge
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
		1	2	3	4	5	6	7	8	9	10	11	12	
1986	354	25.8	25.4	27.5	16.2	7.0	10.1	37.2	12.3	22.8	20.7	21.4	4.7	231.2
1987	354	5.5	7.5	-	3.1	2.0	11.9	15.1	41.0	-	16.8	14.8	15.2	-
2003	344	7.5	10.7	8.5	6.2	14.0	10.8	20.2	21.6	15.4	14.1	14.2	21.0	164.0
2004	344	9.3	8.3	12.0	6.4	11.0	19.4	14.5	7.7	18.4	8.3	5.6	5.6	126.6
2005	344	4.5	4.1	4.3	4.1	28.1	8.8	24.8	17.7	22.8	14.3	12.7	9.0	155.2
2006	344	7.7	10.0	11.5	5.9	8.6	20.8	8.6	21.3	26.6	36.9	18.7	7.4	184.0
2007	344	20.8	8.2	8.2	7.5	32.3	19.1	14.8	14.3	7.1	11.4	31.1	15.0	189.8
2008	344	12.3	17.6	16.4	8.4	20.2	29.1	25.0	15.8	34.8	24.1	21.9	15.1	240.9
2009	344	37.2	18.8	13.5	20.4	19.1	33.4	24.4	17.8	7.8	9.4	16.1	8.7	226.7
2010	344	9.3	6.3	5.8	6.3	13.9	16.8	29.6	23.2	19.1	32.6	11.9	10.5	185.3
Mean	-	14.0	11.7	12.0	8.5	15.6	18.0	21.4	19.3	19.4	18.9	16.8	11.2	189.3

River: Talomo River
Station: Talomo

Year	Drainage Area (km^2)	Monthly Mean Discharge (m^3/s)												Annual Mean Discharge
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
		1	2	3	4	5	6	7	8	9	10	11	12	
2001	165	7.8	8.8	9.6	7.3	8.4	8.4	8.6	8.8	6.9	9.3	10.4	8.4	102.8
2002	165	13.6	9.6	8.8	7.4	10.3	9.1	7.5	8.7	11.3	6.7	7.5	7.0	107.6
2003	165	9.4	12.4	11.1	8.4	10.4	8.2	10.7	10.4	9.4	9.0	8.6	14.3	122.2
2004	165	8.7	8.6	8.9	7.0	12.6	10.0	9.9	6.5	7.9	6.8	8.2	8.3	103.4
2005	165	9.7	7.3	7.4	7.8	7.6	8.8	7.9	8.0	8.1	8.4	7.9	9.7	98.6
2006	165	9.0	10.7	15.6	5.6	6.9	11.5	5.0	5.6	7.0	10.5	6.1	6.1	99.6
2007	165	7.7	5.9	6.1	5.7	6.3	9.8	9.2	7.2	7.1	6.8	7.7	6.3	85.6
2008	165	7.8	8.1	9.9	7.4	7.6	12.9	8.2	8.8	9.8	7.0	4.7	6.7	98.9
2009	165	11.4	11.3	8.3	8.8	8.1	13.3	9.6	8.1	7.3	8.4	11.4	9.7	115.8
2010	165	9.7	7.1	8.4	7.9	7.7	9.5	11.6	14.8	11.9	8.7	8.6	9.0	114.8
Mean	-	9.5	9.0	9.4	7.3	8.6	10.1	8.8	8.7	8.7	8.2	8.1	8.6	104.9

River: Lipadas River
Station: Lipadas

Year	Drainage Area (km^2)	Monthly Mean Discharge (m^3/s)												Annual Mean Discharge
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	
		1	2	3	4	5	6	7	8	9	10	11	12	
1996	149	5.9	6.2	2.0	3.8	2.8	4.7	2.9	5.7	3.2	2.5	4.5	2.3	46.7
1997	149	6.2	4.7	4.7	3.0	4.8	2.6	2.7	2.0	3.4	2.2	2.2	2.5	41.0
1998	149	9.4	7.2	5.0	7.8	5.9	6.4	22.0	3.7	7.4	6.7	7.4	8.7	97.7
1999	149	16.0	8.1	12.3	10.6	8.4	6.8	10.8	9.2	8.4	9.2	8.6	16.9	125.4
2000	149	9.4	18.8	7.7	12.0	8.3	8.8	7.0	6.2	4.9	7.3	6.4	5.8	102.5
2002	149	9.8	11.1	5.7	3.3	4.2	3.9	2.9	3.3	5.9	4.6	4.5	4.2	63.3
2004	149	6.8	6.4	7.4	4.7	7.4	6.4	9.8	5.7	11.9	6.2	6.5	7.7	87.0
2008	149	5.9	5.9	5.6	3.9	3.6	8.9	4.6	5.9	6.8	6.4	7.1	5.0	69.6
2009	149	9.1	7.0	7.8	6.5	5.6	6.3	7.7	9.2	5.8	5.2	4.7	5.1	80.1
2011	149	6.3	8.3	7.5	9.6	8.6	8.5	7.8	9.2	8.4	7.6	5.8	4.9	92.4
Mean	-	8.5	8.4	6.6	6.5	6.0	6.3	7.8	6.0	6.6	5.8	5.8	6.3	80.6

Source: JICA Study Team based on the data from BRS of DPWH

(3) Tidal Level around Davao Gulf

The invert elevations of outlets of nearest rivers (the Lasang River) and main drains to the Gulf are are likely to affect the sea level. Hence the discharge capacities depend on the tide levels, i.e. high capacity at low tide and low at high tide.

For the Davao City, the observed tide record at the Station Ana Port shows the variation of tidal levels as shown in **Table 10.7-11**.

TABLE 10.7-11 TIDAL LEVEL AT DAVAO CITY (STA. ANA PORT)

Tide Condition	Elevation in meter above MLLW
Mean Higher High Water (MHHW)	1.536
Mean High Water (MHW)	1.407
Mean Sea Level (MSL)	0.755
Mean Low Water (MLW)	0.102
Mean Lower Low Water (MLLW)	0.000

Source: Storm Drainage Master Plan, Davao City, Aug 1998

10.7.4 Flood Conditions

In Davao City, drainage several projects (such as, dredging of Davao river, Davao City Storm Drainage Project, etc.) have been implemented in the past. Nevertheless, the flooding has been occurring frequently in Davao City.

Generally, floods can be classified into three types:

- Riverine floods in the river;
- Localized floods in urban area due to a combination of factors, such as cloudburst, saturated soil, poor infiltration rates and inadequate or poorly built infrastructure (such as blocked drains);
- Flooding due to typhoon and storm surge in the coastal areas.

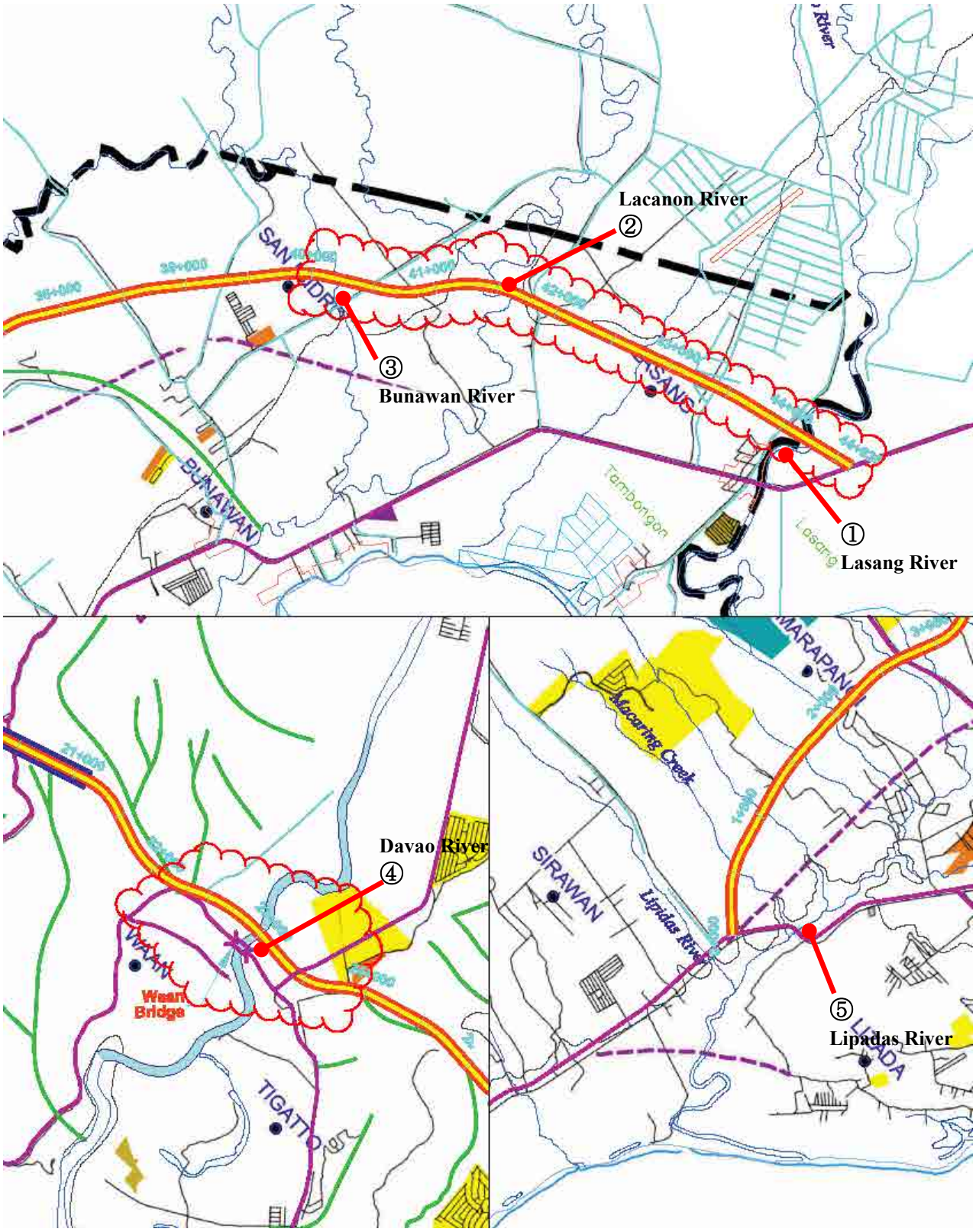
Surroundings of this proposed bypass road are hilly and lowland areas, and the major factors of floods are estimated from riverine floods in the river. According to the interview survey to local inhabitants, following locations occurred floods in the past as shown in **Table 10.7-12** and **Figure 10.7-16**.

From this interview Result, it is predicted that flood risks at surrounding areas from Bunawan River to Lasang River and Davao River are very high.

TABLE 10.7-12 INTERVIEW SURVEY RESULTS

Interviewed Location	Interview Results	Remarks
① Lasang River	Past Flood height: Ground Level + 0.70m (max) Frequency of overbank: Small floods are 6 times/year. Big flood is 1 time/2years.	Along proposed bypass
② Lacanon River	Past Flood height: Ground Level + 0.80m (max) Frequency of overbank: 4 times/2013	Along proposed bypass
③ Bunawan River	Past Flood height: Ground Level + 0.30m (max) Frequency of overbank: only 1 time (June 2011)	Along proposed bypass
④ Davao River	Past Flood height: Ground Level + 1.00m (max) Frequency of overbank: only 2 times (at Dec. 2012)	Along proposed bypass
⑤ Lipadas River	Past Flood height: Ground Level + 1.60m (max) Frequency of overbank: only 2 times (1987 and 2007)	Location away from proposed bypass (existing bridge of national road)

Source: JICA Study Team



Source: JICA Study Team

FIGURE 10.7-16 LOCATION AND RESULTS OF INTERVIEW SURVEY

10.7.5 Estimation of Probable Floods and Water Levels of Major Rivers

(1) Probable Floods at Gauge Stations

Past annual maximum discharges (extremal values) of 5 river gauging stations for the design discharges are collected as shown in **Table 10.7-13**.

TABLE 10.7-13 COLLECTION DATA LIST FOR ANNUAL MAXIMUM DISCHARGE

River Name		Davao			Lasang			Talomo			Lipadas			Matina		
Drainage area (old) km²		1683 (-1999)			354 (-1989)			-			-			-		
Drinage area km²		1469 (2001-)			344 (2002-)			165			149			48		
Extreme Value Data		Date	Discharge (m³/s)	Water Level (m)	Date	Discharge (m³/s)	Water Level (m)	Date	Discharge (m³/s)	Water Level (m)	Date	Discharge (m³/s)	Water Level (m)	Date	Discharge (m³/s)	Water Level (m)
	1	*1985/5/6*	*384.70*	-	*1985/7/10*	*126.52*	-	1986/3/10	78.00	1.90	1986/1/31	53.88	2.55	1959/10/28	35.00	2.04
	2	*1986/3/31*	*140.67*	-	*1986/1/31*	*310.57*	-	1987/2/5	69.00	1.80	1987/2/5	46.75	2.40	1960/8/27	114.20	3.00
	3	*1987/10/1*	*181.16*	-	*1987/8/21*	*141.49*	-	1988/10/23	37.00	1.40	1988/6/26	71.25	2.90	1961/1/31	21.20	1.80
	4	*1988/3/1*	*181.16*	-	*1988/11/25*	*157.04*	-	1989/4/17	78.00	1.90	1989/4/19	71.25	2.90	**1962/1/29**	**146.89**	**3.33**
	5	*1990/8/12*	*185.87*	-	2003/9/13	351.50	5.50	1990/11/9	16.40	1.00	1990/1/13	25.00	1.90	1963/3/3	6.40	1.40
	6	*1992/9/1*	*387.54*	-	2004/6/8	351.50	5.50	1991/6/29	87.00	2.00	1991/6/25	25.83	1.73	1964/2/15	5.30	1.35
	7	*1993/2/6*	*225.63*	-	2005/10/31	467.20	4.91	1993/7/3	48.20	1.56	1992/8/9	26.90	1.76	1966/8/12	12.20	1.60
	8	*1994/10/1*	*163.66*	-	**2006/6/16**	**774.00**	**5.80**	1998/1/6	33.70	1.34	1993/7/27	46.15	2.20	1967/6/29	21.20	1.80
	9	*1999/9/14*	*551.64*	-	2007/11/11	385.50	4.00	1999/12/12	157.00	2.58	1994/6/8	37.15	2.00	1968/1/13	143.80	-
	10	2001/3/28	726.00	4.30	2008/6/29	547.30	4.54	2000/2/16	205.00	2.90	1995/2/8	41.65	2.10	1969/7/1	9.20	1.50
	11	**2002/1/4**	**1360.20**	**5.98**	2009/1/15	346.30	3.86	2001/6/1	67.00	2.00	1996/1/2	41.65	2.10	1970/9/24	46.20	2.20
	12	2003/12/22	627.10	3.98	2010/10/15	385.50	4.00	2002/1/4	175.00	2.70	1997/3/6	59.65	2.50	-	-	-
	13	2004/9/26	864.00	4.70	-	-	-	2003/12/22	97.00	2.10	1998/7/7	55.20	2.10	-	-	-
	14	2005/6/18	355.60	2.98	-	-	-	2004/5/9	108.00	2.20	1999/12/12	229.20	4.50	-	-	-
	15	2006/3/9	678.50	4.15	-	-	-	2005/10/22	78.00	1.90	2000/2/16	261.20	4.80	-	-	-
	16	2007/1/9	719.60	4.28	-	-	-	2006/3/5	108.00	2.20	2001/4/3	200.45	4.20	-	-	-
	17	2008/7/4	651.00	4.06	-	-	-	2007/12/11	97.00	2.10	2002/2/19	141.45	3.50	-	-	-
	18	2009/1/15	474.30	3.44	-	-	-	2008/3/10	145.00	2.50	2003/1/24	56.10	2.12	-	-	-
	19	-	-	-	-	-	-	**2009/6/29**	**285.50**	**3.50**	**2004/9/28**	**304.25**	**5.00**	-	-	-
	20	-	-	-	-	-	-	2010/12/6	78.00	1.90	2008/11/14	126.80	3.08	-	-	-
	21	-	-	-	-	-	-	-	-	-	2009/3/6	222.50	4.20	-	-	-
	22	-	-	-	-	-	-	-	-	-	2010/11/29	272.00	4.70	-	-	-
	23	-	-	-	-	-	-	-	-	-	2011/10/7	159.75	3.50	-	-	-

Note: The annual maximum value of old stations' data at Davao and Lasang Rivers is adjusted by the ratio of basin area of new and old stations.

Source: JICA Study Team based on the data from BRS of DPWH

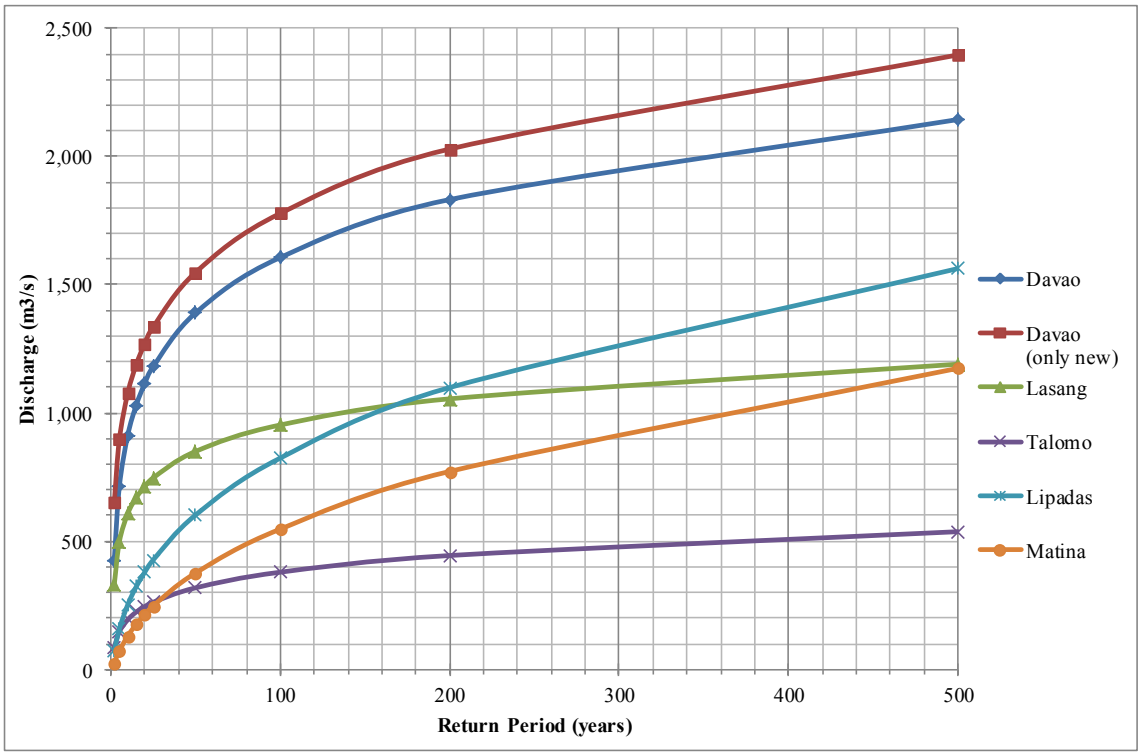
The probable discharges are calculated according to the followings;

- To select the appropriate model for probability distribution from the several methods. In this study, the smallest SLSC (Standard Least-Square Criterion) is adopted from calculation results.
- Calculation return periods are for 2, 5, 10, 15, 20, 25, 50, 100, 200 and 500 year.

The results of probable discharge at 5 discharge-gauge stations (Davao, Lasang, Talomo, Lipadas and Matina) are shown in **Table 10.7-14**.

TABLE 10.7-14 COMPUTATION OF PROBABLE FLOODS AT EXISTING GAUGE STATIONS

Station Name	Davao	Davao (only new)	Lasang	Talomo	Lipadas	Matina	Remarks
Drainage Area (km^2)	1,469	1,469	344	165	149	48	
Return Period (years)	Probable Discharge (m^3/s)						
2	427	651	331	86	71	25	
5	713	896	498	147	158	72	
10	914	1,078	608	194	253	131	
15	1,031	1,189	670	224	323	176	
20	1,115	1,271	713	245	379	214	
25	1,181	1,336	747	262	427	248	
50	1,390	1,548	850	318	602	376	
100	1,606	1,778	953	379	824	547	
200	1,832	2,029	1,055	444	1,099	772	
500	2,144	2,396	1,190	537	1,563	1,174	
Applied probability distribution curve	Generalized extreme value distribution	Generalized extreme value distribution	Gumbel distribution	SQRT-exponential type maximum distribution	3-parameter log-normal distribution (Quantile method)	3-parameter log-normal distribution (Quantile method)	



Source: JICA Study Team

(2) Probable Floods at Crossing Points of Major Rivers

The discharges at proposed crossing points (bridge sites) are calculated by multiplying the proportion of the catchment area of each catchment area to the probable discharges of each gauge stations upstream. (Method by the "specific discharge") Probable discharge used for the hydraulic calculation is shown in **Table 10.7-15**.

TABLE 10.7-15 PROBABLE FLOODS AT CROSSING POINT OF MAIN RIVERS

Station Name		**Davao**	(Davao)	**Lasang**	(Lasang)	**Talomo**	(Talomo)	**Lipadas**	(Lipadas)	(Bato)	**Matina**	(Matina)	(Malogbok)	Remarks
Drainage Area	km^2	1,469	1,673.4	344	412.7	165	170.1	149	41.0	63.8	48	17.2	15.3	
	m^3/s													
Probable Discharge at Return Period	2	651	741.6	331	397.1	86	88.7	71	19.5	30.4	25	9.0	8.0	
	5	896	1020.7	498	597.4	147	151.6	158	43.4	67.6	72	25.9	22.9	
	10	1,078	1228.0	608	729.3	194	200.0	253	69.6	108.3	131	47.0	41.7	
	15	1,189	1354.4	670	803.7	224	231.0	323	88.8	138.2	176	63.2	56.1	
	20	1,271	1447.8	713	855.3	245	252.6	379	104.2	162.2	214	76.8	68.2	
	25	1,336	1521.9	747	896.1	262	270.1	427	117.4	182.8	248	89.1	79.0	
	50	1,548	1763.4	850	1019.6	318	327.9	602	165.5	257.7	376	135.0	119.8	for Design
	100	1,778	2025.4	953	1143.2	379	390.8	824	226.6	352.7	547	196.4	174.3	for Check
	200	2,029	2311.3	1,055	1265.6	444	457.8	1,099	302.2	470.4	772	277.2	246.0	
	500	2,396	2729.4	1,190	1427.5	537	553.7	1,563	429.8	669.0	1,174	421.6	374.1	

Source: JICA Study Team

From each flow regime of 4 river, the normal discharge and low discharge are also estimated as shown in the **Table 10.7-16**.

TABLE 10.7-16 NORMAL AND LOW DISCHARGE AT CROSSING POINT OF MAIN RIVERS

Crossing Points of Proposed Bypass	Recorded Year	at Gauging Station			at Crossing Points of Bypass				
		Drainage Area (km^2)	Normal Discharge (m^3/s)	Low Discharge (m^3/s)	Drainage Area (km^2)	Normal Discharge		Low Discharge	
						($m^3/s/km^2$)	(m^3/s)	($m^3/s/km^2$)	(m^3/s)
Davao	1993-2009	1,469	79.0	64.0	1,673.4	0.05198	87.0	0.04175	69.9
Lasang	1986-2010	344	10.0	7.0	412.7	0.02834	11.7	0.01928	8.0
Talomo	2001-2010	165	7.0	7.0	170.1	0.04528	7.7	0.03954	6.7
Lipadas 1	1996-2011	149	5.0	4.0	41.0	0.03540	1.5	0.02872	1.2
2					63.8		2.3		1.8
Average Discharge per 1 km^2					1	0.04025	-	0.03232	-

Source: JICA Study Team

(3) Discharge Calculation for other Rivers and Channels

Following the DPWH design criteria, Rational Formula will be used for catchment areas less than 20 km^2 and aside from the Probable Flood Method or Flood Frequency Analysis, Unit Hydrograph method will be used to waterway crossings with catchment areas larger than 20 km^2.

Probable Flood Method as shown in the previous section is conducted to 5 gauged rivers in the project alignment, Davao, Lasang, Talomo and 2 Lipadas Rivers.

For ungauged waterways, design floods were estimated by Rational Formula and Unit hydrograph method by first measuring the watershed parameters.

1) Watershed Parameter

The following topographic parameters are determined: catchment area (A), the water course length (L), and the difference in elevation from the farthest watershed point up to the point of

interest (a bridge site, culvert or outfall, H).

In flood plain areas, wherein drainage boundaries can hardly be established for each culvert, drainage is satisfied by a group of balancing culverts.

2) Rational Method

$$\mathbf{Q_y = 0.278CI_{t,y}A}$$

Where:

Q_y	–	Peak discharge (m^3/s),
C	–	Runoff coefficient (**Table 10.2-5**),
$I_{t,y}$	–	Rainfall intensity (mm/hr) for time of concentration (t_c), and
A	–	Catchment area (km^2). The catchment area of a major or minor waterway

3) Unit Hydrograph Analysis

Unit hydrograph approach is generally accepted for larger areas and the method involved derivation of dimensionless hydrograph of the gauged rivers in the region. From this dimensionless hydrograph, the unit hydrograph at the bridge site was derived. With the available design rainfall data and watershed characteristics of the project area, the unit hydrograph is converted to design flood hydrograph. In the absence of the recorded dimensionless hydrograph of the gauged rivers in the region, the SCS synthetic unit hydrograph will be adopted for the study as shown in **Figure 10.7-17.**

The above design flood estimates are analytically checked with the actual flood data and flooding estimates based on the actual or locally observed information.

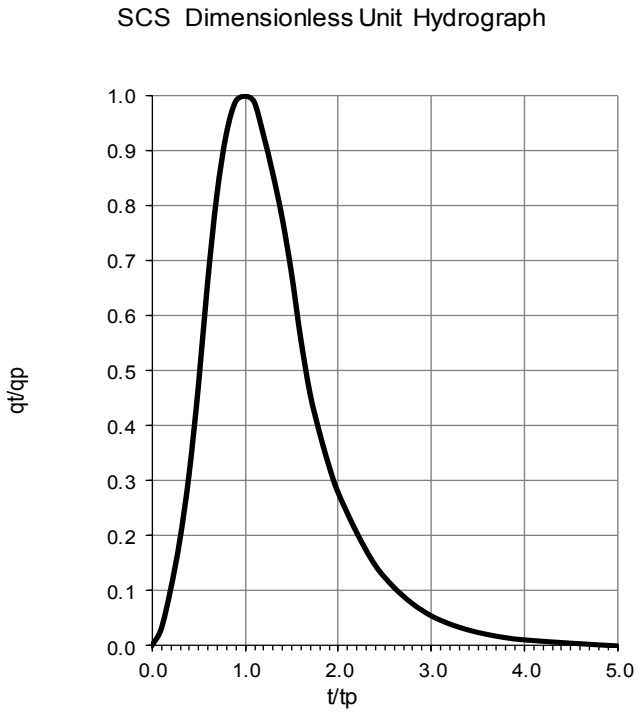


FIGURE 10.7-17 SCS DIMENSIONLESS UNIT HYDROGRAPH

4) Adopted Design Discharge

Adopted design discharge is the computed design discharge using the above methodology plus allowances for siltation and climate change. Climate change is already considered by increasing

the design discharge criteria of culverts as from 10-yr to 15-yr for RCPC and considering a sufficient freeboard to contain 50-yr flood for reinforced concrete box culverts (RCBC) and 25-yr flood for the reinforced concrete pipe culverts (RCPC).

Allowance of 50% was added to the computed design discharge for siltation and debris as the area is prone to slope degradation during heavy rains.

(4) Hydraulic Calculation

1) Calculation Method for Rivers

Hydraulic analysis is carried out to simulate the flood phenomena (High Water Level, etc.) at the related river using HEC-RAS (Hydrologic Engineering Center - River Analysis System) developed by US Army Corps of Engineers, USA.

HEC-RAS has the capability to compute one-dimensional water surface profiles for both steady and unsteady flow. Sub-critical, supercritical and mix flow regime profiles can be calculated.

Water surface profiles are computed from one cross section to the next by solving the energy equation using standard-step method. Energy losses are evaluated by friction (Manning's equation) and contraction/expansion coefficients. HEC-RAS requires inputs for boundary conditions of upstream discharge and either downstream water level or known energy gradient.

HEC-RAS analysis for the identified bridge sites in the alignment is shown in **Table 10.7-17.**

TABLE 10.7-17 BRIDGE HYDRAULIC RESULT SUMMARY

Watershed No.	DESCRIPTION			WA	ADOPTED DEIGN FLOOD, m3/sec		Design Discharge Computation Method	Adopted Design Discharge ,Qd	HEC-RESULTS	
	Survey Waterway No.	Station		km^2	50-yr	100-yr		m^3/sec	**50-YR FLOOD LEVEL, m**	ADOPTED BRIDGE SPAN
2	R1	0+451.22	Macaring Creek-R1	1.86	88.86	97.47	Rational Formula	88.86	**24.65**	Refer to Plan & Profile
3	R2	0+984.35	Creek3-R2	1.12	56.17	61.59	Rational Formula	56.17	**32.05**	Refer to Plan & Profile
5	R3	2+000.00	Creek5-R3	6.24	231.24	254.22	Rational Formula	231.24	**35.18**	Refer to Plan & Profile
6	R4	2+600.00	Bayabas Creek-R4	19.53	643.93	708.84	Rational Formula	643.93	**31.76**	Refer to Plan & Profile
7	R5	2+800.00	Tributary of Bayabas Creek-R5	4.23	176.47	193.79	Rational Formula	176.47	**28.95**	Refer to Plan & Profile
12	R6	5+020.00	Lubogan River-R6	65.55	552.01	606.44	Hydrograph	552.01	**48.70**	Refer to Plan & Profile
13	R7	6+080.00	Lipadas River- R7	43.63	326.65	364.91	Hydrograph	326.65	**105.51**	Refer to Plan & Profile
17	R8	10+764.57	Aclihan Creek-R8	3.07	111.80	122.93	Rational Formula	99.73	**128.44**	
17	R9	11+587.19	Talomo River Tributary-R9	3.07	111.80	122.93	Rational Formula	99.73	**144.04**	
17	R10	12+300.00	Talomo River-R10	3.07	855.72	951.95	Hydrograph	855.72	**127.36**	Refer to Plan & Profile
26	R15	22+950.00	Davao River-R15	1,718.26	2,645.10	3,038.10	Probable Flood	2,645.10	**11.89**	Refer to Plan & Profile
36	R16	32+600.00	Kumonal Creek-R16	7.65	199.24	219.96	Rational Formula	199.24	**24.71**	Refer to Plan & Profile
41	R17	40+325.00	Tagurot-Bunawan River-17	59.88	320.43	356.12	Hydrograph	320.43	**12.47**	Refer to Plan & Profile
42	R18	41+535.00	Lacanon River-18	92.25	340.66	382.85	Hydrograph	340.66	**11.24**	Refer to Plan & Profile
43	R19	42+790.00	Creek42-19	4.28	177.60	195.04	Rational Formula	177.60	**8.34**	Refer to Plan & Profile
44	R20	44+320.00	Lasang River-20	427.30	1,529.40	1,714.80	Probable Flood	1,529.40	**6.90**	Refer to Plan & Profile

Note: With a more detailed survey the above results need to be re-assess during the next Phase of the Study

2) Calculation Method for Culverts

Based on the basic continuity equation Q=AV, hydraulic analysis of structures like the RCPC/RCBC, side ditches, and irrigation canals or re-aligned waterways were conducted.

The above structures are referred as closed conduits. Closed conduits are designed for the condition of flowing full but usually they are flowing less that they are considered as open channels.

Construction slopes flatter than the hydraulic gradient will cause the conduit to run pressure for the design Q that a consideration be given in increasing the size. In steeper construction slope, the conduit may not flow full that a smaller size may be considered.

The following are criteria for design of closed conduit cross-drains adopted for the road project:

a) Minimum slope of 0.20% is recommended for extremely flat terrain as required for the actual outfall elevation.

b) For rolling mountainous terrain, cross-drains are designed for appropriate inlet control works and laid with slope that the computed outlet velocity will not exceed the damaging velocity of 3 m/s. However, in extreme cases where outlet velocity of 3 m/sec. to 5 m/sec cannot be avoided, dumped rock with a distance 4 to 6 m from the outlet is recommended. Outlet velocities beyond 5 m/s will require outlet energy dissipators. For the project area, the use of stone masonry step energy dissipators or box gabions are recommended as masonry stones and smaller stones for gabions are abundant in the area.

c) A minimum of 910 mm dia. is adopted for new installations taking into consideration the condition and performance of the existing cross-drains in the area in relation to the expected debris flow.

d) In areas dictated by some restrictions wherein the use of circular barrel is not feasible as higher discharges or higher debris flows are expected, the use of reinforced concrete box culverts are recommended. In the project area locations where high debris flows are expected, the use of 2-barrel RCBC/RCPC installation will be avoided as much as possible.

e) A minimum of 0.60 meter fill pipe covering is adopted; otherwise an equivalent reinforced concrete box culvert will be adopted in areas where this minimum pipe fill will not be met.

f) Inlet and outlet works are determined through the Headwater Depth (HW) ratio to the depth of Depth of culvert (D). Headwater depth is the vertical distance from the culvert invert to the water surface elevation permissible in the approach channel.

Where:

$\frac{HW}{D}$	$\leq$	1.2	entrance not submerged, no protection works needed at the entrance of culvert
$\frac{HW}{D}$	$\geq$	1.5	necessary to protect the inlet with riprap or stone masonry
HW	$>$	1.0	not usual for flat terrain

Generally, inlet control exists when the ability of the culvert pipe barrel to carry the flow exceeds the ability of the water to enter the culvert though the inlet. Outlet control exists when the ability of the pipe barrel to carry water away from the outlet is less than the flow that can enter the inlet.

In rolling mountainous terrain the inlet is controlling the flow while in flat terrain the outlet governs the amount of flow in pipes.

Sizing of road crossings as governed by either inlet or outlet works is determined with the use of monographs and computer programs available for such purposes.

Design discharge for each cross-drain site was identified. However, in cases were no single waterway line is identified in a certain watershed along the project road, the number of cross-drains were determined according to the required drainage capacity that could satisfy the design discharge for that area. Determination of the number of culvert crossings is simplified by this equation:

$$Np = Qt/Op$$

Where:

NP – total number of cross-drain
Qt – total discharge
Qp – pipe capacity derived from nomographs for outlet or inlet control

In existing cross-drain locations where NpQp < Qt new culvert lines are installed or existing lines are replaced with bigger sizes.

To use a single barrel of multiple barrel installations or an equivalent box culvert dimension is also govern by sufficiency of the ground cover and the expected debris flow.

Using the basic continuity equation, HY-8 is the automated the design methods described in HDS No. 5, "Hydraulic Design of Highway Culverts" FHWA-IP-85-15; HEC No. 14. With the basic inputs as the computed total design discharge, site data which refers to elevations and embankment slope, culvert data which includes culvert type, span and length, original ground and road embankment level, tail water and roadway crossing data, the software automatically analyze to give the headwater elevation, velocity etc. for the given design discharge and section.

Based on the cross-drains hydraulics computation result, the culvert size was determined.

3) Roadside Ditches or Canals

Road on cut sections, on flat terrain wherein embankment height less than 1 meter and on built-up flood areas shall be provided with side ditches.

Channel dimensions, slope and channel velocity are determined as much as possible especially in unlined channels not too severe to cause scouring and erosion and too small to cause deposition of sediments in the channel.

Line ditches such as grouted riprap or concrete lined are recommended in high velocity sections and concrete rectangular covered or without cover canals are recommended in urban areas otherwise, triangular or trapezoidal earth ditches are recommended.

In areas where much sediment load is expected an allowance of at least 50% to 100% is provided to area obtained by Q = AV and road alignment susceptible to underground water capillary actions, underdrains are provided. Results are tabulated in **Appendix 10.7.**

10.8 SLOPE PROTECTION DESIGN

10.8.1 Cut-slope Gradient

The geological features of the project section are underlain by Masuhi Formation (sandstone, shale and conglomerate) of the Tertiary Miocene-Pliocene. Geological features on Masuhi Formation are composed of “Mandog Formation (lithified gravel and sand) and Apo Volcanic Complex (Basalt, andesite, pyroclastic rocks, pyroclastic flow deposits, volcanic mud flow deposits) and Bunawan Limestone” of the Quaternary Pleistocene, and “Tigatto Terrace Gravel and Alluvium (unconsolidated sand and gravel)” of the Quaternary Holocene.

The total length of the proposed road is approximately 44.8 km, including the tunnel section of about 2.3km. Mandog Formation, Bunawan Limestone and Tigatto Terrace Gravel are laid in the section of up to Davao River from the north end point, and Alluvium is laid in the section of Davao River. In addition, Mandog Formation, Bunawan Limestone and Tigatto Terrace Gravel are underlain by Masuhi Formation in the mountain section of up to Matina River from Davao River where is proposed a tunnel. The Apo-Talomo Volcanics of Apo Volcanic Complex

extensively overlies the Masuhi Formation in the section of up to south end point from Matina River.

The cut slopes gradient of each stratum above mentioned are recommended as shown in **Table 10.8-1** based on **Table 10.2-7** it is shown in the "Standard Gradient of Cut Slopes".

TABLE 10.8-1 SUGGESTION OF CUT-SLOPE GRADIENTS

Stratum	Geologic Time	Description	Condition of Subsoil and Rocks	Suggested Cut-slope Gradient
Tigatto Terrace Gravel	Holocene	Terrace deposits which are composed of stratified loose sandy gravel	Sandy Soil Mixed with Gravel or Rock Masses	1.0:1.0
Bunawan Limestone	Late Pleistocene	Coralline limestone	Soft-Hard Rock	0.8:1.0
Apo-Talomo Volcanics	Pleistocene	Volcanic ash, volcanic mud flows, pyroclastic flows	Cohesive Soil Mixed with Rock Masses or Cobblestones	1.2:1.0
Mandog Formation	Early-Late Pleistocene	Lithified interbedded sandy soil and cohesive soil, and including thin gravel layers	Sandy Soil, Cohesive Soil, Soft Rock	1.0:1.0
Masuhi Formation	Late Miocene-Early Pliocene	Interbedded sandstone and mudstone, and including thin conglomerate	Soft Rock	0.8:1.0

10.8.2 Cut-slope Protection

The suitable cut slope protection consisting of the planting and slope structures for the each stratum are recommended as shown in **Table 10.8-2**, according to **Figure 10.2-4** (the selection flowchart of slope protection) it is shown in the “Selection Method of Cut Slope Protection”. Incidentally, the slope structures are assumed the case to make steep slopes than the standard slope gradient.

TABLE 10.8-2 SUGGESTION OF SLOPE PROTECTION

Stratum	Geologic Time	Description	Suggested Slope Protection	
			Planting	Slope Structures
Tigatto Terrace Gravel	Holocene	Terrace deposits which are composed of stratified loose sandy gravel	Vegetation Mat (1.0:1.0)	Grating Crib Works using Shotcrete (0.8:1.0)
Bunawan Limestone	Late Pleistocene	Coralline limestone	Vegetation Base Material Spraying (0.8:1.0)	Concrete Pitching (0.5:1.0)
Apo-Talomo Volcanics	Pleistocene	Volcanic ash, volcanic mud flows, pyroclastic flows	Sowing (1.2:1.0)	Grouted Riprap (1.0:1.0)
Mandog Formation	Early-Late Pleistocene	Lithified interbedded sandy soil and cohesive soil, and including thin gravel layers	Vegetation Mat (1.0:1.0)	Grating Crib Works using Shotcrete (0.8:1.0)
			Vegetation Base Material Spraying (1.0:1.0)	Stone/ Rubble-Concrete Masonry (0.5:1.0, Soil Slope Type)
Masuhi Formation	Late Miocene-Early Pliocene	Interbedded sandstone and mudstone, and including thin conglomerate	Vegetation Base Material Spraying (0.8:1.0)	Mortar/Concrete Spraying (Shotcrete) (0.8:1.0)
				Stone/ Rubble-Concrete Masonry (0.5:1.0, Rock Slope Type)

Note: - The planting should be used in case of the suggested cut-slope gradient shown in Table 10.8.1-1. And the slope structures should be used to make steep slopes than the standard slope gradient (excepting the mortar/concrete spraying).

- The assumed slope gradient is shown at the inside of ( ).

Besides, when the suggested slope protections in **Table 10.8-2** are applied, the considerations are as follows.

- Because the applicable conditions of the vegetation mat are different by the products, it is necessary to select the optimum product of the vegetation mat according to hardness of the ground. Therefore, it is desirable to use different products in Tigatto terrace gravel and Mandog formation.
- The thickness of the vegetation base material should be changed according with the hardness of the ground. The general range of changing is "1 cm (in case of N-value 4 roughly)" to "10 cm (in case of soft rock)". Therefore, the thickness of the vegetation base material may be 7 cm in case of Bunawan Limestone, 3 cm in case of Mandog Formation, 5 cm in case of Masuhi Formation.
- The proposed "grating crib works using shotcrete" for Tigatto Terrace Gravel and Mandog formation is assumed the frame cross section 0.3m-square, the frame interval about 2.0m.
- The proposed "stone/rubble-concrete masonry" for Mandog Formation is assumed to be used only at the slope stage of bottom by the soil slope type (slope height 6 m or less, wall thickness 0.6m).
- The proposed “mortar/concrete spraying (shotcrete)” is suitable than the planting (vegetation base material spraying), because Masuhi Formation is prone to weathering when the

long-range stability of the slope is considered.

- The proposed "stone/rubble-concrete masonry" for Masuhi Formation is assumed to be used only at the slope stage of bottom by the rock slope type (slope height 7 m or less, wall thickness 0.45m).

10.8.3 Embankment-slope Gradient

In the project road, the excavated materials of the excavation sections and the tunnel section should be used as banking materials. Therefore, the main banking materials in the section of up to Davao River from the north end point are thought "gravelly soils, sandy soils and cohesive soils" of Mandog formation. The main banking materials of "the vicinity of Davao River of the tunnel east side and the vicinity of Matina River of the tunnel west side" are thought the debris of "sandstone/shale of Masuhi formation" excavated in the tunnel section. And the sandy gravel of "Tigatto terrace gravel" is also thought as the banking material in the vicinity of Matina River. In addition, the main banking materials in the section of up to the south end point from the vicinity of Talomo River are thought "volcanic mud flow deposits and pyroclastic flow deposits" which compose the surface part of Apo Volcanics.

The embankment slopes gradient of each main banking material above mentioned are recommended as shown in **Table 10.8-3** based on "**Table 10.2-9** and **Table 10.2-10**" which are shown in the "10.2.7.6 Standard Slope Gradients for Embankment".

TABLE 10.8-3 SUGGESTION OF EMBANKMENT SLOPE GRADIENTS

Stratum to Obtain	Banking Materials	Unified Soil Classification of ASTM (Material Classification of AASHTO)	Height of Embankment	Suggested Embankment Slope Gradients
Tigatto Terrace Gravel	Sandy Gravel	GW, GP (A-1)	5m or less	1.5:1.0
			5m to 15m	1.8:1.0
Apo-Talomo Volcanics	Silty gravel, Clayey gravel	GM, GC (A-1)	5m or less	1.5:1.0
			5m to 15m	1.8:1.0
Mandog Formation	Silty sand, Clayey sand , Lean clay , Silt	SM, SC, CL, ML (A-2-6, A-2-7, A-4, A-6)	5m or less	1.5:1.0
			5m to 10m	1.8:1.0
Masuhi Formation	Rock debris	GW, GP (A-1)	10m or less	1.5:1.0
			10m to 20m	1.8:1.0

Except the rock debris of Masuhi Formation, the suggested embankment slope gradients which are shown in **Table 10.8-3** is 1.5:1.0 in case of the embankment height of 5m or less, and it is 1.8:1.0 in case of the embankment height of more than 5m. However, there is a possibility that in the future the rock debris of Masuhi formation vary to silty gravel (GM) or clayey gravel (GC), because Masuhi formation is the soft rock that is easy to weathering. Therefore, it is recommended which the embankment slope gradient of the rock debris of Masuhi Formation may be applied at the same conditions (embankment height) with the other banking materials.

10.8.4 Embankment-slope Protection

Based on "10.2.7.7 Slope Protection of Embankment", the slope protection of embankment should be applied the planting in principle, but such the slope protection as the grouted riprap

should be applied in the inundation risk sites such of the river flood areas.

In addition, when the rock debris is used as the banking materials, the slope should be overlaid by the soil blanket on embankment slope (Cohesive soil) of the thickness 30 cm or more as shown in **Figure 10.2-15**, except the case of using the grouted riprap as the slope protection.

10.8.5 Design of "Grating Crib Works using Shotcrete"

(1) Design Specification

The design of "Grating Crib Works using Shotcrete" is carried out in a limit state design method according to the below Japanese design standard and the design example.

(a) Guideline for Design and Construction of Grating Crib Works (Revised Edition, Third Edition): October 2013 (issued by Japan Slope Protection Association)

(b) Free Frame Method - Limit State Design Example by Performance Verification System: April 2008 (edited by Free Frame Society)

(2) Partial Safety Factor of Grating Crib Works

The partial safety factor of Grating Crib Works, the values shown in **Table 10.8-4** listed in Appendix Table 1.3 of "Guideline for Design and Construction of Grating Crib Works (Revised Edition, Third Edition)" are applied.

TABLE 10.8-4 PARTIAL SAFETY FACTOR OF GRATING CRIB WORKS

Safety Factor / Limit State	Material Factor γ_m		Partial Factor γ_b	Structural Analysis Factor γ_a	Load Factor γ_f	Structure Factor γ_i
	Mortar γ_c	Steel γ_s				
Ultimate Limit State	1.3	1.0	- Bending/Axis Proof Stress (M_{ud}): 1.15 - Shear Proof Stress served by Mortar (V_{cd}): 1.30 - Shear Proof Stress served by Shear Reinforcement (V_{sd}): 1.10 - Proof Stress to Diagonal Compression Failure (V_{wcd}): 1.30	1.0	1.2	1.2
Service Limit State	1.0	1.0	1.0	1.0	1.0	1.0

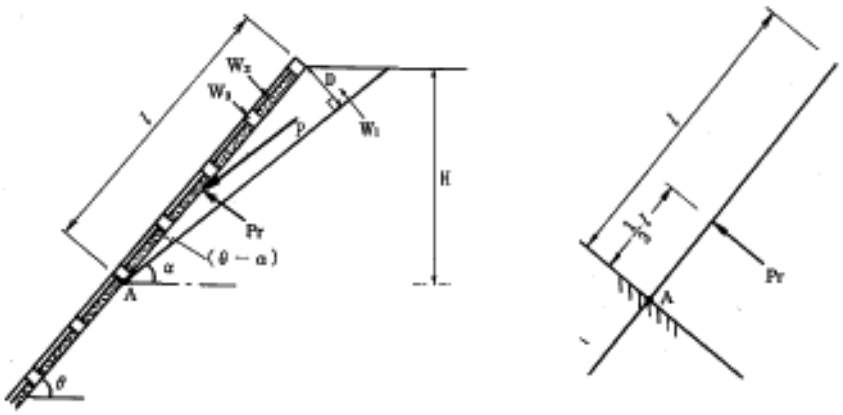
Source: Guideline for Design and Construction of Grating Crib Works (Revised Edition, Third Edition): October 2013 (issued by Japan Slope Protection Association)

(3) Design Method

As shown in **Figure 10.8-1**, the grating crib is designed as a cantilever which the fixed point is the intersection of the vertical frame and the slip line, because a straight slide line is thought from shoulder of slopes.

It is thought the design external force to act on the grating crib is calculated as a concentrated load by the sliding force, and the design external force is calculated by the following expression.

$P = \Delta Fs \times W \times \sin\alpha$
$P_r = P \times \sin(\theta - \alpha)$
$P_d = \gamma_f \times P_r$



Source: Guideline for Design and Construction of Grating Crib Works (Revised Edition, Third Edition): October 2013 (issued by Japan Slope Protection Association)

FIGURE 10.8-1 STRAIGHT SLIDE LINE FROM SHOULDER OF SLOPES

Where;
- P = slip surface direction working load for the grating crib
- P_r = component force working at right angles to the grating crib
- P_d = design load (slip load)
- γ_t = load factor
- W = total weight of the slip (working load)
  - $W = W_1 + W_2 + W_3$
  - W_1 = weight of the slip clod
  - W_2 = weight of the inside material of grating crib
  - W_3 = weight of the grating crib
- α = angle of inclination of the slip surface (slip angle)
- θ = angle of inclination of the slope
- ΔF_s = quantity of the safety factor that should be increased

The quantity of the safety factor that should be increased is the difference between the planning safety factor and the status quo safety factor. Basically, because the grating crib will be constructed sequentially after cut of slope, the assumption of the status quo safety factor 1.0 is sufficiently safe side. Therefore, in case of the planning safety factor 1.2, "the quantity of the safety factor that should be increased" is "ΔFs =1.2-1.0 = 0.2".

The action position of slip load is the position of l / 3 from "A point" where the slip surface and the vertical frame intersect.

Therefore, in case of a cantilever which the point A is fixed end, the design bending moment M_d is given by the following equation; $M_d = -P_d \times l/3$

(4) Design Calculation

1) Design Calculation Model

- Scale of slip; depth D = 1.0m, length l = 6.7m
- Sizes of "Grating Crib Works using Shotcrete"; cross section 300×300mm, span 2000×2000mm
- Slope gradient; 0.8 : 1.0

The design calculation model is shown in **Figure 10.8-2**.

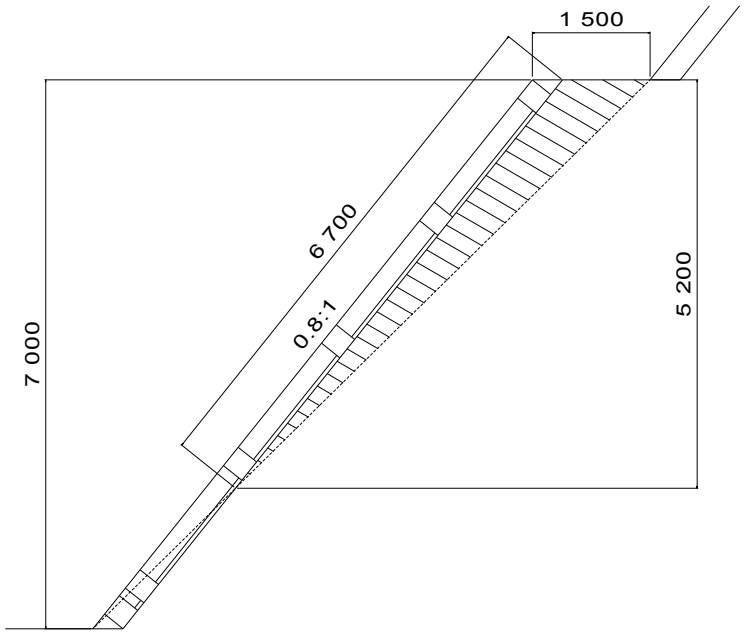


FIGURE 10.8-2 DESIGN CALCULATION MODEL DIAGRAM

2) Design Condition

(a) Unit weight

- Slip clod; γ_1= 20kN/m^3
- Inside material of grating crib (Vegetation Base Material Spraying); γ_2 = 14kN/m^3
- Rebar mortar (frame); γ_3 = 23kN/m^3

(b) Rebar

- Characteristic value of the tensile yield strength; f_y = 345N/mm^2
- Material Factor; γ_s = 1.0
- Design tensile yield strength; $f_{yd} = f_y/\gamma_s$ = 345N/mm^2

(c) Mortar

- Characteristic value of compressive strength (specified design strength); f'_{ck} = 18N/mm^2
- Material Factor; γ_s = 1.3
- Design compressive strength; $f'_{cd} = f'_{ck}/\gamma_c$ = 13.85N/mm^2

(d) Slope gradient; θ=51.34° (0.8 : 1.0)

(e) Slip depth; D = 1.0m, length l = 6.7m

(f) Slip length; l = 6.7m

(g) Thickness of Vegetation Base Material Spraying; d'= 0.05m

(h) Frame cross section/Span; 300×300mm/2000×2000mm

(i) Quantity of safety factor that should be increased; △Fs = 0.2

(j) Load Factor at Ultimate Limit State; γf = 1.2

3) Calculation of Slip Angle α

$$\sin(\theta - \alpha) = D / l = 1.0 / 6.7 = 0.149$$

Due to (θ-α) = 8.57 °, since the θ = 51.34 °, therefore the slip angle α is;

$$\alpha = \theta - 8.57° = 51.34° - 8.57° = 42.77°$$

Slip height H is;

$H = l \times \sin\theta = 6.7m \times \sin 51.34° = 5.23m$

4) Calculation of Working Load W

The working load W is a total of the slip clod W1, the vegetation base material W2 and the grating crib W3;

$W_1 = 1/2 \times d \times H/\sin\alpha \times l_1 \times \gamma_1$
$= 1/2 \times 1.0m \times 5.23m / \sin 42.77° \times 2.0m \times 20\ kN/m^3 = 154.04\ kN$

where;
l_1 = lateral frame span (2.0m)

$W_2 = l / l_2 \times d' \times (l_1\text{-}b) \times (l_2\text{-}b) \times \gamma_2$
$= 6.7m / 2.0m \times 0.05m \times (2.0m - 0.3m) \times (2.0m - 0.3m) \times 14\ kN/m^3 = 6.78kN$

where;
l_2 = vertical frame span (2.0m)
b = frame width (0.3m)

$W_3 = (l + l / l_2 \times (l_1 - b)) \times b \times h \times \gamma_3$
$= (6.7m + 6.7m / 2.0m \times (2.0m - 0.3m)) \times 0.3m \times 0.3m \times 23\ kN/m^3 = 18.49kN$

where;
l_1 = frame height (0.3m)

Therefore;

$W = W_1 + W_2 + W_3$
$= 154.04kN + 6.78kN + 18.49kN = 179.31kN$

The load P of the slip plane direction acting on the grating crib is calculated by multiplying "the quantity of safety factor that should be increased ΔFs" at "the component force of the slip surface direction of the working load".

$P = \Delta Fs \times W \times \sin\alpha$
$= 0.2 \times 179.31kN \times \sin 42.77° = 24.35kN$

The component force working at right angles to the grating crib is as follow;

$P_r = P \times \sin(\theta - \alpha)$
$= 24.35kN \times \sin(51.34° - 8.57°) = 16.54\ kN$

5) Calculation of Design Load and Section Force

The design load Pd is calculated for the ultimate limit state, and it is calculated by multiplying the load factor γ_f (1.20) at the working load P_r.

$P_d = P_r \times \gamma_f$
$= 1.20 \times 6.54\ kN = 7.85kN$

When the action position of design load Pd is the position of l/3 from "A point" where the slip surface and the vertical frame intersect, the maximum bending moment Md of "a cantilever which the point A is fixed end" is as below;

$M_d = P_d \times l/3$
$= 7.85kN \times 6.7m/3 = 17.53\ kNm$

6) Rebar Amount

(a) Width of the frame; b=300mm

(b) Effective height of the frame; d=235mm

(c) Tensile reinforcement amount As

When the two bars of D13 are placed at up and down, the tensile reinforcement amount is as below.

$As = 0.0001267 \times 2 = 0.0002534m^2$

(d) Reinforcement ratio; $P = As / (b \times d) = 0.0002534m^2 / (0.3m \times 0.235m) = 0.00359$

(e) Balance reinforcement ratio Pb

$\alpha = 0.88 - 0.004 \times f_{ck}'$ (in which; $\alpha \leq 0.68$)
$= 0.88 - 0.004 \times 18\ N/mm^2 = 0.808$, thus; $\alpha = 0.68$

where;
α = coefficient on the balanced reinforcement ratio

$\varepsilon'_{cu} = (155 - f'_{ck}) / 30000$ (in which; $0.0025 \leq \varepsilon'_{cu} \leq 0.0035$)
$= (155 - 18\ N/mm^2) / 30000 = 0.0046$, thus; $\varepsilon'_{cu} = 0.0035$

$P_b = \alpha \times \varepsilon'_{cu} / (\varepsilon'_{cu} + f_{yd} / E_s) \times f'_{cd} / f_{yd}$
$= 0.68 \times (0.0035 / (0.0035 + 345\ N/mm^2 / 200000\ N/mm^2)) \times (13.85N/mm^2 / 345\ N/mm^2)$
$= 0.0183$
$P = 0.00359 < 0.0137 = 0.75 \times P_b$ OK

where;
E_s = elastic modulus of rebar ($200\ kN/mm^2$)

7) Safety performance Verification

The safety performance Verification is performed on the flexural failure of ultimate limit state.

(a) Design bending proof stress M_{ud}

$\beta = 0.52 + 80 \times \varepsilon'_{cu}$
$= 0.52 + 80 \times 0.0035 = 0.8$

where;
β = coefficient on the height of equality stress block

$k_1 = 1 - 0.003 \times f'_{ck}$ (in which; $k_1 \leq 0.85$)
$= 1 - 0.003 \times 18\ N/mm^2 = 0.95$, thus; $k_1 = 0.85$

where;
k_1 = reduction coefficient of mortar strength

$k_2 = \beta / 2 = 0.8 / 2 = 0.4$

The ultimate bending proof stress M_u is as below.

$M_u = b \times d^2 \times p \times f_{yd} \times (1 - k_2 / (\beta \times k_1) \times (p \times f_{yd} / f'_{cd}))$
$= 0.3m \times 0.235m^2 \times 0.0046 \times 345000kN/m^2 \times (1-0.4/(0.8 \times 0.85)$
$\times (0.0046 \times 345000kN/m^2 / 13850kN/m^2)) = 24.52\ kNm$

Therefore the design bending proof stress M_{ud} is as below.

$M_{ud} = M_u / \gamma_b = 24.52\ kNm / 1.15 = 21.32\ kNm$

where;
γ_b = partial factor of ultimate limit state (1.15)

(b) Verification for safety

$\gamma_i \times M_d / M_{ud} = 1.2 \times 17.53\ kNm / 21.32\ kNm = 0.99 \leq 1.00$ OK

where;
γ_i = structure factor of ultimate limit state (1.2)

10.9 IMPROVEMENT OF IMPORTANT CONNECTION ROADS

1) Identified important connection roads

The Bypass must be connected to the Urban Centers through the existing roads in order for the Bypass to fully function as a traffic distributor.

Two important connection roads were identified as follows (see **Figure 10.9-1**);

- Mandug Road (L=5.2km)
  This road provides the nearest access to the busiest urban center from the Bypass. Traffic from the South and the West to the Urban Center can utilize this road, thus vital for the Bypass to attract this traffic.
- Malagamot Road (L=5.0km)
  This road provides access to the eastern urban center and the Sasa Port from the Bypass. Traffic from the South, the West and the North to the Eastern Urban Center and Sasa Port can utilize this road, thus vital for the Bypass.

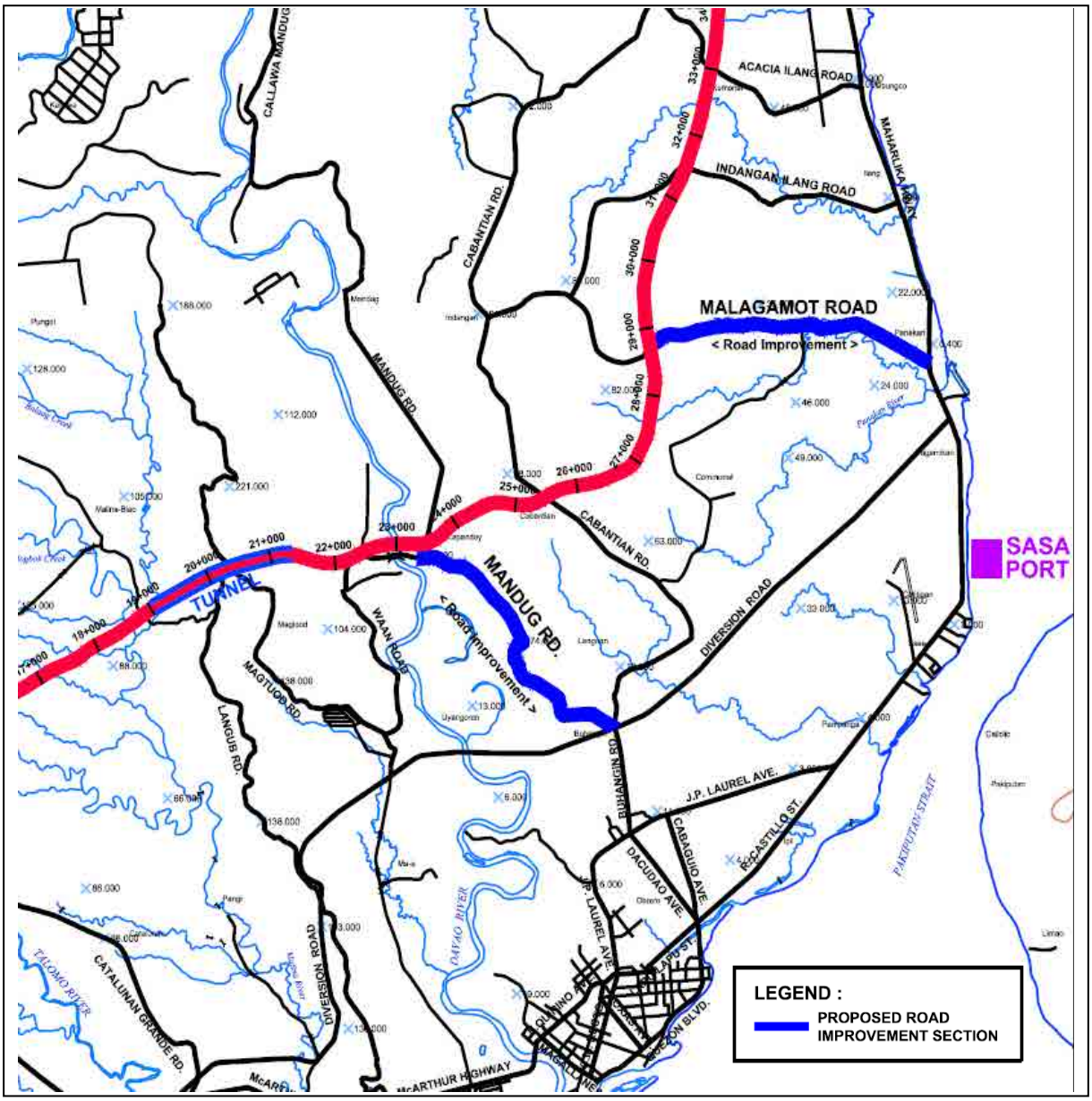


FIGURE 10.9-1 IMPORTANT CONNECTION ROADS

2) Needs of Improvement

The two (2) roads are currently City Roads and being administered by the City Government of Davao. The pavement condition of the two (2) connection roads is in very poor condition, thus reconstruction of pavement of the two roads is necessary and is proposed to be improved as one of the component of the Bypass Project.

The proposed typical cross section of the two (2) roads is shown in **Figure 10.9-2.**

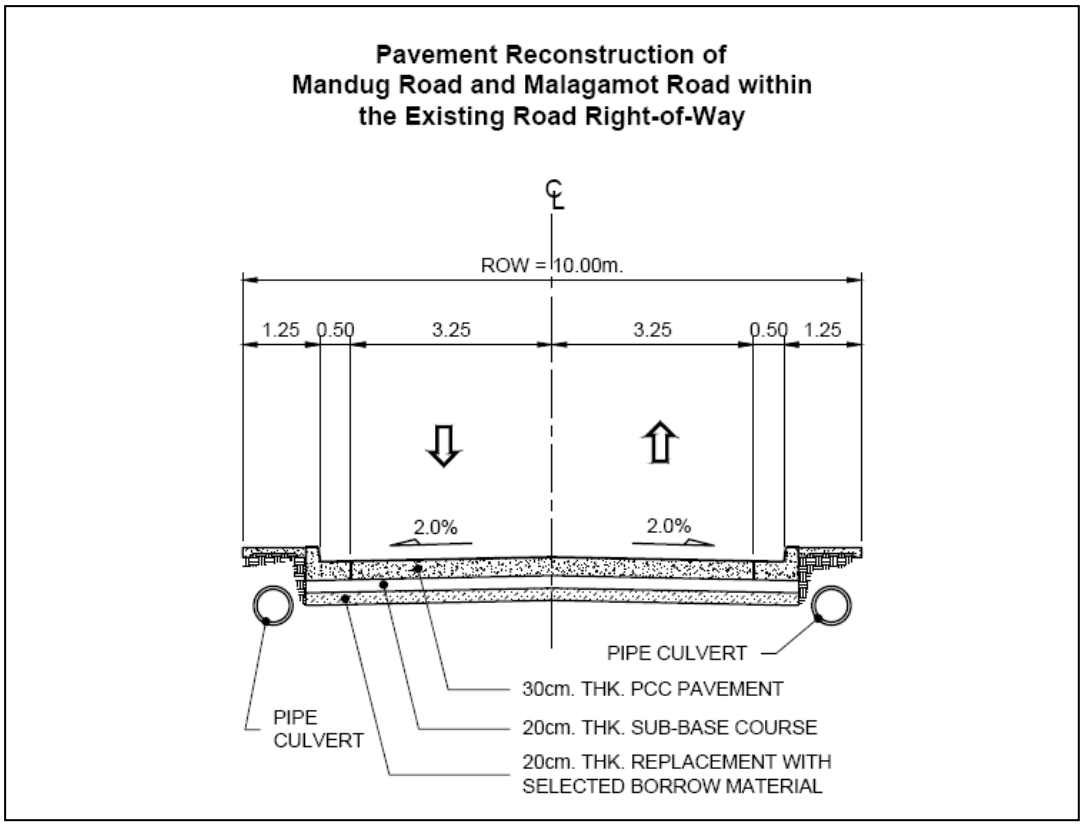


FIGURE 10.9-2 TYPICAL CROSS SECTION OF TWO CONNECTION ROADS

3) Estimated Traffic Volume at Present and Future when the Bypass is Completed

Estimated traffic volume on these two roads is shown in **Table 10.9-1.**

TABLE 10.9-1 ESTIMATED TRAFFIC VOLUME ON TWO CONNECTION ROADS

Unit: Veh./day

		Section near Urban Center	Section near the Bypass
Mandug Road	2013 (Present)	6,770	2,660
	2018	8,220	6,840
	2023	8,990	7,570
	2033	10,530	9,650
Malagamot Road	2013 (Present)	520	140
	2018	2,490	2,490
	2023	4,600	4,600
	2033	5,600	5,600

Source: JICA Study Team

10.10 SCOPE OF CIVIL WORK (SUMMARY)

10.10.1 Scope of Civil Work

The scope of all the civil works are the following;

Road	37.17 km
Bridge	5.13 km
Tunnel	2.28 km
Total	**44.58 km**

	Road	Bridge	Tunnel	Total
Section-I	10,494 m	1,206 m	-	11,700 m
Section-II	13,014 m	1,806 m	2,280 m	17,100 m
Section-III	13,661 m	2,119 m	-	15,780 m
Total	**37,169 m**	**5,131 m**	**2,280 m**	**44,580 m**

10.10.2 Road Section

(1) Road Length

Total road length is 37.17 km, comprised of 10.31km cut section and 5.27 km embankment section.

Cut Section (H>5m)	10.31km
Embankment Section (H>5m)	5.27 km
Low Cut/Embankment Section	21.59 km
Total	**37.17 km**

(2) Number of Intersection

Number of Intersections	
At-grade	18
Overpass	12
Underpass	6

10.10.3 Tunnel Section

(1) Main Tunnel

Total length of tunnel is 2,280m.

Cross Section Type	Length (m)
C1	-
C2	150
D1	1,390
D2	740
Total	**2,280 m**

*Note: See **Figure 10.4.1-2 Cross Section***

(2) Auxiliary Method

All Ground Fasten (AGF) Method = 70m + 70m + 110m = **250m**

(3) Evacuation Tunnel

Total Length of Tunnel = 2,280m

Number of Evacuation Adit	3
Number of Personnel Adit	2
Total	**5**

10.10.4 Structure

(1) Bridge

Total numbers of bridges are as follows;

Section	No. of Bridges			Length (m)	No. of Overpass Bridges
	PSCG	PC-Box	Total		
Section-I	9	1	10	1,206	2
Section-II	14	0	14	1,806	4
Section-III	20	1	21	2,119	6
Total	**43**	**2**	**45**	**5,131**	**12**

Source: JICA Study Team

(2) Culvert

Total numbers of culverts are as follows;

Number of Culverts			
Section	Pipe Culvert	Box culvert for River/Water	Box culvert for Crossing Road
Section-I	19	16	0
Section-II	39	16	3
Section-III	24	8	2
Total	**82**	**40**	**5**

Source: JICA Study Team

10.10.5 Pavement Reconstruction of Connection Roads

- Mandug Road : L = 5.2 km
- Malagamot Road : L = 5.0 km

CHAPTER 11

PROJECT COST ESTIMATE

CHAPTER 11
PROJECT COST ESTIMATE

(Confidential)

CHAPTER 12

ECONOMIC EVALUATION

CHAPTER 12
ECONOMIC EVALUATION

12.1 METHODOLOGY

The economic analysis shall be determined whether the construction and operation of the proposed project will be feasible based on the benefits and costs to be derived from the project. The transport projects such as Davao City Bypass can play a very important role in strengthen of the economic growth. It is required however, that the project must be economically viable, satisfying the government-prescribed hurdle rates.

Annual economic cost and benefits shall be estimated under "with project" and "without project" case. The difference in economic costs and benefits in both cases shall be attributed to the project and subjected to economic feasibility measurement. The economic feasibility of the project shall be indicated by the economic internal rate of return (EIRR), benefit-cost ratio (B/C), and net present value (NPV) at an assumed discount rate of 15%, which is acceptable social discount rate for economic appraisal of public investment projects in the country. The hurdle rates for economic feasibility are the following: EIRR $\geq$ 15%, B/C $\geq$ 1.0, and NPV $\geq$ 0. Sensitivity of the project arising from adverse changes in costs and benefits shall be examined to establish the capacity of the project to exhibit economic feasibility under these cases.

(1) General Work Flow of Economic Evaluation

Figure 12.1-1 shows the work flow of economic evaluation.

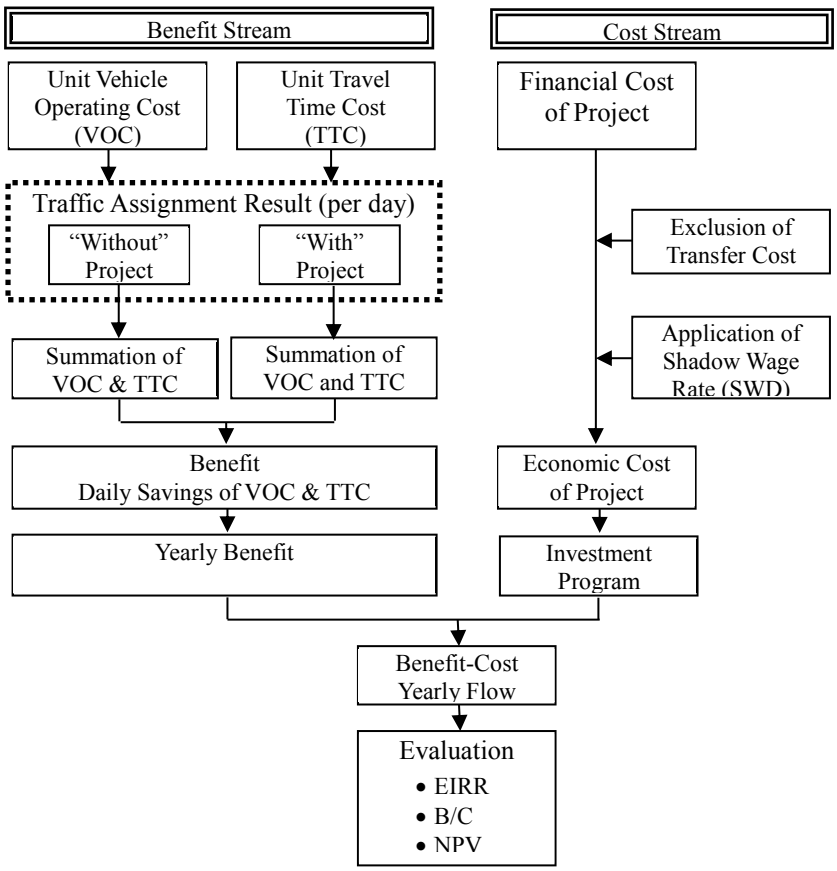


FIGURE 12.1-1 WORK FLOW OF ECONOMIC EVALUATION

(2) Indicators of Economic Evaluation

Economic costs and benefits throughout the project life periods are compared by a discount cash flow analysis. The discount rate (hereinafter referred to as "DR") is at 15%, which is widely used in Philippines as a social discount rate. For economic evaluation, three indicators are calculated: Economic Internal Rate of Return (hereinafter referred to as "EIRR"), Benefit/Cost Ratio (hereinafter referred to as "B/C") and Net Present Value (hereinafter referred to as "NPV"). In addition, the economic life is assumed to be 30 years, taking into account future rapid growth and changes of socioeconomic conditions. Therefore, the Pro-forma cash flow of a project evaluation will be prepared for 2014-2049. They are defined as **Table 12.1-1**.

TABLE 12.1-1 INDICATORS OF ECONOMIC EVALUATION

No.	Indicators	Calculation Formula or Value
1	Discount rate (DR)	15% in Philippines as a social discount rate
2	Economic Internal Rate of Return (EIRR)	r satisfying: B: benefit, C: Cost $\sum \frac{B_n}{(1+r)^n} = \sum \frac{C_n}{(1+r)^n}$
3	Benefit/Cost Ratio (B/C)	$\sum \frac{B_n}{(1+DR)^n} \div \sum \frac{C_n}{(1+DR)_n}$
4	Net Present Value (NPV)	$\sum \frac{B_n - C_n}{(1+DR)^n}$
5	Pro-forma cash flow of a project evaluation	Period for 2012-2049

Source: JICA Study Team

(3) Economic Evaluation Case

Table below shows the economic evaluation cases.
As described in Chapter 11.2, it is proposed that South and Center Section for Yen Loan financing, whereas North Section can be implemented with GOP funding. Economic Evaluation was conducted as whole section case and Yen Loan section case.

TABLE 12.1-2 ECONOMIC EVALUATION CASES

Case-1	Davao Bypass' whole section including future widening
Case-2	Yen Loan Portion Only, Davao Bypass' south and center sections only with improvement of two access roads. No consideration of future road widening.

Stage	Stage-1				Stage-2
Package	Package-I (ODA Fund)			Package-II (GOP Fund)	-
Section	Section I	Section II		Section III	
	South Section	Center Section	Two connection road Improvement	North Section	Future widening, 4-lane whole section
Case-1	O	O	O	O	O
Case-2	O	O	O	-	-

Source: JICA Study Team

12.2 ECONOMIC COST OF THE PROJECT

(CONFIDENTIAL)

12.3 ECONOMIC BENEFIT OF THE PROJECT

Economic benefits are calculated according to multiplied the estimated traffic volumes and unit Vehicle Operating Cost (VOC) /Travel Time Cost (TTC) respectively for each case, and the amount of 'without' case minus 'with' case is considered as the benefit provided by the project. Benefit are calculated from the traffic volume and speed of all links by traffic assignment. The traffic assignment method and road network was described in section 6.2.

(1) Unit Vehicle Operating Cost (VOC) and Unit Travel Time Cost (TTC)

1) Unit Vehicle Operating Cost (VOC)

The VOC per unit distance is estimated by type of vehicle being composed of the following components; they are a) fuel cost, b) oil cost, c) tire cost, d) spare parts cost, e) depreciation cost, f) capital opportunity cost and g) crew and overhead cost. The type of vehicles is motor-tricycle, car, van, Jeepney, bus and truck.

The Department of Public Works and Highways (DPWH) has been periodically updating VOC data in order to use as input to the HDM Model for the appraisal of highway development and maintenance projects. There are the detailed data of VOC in 2008 (see **Table 12.3-1**), therefore, these data are revised and updated in accordance with the GDP Growth Rate of 5.5% . They are summarized in **Table 12.3-2**.

TABLE 12.3-1 UNIT VOC BY VEHICLE TYPE IN 2008

(Pesos per veh-km)

Speed (km/h)	1 Motor-Tricycle	2 Car	3 Jeepney	4 Goods Utility	5 Small Bus	6 Large Bus	7 Rigid Truck 2ax	8 Rigid Truck 3ax	9 Semi-Trailer 4ax	10 Semi-Trailer 5ax
20	3.32	12.33	9.54	10.85	23.81	33.37	23.17	37.71	41.40	43.79
30	2.78	10.51	8.09	9.06	20.31	28.11	20.02	32.50	36.37	38.73
40	2.43	9.19	7.13	7.83	17.78	24.40	17.89	29.06	33.26	35.63
50	2.32	8.53	6.75	7.31	16.53	22.66	17.01	27.86	32.46	34.86
60	2.35	8.22	6.72	7.18	15.96	22.00	16.76	27.85	32.79	35.13
70	2.46	8.14	6.91	7.32	15.79	22.04	16.83	28.51	33.55	35.78
80	2.48	8.21	7.24	7.61	15.83	22.55	17.06	29.45	34.52	36.69
90	2.48	8.37	7.63	7.97	15.95	22.57	17.35	29.45	35.58	37.73
100	2.48	8.58	8.00	8.32	16.10	22.57	17.51	29.45	36.04	38.19
110	2.48	8.78	8.30	8.59	16.22	22.57	17.51	29.45	36.04	38.19
120	2.48	8.83	8.52	8.78	16.30	22.57	17.51	29.45	36.04	38.19

Source: DPWH

TABLE 12.3-2 UNIT VOC BY VEHICLE TYPE IN 2014

(Pesos per veh-km)

Speed (km/h)	1 Motor-Tricycle	2 Car	3 Jeepney	4 Goods Utility	5 Small Bus	6 Large Bus	7 Rigid Truck 2Axle	8 Rigid Truck 3Axle	9 Semi-Trailer 4Axle	10 Semi-Trailer 5Axle
20	4.58	17.01	13.16	14.96	32.83	46.01	31.95	52.00	57.09	60.38
30	3.83	14.49	11.16	12.49	28.00	38.77	27.60	44.81	50.15	53.40
40	3.35	12.67	9.83	10.80	24.52	33.65	24.66	40.07	45.85	49.13
50	3.20	11.76	9.31	10.08	22.79	31.24	23.45	38.41	44.76	48.07
60	3.23	11.33	9.26	9.91	22.00	30.33	23.11	38.40	45.21	48.44

Source: DPWH, JICA Study Team

The VOC saving in whole road network will be calculated according to multiplied the estimated traffic volumes and unit VOC. The unit VOC by type of vehicles will be corresponded to the four

(4) vehicle types of estimated traffic volume such as 1) Passenger Car, 2) Jeepney, 3) Large Bus and 4) Truck. The VOC of truck types will be converted by weighted average of vehicle composition. The unit VOC cost by type of vehicles by vehicle speed is shown in **Table 12.3-3.**

TABLE 12.3-3 UNIT VOC BY FOUR (4) VEHICLE TYPES IN 2014

Peso/km/veh

Speed (km/hr)	Passenger Car	Jeepney	Bus	Truck
20	17.01	13.16	46.01	42.12
30	14.49	11.16	38.77	36.49
40	12.67	9.83	33.65	32.79
50	11.76	9.31	31.24	31.46
60	11.33	9.26	30.33	31.35

Source: DPWH, JICA Study Team

2) Unit Travel Time Cost (TTC)

The Travel Time Cost (TTC) is normally calculated based on the average labor productivity in the Philippines. The basic costs for TTC by type of passenger were obtained also from the DPWH. The values are 2014 price level. In the derivation of the TTC, the average income, employment and the gross national product were used as the basis to calculate for the working time and non-working time per person-hour for representative vehicle type and thence estimate for the passenger time cost per person.

Basically, reduction in travel time is the main component in the derivation of the TTC saving. The annual savings was calculated as the difference in travel time between the base road network and with Davao City Bypass road network. Travel time as estimated in the model is the result of the changes in traffic volume caused changes in the congestion level brought by diversion of part of traffic to a more convenient route in the road network. The unit TTC of vehicles will also be corresponded to the four (4) vehicle types of estimated traffic volume such as 1) Passenger Car, 2) Jeepney, 3) Large Bus and 4) Truck. The TTC of truck types will be converted by weighted average of vehicle composition. The unit TTC cost by type of vehicles in year 2014 which were updated based on the GDP growth rate of 5.5%, is shown in **Table 12.3-5.**

TABLE 12.3-4 UNIT TRAVEL TIME COST IN 2008

Peso/min/veh.

1. Motorcycle/ Tricycle	2. Passenger Car	3. Jeepney	4. Goods Utility	5. Small Bus	6. Large Bus	7. Rigid Truck 2axle	8. Rigid Truck 3axle	9. Rigid Truck 4axle	10. Rigid Truck 5axle
1.37	6.81	7.44	2.57	12.69	27.82	1.02	1.46	2.10	2.10

Source: DPWH

TABLE 12.3-5 UNIT TRAVEL TIME COST IN 2014

Peso/min/veh.

Vehicle Type	2014
Passenger Car	9.39
Jeepney	10.26
Bus	38.36
Truck	1.84

Source: JICA Study Team

(2) Estimation of Economic Benefit (VOC and TTC Saving)

Based on the unit VOC by vehicle type by vehicle speed and the total vehicle-km, daily VOC

saving by year will be estimated. The daily TTC saving by year also will be estimated based on the unit TTC by vehicle type and the total vehicle-hour as shown in **Table 12.3-6**.

TABLE 12.3-6 ECONOMIC BENEFIT

Year	Economic Benefit (1,000 Peso/day)		
	VOC	TTC	Total
Case-1, Whole Section			
2018	2,228	5,353	7,581
2023	1,839	6,582	8,421
2033 (4-lane)	3,046	10,245	13,291
Case-2, South Section + Center Section			
2018	1,737	4,175	5,912
2023	1,436	5,134	6,570
2033	2,395	8,071	10,466

Source: JICA Study Team

(3) Other Economic Benefits

With the increasing congestion of the existing road, the greater is the likelihood of the occurrence of the accidents due to conflicts between pedestrian and vehicle. It is anticipated that with the project, accidents happening could be avoided. In this Study, however, benefit from possible reduction of road accident is not considered since there is no acceptable value assigned to traffic accidents in the country.

12.4 RESULTS OF ECONOMIC ANALYSIS

The performance at **Table 12.4-1** and **Table 12.4-2** of the project based on indicators of economic feasibility is:

<Year 2014, Philippine Peso Base>

Case	Case-1, Whole Section	Case-2, South + Center Sections
EIRR	18.1%	21.6%
B/C	1.25	1.63
NPV (Million Peso @ i=15%)	2,096.5	3,258.8

The economic costs and benefits of the project generated a positive NPV and on EIRR that is much higher than the government prescribed hurdle rate (15%). These values indicate that the project is economically viable.

TABLE 12.4-1 COST-BENEFIT STREAM (CASE-1, WHOLE SECTION)

(CONFIDENTIAL)

TABLE 12.4-2 COST-BENEFIT STREAM (CASE-2, SOUTH SECTION AND CENTER SECTION ONLY)

(CONFIDENTIAL)

12.5 PROJECT SENSITIVITY

The Project Sensitivity to the identified risks is shown in **Table 12.5-1**.

TABLE 12.5-1 PROJECT SENSITIVITY

	Case-1, Whole Section			Case-2, South + Center Sections		
	Base	Cost plus 10%	Cost plus 20%	Base	Cost plus 10%	Cost plus 20%
Base	18.1%	16.7%	15.6%	21.6%	20.1%	18.9%
Benefit less 10%	16.6%	15.3%	14.2%	20.0%	18.6%	17.5%
Benefit less 20%	15.0%	13.8%	12.8%	18.3%	17.1%	16.0%

In order to hurdle the minimum criteria EIRR=15%, cost up and/or benefit down should be below condition.

Case-1, Whole Section	Case-2, South + Center Sections
● Cost Plus 25% ● Benefit less 20% ● Cost plus 11% and Benefit less 11%	● Cost Plus 62% ● Benefit less 38% ● Cost plus 23% and Benefit less 23%

CHAPTER 13

ENVIRONMENTAL CONSIDERATIONS

CHAPTER 13
ENVIRONMENTAL CONSIDERATIONS

In this chapter, summarized information and result of analysis is described based on relevant Philippines laws and JICA Guidelines for Environmental and Social Considerations (April, 2010). Detailed information is contained in the main Environmental Impact Statement (EIS) Report.

13.1 BASELINE OF THE ENVIRONMENTAL AND SOCIAL CONDITION

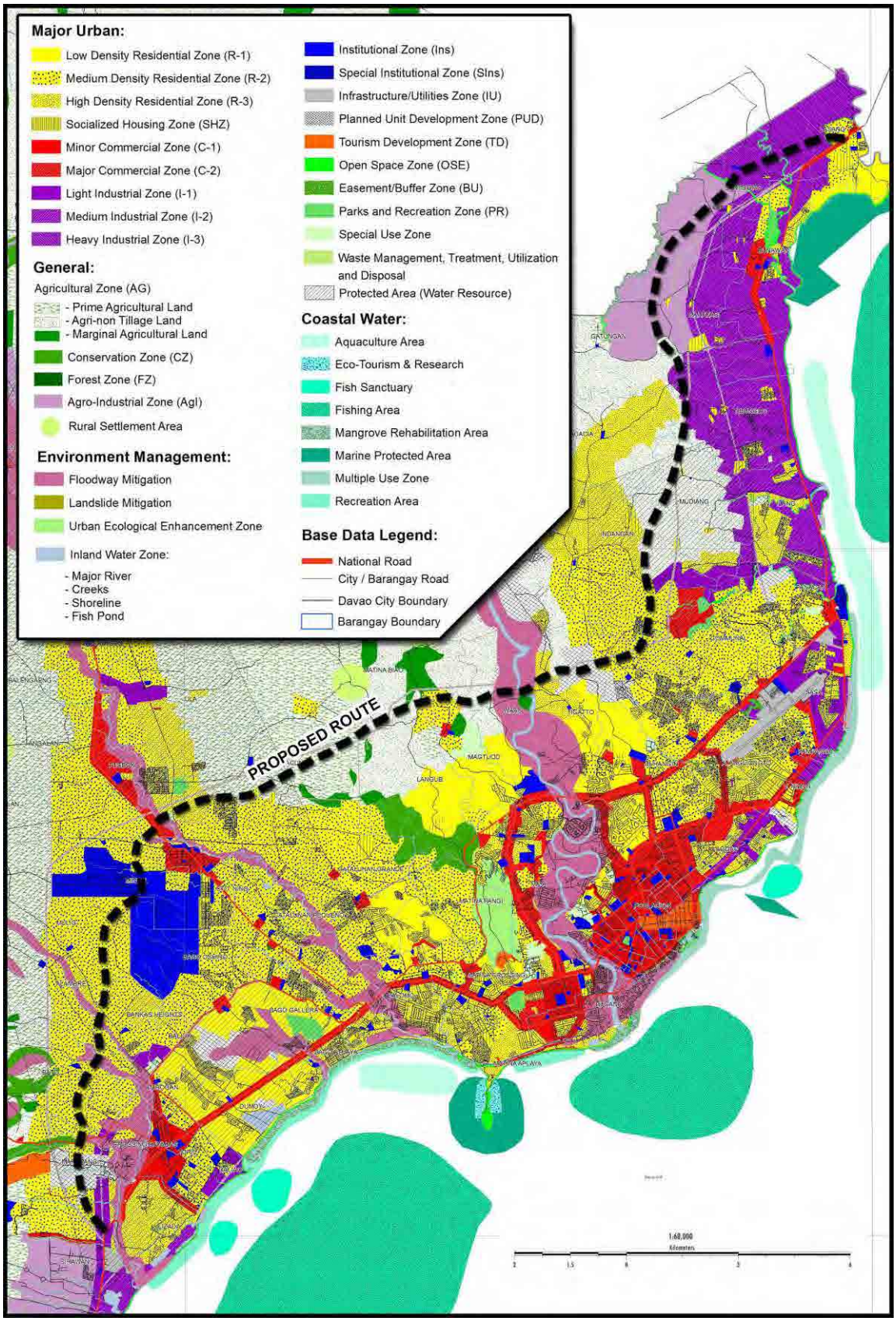
Based on the existing information, environmental and social condition around the project site is reviewed in the following sections. The name of articles and items are in accordance with relevant Philippines regulations (Memorandum Circular 2010 No.14).

13.1.1 Land

(1) Land use

The land use on the planned area is used for mainly agricultural area such as palm trees and secondary woodland. Residential, industrial area and native bush & woodland are slightly distributed on the planned alignment in accordance with satellite image.

On the other hand, the alignment is passing through planned industrial zone (I-1, I-2 and I-3), medium density residential zone (R-2) and agricultural & pasture land zone as the result of minimization of impact on high density residential area. The mentioned land use map is shown in **Figure 13.1-1**.

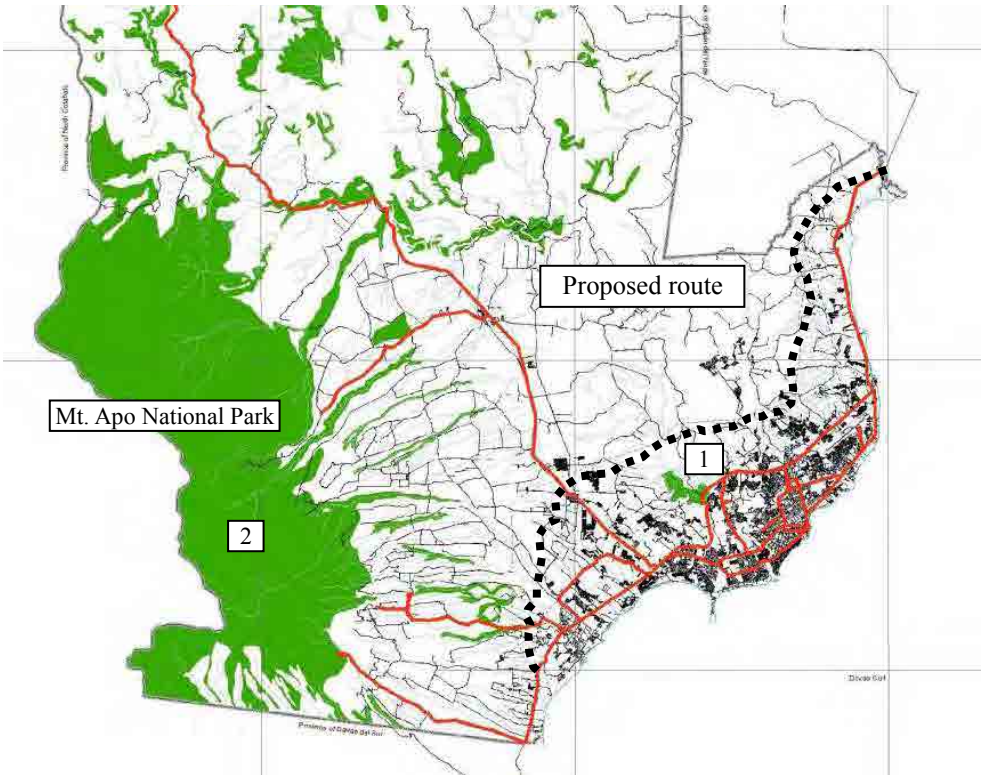


Source: Davao City 2013 (Comprehensive Zoning Ordinance of Davao City 2013-2022)

FIGURE 13.1-1 DETAILED URBAN ZONIG MAP (2013-2022)

(2) Protected area

These conservation zones are declared by laws as national parks, watershed reserves, wildlife preserves and sanctuaries. The alignment has been set up with avoiding such designated protected areas as shown in **Figure 13.1-2**.



Source: CLUP Davao City Volume2 Zoning Ordinance 2013-2022

FIGURE 13.1-2 PROTECTED AREA AROUND THE PROJECT SITE

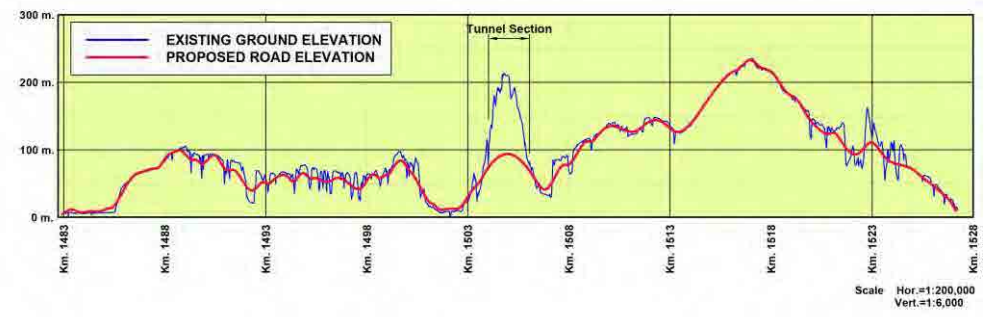
The distributed protected areas are 1) Malagos Watershed Reservation and 2) Mt. Apo National Park around project area. These status and outlines are shown in **Table 13.1-1**.

TABLE 13.1-1 DEFINITION OF CONSERVATION ZONE

Location	Name of Conservation Zone	Relevant laws and regulation	Description
1) Malagos, Baguio District	Malagos Watershed Reservation	Presidential Proclamation 2146: Proclaiming Certain Areas and Types of Projects as Environmentally Critical and Within the Scope of the Environmental Impact Statement System Established under Presidential Decree No. 1586. (December 14, 1981)	This area is declared as Conservation area of Environmental Critical Area under the category of Watershed Forest Reserve with an area of 235 hectares. It is proclaimed as no. 612 on August 31, 1933. Aforementioned proclamation aims to attain and maintain a rational and orderly balance between socio-economic growth and environmental conservation and protection.
2) Kidapawan, Makilala, Magpet, Cotabato; Sta. Cruz, Bansalan, Digos City and Davao City, Davao del Sur	Mt. Apo National Park	• Republic Act 7586 "National Integrated Protected Areas system Act of 1992." • Republic Act 9237 "Mount Apo Protected Area Act of 2003"	This area was declared as protected area under the category of natural park with an area of 54,974.87 hectares of protected area along with 9,078 hectares of buffer zone. On May 9, 1936, Mount Apo was proclaimed as a national park with Proclamation no. 59 by President Manuel L. Quezon, followed by Proclamation no. 35 of May 8, 1966 then Proclamation No. 882 of September 24, 1996. This area is targeted to be protected for the importance of cultural and ecological diversity and conservation of various resources.

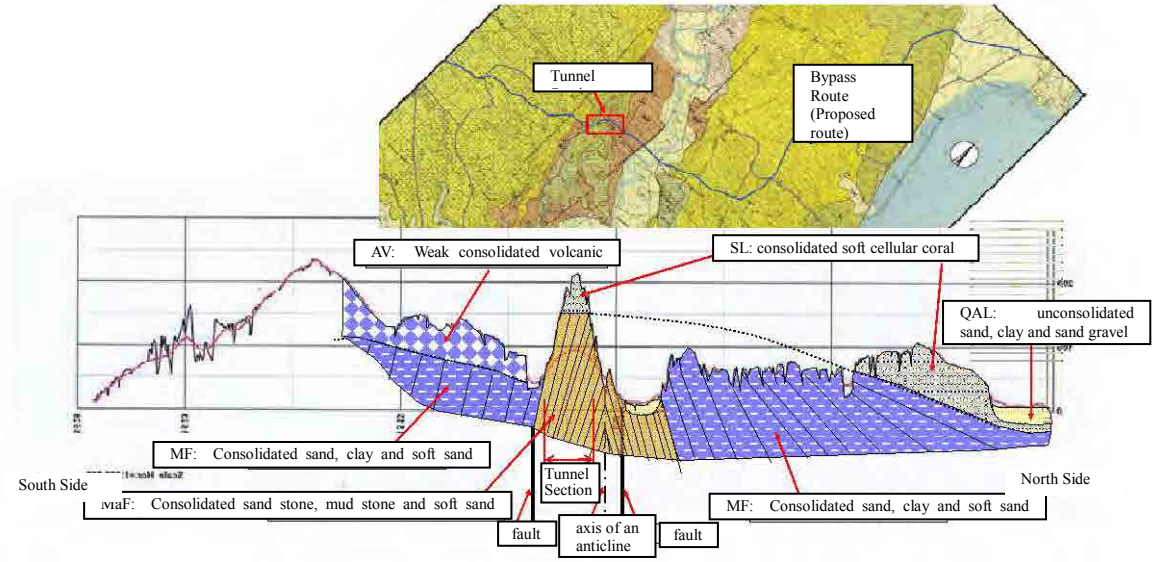
(3) Topography and Geology

The project site is located 2-10km east from shoreline. The route is passing through a mountainous area between some rivers, and the slope angle of tunnel section is approximately 20 degrees and the depth is more than 100m from the surface as shown in **Figure 13.1-3**. The geology consists of sedimentary rock and volcanic debris from Mt. Apo. as shown in **Figure 13.1-4**.



Source: JICA Survey Team

FIGURE 13.1-3 PROJECT LOCATION AND THE SURROUNDING TOPOGRAPHY

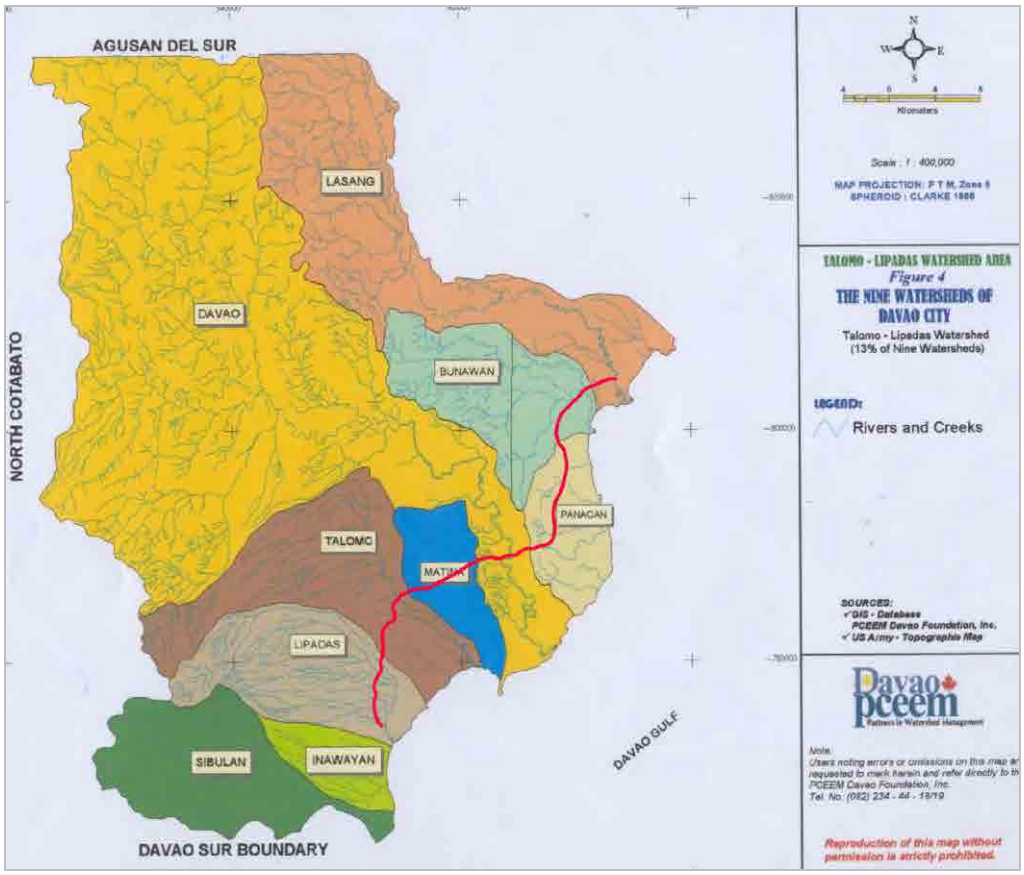


Source: JICA Survey Team

FIGURE 13.1-4 PROJECT LOCATION AND THE SURROUNDING GEOGRAPHY

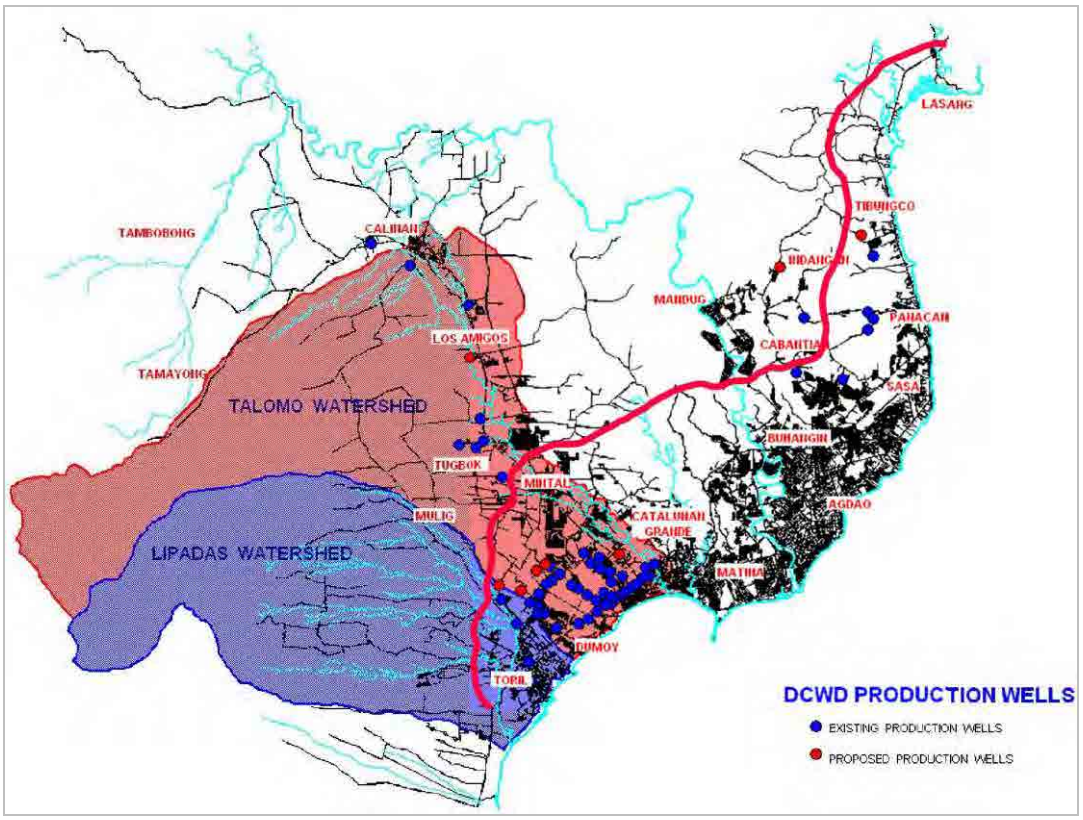
(4) Hydrology

The nine watershed are recognized in Davao City as shown in **Figure 13.1-5**. The alignment is passing through downstream area of 7 watersheds such as Lipadas, Talomo, Matina, Davao, Panacan, Bunawan and Lasang. The Talomo watershed areas are located in a part of Mt. Apo national park, thus most of production wells are distributed and concentrated in downstream of the area as shown in **Figure 13.1-6**. The alignment has been set up with avoiding such production wells area.



Source: Davao City Water District 2013

FIGURE 13.1-5 WATERSHED AREA IN DAVAO CITY

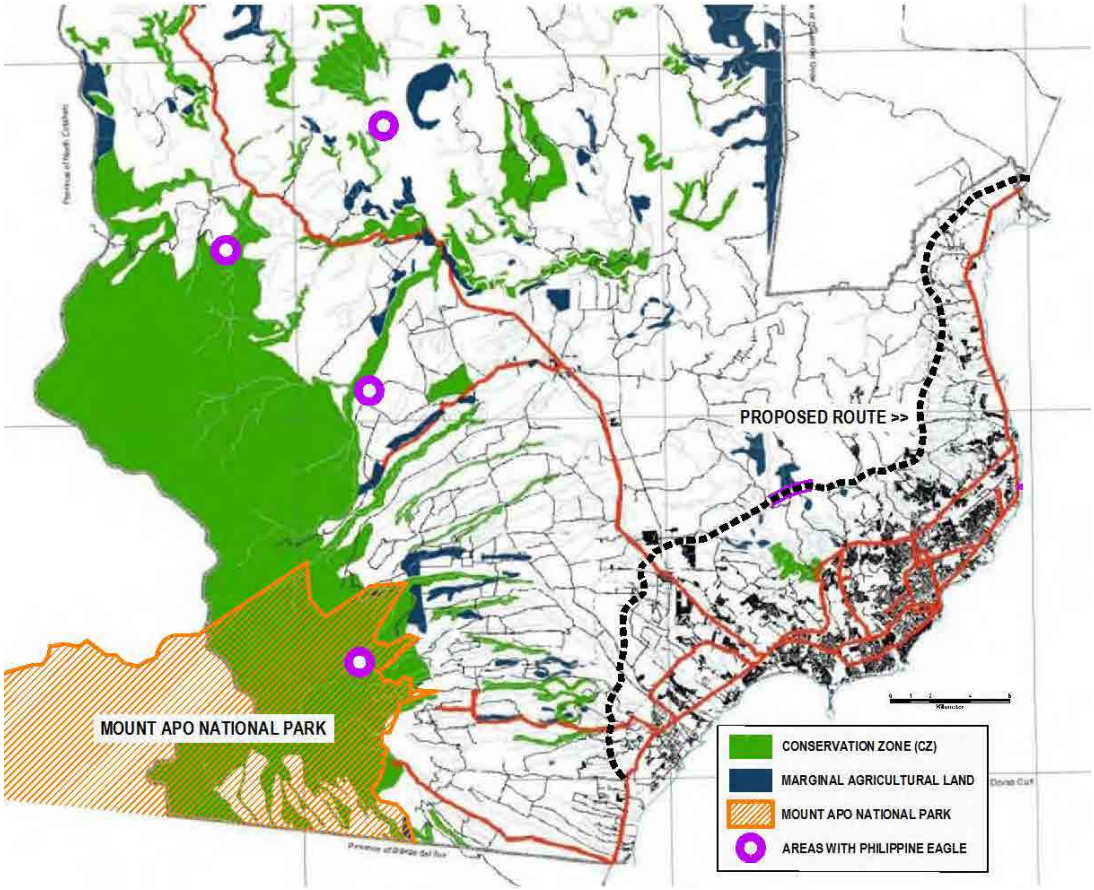


Source: Davao City Water District 2013

FIGURE 13.1-6 PRODUCTION WELL LOCATION IN DAVAO CITY

(5) Biology

General condition of the proposed route is passing through developed areas such as plantation farm land, open grass land and pasture land. Some areas are forest, however mostly are secondary forests for timber production. A protected area named Mt. Apo Natural Park is approximately 10km west of the project area as shown in **Figure 13.1-2**. It's known Mt. Apo is home to one of the world's largest eagles: the critically endangered Philippine Eagle, the country's national bird. According to the Philippines Eagle Student Workbook (JICA), their major habitats are not distributed in the project area as shown in **Figure 13.1-7**. Accoriding to interview with Regional DENR Wildlife Section and the Philippine Eagule Fundation, idetified nesting and activitiy area of the eagle is in the Mt. Apo national park area, not project area.



Source: JICA (the Philippines Eagle Student Workbook), CLUP Davao City Volume2 Zoning Ordinance 2013-2022

FIGURE 13.1-7 PHILIPPINE EAGLE DISTRIBUTION ON THE CONSERVATION ZONE

13.1.2 People

(1) Population and Economy

The road alignment is located in Davao City and Panabo City, passing through 3 Districts in Davao and 26 Barangays in Davao and Panabo. The population is 1,449 thousand and density is 593 persons / km^2 in Davao City, 2010 as shown in **Table 13.1-2**. Integrated population where the alignment is located is approximately 250 thousand persons on 26 Barangays as shown in **Table 13.1-3**. As other economic indicators are shown below, estimated income is small comparing with Metro Manila and the rate of unemployment is lower than national average.

TABLE 13.1-2 SOCIO-ECONOMIC SITUATION IN THE PROJECT AREA (DAVAO CITY, PANABO CITY AND DAVAO REGION)

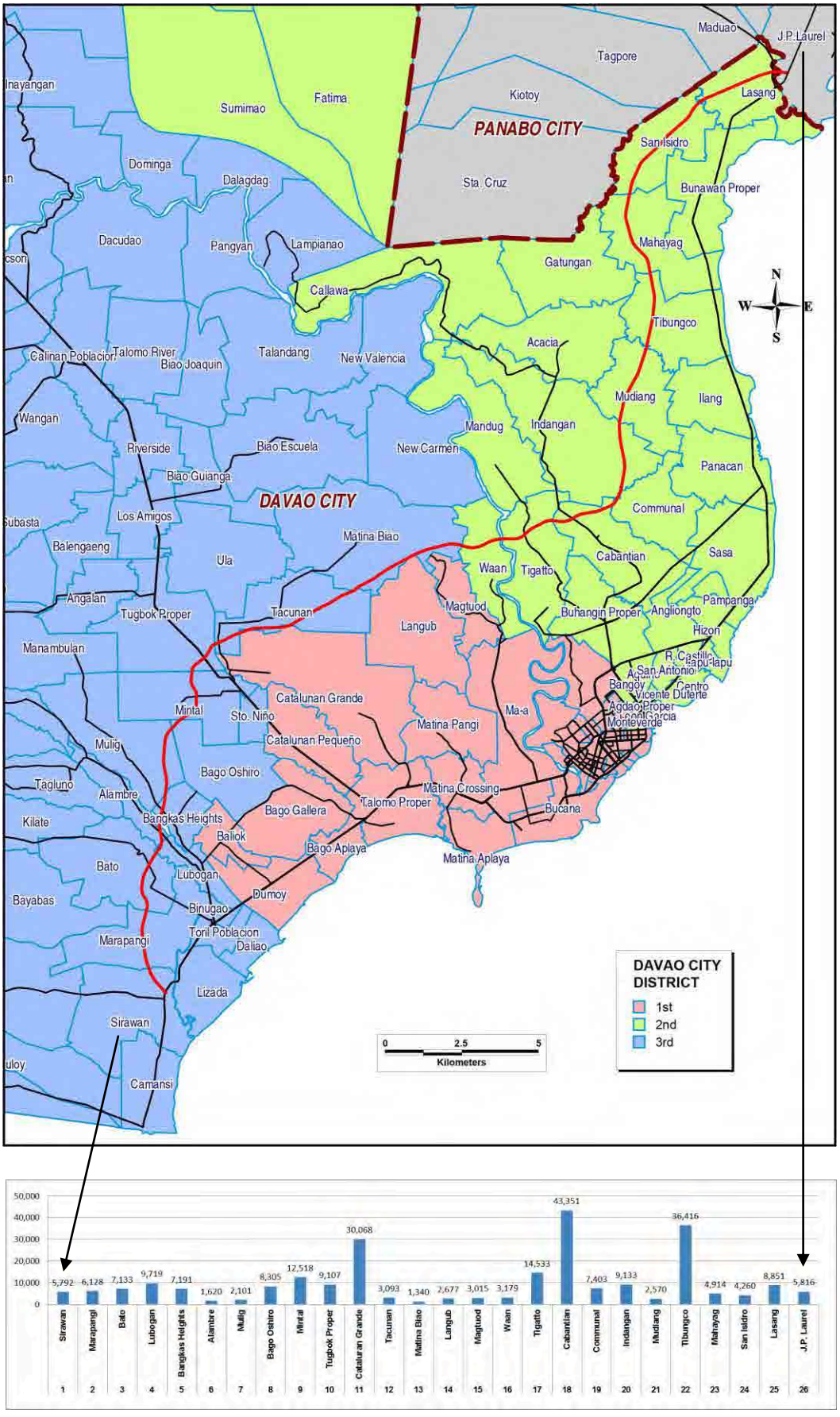
Item		Value	Year	Remarks
Population (Persons x 1,000)	Davao City	1,449.3	2010	Annual Increase rate for 10 years 2.36% (2000/1147.1-2010/1449.3)
	Panabo City	174.4	2010	Annual Increase rate for 10 years 2.67% (2000/134.0-2010/174.4)
Average Income (Peso/family/year)	Davao Region (Region XI)	166,000	2009	Manila: 354,645 Peso/family/year (2009)
Average Expenditure (peso/family/year)	Davao Region (Region XI)	142,000	2009	Manila: 321,197 Peso/family/year (2009)
Unemployment Rate (%)	Davao Region (Region XI)	4.6	2011	National average : 6.4% (2011)
Annual Poverty threshold (Peso/person/year)	Davao City	17,040	2009	Poverty incidence (2009) Davao City 13.2%, Davao region 31.3%
	Panabo City	-	-	
Area (km2)	Davao City	2,444km2	2010	-
	Panabo City	251.23km2	2010	
Population Density (Persons/km2)	Davao City	593	2010	
	Panabo City	694	2010	

Source: National Statistic Office

TABLE 13.1-3 POPULATION OF BARANGAYS ON THE PROPOSED ROUTE

City	District	Sub District	Barangay	Population
Davao	First	Talomo	Cataluran Gr	30,068
			Langub	2,677
			Magtuod	3,015
	Second	Bunawan	Lasang	8,851
			San Isidro	4,260
			Mahayag	4,914
			Tibungco	36,416
			Mudiang	2,570
		Buhangin	Indangan	9,133
			Communal	7,403
			Cabantian	43,351
			Tigatto	14,533
			Waan	3,179
	Third	Tugbok	Matina Biao	1,340
			Tacunan	3,093
			Tugbok Prop	9,107
			Mintal	12,518
			Bago Oshiro	8,305
		Toril	Mulig	2,101
			Alambre	1,620
			Bangkas Hei	7,191
			Lubogan	9,719
			Bato	7,133
			Marapangi	6,128
			Sirawan	5,792
Panabo			J.P. Laurel	5,816
				250,233

Source: National Statistic Office



Source: JICA (National Statistics Office 2012)

FIGURE 13.1-8 POPULATION PER BARANGAY

(2) Traffic situation

Existing trunk roads in the city are mainly Pan-Philippine Highway which plays a part of bypass in the business district of Davao City, and Davao-Bukidnon Road which is connecting with the western cities such as Cagayan de Oro City. Other local roads are running from Pan-Philippines Highway to the west direction on ridge line. Traffic volume of the trunk road is shown in **Figure 6.1-1** and **Figure 6.1-2**.

Traffic congestion of roads in the urban center is chronic and travel speed of most road are less than 20km/hr as shown in **Figure 6.1-32**.

13.2 LEGISLATION AND INSTITUTION FOR ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

13.2.1 Legislation for Environmental Considerations

Major laws regarding environment is shown in **Table 13.2-1**. Environmental related laws in the Philippines are composed of under the Presidential Decree (PD) No.1151 as environmental policy and PD No. 1152 as environmental regulation in relation to the national policy and regulation.

TABLE 13.2-1 PHILIPPINE'S MAJOR ENVIRONMENTAL LAWS

Title	Contents
Presidential Decree (PD)No.1151	Environmental policy
Presidential Code (PD)No. 1152	Environmental regulation

Major environmental laws are made for natural resources, protection of wild life and bio-diversity, forest resources, mining, coastal and marine, ambient air, water quality, waste and disposal, land use and resettlement, conservation of historical and cultural assets, environmental assessment, and national integrated protected area system. Major environmental related laws and decrees are summarized in **Table 13.2-2**.

TABLE 13.2-2 PHILIPPINE'S ENVIRONMENTAL LAWS AND DECREE BY CATEGORY

Category	Title	Outline
Natural Resources	Constitution Article 12./Clause 2.	Investigation of natural resources, development use
	Presidential Decree (PD)/ No.1198	Protection of natural environment
Protection of wildlife and bio diversity	Republic Decree No. 826	Preservation of Natural parks and establishment of wildlife protection committee
	Republic Decree No.1086 (1954)	Prohibition of capture of Mindoro buffalo (Tamaraw)
	Republic Decree No.6147	Preservation of Monkey Eating Eagle
	Statement No. 2141	Preservation of wilderness region
	Administrative order	No.243(1970) Prohibition of slaughter for buffalo
Forest resources	Presidential Decree (PD) No.209	Encourage of common forest project
	Presidential Decree (PD) No. 277	Encourage of report on offender against forest law
	Presidential Decree (PD) No. 278	Procedural regulation on development application for forest resources and forest land development use
	Presidential Decree (PD) No. 331 (1973)	Sustainable forest development Forest resources
	Presidential Decree (PD) No. 389	Regulation on forest recovery
	Presidential Decree (PD) No. 705 (1975)	Amendment of regulation on forest recovery
	Presidential Decree (PD) No. 865	Export of lumber (selective deforestation)
	Presidential Decree (PD) No. 953	Request of forestation
	Presidential Decree (PD) No. 1153	Decree of forestation
	DNR DecreeNo.78(1987)	Regulation on permission range for felling and collection of oak, other hard wood
	DNR Decree No.79 (1987)	Establishment of foundation of forest regeneration
	DNR Decree No.79 (1987)	Establishment of foundation of forest regeneration
	DNR memorandum No.8 (1986)	Full prohibition of log export

Category	Title	Outline
	Notification No. 818	Diminution of forest
	Forest development bureau circular No. 13 (1986)	Full prohibition of land possession within mangrove area, river area, preservation area, wilderness area, National park, wildlife reserve, experimental forest and etc.
Mining	Presidential Decree (PD) No.1251	Prospect mining
	Presidential Decree (PD) No.463 (1974)	Mining resource development Decree
	Presidential Decree (PD) No.1189 (1979)	Land use of ex-mining site for compensation of the land owner
Coastal marine	Presidential Decree (PD) No.600 (1974)	Prevention of marine pollution
	Presidential Decree (PD) No. 602 (1974)	Establishment for oil pollution management center
	Presidential Decree (PD) No. 979	Prevention of ocean pollution
Ambient air	Republic law No. 3931	Establishment of National air, water pollution control committee, definition of pollution and penalty
	Presidential Decree (PD) No.1181	Air pollution regulation on incidence origin of travelling
	Presidential Decree (PD) No.1160	Barangay captain Community leader on implementation of law on prevention of public nuisance
	Circulation No. 247	Appointment of highway patrol guard
	Circulation No 551	Equipment of prevention devices of motor vehicles
Water quality	Republic law No.4850	Establishment of Laguna Lake development Bureau
	Republic law No.3931	Establishment of National committee for ambient air pollution management
	Presidential Decree (PD) No.600	Establishment of Philippine coastal guard, measure for marine pollution
	Presidential Decree (PD) No.1252	Establishment of foundation for treatment of mining discharge water
	Presidential Decree (PD) No.602	Establishment of National oil pollution management center
	DENR Decree No. 34	Classification of water and use
	DENR Decree No. 35	Regulation on discharge water for Industrial and urban drainage
Waste disposal	Presidential Decree (PD) No. 825 (1975)	Penalty regulation on illegal dump of disposal, dirt and other wastes
	Presidential Decree (PD) No. 826 (1975)	Regulation on treatment responsibility of solid and liquid wastes by local government
	Presidential Decree (PD) No.1152 (1977)	Regulation on treatment method and treatment management for wastes
	Republic Act (RA) 6969 (1990)	An Act to Control Toxic Substances and Hazardous and Nuclear Wastes, Providing Penalties for Violations thereof, and for their Purposes
	DAO 36 Series of 2004 (DAO 04-36)	DAO 04-36 is a procedural manual of DAO 92-29, a comprehensive documentation on the legal and technical requirements of hazardous waste management
	DAO 98-50	Adopting the Landfill Site Identification and Screening Criteria for Municipal Solid Waste Disposal Facilities
	DAO 98-49	Technical Guidelines for Municipal Solid Waste Management
	RA 9003	Ecological and Solid Waste Management Act
	DAO 01-34	Implementing Rules and Regulations (IRR) of RA 9003
	AO 93-90	Creating a Project Management Office on Solid Waste Management (PTWFM) under the Presidential Task Force on Waste Management
Land use and resettlement	Constitution Article 13	Establishment of human protective committee and their responsibility

Category	Title	Outline
	DPWH Decree No.65	Land use procedure for public project and expressway project
	DPWH Decree No.120 (1988)	Compensation of private land for DPWH project
	DPWH Decree No.234 (1990)	Amendment of compensation of private land for DPWH project
	Revised administrative code No. 64	Competence of house of justice on private land acquisition by the government
	DPWH Decree No.65 (1983)	Guideline for land use and right of way
	Presidential Decree (PD)No. 1517	Designation of reserve area at reorganization of urban land use
	Senate article No. 328	Decree of temporally prohibition for removal of displaced persons
	Republic Act 7279 (Urban Development and Housing Act of 1992)	An act to provide doe a comprehensive and continuing urban development and housing program, establish the mechanism for its implementation, and for other purpose; Procedure for removal of habituated peoples
Land acquisition	Republic Act 6389 (1971): The Agricultural Land Reform Code	The agricultural lessee shall be entitled to disturbance compensation equivalent to five times the average of the gross harvests on his landholding during the last five preceding calendar years
	Executive Order (1985)	Providing the procedures and guidelines for the expeditions acquisition by the government of private real properties or rights thereon for infrastructure and other government development projects
	Republic Act 8974 (2000)	An act to facilitate the acquisition of right-of-way, site or location for national government infrastructure project and for other purposes
Human rights	Executive Order NO.153 (2002)	Instituting the national drive to suppress and eradicate professional squatting and squatting syndicates; Amending E.O.178 (1999) and E.O. 128 (1993)
	Indigenous People's Rights Act (IPRA) of 1997	sets the conditions, requirements, and safeguards for plans, programs and projects affecting Indigenous Peoples (IPs)
	NCIP Administrative Order No. 1, Series of 2006	The procedure for obtaining the "Free and Prior Informed Consent" (FPIC) for affected communities
Conservation of historical cultural assets	Republic Decree No. 4365	Responsibility of National historic committee on authorization , restoration and maintenance for historical assets
	Republic Decree No.4346	Responsibility of protection and propulsion of maintenance for cultural assets within National museum
Environmental assessment	Presidential Decree (PD) No.1586	Environmental assessment system and administrative organization
	Presidential Proclamation No. 2146	3 Industrial sectors with large environmental impacts and 12 environmentally critical regions
National integrated protected area system	National integrated protected area system act (1992)	Review of National integrated protected area

Source: JICA Survey Team

The government of Philippine has been ratified international treaties, agreements, and protocols in relation to environmental and social consideration which are listed in **Table 13.2-3**.

TABLE 13.2-3 PHILIPPINE'S ENVIRONMENTAL AGREEMENT ON THE GLOBAL TREATY

Title	Year
Washington Treaty Convention on the international trade in endangered species of wild flora and fauna	(1981)
International tropical timber agreement	(1983)
United Nations convention on the law of the sea	(1984)
World heritage convention concerning the protection of the world cultural and natural heritage	(1985)
Montreal Protocol on substances that deplete the Ozone layer	(1991)
Vienna convention for the protection of the ozone layer	(1991)
Convention on biological diversity	(1993)
Basel convention on the control of trans-boundary movement of hazardous wastes and their disposal	(1993)
Ramsar convention on wetlands of international importance, especially as waterfowl habitat	(1994)
Framework convention on climate change	(1994)
Kyoto protocol	(1998)
Cartagena protocol on bio-safety to the convention on biological diversity	(2000)
Stockholm convention on persistent organic pollutants	(2001)

Source: JICA Survey Team

13.2.2 Philippines Environmental Impact Assessment System

In the Philippines, all private or public projects or activities which are envisaged to potentially have a negative impact on the environment are subject to environmental impact assessment (EIA) by Philippine Environmental Impact Statement System (PEISS). EIA is the preliminary analysis of the potential impacts of the project on the environment. Aware of the possible negative effects of the implementation of industrial and other activities, the Philippine government has instituted measures to encourage the use of EIA as a planning and decision making tool.

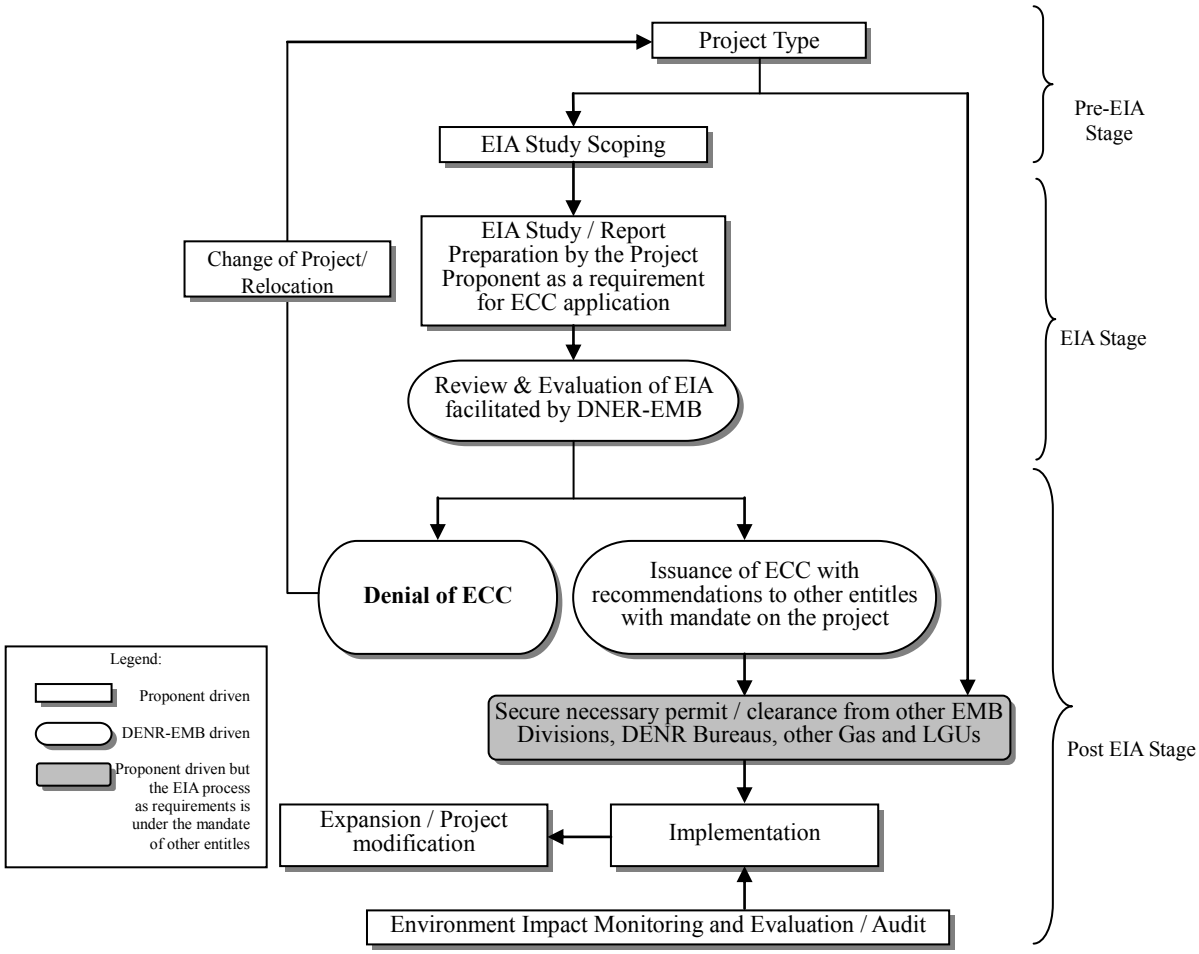
PEISS is a set of laws, regulations, administrative orders and guidelines concerned with Environmental Impact Assessment (EIA). **Table 13.2-4** shows some of the important laws and guidelines:

TABLE 13.2-4 PHILIPPINE'S LAWS AND REGULATIONS REGARDING EIA

Title	Outline
Environmental Impact Statement System (EISS), Presidential Decree No. 1586 (1978)	An act establishing and centralizing the Environmental Impact Statement (EIS) System under the National Environmental Protection Council (NEPC), which merged with the National Pollution Control Commission (NPCC) in June 1987 to become the Environmental Management Bureau (EMB).
Presidential Proclamation No. 2146 (1981) and No. 803 (1996)	It proclaims Environmentally Critical Projects (ECPs) to have significant impact on the quality of environment and Environmentally Critical Areas (ECAs) as environmentally fragile areas within the scope of the EIS System.
DAO 96-37 (revised to become DAO 92-21)	Devolved responsibility for EIS to the EMB-Regional Office and further strengthened the PEISS. Placed emphasis on promoting maximum public participation in EIA process to validate the social acceptability of the Project.
DENR Administrative Order No. 30 Series of 2003 (DAO 03-30)	Revised Procedural Manual (2007): Provides for implementation of rules and regulations of Presidential Decree No. 1586, establishing PEISS. Also, provided detailed definitions of technical terms and detailed information regarding procedures, related laws and regulations.

Source: JICA Survey Team

The procedures of EIA are shown in **Figure 13.2-1**. The process stage is categorized as: (1) pre-study stage (screening and scoping), (2) EIA study stage and (3) post-study stage (review, decision-making and monitoring).



Source: Revised Procedural Manual for DENR Administrative Order No.30 Series of 2003 (DAO 03-30)(2007)

FIGURE 13.2-1 FLOWCHART OF EIA

13.2.3 Screening of the Project

According to the Presidential Decree (PD) 1586 (1978), the EIA process covers project which have been originally declared as Environmentally Critical Projects (ECPs) or projects in Environmentally Critical Areas (ECAs) presumed to have significant impacts on the quality of the environment. On the other hand, non-covered projects are required environmental safeguard if deemed necessary by DENR. The project components are consisting of app. 45 km new road and more than 1km tunnel construction, and any ECAs such as declared national parks, designated watershed reserves and other areas in accordance with the Proclamation No. 2146 (1981) is not located in the project area, thus the project has been classified as Group-I-A which is required Environmental Impact Statement (EIS) and Environmental Compliance Certificates (ECCs) under Environmental Management Bureau Central Office. The criteria of ECPs are shown in **Table 13.2-5**.

TABLE 13.2-5 LIST OF ENVIRONMENTALLY CRITICAL PROJECTS (ECPS) FOR GROUP-I INFRASTRUCTURES

Project Type	Parameter	Requirements
Major Dams	Reservoir ≧25ha or ≧20 million m3	-Applied to; Single project -Required document EIS -Decision document ECC -Endorsers official Community organizer: EIAMD Chief/ EMB Director -Deciding Authority EMB Director / DENR secretary -Max time to grant ECC application 120 days
Major Reclamation	Projects ≧50ha	
Bridges and viaducts(elevated road), new construction	≧10km	
Roads, new construction	**≧20km** **≧10km with critical slope**	
Tunnels and sub-grade roads and Railways	**≧1km**	
Fuel Cell	≧100MW	
Gas-fired thermal power plants	≧50MW	
Geothermal facilities	≧50MW	
Hydropower facilities Impounding	≧20 million m3	
Other thermal power plants	≧30MW	

Source: Group I : Environmentally Critical Projects (ECPs) in both ECAs and Non-ECAs (Presidential Decree: No.2146 (1981) for Infrastructure projects

13.2.4 Gaps between Philippines and JICA's Guideline of EIA

Based on the principles for "EIA Reports for Category A Projects" requested by JICA Guideline, gaps between the Guideline and the legislation in Philippines reviewed in **Table 13.2-6**. Basically, the Philippines legislation deems to meet the policy of JICA's Guideline, thus Philippines EIA process is applicable on this project.

TABLE 13.2-6 GAPS BETWEEN JICA GUIDELINE AND THE PHILIPPINE LEGISLATION ON EIA

JICA Guideline (Appendix 2. EIA Reports for Category A Projects)	**Legislation of Philippine** (DENR Administrative Order No. 30 Series of 2003 (DAO 03-30))	**Gaps**	**Policy to fill up gaps in this Study**
1. When assessment procedures already exist in host countries, and projects are subject to such procedures, project proponents etc. must officially finish those procedures and obtain the approval of the government of the host country.	The project is required to prepare the EIA and obtain the environmental compliance certificates (ECCs) in accordance with Philippine laws	- (no difference)	Not required
2. EIA reports (which may be referred to differently in different systems) must be written in the official language or in a language widely used in the country in which the project is to be implemented. When explaining projects to local residents, written materials must be provided in a language and form understandable to them.	The order stipulates that EIA shall be written in the local dialect or mixed with the popularly known language of the host communities. In this case, English is recognized as a popularly known language in the project area.	-	Not required
3. EIA reports are required to be made available to the local residents of the country in which the project is to be implemented. The EIA reports are required to be available at all times for perusal by project stakeholders such as local residents and copying must be permitted.	The Proponent is required to give copies of the full EIA Report to the EMB Regional office host municipalities; copies of Executive Summary to the host barangays	-	Not required

JICA Guideline (Appendix 2. EIA Reports for Category A Projects)	Legislation of Philippine (DENR Administrative Order No. 30 Series of 2003 (DAO 03-30))	Gaps	Policy to fill up gaps in this Study
4. In preparing EIA reports, consultations with stakeholders, such as local residents, must take place after sufficient information has been disclosed. Records of such consultations must be prepared.	The prescript public consultation is held with project affected persons and other relevant agencies at scoping stage and draft EIA stage respectively after sufficient announcement of the meeting(s). Project outline is explained sufficiently prior to public consultation at scoping stage.	-	Not required
5. Consultations with relevant stakeholders, such as local residents, should take place if necessary throughout the preparation and implementation stages of a project. Holding consultations is highly desirable, especially when the items to be considered in the EIA are being selected, and when the draft report is being prepared.	The prescript public consultation is held with project affected persons and other relevant agencies at scoping stage and draft EIA stage respectively after sufficient announcement of the meeting(s).	-	Not required

Source: The Survey Team

13.2.5 Roles of the Relevant Agencies

The Project is required of EIA and to secure ECC. Review and supervision of Philippine Environmental Impact Assessment System (PEISS) are conducted by the Environmental Management Bureau (EMB) under the Department of Environment and Natural Resources (DENR). The respective organization charts of EMB under DENR are shown below. Although Environmental Compliance Certificates (ECCs) is provided from Central office EMB Director and DENR Secretary, logistical arrangements in the project area such as arrangement of public consultation is conducted by the regional office environmental management bureau (RO EMB).

Roles of the relevant agencies of EIA of the project are show in **Table 13.2-7**;

TABLE 13.2-7 ROLES OF THE RELEVANT AGENCIES ON EIA OF THIS PROJECT

Relevant Agency		Roles
Department of Public Works and Highways (DPWH)		To proceed with the project of EIA procedure as the project proponent Detailed roles are show below; ✓ Holding of a meeting for Information, Education and Communication (IEC) ✓ Holding a meeting for Public Scoping for EIA ✓ Preparation & submission of project description for scoping (PDS) and Environmental Impact Statement (EIS) ✓ Payment of EIA review support fund ✓ Making the necessary logistical arrangements for public consultation ✓ Submission of final EIS and Environmental Performance Report and Management Plan (EPRMP)
Department of Environment and Natural Resources	CO EMB	Responding to the application from the proponents, management of EIA review committee (EIARC) and the Director of EMB will issue the environmental compliance certificates (ECCs) for the port project Detailed roles are shown below; ✓ Facilitating of EIA Review Committee (EIARC) (scoping stage and substantive review stage)

Relevant Agency		Roles
(DENR)		✓ Scoping ✓ Procedural screening of EIS ✓ Conduct of public consultation ✓ Preparation of decision document ✓ Approval of ECCs from EMB Director / DENR Secretary
	RO EMB	Supporting of EIA process in the project area; ✓ Participation of public scoping facilitated by proponent of the project ✓ Making the necessary arrangements for EIARC site validation and public consultation

Source: Survey Team

13.3 ANALYSIS OF ALTERNATIVES

(1) Alignment Selection Criteria

The comparative analysis of alternatives was described in Chapter 7 and 9.The summary is shown below. The criteria for alignment selection are as follows;

- Bypass should be as closer to urban center as possible to attract more traffic.
- Minimize to affect existing houses/subdivisions and planned development.
- Alignment selected by the Business Case Study (BCS) is used as a base case.
- Connection with the intersecting roads which function as distributor shall be fully considered.
- Accessibility to ports and airports should be improved.

Figure 13.3-1 shows the selected alignment for the bypass road.

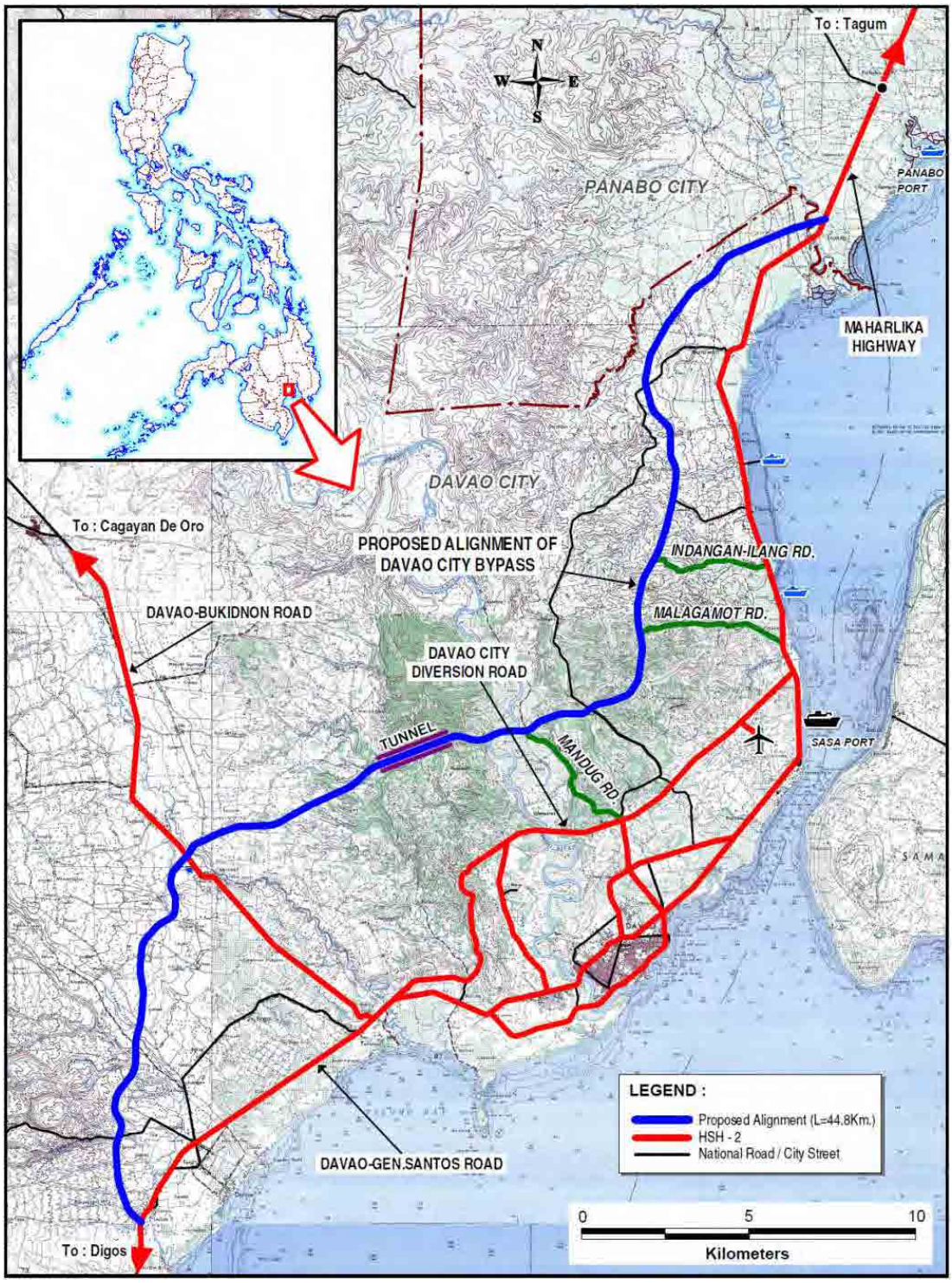


FIGURE 13.3-1 SELECTED ALIGNMENT OF DAVAO CITY BYPASS

(2) Evaluation Criteria

Alternative alignments are assessed by the number of items evaluated as "Good", "Medium", and "Bad". An alternative which has more number of "Good" and lesser number of "Bad" is recommended.

- For the alternative which achieve the lowest value (or highest value) ⟶ Good (○)
- For the alternative within 10% difference compared to the lowest (or highest)) ⟶ Medium (△)

- For the alternative over 20% difference compared to the lowest (or highest) ⟶ Bad (×)

Figure 13.3-2 shows the alternative alignments for the bypass road.

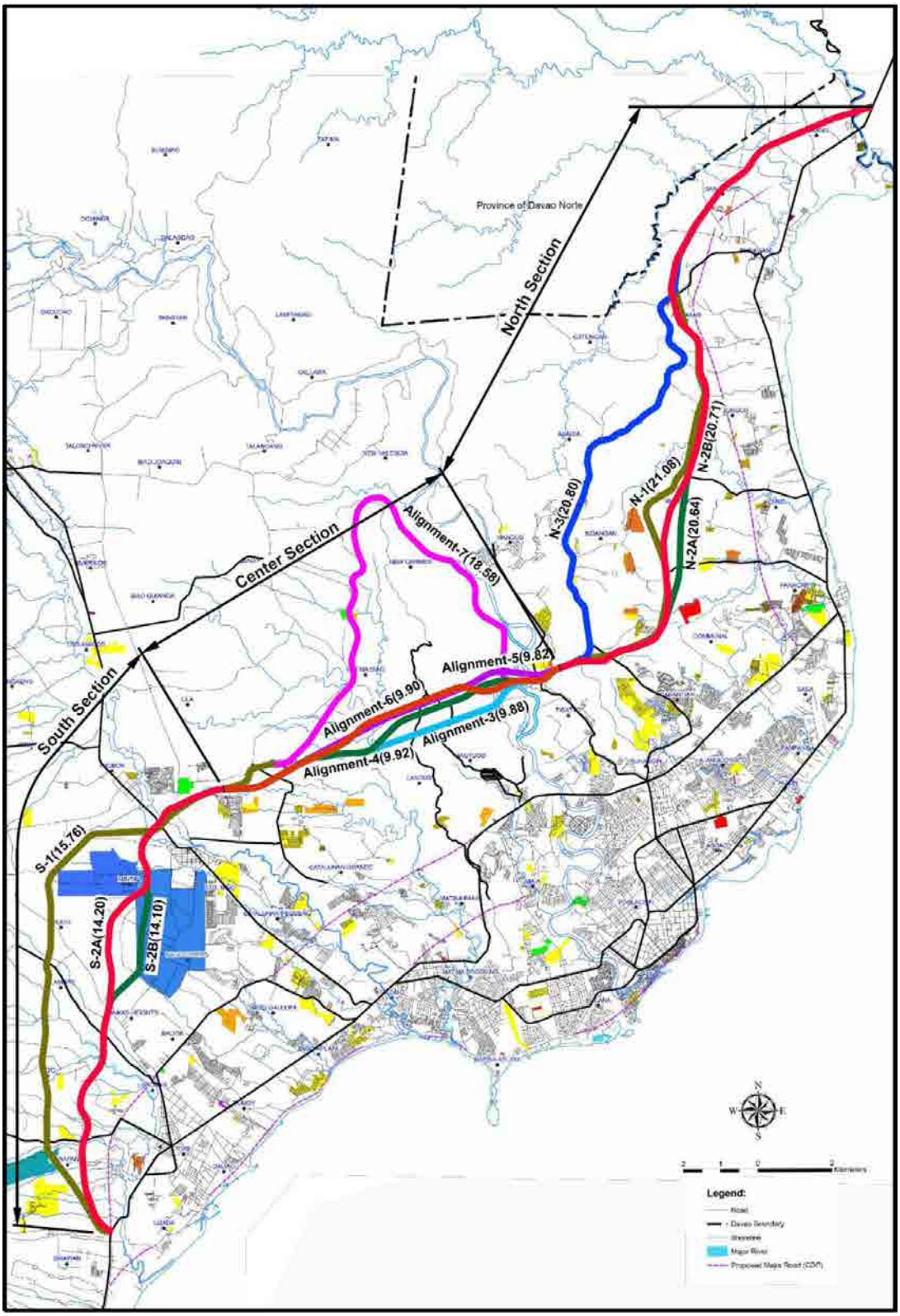


FIGURE 13.3-2 ALTERNATIVE ALIGNMENTS STUDIED FOR DAVAO CITY BYPASS

(3) Selected Alignment

Selected alignments for the South, Center and North Section are S-2A, Alignment-6, and N-2B respectively.

13.4 SCOPING

Scope of the EIA study for the project is discussed in this section. The environmental scoping is conducted based on an environmental reconnaissance by the JICA Survey Team from 20th September to 24th.

The result of scoping is indicated on the Leopold scoping matrix and reason tables as shown in **Table 13.4-1** and **Table 13.4-2**.

First of all, impact factors, impacted item and impact degree are shown on the following scoping matrix based on JICA's Guidelines. According to the scoping matrix, two (2) items such as No.3 (waste soil due to excavation) and No. 13 (Involuntary resettlement) are rated as "A" (significant impact) due to huge earth work volume and significant social impacts, fourteen (13) items are rated as "B" (Some impact is expected), six (6) item is rated as "C" (unknown impact is expected) and the others are rated as "D" (Few impacts are expected).

TABLE 13.4-1 DRAFT SCOPING MATRIX BASED ON JICA'S GUIDELINES AND PHILIPPINES ITEMS

	No	Affected Activities / Impact Items (JICA)	(Philippines)	Overall Rating	Pre/ During Construction Phase									Operation Phase		
					Land acquisition and Loss of properties	Change of Land use plan, Control of various activities by regulations for the construction	Reclamation of Wetland, etc.	Deforestation	Alteration to ground by cut land, filling, drilling, tunnel, etc.	Operation of Construction Equipment and Vehicles	Construction of Roads, tollgates, parking lots, Access roads for bridges and other related facilities	Traffic Restriction in construction area	Influx of construction workers, construction of base camp	Increase of Through Traffic	Appearance/ Occupancy of Roads and related building structures including tunnel and embankment	Increasing influx of settlers
Pollution	1	Air Pollution	Air quality & noise	**B**	D	D	D	D	D	B	D	D	D	B	D	D
	2	Water pollution	Water quality	**B**	D	D	D	D	B	D	D	D	B	D	D	D
	3	Waste	Abandonment	**A**	D	D	D	A	A	D	D	D	D	D	D	D
	4	Soil contamination	Soil quality/fertility	**B**	D	D	D	D	B	D	D	D	D	D	D	D
	5	Noise and Vibration	Noise	**B**	D	D	D	D	D	B	D	D	D	B	D	D
	6	Ground Subsidence	Subsidence/collapse	D	D	D	D	D	D	D	D	D	D	D	D	D
	7	Odor		D	D	D	D	D	D	D	D	D	D	D	D	D
	8	Sediment quality	Soil quality (No.4)	**B**	D	D	D	D	B	D	D	D	D	D	D	D
Natural Environment	9	Protected Area	Environmentally Critical Areas (ECAs)	D	D	D	D	D	D	D	D	D	D	D	D	D
	10	Ecosystem	Terrestrial Biology Freshwater or marine ecology	**C**	D	D	D	C	C	D	C	D	D	C	D	D
	11	Hydrology	Hydrology and oceanography	**B**	D	D	D	D	B	D	D	D	D	D	B	D
	12	Topography and geology	Geography, topography and landslides	**B**	D	D	D	D	B	D	D	D	D	D	B	D

	No	Affected Activities / Impact Items (JICA)	(Philippines)	Overall Rating	Pre/ During Construction Phase: Land acquisition and Loss of properties	Change of Land use plan, Control of various activities by regulations for the construction	Reclamation of Wetland, etc.	Deforestation	Alteration to ground by cut land, filling, drilling, tunnel, etc.	Operation of Construction Equipment and Vehicles	Construction of Roads, tollgates, parking lots, Access roads for bridges and other related facilities	Traffic Restriction in construction area	Influx of construction workers, construction of base camp	Operation Phase: Increase of Through Traffic	Appearance/ Occupancy of Roads and related building structures including tunnel and embankment	Increasing influx of settlers
Social Environment	13	Involuntary resettlement	People	**A**	A	D	D	D	D	D	D	D	D	D	D	D
	14	The poor	People	**C**	C	D	D	D	D	D	D	D	D	D	D	D
	15	Indigenous and ethnic people	Indigenous people (IPs)	**C**	C	D	D	D	D	D	D	D	D	D	D	D
	16	Local economy such as employment and livelihood	People	**B**	B	D	D	D	D	D	D	D	D	D	D	D
	17	Land use and utilization of local resources	Land use and classification	**B**	B	D	D	B	D	D	D	D	D	D	D	B
	18	Waste Usage	Hydrology / Hydrogeology/Water quality	**B**	B	D	D	D	B	D	D	D	D	D	B	D
	19	Existing social infrastructures and services	People	**C**	C	D	D	D	D	D	D	D	D	D	C	D
	20	Social institutions such as social infrastructure and local decision making institutions		D	D	D	D	D	D	D	D	D	D	D	D	D
	21	Misdistribution of benefit and damage		D	D	D	D	D	D	D	D	D	D	D	D	D
Social Environment	22	Local conflict of interests	People	**B**	D	D	D	D	D	D	D	D	B	D	D	D
	23	Cultural Heritage	People	**C**	C	D	D	D	D	D	D	D	D	D	D	D
	24	Landscape		D	D	D	D	D	D	D	D	D	D	D	D	D
	25	Gender		D	D	D	D	D	D	D	D	D	D	D	D	D
	26	Right of Children		D	D	D	D	D	D	D	D	D	D	D	D	D
	27	Infectious diseases such as HIV/AIDS	People	**B**	D	D	D	D	B	D	D	D	B	D	D	D
	28	Labor environment (including work safety)		D	D	D	D	D	D	D	D	D	D	D	D	D
Others	29	Accidents	Traffic situation	**B**	D	D	D	D	D	B	D	B	D	B	D	D
	30	Cross Boundary impacts and climate change	Meteorology / Climatology	**C**	D	D	D	C	D	D	D	D	D	C	D	D

Note) Rating:
A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (**serious impacts are not expected, but survey and analysis shall be done**) D: Few impacts are expected. Detailed quantitative survey is not necessary.

Source: JICA Survey Team

TABLE 13.4-2 REASONS FOR DRAFT SCOPING

Category	No	Impacted Item on JICA Guidelines (Philippines Item)	Rating		Reasons of the Rating
			Pre/ During Construction	Operation Phase	
Pollution	1	Air pollution (Air quality & noise)	B	B	**Construction phase:** Temporary negative impacts are expected on air quality due to construction machines and equipment. **Operation phase:** Negative impacts on air quality are expected due to emission from vehicles passing on the new road
	2	Water pollution (Water quality)	B	D	**Construction phase:** Turbid water may be generated by earth works and drilling of tunnel section. Additionally Organic polluted water may be discharged from base camp. **Operation phase:** No serious impacts are expected
	3	Waste (Abandonment)	A	D	**Construction phase:** Construction waste such as waste soil and cutting trees are expected to be generated by deforestation, cutting land and drilling tunnel. Additionally domestic waste and night soil may be generated from construction base camp. **Operation phase:** No serious impacts are expected
	4	Soil contamination (soil quality)	B	D	**Construction phase:** Muck soil from tunnel section may contain oil and chemicals. On the other hand, construction works in other section does which causes soil contamination is not expected, and there are not any polluted lands on the route. **Operation phase:** No impacts are expected
	5	Noise (Noise)	B	B	**Construction phase:** Noise and vibration generation is expected due to works of construction machines and equipment. **Operation phase:** Noise and vibration generation is expected by vehicles passing on the new road.
	6	Ground subsidence (Subsidence)	D	D	No impacts are expected since activities which cause ground subsidence (such as use of large amount of groundwater) not expected and there are any soft ground which causes subsidence.
	7	Odor	D	D	No impacts are expected since activities which cause odor are not expected.
	8	Sediment quality (Soil quality)	B	D	**Construction phase:** Muck soil from tunnel section may contain oil and chemicals. On the other hand, construction works in other section does which causes soil contamination is not expected, and there are not any polluted lands on the route. **Operation phase:** Road operation which causes impacts on sediment quality is not expected.
Natural environment	9	Protected area (ECAs)	D	D	**Construction and operation phase:** No protected area such as designated conservation zone is observed in the project affected area.
	10	Ecosystem (Terrestrial Biology Freshwater or marine ecology)	C	C	**Construction and Operation phase:** Although any designated protected areas and considerable species habitats have not been identified in the construction site, the impacts by deforestation, alteration of ground and construction of road will be assessed based on the baseline survey results.
	11	Hydrology (Hydrology and oceanography)	B	B	**Construction and Operation phase:** Construction of bridges and drainage facility on the route may change hydrological situation of the rivers, and may give impact on flooding situation. Furthermore, Cutting and drilling earthworks may give impact to hydrological situation underground (may cut water vein underground).
	12	Topography and geology (Geography, topography and landslides)	B	B	**Construction and operation phase:** Considerable topography and geological sites are not located in the project area, thus no impact is expected. However there are risks of landslide and collapse in the high-embankment section.
Social environment	13	Involuntary resettlement (People)	A	D	**Pre-Construction phase:** More than 100 buildings to be relocated are estimated on the corridor of impact. **Operation phase:** No impact is expected

Category	No	Impacted Item on JICA Guidelines (Philippines Item)	Rating		Reasons of the Rating
			Pre/ During Construction	Operation Phase	
	14	The poor (People)	C	C	**Pre-Construction phase:** Impacts will be assessed considering the feature of the local society around the project site. **Operation phase:** Few impacts are expected
	15	Indigenous and ethnic people (Indigenous people)	C	C	**Pre-Construction phase:** Although a couple of indigenous people groups are identified in the project area, impacts will be assessed considering the feature of the local society around the project site. **Operation phase:** Few impacts are expected
	16	Local economy such as employment and livelihood	B	D	**Pre-construction phase:** Livelihood of residents and farmers may be affected by resettlement and acquisition of agricultural area and plantation field. **Operation phase:** Few impacts are expected.
	17	Land use and utilization of local resources (Land use and classification)	B	B	**Pre-construction phase:** App. 30m width and 40km area on mainly agricultural areas and plantation areas will be affected by the project. **Operation phase:** Roadside area may be developed as commercial or industrial area in non-designated land use area. Such unplanned development and influx of new settlers may give impact on land use and local resources.
	18	Water usage (Hydrology / Hydrogeology/Water quality)	B	B	**Construction phase:** Earth works such as cutting land and drilling of tunnel may give impact on drinking water resources such as springs and wells. **Operation phase:** Existence of tunnel may give impact on water vein and existing spring water and wells
	19	Existing social infrastructures and services (People)	C	C	**Pre-Construction and Construction phase:** Relocation of religious facilities, school, cemetery and other public facilities need to be considered. **Operation phase:** Existence of bypass may disturb commuting / going to school and hospital.
	20	Social institutions such as social infrastructure and local decision making institutions	D	D	Impacts are not expected, since local decision making institute represented by Barangay, District and Davao city will continue after the road construction.
	21	Misdistribution of benefit and damage	D	D	Misdistribution of benefit and damage caused by the road construction is not expected.
	22	Local conflict of interests (People)	B	D	**Construction phase:** Local inhabitants and local authorities may request to ensure job opportunities as construction workers. **Operation phase:** No impact is expected
	23	Cultural heritage (People)	C	D	**Pre-Construction and Construction Phase:** Impact will be assessed based on the confirmation of cultural heritages around the project site.
	24	Landscape	D	D	**Construction phase:** Few impact is expected **Operation phase:** There are no law-based designated landscape areas around project area. Additionally any recreation sites such as hiking trail, natural parks which provides aesthetic landscape to visitors are not observed along the proposed alignment.
	25	Gender	D	D	Negative impacts specified for women are not expected.
	26	Right of children	D	D	Negative impacts specified for children are not expected.
	27	Infectious diseases such as HIV/AIDS (People)	B	D	**Construction phase:** Infectious diseases such as STD are possible to be spread due to inflow of construction workers. Furthermore, alteration to ground by cut land and filling may provoke to provide habitats of mosquito that possibly transmits dengue fever. **Operation phase:** Road operation which causes infectious diseases is not expected.

Category	No	Impacted Item on JICA Guidelines (Philippines Item)	Rating		Reasons of the Rating
			Pre/ During Construction	Operation Phase	
	28	Labor environment (including work safety)	B	D	**Construction phase:** Construction work environment needs to be considered in accordance with relevant laws and regulations. **Operation phase:** No impact is expected.
Others	29	Accidents (Traffic situation)	B	B	**Construction phase:** Construction vehicles may use existing local road near residential areas, thus number of traffic accident may increase. **Operation phase:** Risks of traffic accidents on the new road is expected.
	30	Cross boundary impacts and climate change (Meteorology / Climatology)	C	C	**Construction phase:** Deforestation for land clearance may give impact on cross boundary impacts and climate change. **Operation phase:** Greenhouse gas around the new road may increase by the traffic. However the estimated total traffic number in the project area, Davao City is same as both cases "With/Without Project", only travelling speed will increase with project case. Thus the project does not give negative impact on this item.

Note) Rating:
A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (**serious impacts are not expected, but survey and analysis shall be done**) D: Few impacts are expected. Detailed quantitative survey is not necessary.

Source: JICA Survey Team

Category	No	Impacted Item on JICA Guidelines (Philippines Item)	Rating		Baseline Survey	Forecast Analysis
			Pre/ During Construction	Operation Phase		
Pollution	1	Air pollution (Air quality & noise)	B	B	-Site measurement (7 sites) CO, NO2, SO2 and TPM -Secondary data collection, if any	**Construction Phase:** Qualitative analysis **Operation Phase:** - Quantitative analysis(CO, NO2, SO2 and SPM) (Puf model : calm wind model)
	2	Water pollution (Water quality)	B	D	-Site measurement 5 sites: river water DO, TSS, BOD, COD, pH, Total/Fecal Coliform, temperature -Secondary data collection, if any	**Construction and Phase:** Qualitative analysis
	3	Waste (Abandonment)	A	D	Review of specification on design and construction plan	**During Construction Phase:** Quantitative analysis of volume of cutting trees by type and excavated or drilling soil and muck
	4	Soil contamination (soil quality)	B	D	Review of specification on design and construction plan	**During Construction Phase:** Qualitative analysis
	5	Noise and vibration (Noise)	B	B	Noise -Site measurement (7 sites) $L_{Aeq, 10min}$ weekday (in accordance with DENR regulation) -Secondary data collection, if any	**During Construction Phase:** Qualitative analysis based on construction machines on standard formation **Operation Phase:** - Quantitative analysis(ASJ CN-Model 2008)
	8	Sediment quality (Soil quality)	B	D	Literature survey (land use history on affected land of the project)	**During Construction Phase:** Qualitative analysis base on the literature survey
Natural environment	10	Ecosystem (Terrestrial Biology Freshwater or marine ecology)	C	C	Literature survey and site survey for fauna and flora. With regard to Philippine eagles, interview survey from specialist is required.	**During construction and operation phase:** Qualitative analysis base on the literature survey, site survey and construction plan & traffic volume in the future The degree of impact for Philippines

Category	№	Impacted Item on JICA Guidelines (Philippines Item)	Rating		Baseline Survey	Forecast Analysis
			Pre/ During Construction	Operation Phase		
						Eagles will be anticipated qualitatively.
	11	Hydrology (Hydrology and oceanography)	B	B	Literature survey and referring to hydrographic and geological survey result on feasibility study and designing	**During construction and operation phase:** Quantitative analysis on following items base on the hydrographic analysis for bridge and drainage designing. -Impact on hydrological situation on the rivers and streams -Impact on water vein underground -Impact on flooding situation
	12	Topography and geology (Geography, topography and landslides)	B	B	Literature survey and topographic survey for designing	**During construction and operation phase:** Qualitative analysis base on the topographic analysis for designing
Social environment	13	Involuntary resettlement (People)	A	D	Literature survey and a series of RAP surveys (Inventory of loss assets, census, social economic survey and replacement cost study)	**During construction phase:** Quantitative analysis based on RAP surveys
	14	The poor (People)	C	D	Literature survey and a series of RAP surveys	**During construction phase:** Quantitative analysis based on RAP surveys
	15	Indigenous and ethnic people (Indigenous people)	C	D	Literature survey and a series of RAP surveys	**During construction phase:** Quantitative analysis based on RAP surveys
	16	Local economy such as employment and livelihood (People)	B	D	Literature survey and a series of RAP surveys	**During construction phase:** Qualitative analysis based on RAP surveys
	17	Land use and utilization of local resources (Land use and classification)	B	B	Literature survey and a series of RAP surveys (Confirmation of fishing ground in the crossing rivers such as Davao river is required)	**During construction phase:** Quantitative analysis based on RAP surveys (area of land acquisition by land use)
	18	Water usage (Hydrology / Hydrogeology/Water quality)	B	B	Literature survey, geological survey and water usage survey (identification of springs and wells around tunnel and cutting land areas based on the data from DCWD and RAP survey)	**During construction and operation phase:** Qualitative analysis base on the baseline survey for following items - Impact on springs and wells - Impact on watershed area
	19	Existing social infrastructures and services (People)	C	D	Literature survey and a series of RAP surveys	**During construction phase:** Quantitative analysis based on RAP surveys
	22	Local conflict of interests (People)	B	D	Collection of information and opinions in stakeholder meeting(s)	**During construction:** Qualitative analysis based on RAP surveys and opinions through stakeholder meeting(s)
	23	Cultural heritage (People)	C	D	Literature survey, a series of RAP surveys and collection of local information through stakeholder meeting(s)	**During construction:** Quantitative analysis based on RAP surveys and opinions through stakeholder meeting(s)

Category	No.	Impacted Item on JICA Guidelines (Philippines Item)	Rating		Baseline Survey	Forecast Analysis
			Pre/ During Construction	Operation Phase		
	27	Infectious diseases such as HIV/AIDS (People)	B	D	Literature survey and collection of local information through stakeholder meeting(s)	**During construction phase:** Qualitative analysis based on baseline survey. Followings impacts are considered - Risks of HIV/AIDS - Risks of dengue fever - Other specific infection disease
Others	29	Accidents (Traffic situation)	B	B	Collection of traffic accident data from police station	**Operation phase:** Quantitative analysis based on baseline survey
	30	Cross boundary impacts and climate change (Meteorology / Climatology)	C	C	-Estimation of affected forest area and traffic conditions based on the project plan	**Pre-construction phase at 2013:** Estimation of generated greenhouse gases (CO2) from traffic **Construction phase at 2016** Estimation of generated greenhouse gases (CO2) from traffic and construction machine **Operation phase at 2023 and 2033** Estimation of generated greenhouse gases (CO2) from traffic

Rating:
A: Serious impact is expected. B: Some impact is expected. C: Extent of impact is unknown (**serious impacts are not expected, but survey and analysis shall be done**) D: Few impacts are expected. Detailed quantitative survey is not necessary.

Source: JICA Survey Team

13.5 SUMMARY OF BASELINE SURVEY AND FORECAST

The summarized result of baseline survey and forecast of impacts are shown in **Table 13.5-1**. The survey points for air, water quality and noise are shown in **Figure 13.5-1**. The baseline data and quantitative forecast of air, water quality and noise are shown in **Table 13.5-2**. The survey points of fauna and flora are shown in **Figure 13.5-3**.

With regard to pollution items such as air, water and noise, all the forecasted values does not exceed standard values, thus it is not likely to give serious impact on these items. However construction waste soil from cutting land and drilling in the tunnel section should be reused or disposed in appropriate designated disposal site.

Although some species on the IUCN List are identified through the baseline survey on fauna and flora, these species are distributed around the project area. The estimated number of resettlers exceeds 200 persons, thus appropriate mitigation measures are indispensable on the resettlement action plan.

TABLE 13.5-1 RESULT OF BASELINE AND FORECAST ON MAIN ITEMS

Category	No.	Impacted Item on JICA Guidelines (Philippines Item)	Rating on the Scoping		Summary of Result		
			Pre/ During Construction	Operation Phase	Baseline	Forecast	Evaluation (Quantitative Standards)
Pollution	1	Air pollution (Air quality & noise)	B	B	All measured items (CO, NO2, SO2 and TSP) at 7 points indicated less than standard values. Any sensitive receptors such as school, hospital and residential areas are not observed along the	Forecasted values for NO2, SO2 and SPM at 2 points in residential area do not exceed standard values.	Expected impacts by the project are not significant because all forecasted values meet standard values. (Quantitative Standards is shown in Table 13.5-3)

Category	No	Impacted Item on JICA Guidelines (Philippines Item)	Rating on the Scoping		Summary of Result		
			Pre/ During Construction	Operation Phase	Baseline	Forecast	Evaluation (Quantitative Standards)
					alignment. However a residential area named Elenita Heights (Sta. A6) and the University of Philippine Mindanao is located 200-700 m away from the alignment. (see FIGURE 13.5-1 SITE SURVEY LOCATION FOR AIR, NOISE AND WATER)		
	2	Water pollution (Water quality)	B	D	All measured items (DO, pH, TSS and BOD) except coliform indicated less than standard values.	During construction, construction activities may cause turbid water and oil & grease contamination. Additionally organic polluted water may be discharged from base camp.	As shown on the left, some impacts are expected, thus these impacts are minimized by mitigation measures such as setting up silt fence, sedimentation pond, portable toilet and appropriate management of construction machines. (Quantitative Standards is shown in Table 13.5-4)
	3	Waste (Abandonment)	A	D	Not required	Construction waste such as waste soil and cutting trees are expected to be generated by deforestation, cutting land and drilling tunnel. Additionally domestic waste and night soil may be generated from construction base camp.	As shown on the left, some impacts are expected, thus these impacts are minimized by mitigation measures such as setting up temporary sanitation facilities and appropriate management and disposing in designated site.
	4	Soil contamination (soil quality)	B	D	Not required (contaminated soil is not existing from land use history)	During construction, drilling or muck soil from tunnel section may contain oil and chemicals. It may affect to soil quality around project area.	As shown on the left, some impacts are expected, thus these impacts are minimized by mitigation measures such as appropriate management of construction machines and setting up sedimentation pond, if required.
	5	Noise (Noise)	B	B	All measured noise level at 7 points exceeds standard values. Even in the residential area, the measured level is between 50 and 70 dB(A) for 24 hours due to some sound sources such as Islamic call to prayer, barks of dog, music and insect sounds etc. Any sensitive receptors such as school, hospital and residential areas are not observed along the alignment. However a residential area named Elenita Heights (Sta. N6) and the University of Philippine Mindanao is located 200-700 m away from the alignment. (see FIGURE 13.5-1 SITE SURVEY LOCATION FOR AIR, NOISE AND WATER)	During construction, construction noise affect to the nearest residential area. In operation phase, forecasted values at 2 points on the boundary of ROW and at 2 points in residential area satisfied with the standard noise level. (see FIGURE 13.5-2 QUANTITATIVE FORECASTED POINTS FOR AIR AND NOISE)	During construction, as shown on the left, some impacts are expected, thus mitigation measures such as setting up soundproof barriers on the boundary and adoption of working time are planned. In operation phase, although impacts rate by the project is not exceeding the standard values. However, installation of noise barriers near considerable facilities such as school and hospital should be considered, if required. Furthermore, land use management along the road is considered in the near future from the view of secure of buffer zone along the bypass. (Quantitative Standards is shown in Table 13.5-5)
	8	Sediment quality (Soil quality)	B	D	Not required	During construction, drilling or muck soil from tunnel section may contain oil and chemicals. It may affect to soil quality in the river around project area.	As shown on the left, some impacts are expected, thus these impacts are minimized by mitigation measures such as appropriate management of construction machines and setting up sedimentation pond, if required.

Category	No	Impacted Item on JICA Guidelines (Philippines Item)	Rating on the Scoping		Summary of Result		
			Pre/ During Construction	Operation Phase	Baseline	Forecast	Evaluation (Quantitative Standards)
Natural environment	10	Ecosystem (Terrestrial Biology Freshwater or marine ecology)	C	C	No protected area such as national parks and forest reserves in the project area. As the result of baseline site survey; 1) Trees and understory flora Recorded species: 185 IUCN Red list: 21 (LC:16 and Vul: 5) 2) Birds Recorded species: 29 IUCN Red list: 29 (LC:28 and Vul: 1) 3) Bats Recorded species: 4 IUCN Red list: 3 (LC:3) 4) Frogs Recorded species: 5 IUCN Red list: 5 (LC:5) Note) Philippine eagle was neither heard nor observed in the project area. *LC: Least Concern, Vul: Vulnerable (see FIGURE 13.5-3 FLORA AND FAUNA SURVEY LOCATIONS)	Some listed species on the IUCN red list are observed in the project area. However since these species area distributed in other second forest of Davao City and elsewhere in the remnant forest cover of Mindanao, it is not likely the project gives serious impact on fauna and flora. However the faunal habitats observed to have high species diversity that may be affected by the project are the riparian habitats of Matina River, thus it is recommended to minimize of impacts by mitigation measures. With regard to the Philippine Eagle, the no nesting area and no feeding area in the project site in accordance with 3 specialists. The identified nesting are located 11.6 km and 39.5 km away from the project area, thus it is not likely to give serious impact with the Eagle.	As shown on the left, some impacts are expected, thus these impacts are minimized by mitigation measures such as relocation & replanting trees along the road under instruction of DENR. Furthermore, appropriate land management will be done by Davao City, so as not to cause unplanned development (i.e., land squatting by migrants) in areas with dense vegetation.
	11	Hydrology (Hydrology and oceanography)	B	B	The major groundwater source is located at the skirt of Mt. Apo and Mt. Talomo named Dumoy area. There are app. 30 wells with depth range -90 to -152 m. In tunnel section, the boring logs indicated the presence of ground water in only 3 of 8 boreholes, but these confirmed layers does not include rich aquifers. Flood is recorded at Lasang, Lacanon, Bunawan, Lipadas and Davao river.	With regard to groundwater source, These existing water sources are located approximately 2-3 km or more from the proposed bypass alignment is not expected to be influenced by the project. In the tunnel section, contained water is extremely law, thus therefore, the flow of water or seepage into the tunnel. Hence it is not likely to give serious impacts on the groundwater. With regard to change of flooding situation, if the bypass is constructed without sufficient drainage, current flood situation will be deteriorated.	It is not likely to give serious impact on the groundwater as shown on the left forecast. With regard to flooding situation, installation of sufficient drainage facilities based on meteorological survey and hydrological surveys will secure stable hydrological situation without flooding.
	12	Topography and geology (Geography, topography and landslides)	B	B	According to the reconnaissance, no slope failure is expected near tunnel section.	Slope failure, soil erosion, and rock fall may potentially occur along high cut slope sections by unstable soil layers of sand and gravel due to cut, weathering, erosion, and water infiltration.	As shown on the left, some impacts are expected, thus these impacts and risks are minimized by mitigation measures such as slope protection.
Social environment	13	Involuntary resettlement (People)	A	D	According to RAP survey, 57 affected dwellings and 228 resettlers are identified. (see Table 13.10-1)	Land acquisition by the project causes large-scale resettlement. Thus full scale-RAP shall be prepared in accordance with JICA Guidelines.	Appropriate compensation and social assistance in accordance with Resettlement Action Plan (RAP) is prepared and minimize the adverse social impacts.
	14	The poor (People)	C	C	As shown in TABLE 13.10-12, a relatively high percentage of the surveyed households (71.6%) are earning above the poverty	Land acquisition by the project gives some adverse impact to poor people under poverty line.	↑ ditto

Category	No	Impacted Item on JICA Guidelines (Philippines Item)	Rating on the Scoping		Summary of Result		
			Pre/ During Construction	Operation Phase	Baseline	Forecast	Evaluation (Quantitative Standards)
					threshold of Php 17,040 for a family of four (4) in Region XI DAVAO Region; 7% have annual household incomes that are below the poverty threshold; while the remaining 13.9% are living below the food threshold.		
	15	Indigenous and ethnic people (Indigenous people)	C	C	According to Davao City, no designated indigenous area is observed. Non Overlap Certificate of the designated indigenous area was issued from the National Commission on Indigenous Peoples (NCIP) on 26th Aug. 2014	Few impacts are expected on designated indigenous and ethnic group. However situation of minority religious group(s) such as Islamic group shall be monitored, and then adequate assistance and coordination shall be given, if necessary.	↑ ditto
	16	Local economy such as employment and livelihood (People)	B	D	TABLE 13.10-8 presents the primary source of income of the respondents. As shown on the table, the main source of income is farming (26.4%), followed by own business (22.9%), and professional practice (15.9%). There is also a high percentage who have indicated that they are unemployed or no source of income (17.9%).	Land acquisition by the project gives some adverse impact to tenant farmers and employees of the shops. According to RAP survey, app. 50% PAFs are farmers and own business operators.	Appropriate compensation and social assistance in accordance with Resettlement Action Plan (RAP) is prepared and minimize the adverse social impacts.
	17	Land use and utilization of local resources (Land use and classification)	B	B	According to literature survey based on land use map of Davao City, the project alignment is passing through mainly agricultural area such as plantation and residential zone. The proposed alignment is already incorporated in the land use map 2013-2022	Although the proposed will not traverse through Tourist Development Zones (TDZ), it is deemed beneficial for this development zone in terms of providing better access to the site. In terms of the Agricultural Land Zone (AG), impacts are considered as both positive and negative. Positive in the sense that the Bypass can provide better and faster way, and as such more economical way of transporting products from these areas to trading centers and other distribution sites. Negative in the sense that there is an imminent danger of illegal conversion into other uses.	As shown on the left, some impacts are expected, thus these impacts and risks are minimized by appropriate land management along the bypass under Davao City.
	18	Water usage (Hydrology / Hydrogeology/ Water quality)	B	B	Main drinking water source in Davao City is groundwater located in Dumoy area, not river water. Most of the study sites are near human settlements and are generally used for domestic purposes such as bathing and doing laundry.	During construction, construction activities such as earthworks and excavation in the river will cause turbid water and increase suspended solid in the river. This turbid water does not give impact to drinking water, but may affect to domestic use of the river water.	As shown on the left, some impacts are expected, however these impacts are minimized by mitigation measures such as setting up silt fence and sedimentation pond. However this pond shall be well maintained not to provide habitats for mosquito which infects dengue fever.
	19	Existing social infrastructures and services (People)	C	C	According to RAP survey, any affected social infrastructures such as school, hospital and church are not observed.	The project does not give any impact to social infrastructures. Thus it is not likely to give any serious impacts on this item	Appropriate compensation and social assistance in accordance with Resettlement Action Plan (RAP) is prepared and minimize the adverse social impacts, if any impacts are expected in the detailed design
	22	Local conflict of interests (People)	B	D	A stakeholder requested to provide work opportunities as a construction worker during construction in the stakeholder meetings on scoping stage.	The local conflicts regarding work opportunities between local communities may be raised in case of unfair employment.	This risk is minimized by mitigation measures such as provision of first priority in hiring during construction period.

Category	No	Impacted Item on JICA Guidelines (Philippines Item)	Rating on the Scoping		Summary of Result		
			Pre/ During Construction	Operation Phase	Baseline	Forecast	Evaluation (Quantitative Standards)
	23	Cultural heritage (People)	C	D	According to RAP survey, no cultural heritages are observed on the alignment	Few impacts are expected	Not required
	27	Infectious diseases such as HIV/AIDS (People)	B	B	A stakeholder requested not to create a habitat of mosquito that transmits dengue fever in incidental pond in the construction area without appropriate drainage. According to statistical data, dengue cases have remarkably increased from 3,176 cases in 2008 to 7,326 in 2012, or an increase of about 130.67 percent.	Infectious diseases such as STD are possible to be spread due to inflow of construction workers. Furthermore, alteration to ground by cut land and filling may provoke to provide habitats of mosquito that possibly transmits dengue fever.	This risk is minimized by mitigation measures such as construction of sufficient drainage, management of construction yard and health check & education for workers.
	28	Labor environment (including work safety)	B	D	Not required	There are risks for workers during construction, if the construction contractor does not comply with relevant labor laws and regulations.	These risks are avoided and minimized by complying with relevant laws and regulations by the contractor under observation of DPWH.
Others	29	Accidents (Traffic situation)	B	B	Not required	Construction vehicles may use existing local road near residential areas, thus number of traffic accident may increase.	These risks are avoided and minimized by installation of traffic sign board, lighting in the night, safety personnel and parking for construction machines.
	30	Cross boundary impacts and climate change (Meteorology / Climatology)	C	C	Not required	Generated estimated CO2 (t/year)volume during construction and operation phase are;	Basically the project will give positive impact after construction.

Year	Status	Without Project	With Project
2013	Before Const.	465,794	465,794
2016	Const.	475,036	547,162
2023	Operation	636,936	611,336
2033	Operation	757,312	742,086

TABLE 13.5-2 SUMMARY OF BASELINE AND FORECASTED VALUE (AIR, NOISE AND WATER)

No	Item	Baseline Survey (Standard Value)						Quantitative Forecast Analysis (Standard Value)			
1	Air pollution (Air quality & noise)	St.	Location	TSP (300ug/Ncm)	NO2 (260 ug/Ncm)	SO2 (340 ug/Ncm)	CO (30ppm)	SPM (0.1 mg/m3)	NO2 (260 ug/Ncm)	SO2 (340 ug/Ncm)	CO (30ppm)
		A1	Connected road	298.5	6.1	7.8	1.0	-	-	-	-
		A2	Connected road	158.3	3.7	1.8	<1.0	-	-	-	-
		A3	Connected road	128.1	2.4	4.6	<1.0	-	-	-	-
		A4	Connected road& near university	275.9	3.7	13.9	1.0	-	-	-	-
		A5	Connected road	221.1	4.3	5.1	1.0	-	-	-	-
		A6	Residential area (Ambient)	57.7	1.7	0.8	1.0	0.05832	6.7	2.4	-
		A7	Near School (Ambient)	82.0	0.9	1.1	1.0	0.05775	1.7	1.8	-
2	Water pollution (Water quality)	St.	Location	DO (5 mg/l)	TSS (30mg/l)	BOD (7 mg/l)	Total Coli. (1000 MPN/100ml)	Basically waste water is not discharged during and after construction, thus quantitative forecast has not been conducted			
		W1	Lasang River	7.3	ND	1.1	5,400				
		W2	Davao River	7.6	82.0	0.5	9,200				
		W3	Matina River	7.3	2.0	2.0	9,200				
		W4	Talomo River	7.5	4.0	3.9	16,000				
		W5	Lipadas River	7.1	1.0	2.7	9,200				

No	Item	Baseline Survey (Standard Value)						Quantitative Forecast Analysis (Standard Value)			
5	Noise and vibration (Noise)	St.	Location	Laeq dB(A) Morning N1-5: 60 N6-7:45	Daytime N1-5: 65 N6-7:50	Evening N1-5: 60 N6-7: 45	Night Time N1-5: 55 N6-7: 40	Laeq dB(A) (estimated values with BG) Morning N1-5: 60 N6-7:45	Daytime N1-5: 65 N6-7: 50	Evening N1-5: 60 N6-7: 45	Night Time N1-5: 55 N6-7: 40
		N1	Connected road	-	72	-	-	-	-	-	-
		N2	Connected road	-	72	-	-	-	-	-	-
		N3	Connected road	-	74	-	-	-	-	-	-
		N4	Connected road& near university	-	80	-	-	-	-	-	-
		N5	Connected road	-	73	-	-	-	-	-	-
		N6	Residential area (Ambient)	64	64	57	53	45 (64)	47 (64)	44 (58)	40 (53)
		N7	Near School (Ambient)	62	64	69	62	44 (62)	46 (64)	43 (69)	39 (62)

TABLE 13.5-3 STANDARD VALUES OF AIR QUALITY INPHILIPPINES

Item	TSP	NO2	SO2	CO
Philippine Standard Values	300ug/Ncm	260 ug/Ncm	340 ug/Ncm	30ppm
Japanese Standard Values	(SPM) 0.2 mg/m^3	0.04-0.06ppm	0.1ppm	10ppm

Note) DENR National Ambient Air Quality Standards for Source Specific Air Pollutants based on 60 minutes averaging time

TABLE 13.5-4 STANDARD VALUES OF NOISE LEVEL IN PHILIPPINES

Class		Morning Time 05:00-09:00 (dB(A))	Day Time 9:00-18:00 (dB(A))	Evening Time 18:00-22:00 (dB(A))	Night Time 22:00-5:00 (dB(A))
Philippines Standard	Class AA	45	50	45	40
	Class A (General)	50	55	50	45
	Class A (facing 4 lanes road area)	50	60	50	45
	Class B (Commercial area)	60	65	60	55
	Class C	65	70	65	60
Japanese Standard	Class AA	-	(6:00-22:00) 50	(22:00-6:00) 40	-
	Class A	-	55	45	-
	Class A2	-	60	55	-
	Class B	-	55	45	-
	Class B2	-	65	60	-
	Class C	-	60	55	-
	Class C2	-	65	60	-
	Class D	-	70	65	-

Note1: Definition of Class on Philippines Standards (Agreement between DPWH, EMB and MMT as indicated in Annex 2-20 of the RPM for DAO 2003-30)

"AA" categorized areas (a section or contiguous area which requires quietness, such as an area within 100 m from school sites, nursery schools, hospitals, places of worships, and special homes for the aged)

"A" categorized areas (general residential areas)

"A" categorized areas (directly facing/fronting a 4 lanes road in residential area):

"B" categorized areas (general commercial areas)

"C" categorized areas (light industrial areas)

Note2: Definition of Class on Japanese Standards (Ministry of Environment in Japan)

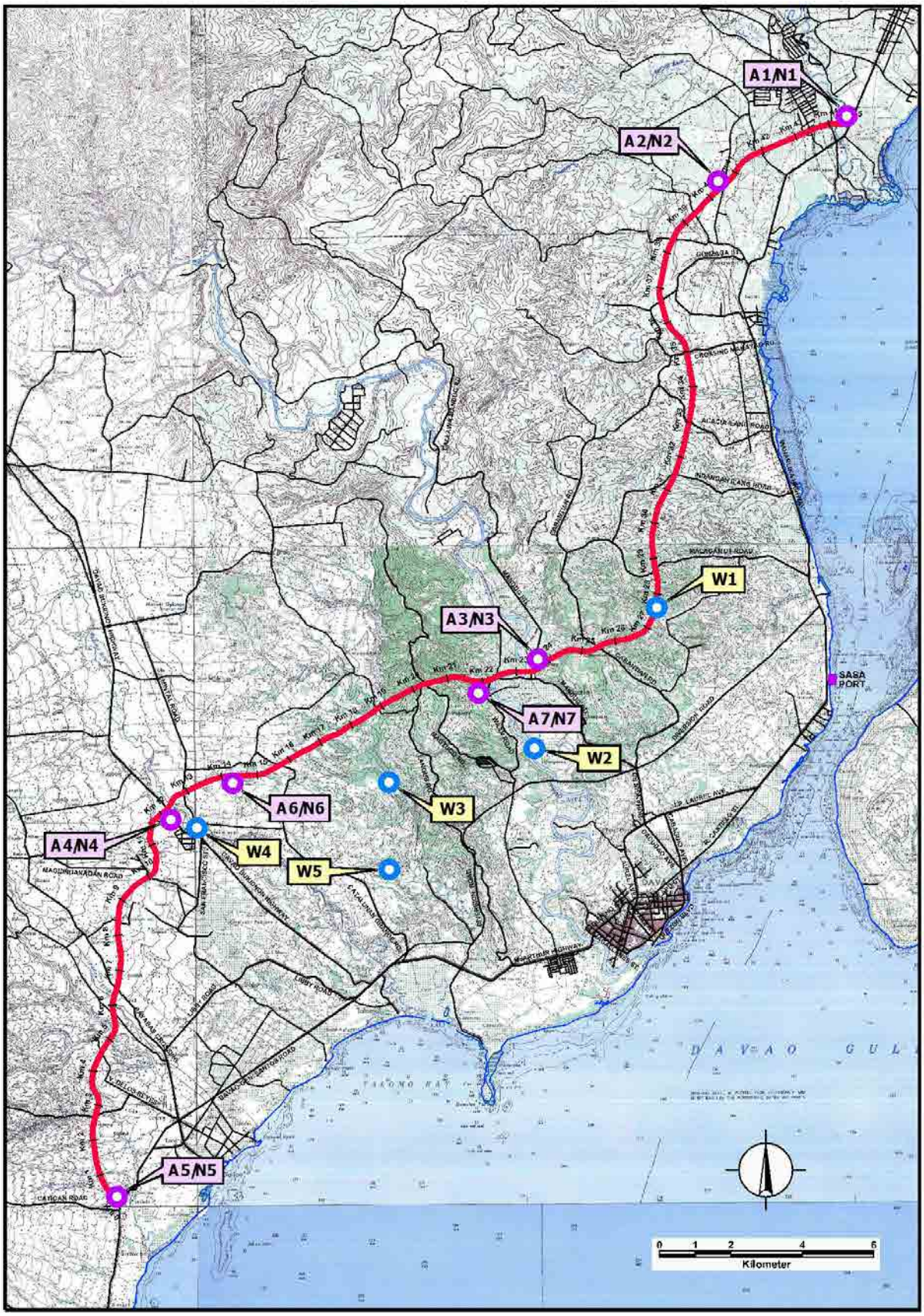
"AA" categorized areas (sensitive area required to be calm such as hospital and social welfare facilities)

"A" categorized areas (general residential areas)
"A2" categorized areas (directly facing/fronting more than 2 lanes road in "A" area):
"B" categorized areas (mainly residential areas)
"B2" categorized areas (directly facing/fronting more than 2 lanes road in "B" area)
"C" categorized areas (mixed area with residential, commercial and industrial areas)
"C2" categorized areas (directly facing/fronting more than 2 lanes road in "C" area)
"D" categorized areas (directly facing/fronting trunk road)

TABLE 13.5-5 STANDARD VALUES OF RIVER WATER QUALITY IN PHILIPPINES

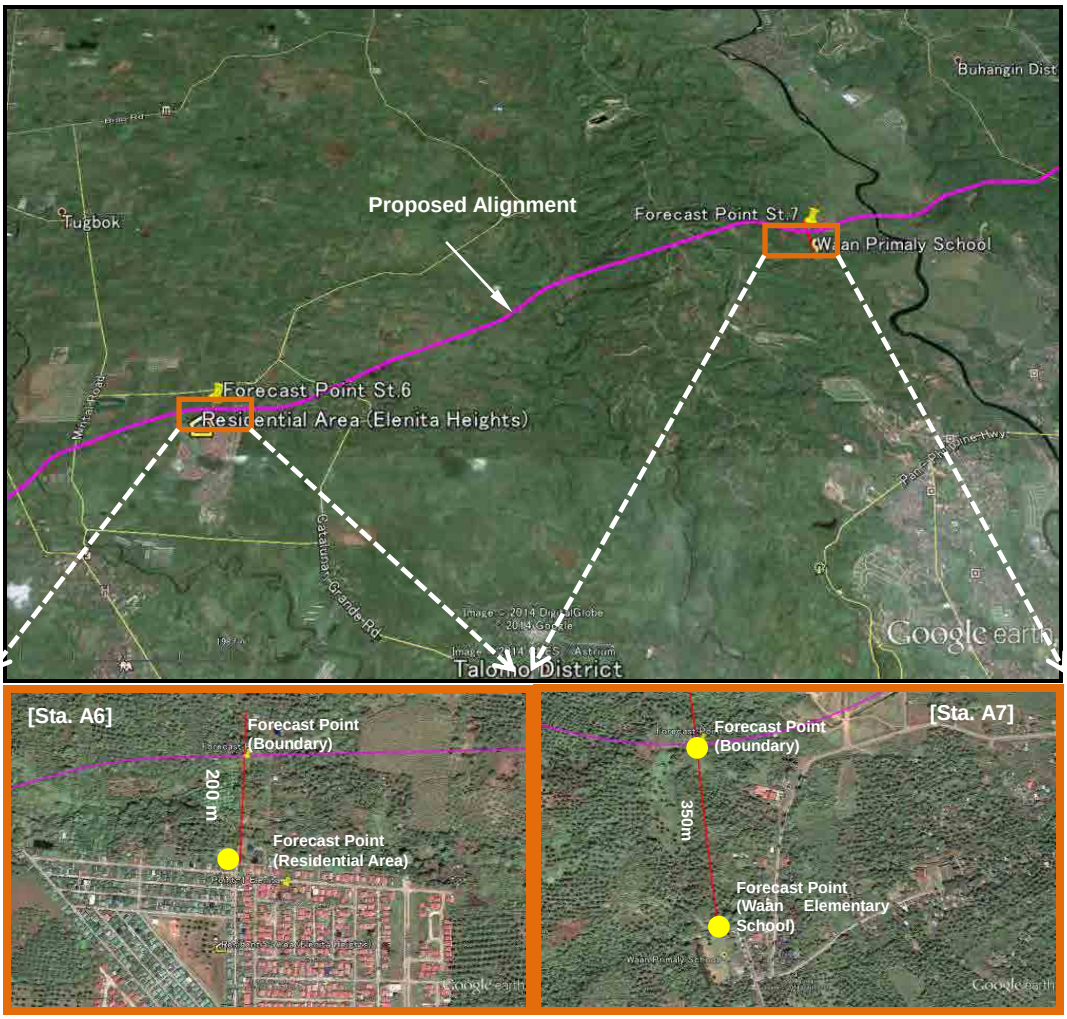
Item	DO	pH	TSS	BOD	COD	OIL	Total Coliforms
Philippine Standard Values	5.0 mg/l	6.5-8.5	30 mg/l	7 mg/l	100	2	1,000 MNP/100ml
Japanese Standard Values	5.0 mg/l	6.5-8.5	(SS) 25 mg/l	3 mg/l	-	2	5,000 MNP/100ml

Note)
- DENR Administrative Oder (DO) No34-series of 1990 Revised water usage classification water quality criteria amending section Nos:68 and 69, Chapter III of the 1978 NPCC Rules and Regulations (corrected version)
- Class C: Fishery water, recreation rater Class II (boating) and Industrial Water Supply Class I (for manufacturing processes after treatment)
- Table 1- Water Quality Criteria for Conventional and other pollutants contributing to aesthetics and oxygen demand for fresh waters (a)
- Japanese Standards : Class B (fishery class 2nd Class and water supply class 3rd) Ministry of Environment in Japan



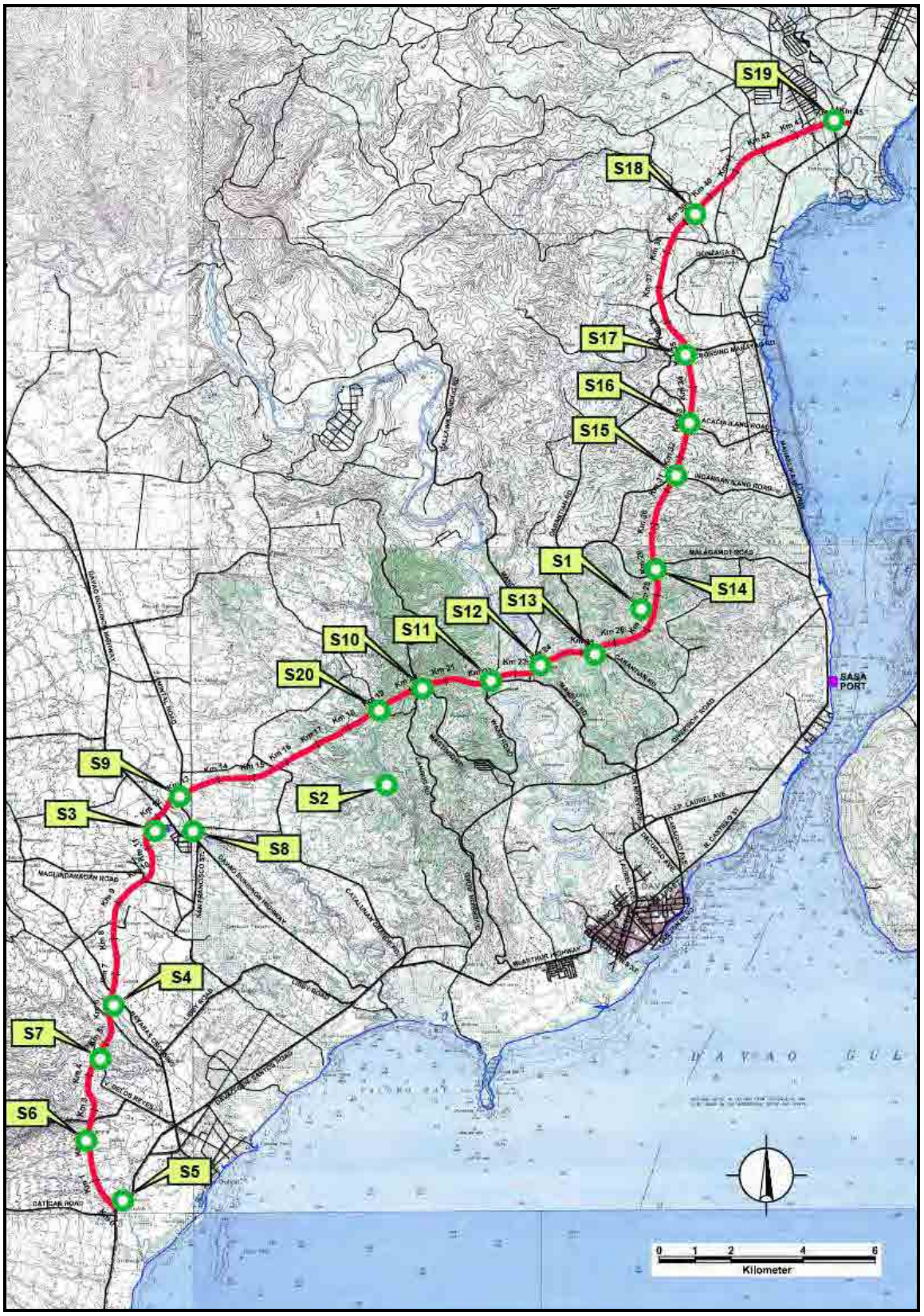
Source: JICA Study Team

FIGURE 13.5-1 SITE SURVEY LOCATION FOR AIR, NOISE AND WATER



Source: JICA Study Team

FIGURE 13.5-2 QUANTITATIVE FORECASTED POINTS FOR AIR AND NOISE



Source: JICA Study Team

FIGURE 13.5-3 FLORA AND FAUNA SURVEY LOCATIONS

13.6 ENVIRONMENTAL MANAGEMENT PLAN

A proposed mitigation plans during and after construction are shown in TABLE 13.6-1. All mitigation measures are included submitted EIS by DPWH. All cost for mitigation measures are finalized in detailed engineering design phase.

TABLE 13.6-1 ENVIRONMENTAL MANAGEMENT PLAN

Category	№	Impacted Item on JICA Guidelines (Philippines Item)	Major Mitigation Measures		Responsibility	
			Pre and During Construction phase	Operation phase	Implementation Agency	Responsible Agency
Pollution	1	Air pollution (Air quality & noise)	[Dust] ✓ Water sprinkling near residential area ✓ 20 kph speed limit for construction machines at construction sites adjacent to settlement areas	[NO2, SO2 and TSP] ✓ Setting up green buffer zone along the road (the zone and planting trees are carried out during construction)	Contractor	[During Const.] DPWH [Operation Phase] Davao and Panabo City
	2	Water pollution (Water quality)	[Turbid water and other items] ✓ Discharge through sedimentation pond and silt fence ✓ Installation of portable toilet for workers ✓ Appropriate waste and construction machines management	Not required	Contractor	DPWH
	3	Waste (Abandonment)	[Construction waste (trees and waste soil)] ✓ After considering the possibility of reuse, construction waste is disposed at **designated disposal site** Note) [Muck soil from tunnel section] ✓ Reuse or disposed at designated disposal site after treatment [Garbage from base camp] ✓ Garbage at workers camp and waste oil shall be brought to disposal site or facility [Night soil] ✓ Temporary sanitation facility such as septic tank shall be introduced to the workers camp.	Not required	Contractor	DPWH
	4	Soil contamination (soil quality)	[Muck soil from tunnel section] ✓ Reuse or disposed at designated disposal site after treatment	Not required	Contractor	DPWH
	5	Noise and vibration (Noise)	[Construction noise] ✓ Installing noise barrier and selecting low-noise equipment. ✓ Avoiding works of heavy equipment during night time. ✓ Informing the construction schedule to surrounding communities to obtain their consensus.	[Traffic noise] ✓ Establishment of green belt as buffer zone along the road ✓ Secure sufficient distance from boundary of the road to residential area after construction of the road (secure noise decay distance) on land use plan along the road ✓ Installation of noise barrier near sensitive facility, if required	Contractor	
	6	Sediment quality (Soil quality)	[Muck soil from tunnel section] ✓ Reuse or disposed at designated disposal site after treatment	Not required	Contractor	DPWH
Natural environment	10	Ecosystem (Terrestrial Biology Freshwater or marine ecology)	✓ Relocation & replanting trees along the road in ROW ✓ Tree planting at sites designated by DENR ✓ Create ecotone habitats in consideration of Amphibia, if the existing habitats along the river are impacted by the project	✓ Appropriate land use management not to develop natural area along the road	[Const.] Contractor [Operation] Davao and Panabo City	[Const.] DPWH [Operation] Davao and Panabo City

Category	№	Impacted Item on JICA Guidelines (Philippines Item)	Major Mitigation Measures		Responsibility	
			Pre and During Construction phase	Operation phase	Implementation Agency	Responsible Agency
	11	Hydrology (Hydrology and oceanography)	✓ Designing of bridges with sufficient capacity ✓ Installation of sufficient drainage facilities on bypass ✓ Secure waterways in construction area	Not required	Contractor	DPWH
	12	Topography and geology (Geography, topography and landslides)	✓ Installation of slope protection measures	Not required	Contractor	DPWH
Social environment	13	Involuntary resettlement (People)	✓ Appropriate compensation and social assistance in accordance with RAP	✓ Assessing whether resettlement have been met, particularly with regards to livelihood and restoration and/or enhancement of living standards in accordance with RAP	DPWH	Davao and Panabo City
	14	The poor (People)	✓ Appropriate social assistance in accordance with RAP	✓ Assessing whether resettlement have been met, particularly with regards to livelihood and restoration and/or enhancement of living standards in accordance with RAP	DPWH	Davao and Panabo City
	15	Indigenous and ethnic people (Indigenous people)	Not required for designated indigenous and ethnic group because NCIP has been issued. However situation of minority religious group(s) such as Islamic group shall be monitored and adequate assistance and coordination shall be given, if necessary.	Not required for designated indigenous and ethnic group because NCIP has been issued. However situation of minority religious group(s) such as Islamic group shall be monitored and adequate assistance and coordination shall be given, if necessary.	-	-
	16	Local economy such as employment and livelihood	✓ Appropriate compensation and social assistance in accordance with RAP	Not required	DPWH	Davao and Panabo City
	17	Land use and utilization of local resources (Land use and classification)	✓ Appropriate land acquisition and compensation for agricultural area	✓ Management of appropriate land use in accordance with approved detailed zoning map	[Const.] DPWH [Operation] Davao and Panabo City	Davao and Panabo City
	18	Water usage (Hydrology / Hydrogeology/ Water quality)	✓ Installation of alternative water distribution system when unexpected situation such as reduction of spring water and water level of wells	✓ Installation of alternative water distribution system when unexpected situation such as reduction of spring water and water level of wells	DPWH, Davao and Panabo City	DPWH, Davao and Panabo City
	19	Existing social infrastructures and services	✓ Appropriate compensation and/or relocation in accordance with RAP	Not required	Contractor and DPWH	Davao and Panabo City
	22	Local conflict of interests	✓ Local workforce is prioritized for construction of the road.	Not required	Contractor	DPWH
	23	Cultural heritage	✓ Appropriate compensation and/or relocation in accordance with RAP	Not required	DPWH	Davao and Panabo City
	27	Infectious diseases such as dengue and HIV/AIDS	✓ Installation of sufficient drainage facilities not to provide habitat for vector mosquito ✓ Provision of adequate temporary	Not required	Contractor	DPWH

Category	№	Impacted Item on JICA Guidelines (Philippines Item)	Major Mitigation Measures		Responsibility	
			Pre and During Construction phase	Operation phase	Implementation Agency	Responsible Agency
			sanitation facilities ✓ Enforcement of medical screening and periodical medical check-up ✓ In order to prevent spread of infectious diseases such as HIV/AIDS, awareness of the labors is promoted			
	28	Labor environment (including work safety)	✓ Complying with relevant laws and regulations by the contractor under observation of DPWH	Not required	Contractor	DPWH
Others	29	Accidents (Traffic situation)	✓ Deploying flagman at the gate and crossing points of the construction vehicles ✓ Installation of safety sign board ✓ Installing fence around the construction site to keep out local people such as children ✓ Installation of lightning in the night time ✓ Installation of parking for idling construction machines ✓ Restricting mobilization speed in the construction site ✓ Safety training for the workers ✓ Safety patrol at the construction site by supervisors	Not required	Contractor	DPWH
	30	Cross boundary impacts and climate change (Meteorology / Climatology)	✓ Replanting natural native trees and other agricultural trees such as coconuts	Not required	Contractor	DPWH

Source: JICA Survey Team

Note) Designated disposal site: One of the candidate disposal sites is existing Magtuod disposal site, however concrete designated disposal sites are concluded in detailed engineering design (DED) stage under discussion with Regional DPWH and Davao and Panabo City.

13.7 ENVIRONMENTAL MONITORING PLAN

13.7.1 INSTITUTIONAL ARRANGEMENT

Environmental management and monitoring organization is shown in **Figure 13.7-1** which shows concerned agencies by construction stage and their functions.

All planed mitigation measures are carried out by the contractor and reported to the self-monitoring team and multi partite monitoring team (MMT). The monitoring results are reviewed and conducted corrective and preventive action, if necessary. The name of organization which conducts monitoring and environmental management and responsibility is shown in **Table 13.7-1**.

TABLE 13.7-1 ENVIRONMENTAL MANAGEMENT AND MONITORING IMPLEMENTATION ORGANIZATION

Stage	Name of Organization	Role and Responsibility
Pre-Construction and Construction Phases	DPWH-Environment and Social Safeguards Division (ESSD)	• Assist the UPMO Bi-Lateral Cluster 1and the Contractor in the setting up of the Multi-Partite Monitoring Team (MMT); • Overseeing the implementation of the EMP by the Contractor/s; • Overseeing the updating of the Resettlement Action Plan (RAP) after the DED; • Assisting in the conduct of IEC Meetings as enumerated in the IEC Framework of this EIS;

Stage	Name of Organization	Role and Responsibility
		• Monitoring actual payments of compensation to affected landowners, structure owners, and crops/trees owners; • In coordination with the Davao City District Engineering Office prepare periodic supervision and monitoring reports on RAP implementation; and • Other necessary roles upon finalization of the RAP during the DED stage
	The Construction Supervision Consultant	• Inspection of mitigation measures and environmental monitoring conducted by the contractor based on the approved EIS • Report the monitoring result to DPWH and donor (JICA) on monthly report
	DPWH UPMO Bi-Lateral Cluster 1	• Ensure that compliance to all conditions stipulated in the ECC are included as provisions in the Bid Documents to be issued to prospective Contractors; • Ensure that all engineering interventions in the approved EMP, RAP, and ECC issued are included in the Terms of Reference (TOR) of the Detailed Engineering Design; • Execution of MOA with DENR-EMB Region XI, Davao City and Panabo City LGUs regarding formation and operationalization of the Multi-Partite Monitoring Team (MMT) for implementing the EMoP; and • Other necessary roles upon finalization of the RAP during the DED stage
	Multi-Partite Monitoring Team (MMT) shall be composed of representatives of DPWH, DENR-EMB-FMB, LGUs, NGOs, academia, representative of affected persons and organizations and associations.	• Validate project compliance with the conditions stipulated in the ECC and the EMP; • Validate DPWH's conduct of self-monitoring; • Receive complaints, gather relevant information to facilitate determination of validity of complaints or concerns about the project and timely transmit to the Proponent and EMB recommended measures to address the complaint; • Prepare, integrate and disseminate simplified validation reports to community stakeholders; and • Make regular and timely submission of MMT Reports based on the EMB-prescribed format • Observe/participate as applicable during conduct of monitoring activities; • Coordinate with the Pollution Control Officer (PCO) of Contractors assigned to the Project, to ensure that conditions stipulated in the ECCs are properly complied with, including the gathering of baseline data on air and water quality, and subsequent monitoring of such; • Notify DPWH ESSD about any act or activity by the Contractors that are deemed as violations to the stipulations in the ECCs and amendments issued, and recommend immediate courses of action to avoid or mitigate any violation to said stipulations; and • Compile monitoring data gathered by the Contractors and supervise preparation of semi-annual monitoring reports to be submitted to the DENR
Pre-Construction and Construction Phases	POs and NGOs (Banana Contract Growers, Banana Plantation Owners, Coconut Plantation Owners, and Farmers' Associations)	• Actively participate in ALL activities of the MMT; • Receive complaints from Barangay Homeowners' Associations, women's organizations, and other concerned sectors; • Gather relevant information to facilitate determination of validity of complaints or concerns about the project; • Promptly transmit to the MMT recommended measures to address the complaint; and • Prepare, integrate and disseminate simplified validation reports and feedback to community stakeholders

Stage	Name of Organization	Role and Responsibility
	The Contractor	• Ensuring that all engineering interventions in the approved EMP, RAP, and ECC issued are included in the Terms of Reference (TOR) of the Detailed Engineering Design; • Implementation of mitigation measures and monitoring based on the approved EMP on EIS and RAP
Operation	DPWH Region XI and Davao City District Engineering Office	• DPWH shall conduct monitoring on the approved EMP on EIA and RAP, and report to DENR and LGUs • The result of monitoring shall be disclosed at DPWH and LGUs • Regular inspection and maintenance of the Bypass Road, including all appurtenant structures • The Planed monitoring is carried out for two (2) years after construction of the bypass

Source: JICA Study Team

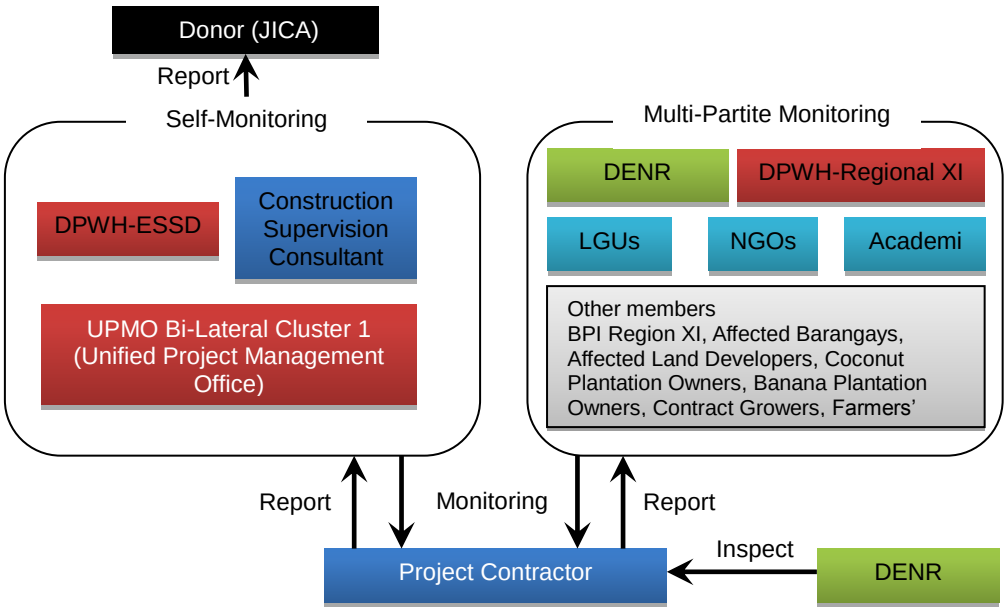


FIGURE 13.7-1 ENVIRONMENTAL MANAGEMENT AND MONITORING IMPLEMENTATION ORGANIZATION

13.7.2 ENVIRONMENTAL MONITORING PLAN

A proposed monitoring plan during and after construction are shown in **Table 13.7-1** and **Table 13.7-2**.

All monitoring plans are included submitted EIA by DPWH to EMB. The monitoring in operation phase shall be carried out for two (2) years at least.

Proposed items to be monitored by JICA are shown in **Table 13.7-3**. Air, water quality, noise, ecosystem, resettlement and livelihood of relocated people shall be monitored during and after construction.

TABLE 13.7-2 ENVIRONMENTAL MONITORING PLAN (PER AND DURING CONSTRUCTION)

Category	№	Impacted Item on JICA Guidelines (Philippines Item)	Parameter	Method	Location	Frequency a year	Cost (peso)	Standard
Pollution	1	Air pollution (Air quality & noise)	TSP, SO2, NO2 and CO	1. TSP –Gravimetric 2. SO2 –Pararosaniline 3. NO2 – Griess Saltzman Reaction 4. CO –Direct Reading (Gas Analyzer)	7 sites (same locations of baseline survey)	2 times	800,000	TSP 300μg/Ncm SO2 340 μg/Ncm NO2 260 μg/Ncm CO 30 ppm
	2	Water pollution (Water quality)	pH, DO, Oil & Grease, BOD, Fecal Coliform/ Total Coliform, and TSS	Methodologies are described in DAO 34-1990 and EMB-DENR Manual for Ambient Water Quality Monitoring Volume I	5 sites (same locations of baseline survey)	2 times	600,000	For Class "C" freshwater pH – 6.5 to 8.5 DO – 5.0 mg/L Oil & Grease – 2.0 mg/L BOD – 7.0 mg/L TSS – not more than 30 mg/L increase
	3	Waste (Abandonment)	Volume of waste soil, cutting tree and domestic garbage	Record volume of generated waste	Cutting land section, tunnel section, cutting tree section and workers camp	4 times	200,000	Generated waste shall be reused or disposed at designated site.
	5	Noise and vibration (Noise)	Ambient and road side noise (dB(A)L_{Aeq})	$L_{Aeq, 10min}$ during morning, daytime, evening and night time	7 sites (same locations of baseline survey)	2 times	400,000	For "A" categorized areas (general area) Morning: 50 dB(A) Daytime: 60 dB(A) Evening: 50 dB(A) Night : 45 dB(A) For "B" categorized areas (general commercial areas) Morning: 60 dB(A) Daytime: 65 dB(A) Evening: 60 dB(A) Night : 55 dB(A)
Natural environment	10	Ecosystem (Terrestrial Biology Freshwater or marine ecology)	Situation of Cutting tree area	Ocular inspection	Major bridge section	4 times	200,000	Cutting tree area is limited on ROW
	11	Hydrology (Hydrology and oceanography)	Flooding situation	Flood level measurement during high precipitation periods Interview with local residents	Flood-prone areas, particularly near major river systems	4 times	200,000	Project activities and structures does not cause flooding
	12	Topography and geology (Geography, topography and landslides)	Stability of slope	Ocular inspection	High cut and high embankment section	4 times	200,000	Must be continuously undertaken until slopes are fairly stable and vegetation cover achieves high survival rate
Social environment	13	Involuntary resettlement (People)	Payment and implementation of social assistance in accordance with RAP	Consultation Meeting and/or Survey with the project affected persons (PAPs)	Affected barangays	Monthly	500,000	Must be completed prior to construction stage
	14	The poor (People)	↑ditto	↑ditto	↑ditto	↑ditto		↑ditto
	16	Local economy such as employment	↑ditto	↑ditto	↑ditto	↑ditto		↑ditto

Category	№	Impacted Item on JICA Guidelines (Philippines Item)	Parameter	Method	Location	Frequenc y a year	Cost (peso)	Standard
		and livelihood						
	19	Existing social infrastructures and services	↑ditto	↑ditto	↑ditto	↑ditto		↑ditto
	22	Local conflict of interests	Constructio n worker's native barangay	Confirmation of workers list from contractor	All barangays on the affected route	4 times		Employment opportunity shall be provided fairly
	27	Infectious diseases such as HIV/AIDS	Number of infected patient	Confirmation of health check list from contractor	All construction workers	4 times		Infection disease rate shall be less than average rate
	28	Labor environment (including work safety)	Number of workers with required instrument such as helmet	Count numbers of workers with instrument	All construction workers (weekly meeting place)	4 times		All workers shall have designated device such as helmet

Source: JICA Study Team

TABLE 13.7-3 ENVIRONMENTAL MONITORING PLAN (OPERATION PHASE)

Category	№	Impacted Item on JICA Guidelines (Philippines Item)	Parameter	Method	Location	Frequency a year	Cost (peso)	Standard
Pollution	1	Air pollution (Air quality & noise)	TSP, SO2, NO2 and CO	1. TSP –Gravimetric 2. SO2 –Pararosaniline 3. NO2 – Griess Saltzman Reaction 4. CO –Direct Reading (Gas Analyzer)	7 sites (same locations of baseline survey)	1 time	400,000	TSP 300µg/Ncm SO2 340 µg/Ncm NO2 260 µg/Ncm CO 30 ppm
	2	Water pollution (Water quality)	pH, DO, Oil & Grease, BOD, Fecal Coliform/ Total Coliform, and TSS	Methodologies are described in DAO 34-1990 and EMB-DENR Manual for Ambient Water Quality Monitoring Volume I	5 sites (same locations of baseline survey)	1 times	600,000	For Class "C" freshwater pH – 6.5 to 8.5 DO – 5.0 mg/L Oil & Grease – 2.0 mg/L BOD – 7.0 mg/L TSS – not more than 30 mg/L increase
	5	Noise and vibration (Noise)	Ambient and road side noise (dB(A)L_{Aeq})	$L_{Aeq, 10min}$ during morning, daytime, evening and night time	7 sites (same locations of baseline survey)	1 times	200,000	For "A" categorized areas (general area) Morning: 45 dB(A) Daytime: 50 dB(A) Evening: 45 dB(A) Night : 40 dB(A) For "B" categorized Areas (general commercial areas) Morning: 60 dB(A) Daytime: 65 dB(A) Evening: 60 dB(A) Night : 55 dB(A)
environme	10	Ecosystem (Terrestrial Biology Freshwater or marine ecology)	Situation of Cutting tree area	Ocular inspection	Major bridge section	1 times	100,000	Cutting tree area is limited on ROW

Category	No	Impacted Item on JICA Guidelines (Philippines Item)	Parameter	Method	Location	Frequency a year	Cost (peso)	Standard
	11	Hydrology (Hydrology and oceanography)	Flooding situation	Flood level measurement during high precipitation periods Interview with local residents	Flood-prone areas, particularly near major river systems	1 times	100,000	Project activities and structures does not cause flooding
	12	Topography and geology (Geography, topography and landslides)	Stability of slope	Ocular inspection	High cut and high embankment section	4 times	200,000	Must be continuously undertaken until slopes are fairly stable and vegetation cover achieves high survival rate
Social environment	13	Involuntary resettlement (People)	Payment and implementation of social assistance in accordance with RAP	Consultation Meeting and/or Survey with the project affected persons (PAPs)	Affected barangays	Monthly	500,000	Must be completed prior to construction stage
	14	The poor (People)	↑ditto	↑ditto	↑ditto	↑ditto		↑ditto
	16	Local economy such as employment and livelihood	↑ditto	↑ditto	↑ditto	↑ditto		↑ditto
	19	Existing social infrastructures and services	↑ditto	↑ditto	↑ditto	↑ditto		↑ditto
	22	Local conflict of interests	Construction worker's native barangay	Confirmation of workers list from contractor	All barangays on the affected route	Quarterly		Employment opportunity shall be provided fairly
	27	Infectious diseases such as HIV/AIDS	Number of infected patient	Confirmation of health check list from contractor	All construction workers	Quarterly		Infection disease rate shall be less than average rate

Source: JICA Study Team

TABLE 13.7-4 ENVIRONMENTAL MONITORING FORM (JICA FORM)

-If environmental reviews indicate the need of monitoring by JICA, JICA undertakes monitoring for necessary items that are decided by environmental reviews. JICA undertakes monitoring based on regular reports including measured data submitted by the project proponent. When necessary, the project proponent should refer to the following monitoring form for submitting reports.

-When monitoring plans including monitoring items, frequencies and methods are decided, project phase or project life cycle (such as construction phase and operation phase) should be considered.

1. Relevant Permission and Public Consultation

Monitoring Item	Monitoring Results during Report Period
Confirmation of relevant written permissions and minutes of meetings for held consultations and meetings	

2. Mitigation Measures/Monitoring

- Air Quality（Traffic /Ambient Air Quality）

Item	Unit	Measured Value（Mean） Along road/Residential area	Measured Value（Max.）	Country's Standards	Referred International Standards (Japanese standard)	Remarks (Measurement Point, Frequency, Method, etc.)
TSP	μg/Ncm	216.4/69.9	298.5/82.0	300	SPM (0.1mg/m3)	– Same points as baseline survey: 7 points (see table 13.5.1) – 2 times a year during construction – Once a year during operation – Air sampler High volume sampler
NO2	μg/Ncm	6.6/1.0	6.1/1.7	260	0.04-0.06(ppm)	
SO2	mg/Ncm	4.0/1.3	13.9/1.1	340	0.04(ppm)	
CO	ppm	<1.0/1.0	1.0/1.0	30	10(ppm)	
					-	

- Water Quality（Water Quality in the river）

	Unit	Measured Value（Mean）	Measured Value（Max.）	Country's Standards	Referred International Standards (Japanese Standards/ B category river)	Remarks (Measurement Point, Frequency, Method, etc.)
pH	-	7.8	8.0	6.5-8.5	6.5-8.5	– Upstream and downstream portions of affected water bodies (see table 13.5.1) – 2 times a year during construction – Once a year during operation – Grab sampling
DO	mg/l	7.4	7.6	5	5	
TSS	mg/l	22.5	82	30	SS 25	
BOD	mg/l	2.0	3.9	7	3	
Total Coliform	1,000 MPN/ 100ml	9,800	16,000	1,000	5,000	

- Noise / Vibration

Item	Unit	Measured Value (Mean)	Measured Value (Max.)	Country's Standards	Referred International Standards (Japanese Standard)	Remarks (Measurement Point, Frequency, Method, etc.)
Noise level	dB(A)	Along the road 74(daytime) Residential area 64(daytime)	Along the road 80(daytime) Residential area 64(daytime)	For "A" categorized areas (general / residential area) Morning: 45 dB(A) Daytime: 50 dB(A) Evening: 45 dB(A) Night : 40 dB(A) For "B" categorized Areas (general commercial areas) Morning: 60 dB(A) Daytime: 65 dB(A) Evening: 60 dB(A) Night : 55 dB(A)	Residential Area 55 (daytime) Commercial Area 60(daytime) Along the trunk road 70 (daytime)	– Same points as baseline survey, – 2 times a year during construction – Once a year during operation – Digital sound level meter

- Odor

Monitoring Item	Monitoring Results during Report Period
Not required	

3. Natural Environment

- Ecosystem

Monitoring Item	Monitoring Results during Report Period
Situation of cutting tree area (during construction) Situation of replanting area along the road (operation phase)	

4. Social Environment

- Resettlement (During and after Construction)

Monitoring Item	Monitoring Results during Report Period
Number of PAPs to be resettled/ relocated/ provided livelihood assistance where required. (during Construction)	
Inventory and valuation of PAPS affected assets (during Construction)	
Notice period given to PAPs before shifting them from their original locations within the ROW (Pre and during construction)	
Number of grievances recorded and redressed (Pre and during Construction)	
Conflicts between religions (Pre, during and after construction)	

- Living / Livelihood

Monitoring Item	Monitoring Results during Report Period
Pre-and post-resettlement incomes and livelihood of PAPs especially for poor people (during and after construction)	

13.8 STAKEHOLDER MEETING

Totally 10 stakeholder meetings have been held on Scoping stage as shown in **Table 13.8-1**. The first stakeholder meeting was held with Davao City and other relevant major landowners for formulation consensus of the route. The second meetings with Davao and Panabo City are prescript Information Education Communication meetings (IEC meeting) based on the Philippines EIA regulations. The third meetings have been held at 7 venues for project affected person in accordance with the EIA regulation.

TABLE 13.8-1 CONTENTS OF STAKEHOLDER MEETINGS ON SCOPING STAGE

Date (venues)	Objectives of the meeting	Major Agenda	Participants	No. of Participants
2013 11th October	Selection of alignment	Discussion of alternative alignments and exchange opinions with DPWH, Davao City and major landowners	DPWH (Central and Regional) Davao City Major landowners (company and government agency)	40
2nd and 5th December Two (2) venues 1) Davao City DPWH 2) Panabo City Hall	Information Education and Communications (IEC) in accordance with Philippines EIA Laws	Explanation of project background, objectives, necessity and positive & negative impacts The meeting was held in Davao and Panabo city respectively	DPWH (Central and Regional) Davao and Panabo City (separated) Barangay captains on the proposed alignment	Davao City: 23 Panabo City: 14
16th to 20th December Seven (7) venues 1) Brgy. Hall of Marapangi, 2)Brgy. Hall of Marapangi, 3)Brgy. Hall of Tigatto, 4) Brgy. Catalunan Grande Gym 5) Brgy. Mintal Community Gym, 6) Brgy. Hall of Mahayag, 7) Conference Room Panabo City Hall	Public Scoping in accordance with Philippines EIA Laws	Explanation of project background, objectives, necessity and positive & negative impacts The meeting was held at 7 venues for 26 Barangays in Davao and Panabo city	DPWH (Regional) Davao and Panabo City Other Government agencies Barangay official PAPs and inhabitants NGOs and other organizations	Davao City (26 Barangay) 173 Panabo City (1 Barangay) 6

Source: JICA Survey Team

216 participants have attended IEC and a series of public scoping meetings.

29 project affected persons, 78 Barangay officials, 89 residents, and 49 government officials attended totaling to 216 participants. Major opinions and answers are shown in **Table 13.8-2**. The main topics and comments from participants were disaster prevention, land acquisition and loss of assets. The proponent in cooperation with JICA Survey Team answered about these comments and questions, and it seemed that all questioners understood and agreed DPWH and JICA Survey Team's answers basically.

Other planed public consultation on draft EIS stage in accordance with the EIA regulation and explanation of draft RAP will be held in October and November 2014 as shown in TABLE 13.7.2-3 and TABLE 13.7.2-1 (AS OF October, 2014).

TABLE 13.8-2 MAJOR OPINIONS IN STAKEHOLDER MEETINGS ON SCOPING STAGE

Date and Objectives	Agenda	Major Opinions	Answers (DPWH and JICA Survey Team's answers and comments has been accepted and understood basically)
2013 11th October Discussion about proposed alignment with major stakeholders	1. Project background, necessity of the project and component 2. Concept of proposed alignment 3. Exchange opinions	(1) The Business Case Study (BCS) route has been approved on the Development plan for Davao City. Thus minor modification of the route is acceptable for Davao City. (Davao City Planning Section) (2) Construction of the Davao Bypass give positive impact on not only traffic stream, but also economic development of Davao city. (Davao City Planning Section) (3) It is necessary to secure safety and in tunnel section (Davao City Planning Section) (4) The proposed alignment may traverse a compound of the University of Philippines Mindanao, thus detailed confirmation and discussion with head quarter is necessary (Mindanao Philippine University) (5) It is understandable to construct a tunnel, however some discussions are necessary from the view of cost, environment and traffic safety in the tunnel (Mindanao Philippine University) (6) The proposed alignment may affect to transmission lines (Private company: Davao Light and Power Company)	
2013 2nd and 5th December Information Education and Communications (IEC) in accordance with EIA Laws	1. Project background and component 2.EIA and RAP Process 3. Major impacts 4.Tentative schedule 5. Exchange opinions	1. Davao City (2nd of December, 2013) (1) The proposed bypass might aggravate the present flooding problem, so mitigating measures to be adopted to manage the current flooding situation (Barangay officials) (2) Consider implementation of bio-engineering measures to mitigate effects of the project on soil erosion (DPWH) (3) Width of the proposed right of way for the first phase of the project (Davao City) (4) Issue on the ownership/management of the trees to be cut (Davao City) (5) If rehabilitation of the areas to be excavated during implementation of the project is integrated in the design (Davao City) (6) Have you identified the properties to be traversed by the alignment to determine if there are water resources that will be affected? (Barangay officials)	(1) Drainage systems will be designed in consideration of the existing flood situation in the study area to prevent aggravation of present flooding situation (2) Slope protection methods will be adopted not to cause soil erosion (3) Initially, the ROW is 30 m, but if the DPWH decided to acquire the entire 60 m, the then the ROW will be 30 m on each direction (4) Most of the trees identified along the bypass alignment are coconut trees. In such case, The EIA/RAP Team will refer to the latest regulations of PHILCOA (Philippine Coconut Authority) regarding the ownership/management of the cut coconut trees. Natural growing trees will be turned over to DENR-FMB Region XI. (5) Rehabilitation of the excavated areas is included in the design. Also the EIA study will include recommendation on the complete restoration/ rehabilitation of the excavated areas (6) These properties will only be identified during the parcellary survey which will be conducted after the Feasibility Study (FS). If during the EIA study, water sources are found along the alignment, appropriate mitigating measures will be recommended to protect the identified water sources that may be affected

Date and Objectives	Agenda	Major Opinions	Answers (DPWH and JICA Survey Team's answers and comments has been accepted and understood basically)
		2. Panabo City (5th of December, 2013) (1) Is there a way of extending the bypass road further north of Panabo City? (Mayor of Panabo City) (2) Ending of bypass road on J.P Laurel may add to the existing traffic congestion in the City. Hopeful that JICA will consider connecting the bypass road on their proposed circumferential road of the city government that will ease the traffic problem.	(1) JICA survey team will further review on it (2) It would be best that a proposal letter be submitted to DPWH main office on the concern
16th – 20th December Public Scoping Meetings based on EIA laws	1.Project description	(1) Plans on existing roads to be intersected by the bypass alignment (PAPs/Inhabitants) (2) Time frame of project completion (PAPs/Inhabitants) (3) If access roads to and from the bypass will be provided in the barangays traversed by the alignment (Barangay officials) (4) Exact area to be traversed by the bypass alignment (Barangay officials)	(1) If the proposed bypass will intersect an existing road, a culvert or flyover bridge will be constructed, depending on the type of road (2) Implementation and completion date of the project cannot be determined yet as the project is still in the FS stage (3) All roads to be intersected by the alignment will be maintained. Provision of access points to and from the bypass in the barangays traversed be the alignment will be determined during the Detailed Design stage (4) The exact areas to be traversed by the alignment cannot be determined yet until the parcellary survey is completed during the conduct of the Detailed Engineering Design (DED) stage. The alignment presented is based on the pre-FS
	2. Item on the EIA 2-1 Land (Topography and geology)	(1) Structural integrity of the road should be considered with respect to potential occurrences of high intensity earthquakes (PAPs/Inhabitants(Indigenous People)) (2) If blasting will be adopted method be undertaken for the tunnel section (NGOs/other organizations) (3) Concern on soil erosion along the section of the alignment near the horse race track (adopt adequate soil erosion measures) (PAPs/Inhabitants) (4) Possible occurrence of slope failure at the tunnel section area due to existence of fault lines (NGOs/other organizations) (5) Consider presence of fault lines in the areas traversed by the bypass alignment (PAPs/inhabitants)	(1) Aside from the study undertaken by the geologist of the JICA Study Team, a geo-hazard specialist who is a member of the EIA Study Team will conduct a thorough geological study along the alignment, particularly at the tunnel section to ensure stability of the structure to be constructed (2) Based on the results of the geological study undertaken at the tunnel section, blasting is not necessary during construction since the rock identified in the area is categorized under the soft type (3) Suitable and adequate slope protection measures at bypass road sections identified to have potential slope failures are considered in the design (4) The structural integrity of the tunnel structure will be the utmost concern of the Design Team. The tunnel structure will be designed with consideration to the existing fault lines and other geological factors to ensure its stability to withstand high intensity earthquake occurrences (5) DPWH in cooperation with JICA Survey Team as well as the EIA Study Team is composed of experts from the different disciplines of the environment that includes a geo-hazard specialist, who is undertaking the study on the existing ground hazards, particularly at the tunnel section. The findings will be included in the EIA report to be submitted to the DENR

Date and Objectives	Agenda	Major Opinions	Answers (DPWH and JICA Survey Team's answers and comments has been accepted and understood basically)
	2-2 Hydrological situation	(1) Possible loss/damage of spring water resources in the tunnel section (Barangay officials) (2) Possible stagnation of water along natural waterways crossed by the alignment due to improper management of construction spoils and debris, which may also cause dengue outbreak (Barangay officials) (3) The proposed bypass road may aggravate the existing problem of flooding in low-lying areas due to inefficient drainage systems (Barangay officials, PAPs/inhabitants)	(1) Part of the Environmental Impact Assessment (EIA) is to identify existence of natural water sources and assess the potential effects of the project (2) Culverts and/or bridges will be constructed along the waterways to be crossed by the alignment. Well engineered drainage systems will installed along waterways to ensure flooding will not occur. Mitigation measures to ensure proper management of construction spoils and debris will be included in the EIA Study to be undertaken (3) Well engineered drainage systems will be installed along the bypass alignment to ensure that it will not aggravate the existing flood problem experienced in the adjacent low-lying areas
	2-3Social environment (resettlement and indigenous peoples)	(1) If owners of lands to be affected by the bypass alignment will be compensated? (Barangay officials) (2) Provision of alternative livelihoods and compensation to affected informal settlers (Barangay officials) (3) If coconut trees to be cut will be given to the land owners (Barangay officials) (4) Possible restriction of access to existing roads for farmers going to their farmlands. Probable safety hazard to farmers accessing their lands adjacent to the bypass road (PAPs/inhabitants) (5) If the landowner has rights to any natural resources or treasures that maybe extracted from his property, particularly at the tunnel section (Barangay officials) (6) Entitlements of the landowners on top of the tunnel section. Compensation for affected residential structure owners or communities on the top of the tunnel section tunnel section (Barangay officials, NGOs/other organizations) (7) Consideration for affected IPs who are categorized as informal settlers (PAPs/inhabitants(Indigenous Peoples)) (8) By tradition, Muslims do not allow relocation of mosques	(1) The government will then offer compensation based on the present BIR zonal valuation of the property. (2) In case of JICA loan project, JICA requires strict compliance on livelihood restoration of PAPs. A Resettlement Action Plan (RAP) which will address all issues concerning the PAPs such as just compensation of affected lands and structures, relocation for informal settlers, livelihood restoration. The RAP will be prepared and implemented prior to construction of the project to ensure that all issues concerning the PAPs are properly and completely settled (3) Once the DPWH purchased the property for ROW purposes, everything will be included in the payment. The cut coconut trees will be turned over to DENR-FMB (Forest Management Bureau) (4) Existing roads to be intersected by the bypass alignment will be maintained. Since the road is on embankment, box culverts or bridge crossings will be provided at intersections depending on the type of road to be crossed by the alignment. The type and size of culverts to be constructed at affected Barangay Roads will be designed in consideration with the farm implements utilized by the farmers in the area to ensure safe and unhampered access to farmlands (5) The landowner only has surface rights to his land. According to the national law, mineral resources found within the country's land such as gold are considered as property of the state (6) Entitlements of the landowners on top of the tunnel section will have to be consulted with the DENR-LMS (Department of Environment and Natural Resources-Land Management Services). Resettlement existing communities and/or compensation residential structure owners on top of the tunnel section will not be necessary since the tunnel opening will be at least 200 m below the surface. In addition, construction of the tunnel section will employ modern technologies without blasting activities (7) A Resettlement Action Plan (RAP) will also be prepared to address the

Date and Objectives	Agenda	Major Opinions	Answers (DPWH and JICA Survey Team's answers and comments has been accepted and understood basically)
		(Barangay officials) (9) Security cameras should be installed in the tunnel section of the bypass road (PAPs/Inhabitants(IPs)) (10) Locals should benefit from the project through employment and short-term business opportunities (Barangay officials) (11) If schools to be affected by the proposed bypass alignment will be relocated (other government agency) (12) Close coordination with Urban Development and Housing Authority Office (UDHAO) and Urban Poor Affairs Office (UPAO) must be undertaken to prevent violent encounters with the informal settlers during relocation (other government agency) (13) Compensation on affected lands with existing ownership dispute (PAPs/inhabitants)	concerns of both formal and informal settlers in the affected area, especially IPs (8) Since the alignment is not final yet, re-alignment at sections which will affect school, church, and mosques will still be considered. If re-alignment is not possible, then a series of consultation meetings will have to be undertaken with the concerned groups (9) The suggestion is noted (10) Priority in hiring of qualified workers in the impact areas is stipulated as one of the conditions of the ECC. Qualified workers will only be required to secure endorsement from the Barangay Chairman as a proof of residency in the area (11) Schools to be affected will be relocated, but as much as possible alignment sections which would affect educational facilities and other institutional structures will be realigned (12) The issue is noted. The UDHAO and UPAO should be involved to ensure peaceful relocation procedure (13) Compensation will be settled once ownership of the land is determined

TABLE 13.8-3 SCHEDULED STAKEHOLDER MEETING ON EIA AND RAP

Expected Date	Objectives of the meeting	Major Agenda	Participants	Summary of SHM
2014 October-November	Explanation of draft EIA	- Project outline - Forecasted environmental and social impact - Environmental management plan - Opinion exchange	All citizens of Davao and Panabo city	The result will be inserted into EIS report
2014 October-November	Explanation of draft RAP	Explanation of draft RAP	Mainly PAPs and Barangay officials	The result will be inserted into EIS report

Source: JICA Survey Team

13.9 SCHEDULE

The expected schedule for obtaining of environmental certificate commitment (ECCs) is shown in the next table. Major activities to activate a series of process on ECCs approval plan are as follows;

(1) Procedural Screening by EMB: October 2014

DPWH in cooperation with JICA Survey Team has submitted a draft EIS to EMB, and then EMB has carried out procedural screening for the draft EIS.

(2) Substantive Review of EIS by EMB: October – November 2014

EMB will attend the first EIA Review Committee (EIARC), and comments will be issued from the members of EIARC. Additionally a public consultation in Davao and Panabo City will be held by EMB. The project proponent shall prepare additional information (AI) and modify the draft EIS based on comments and opinions from EIARC and participants of public consultations. The EIARC members will inspect the modified EIS in the final EIARC. This substantive review by EMB will be completed and issued the Environmental Certificate Compliance Certificate (ECC) within 40 working days in accordance with implementing rules and regulations of presidential decree No. 1586, establishing the Philippine environmental impact statement system.

(3) Approval ECC (by middle of November 2014)

DPWH shall obtain ECC from EMB before at least 120 days prior to the loan agreement with Japan Government in accordance with JICA Guidelines.

TABLE 13.9-1 EIA SCHEDULE (AS OF OCTOBER, 2014)

Year/ Month		2013						2014											
Work Item	Required Document	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
a. Alternative Analysis of routes and authorization by (DPWH and DAVAO City)																			
b. Preparation of PDS	Draft PDS (parepared in 15th KUROKI-EcosysCorp) Finalization based on final alighment (by Ecosys)																		
c. IEC with LGUs, Barangay Captains and DPWH and Public Scoping (IEC member and Affected Person and firms)	Draft PDS base-explanation to stakeholders (Stakeholders to be participated shall be consulted with EMB)			IEC: Dec 2 and 5th P.Scoping: 16-20															
1. Project Screening based on PDS (by Proponent)	EIA Coverage and Requirements Screening Check list (ECRSC) - A self-screening form used by the Proponent (refer to ECPs and ECAs)																		
2. Scoping Activity with Environmental Management Breau (EMB)	2-1: Letter Request for Scoping 2-2: Required documents (PDS and other documents) 2-3 Site Visiting by RevCom 2-4 Scoping (TOR of EIA)				Presentation for Scoping Feb. 12th				▲										
3. EIA Study & Report Preparation (by Proponent)	3-1: Environmental Impact Statement																		
4.Procedural Screening of EIS (by EMB)	Scoping and Procedural Screeing Checklist (Confirmation by EMB Review Team)																		
5. Substantive Review of the EIS (by EMB)	EIA Review Committee Report (prepared by EIARC)																		
6. Submittal of Additional Information from EIARC	Additional Information Report (prepared by Proponent)																		
7. Public Consultation	Proceedings of the public hearing (Anouncement on news paper once a week x 2 times)												Public consultation for Draft EIA						
8. Endorsement of Recommendation by EIARC	Endorsement Letter (by EMB Director)																		
9.Sign-off/Issuance or Denial of Environmental Compliance Certificate (ECC)	ECC issues (by DENR Secretary)																		
10. Transmittal of ECC to Concerned NGAs(National Government Agencies)/LGUs(Local Government Units)	Submission of ECC to NGAs and LGUs (by EMB)																		
A. JICA Env Committee									▲(Jan.31)										
		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

Source: JICA Survey Team

13.10 RESETTLEMENT ACTION PLAN

13.10.1 Summary of Resettlement and Assets

13.10.1.1 Household Interview Survey

Households in the project area was classified into three (3) types as;

Type A: Households who are living in the residential houses which will be affected by the project. A total of 57 households were identified and 39 (or 68 %) households of which were interviewed.

Type B: Households who own land to be affected by the project. Estimated number of lots is approximately 331, and 139 (or 42 %) households of which were interviewed.

Type C: Households who are living in the project area, but houses and lands are not affected by the project. A total of 23 households were interviewed.

13.10.1.2 Summary of Project Affected Persons (PAPs)

(1) Summary of Survey Result

Table 13.10-1 shows the summary of the number of households and people whose structures will be affected and to be relocated. **Table 13.10-2** shows the summary of the number of households which will lose their own land based on **Table 13.10-1**.
Note that the socio-economic survey was started on 16 June 2014, being set it as the cut-off date for the project, in accordance with the definition in World Bank OP 4.12.

TABLE 13.10-1 SUMMARY OF THE ESTIMATED NUMBER OF HOUSEHOLDS TO BE AFFECTED BY THE PROJECT

Location	No. of Households (HHs) Affected (a)	No. of Residential HH Affected in (a) (b)	Status of (a)				No. of people Relocated		PAPs with Loss of Income (i)
			Land-Owner (c)	Lessee (d)	Tenant (e)	Busi-ness (f)	Formal (g)	Lessees of Land (h)	
South	157	23	130	16	11	-	92	--	1
Center	121	1	119	2	-	-	-	4	-
North	110	33	62	42	6	-	-	132	4
Total	**388**	**57**	**311**	**60**	**17**	**-**	**92**	**136**	**5**

Source: JICA Study Team

Note: HHs affected in (a) indicate all HHs whose lands and structures will be affected, while HHs affected in (b) show the number of HHs whose structures will be only affected.

TABLE 13.10-2 SUMMARY OF THE NUMBER OF HOUSEHOLDS WHO WILL LOSE LAND

Location	No. of Lot Affected	No. of HHs who will Lose Land	Ownership of Land			No. of People who Lose Land
			Owner	Tenant	Lessee/Renter	
South	134	89	107	11	16	356
Center	120	35	119	-	1	140
North	77	20	62	6	9	80
Total	**331**	**144**	**288**	**17**	**26**	**576**

Source: JICA Study Team

For understanding the outline easier, the numbers of PAPs and PAHs and area of land to be acquired by location are extracted as below:

Location	No. of PAPs (No. of PAHs)		Total	Land to be Acquired (ha)
	Lose Land	Relocated		
South	444 (134)	92 (23)	**536 (157)**	70.2
Center	480 (120)	4 (1)	**484 (121)**	102.6
North	308 (77)	132 (33)	**440 (110)**	94.8
Total	**1,232 (331)**	**228 (57)**	**1,460 (388)**	**267.6**

(2) Survey Results

The number of residential houses, households and project-affected persons (PAPs) is shown in **Table 13.10-3** according to the results from the interview survey.

TABLE 13.10-3 SUMMARY OF THE NUMBER OF HOUSEHOLDS TO BE AFFECTED BY THE PROJECT (BASED ON THE INTERVIEW SURVEY)

Unit: No. of Respondents

Location	Sub -district	No. of HHs Affected (a)	No. of Residential HHs Affected in (a) (b)	Status of (a)				No. of people Relocated		PAPs with Loss of Income (i)
				Land Owner (c)	Lessee (d)	Tenant (e)	Busi-ness (f)	Formal (g)	Lessees of Land (h)	
South	Toril	53	7	40	7	6	-	-	-	-
Center	Tugbok	74	17	50	18	6	-	68	-	1

Location	Sub -district	No. of HHs Affected (a)	No. of Residential HHs Affected in (a) (b)	Status of (a)				No. of people Relocated		PAPs with Loss of Income (i)
				Land Owner (c)	Lessee (d)	Tenant (e)	Busi-ness (f)	Formal (g)	Lessees of Land (h)	
North	Talomo	4	-	1	-	3	-	-	4	-
	Buhangin	30	2	23	2	5	-	-	8	-
	Bunawan	40	12	25	12	3	-	-	48	4
Total		**201**	**38**	**139**	**39**	**23**	**-**	**68**	**60**	**5**

Source: JICA Study Team

Note: HHs affected in (a) indicate all HHs whose lands and structures will be affected, while HHs affected in (b) show the number of HHs whose structures will be only affected.

Household Size

Majority of PAPs have household size between 0 to 3 (45.8%) and 4 to 6 (37.1%), which is consistent with data obtained from the CLUP, which gave 4.2 as the average household size of families residing in urban barangays, as shown in **Table 13.10-4**.

TABLE 13.10-4 SUMMARY OF PAPS HOUSEHOLD SIZE

Unit: No. of Respondents

Section	South				Center				North		Total	
Sub-District	Toril		Tugbok		Talomo		Buhangin		Bunawan			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Household Size												
0 to 3	24	26.1	40	43.5	1	1.1	12	13.0	15	16.3	92	45.8
4 to 6	18	24.0	23	30.7	1	1.3	14	18.7	19	25.3	75	37.3
7 to 9	8	33.3	6	25.0	2	8.3	4	16.7	4	16.7	24	11.9
10 and more	3	30.0	5	50.0	0	0.0	0	0.0	2	20.0	10	5.0
Total	**53**		**74**		**4**		**30**		**40**		**201**	**100**

Source: JICA Study Team

Household Structure

Majority has households consisting of parents and children (nuclear) living together, with 116 respondents, or 57.7%, as shown in **Table 13.10-5**. This is followed by those living with parents and/or siblings, or extended families, with 18.4%. There is also a significant number of PAPs living alone (9.4%), and households living in one structure (14.4%).

TABLE 13.10-5 SUMMARY OF PAPS HOUSEHOLD SURUCTURE

Unit: No. of Respondents

Section	South				Center				North		Total	
Sub-District	Toril		Tugbok		Talomo		Buhangin		Bunawan			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Household Structure												
Single	6	31.6	10	52.6	0	0.0	3	15.8	0	0.0	19	9.5
Nuclear	31	26.7	43	37.1	2	1.7	18	15.5	22	19.0	116	57.7
Extended	5	13.5	12	32.4	1	2.7	6	16.2	13	35.1	37	18.4
Joint	11	37.9	9	31.0	1	3.5	3	10.3	5	17.2	29	14.4
Total	**53**		**74**		**4**		**30**		**40**		**201**	**100**

Source: JICA Study Team

Ethno-Linguistic Affiliation

The most common dialect spoken by PAPs is Bisaya/Binisaya. It is the mother tongue of 52.7% of the respondents. It is followed by Cebuano with 26.9%, then by Boholano with 5%, and Davaweño with 3.5%. The remaining 11.9% are shared among the Hiligaynon/Ilongo, Tagalog, and Ilocano dialects as shown in **Table 13.10-6**.

TABLE 13.10-6 SUMMARY OF PAPS ETHNO-LINGUISITIC AFFECTION

Unit: No. of Respondents

Section	South				Center			North			Total	
Sub-District	Toril		Tugbok		Talomo		Buhangin		Bunawan			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Ethno-Linguistic Affiliation												
Bisaya/Binisaya	37	34.9	31	29.8	1	0.9	17	16.0	20	18.9	106	52.7
Cebuano	6	11.1	29	53.7	1	1.8	6	11.1	12	22.2	54	26.9
Boholano	3	30.0	4	40.0	0	0.0	1	10.0	2	20.0	10	5.0
Davaweño	0	0.0	2	28.6	0	0.0	3	42.9	2	28.6	7	3.5
Hiligaynon/Ilongo	1	12.5	3	37.5	0	0.0	2	25.0	2	25.0	8	4.0
Tagalog	6	66.7	1	11.1	0	0.0	1	11.1	1	11.1	9	4.4
Ilocano	0	0.0	2	100	0	0.0	0	0.0	0	0.0	2	1.0
Others	0	0.0	2	40.0	2	40.0	0	0.0	1	20.0	5	2.5
Total	**53**		**74**		**4**		**30**		**40**		**201**	**100**

Source: JICA Study Team

Residency of PAPs

Almost half of the respondents (45.3%) stated that they have been residents of the area from the 1990's and 2000's. There is also a significant number of respondents who have been residing in the area from the 60's to the 70's (26.9%) indicated in **Table 13.10-7**.

TABLE 13.10-7 SUMMARY OF PAPS LENGTH OF STAY

Unit: No. of Respondents

Section	South				Center			North			Total	
Sub-District	Toril		Tugbok		Talomo		Buhangin		Bunawan			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Length of Stay												
1930's	0	0.0	1	33.3	0	0.0	2	66.7	0	0.0	3	1.5
1940's	4	30.8	5	38.5	0	0.0	2	15.4	2	15.4	13	6.5
1950's	5	25.0	9	45.0	0	0.0	3	15.0	3	15.0	20	9.9
1960's	3	14.3	10	47.6	1	4.8	3	14.3	4	19.1	21	10.5
1970's	11	33.3	11	33.3	1	3.0	5	15.2	5	15.2	33	16.4
1980's	6	30.0	8	40.0	0	0.0	2	10.0	4	20.0	20	9.9
1990's	12	35.3	12	35.3	1	2.9	1	2.9	8	23.5	34	16.9
2000's	12	21.1	18	31.6	1	1.8	12	21.1	14	24.6	57	28.4
Total	**53**		**74**		**4**		**30**		**40**		**201**	**100**

Source: JICA Study Team

Socio-Economic Status

(i) Primary Occupation

Table 13.10-8 presents the primary source of income of the respondents. As shown on the table, the main source of income is farming (26.4%), followed by own business (22.9%), and professional practice (15.9%). There is also a high percentage who have indicated that they are unemployed or no source of income (17.9%).

TABLE 13.10-8 SUMMARY OF PAPS PRIMARY OCCUPATION

Unit: No. of Respondents

Section	South				Center			North			Total	
Sub-District	Toril		Tugbok		Talomo		Buhangin		Bunawan			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Primary Occupation												
Farming	18	34.0	24	45.3	1	1.9	4	7.6	6	11.3	53	26.4
Skilled & Unskilled	3	17.7	5	29.4	0	0.0	5	29.4	4	23.5	17	8.4
Professional Practice	13	40.6	6	18.7	1	3.1	8	25.0	4	12.5	32	15.9
Own Business	7	15.2	20	43.5	0	0.0	7	15.2	12	26.1	46	22.9
Agricultural Product	2	28.6	2	28.6	1	14.3	1	14.3	1	14.3	7	3.5
Pension	0	0.0	2	33.3	0	0.0	3	50.0	1	16.7	6	3.0
Others	1	25.0	1	25.0	1	25.0	0	0.0	1	25.0	4	2.0
None	9	25.0	14	28.9	0	0.0	2	5.6	11	30.6	36	17.9

Section	South				Center				North		Total	
Sub-District	Toril		Tugbok		Talomo		Buhangin		Bunawan			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Primary Occupation												
Total	**53**		**74**		**4**		**30**		**40**		**201**	**100**

Source: JICA Study Team

(ii) Tenure on Land Occupied

Majority of the PAPs (79.6%) own their land; the rest are tenants (8.0%), and lessees who are occupying land with permit (11.9%). Distribution of type of land tenure is presented in **Table 13.10-9**.

TABLE 13.10-9 SUMMARY OF PAPS TENURE ON LAND

Unit: No. of Respondents

Section	South				Center				North		Total	
Sub-District	Toril		Tugbok		Talomo		Buhangin		Bunawan			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Tenure on Land												
Owner	44	27.5	60	37.5	4	2.5	28	17.5	24	15.0	160	79.6
Tenant	6	37.5	6	37.5	0	0.0	2	12.5	2	12.5	16	8.0
Lessee	2	8.3	8	33.3	0	0.0	0	0.0	14	58.3	24	11.9
Institutional	1	100	0	0.0	0	0.0	0	0.0	0	0.0	1	0.5
Total	**53**		**74**		**4**		**30**		**40**		**201**	**100**

Source: JICA Study Team

(iii) Access to Basic Social Services

In terms of educational attainment, result shows that majority of respondents for both sexes have no formal schooling with 33.8% for husbands and higher for females with 49.2% shown in **Table 13.10-10**.

TABLE 13.10-10 SUMMARY OF PAPS EDUCATION ATTAINMENT

Unit: No. of Respondents

Section	South				Center				North		Total	
Sub-District	Toril		Tugbok		Talomo		Buhangin		Bunawan			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Educational Attainment – Husband (Wife)												
Primary	8 (4)	29.6 (16.0)	12 (9)	44.4 (36.0)	0 (0)	0.0 (0.0)	4 (3)	14.8 (12.0)	3 (9)	11.1 (36.0)	27 (25)	13.4 (12.4)
Secondary	11 (3)	27.5 (14.3)	11 (4)	27.5 (19.1)	0 (1)	0.0 (4.8)	5 (7)	12.5 (33.3)	13 (6)	32.5 (28.6)	40 (21)	19.9 (10.5)
Tertiary	15 (10)	40.5 (27.8)	17 (17)	46.0 (47.2)	0 (1)	0.0 (2.8)	3 (4)	8.1 (11.1)	2 (4)	5.4 (11.1)	37 (36)	18.4 (17.9)
Post Graduate	1 (0)	14.3 (0.0)	1 (0)	14.3 (0.0)	0 (1)	0.0 (25.0)	3 (1)	42.9 (25.0)	2 (2)	28.6 (50.0)	7 (4)	3.5 (2.0)
Vocational	0 (1)	0.0 (100)	0 (0)	0.0 (0.0)	0 (0)	0.0 (0.0)	0 (0)	0.0 (0.0)	0 (0)	0.0 (0.0)	0 (1)	0.0 (0.5)
None	16 (33)	23.5 (33.3)	26 (38)	38.2 (38.4)	0 (1)	0.0 (1.1)	14 (13)	20.6 (13.1)	12 (14)	17.7 (14.1)	68 (99)	33.8 (49.2)
No Answer	2 (2)	9.1 (13.3)	7 (6)	31.8 (40.0)	4 (0)	18.2 (0.0)	1 (2)	4.5 (13.3)	8 (5)	36.4 (33.3)	22 (15)	11.0 (7.5)
Total	**53 (53)**		**74 (74)**		**4 (4)**		**30 (30)**		**40 (40)**		**201 (201)**	**100 (100)**

Source: JICA Study Team

Table 13.10-11 shows that majority of interviewed PAPs source of drinking water are from Level III (46.8%); i.e., house connections through the Davao City Water District (DCWD), and Level II (34.8%) water supply systems.

TABLE 13.10-11 SUMMARY OF PAPS SOURCE OF WATER FOR DRINKING

Unit: No. of Respondents

Section	South				Center			North			Total	
Sub-District	Toril		Tugbok		Talomo		Buhangin		Bunawan			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Source of Water for Drinking												
Level 1	5	9.4	1	1.3	0	0.0	2	6.7	8	20.0	16	8.0
Level III	23	43.4	9	1.3	3	75	9	30.0	26	65.0	70	34.8
DCWD	17	32.1	59	12.2	1	25	14	46.7	3	7.5	94	46.7
Spring Box	2	3.8	1	79.7	0	0.0	0	0.0	0	0.0	3	1.5
Illegal Connection	0	0.0	2	1.3	0	0.0	0	0.0	0	0.0	2	1.0
Private Owned	2	3.8	0	2.7	0	0.0	0	0.0	0	0.0	2	1.0
None	3	5.7	1	1.3	0	0.0	1	3.3	1	2.5	6	3.0
Others	1	1.9	1	0.0	0	0.0	4	13.3	2	5.0	8	4.0
Total	**53**		**74**		**4**		**30**		**40**		**201**	**100**

Source: JICA Study Team

(iv) Poverty Threshold

As shown in **Table 13.10-12**, a relatively high percentage of the surveyed households (71.6%) are earning above the poverty threshold of Php 17,040 for a family of four (4) in Region XI DAVAO Region; 7% have annual household incomes that are below the poverty threshold; while the remaining 13.9% are living below the food threshold[1].

TABLE 13.10-12 SUMMARY OF POVERTY THRESHOLD AMONG PAPS

Unit: No. of Respondents

Section	South				Center			North			Total	
Sub-District	Toril		Tugbok		Talomo		Buhangin		Bunawan			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Poverty Threshold among PAPs												
Above Poverty Threshold	37	18.4	53	26.4	3	1.5	24	11.9	27	13.4	144	71.6
Below Poverty Threshold but above Food Threshold	3	1.5	6	3.0	1	0.5	0	0.0	4	2.0	14	7.0
Below Food Threshold	7	3.5	11	5.5	0	0.0	2	1.0	8	4.0	28	13.9
No Response	6	3.0	4	2.0	0	0.0	4	2.0	1	0.5	15	7.5
Total	**53**		**74**		**4**		**30**		**40**		**201**	**100**

Source: JICA Study Team

For their health needs, 50.2% depend on barangay health centers. A few (11.9%) go to hospitals, and the rest access private clinics and hospitals. In terms of sanitation, majority or 68.0% use semi-flush toilet facilities, 25.0% with flush facilities, and a few still using the Antipolo and open pit type. For their mode of transportation, the top three answers are: (i) tricycles and pedicabs (59.7%), and (ii) jeep, bus, and tricycle (15.9%), and (iii) jeepney (12.4%), which accounts for 88.0% of total respondents.

13.10.1.3 Impact on Land

The number of marginally and severely affected landowners per barangay is shown in **Table 13.10-13**. As defined in LARRIP Policy 3rd Edition severely affected land are those where area to be acquired is greater than 20% of the total area of land, or when the remaining portion after land take is no longer economically viable. Considering that the Project is still at the Feasibility Study stage and no parcellary surveys have been conducted, severity of impact may change after conduct of such. Note that for flexibility, basis of valuations presented are of two types, namely: (i) BIR Zonal Values and (ii) Schedule of Fair Market Values of Davao City in accordance with City Ordinance 040-07 Series of 2007, also known as an Ordinance Fixing the Schedule of Fair

[1] Food threshold is the minimum income/expenditure required for a family/individual to meet the basic food needs, which satisfies the nutritional requirements for economically necessary and socially desirable physical activities.

Market Values (SFMV) of Real Properties Within the Territorial Jurisdiction of Davao City for the 2008 General Revision which took effect in 2009[2].

TABLE 13.10-13 SEVERITY OF IMPACT ON AFFECTED LANDS

City/Sub-District/ Barangay	Total No. of Lots	Severe	Marginal	Total Area (in ha)
Davao City				
Toril				
Sirawan	9	4	5	5.77
Marapangi	21	8	13	11.66
Bato	24	14	10	11.78
Alambre	7	4	3	3.23
Bangkas Heights	7	3	4	5.17
Mulig	24	10	14	15.35
Tugbok				
Mintal	22	14	8	10.05
Tugbok	16	10	6	7.37
Tacunan	46	22	24	30.66
Talomo				
Magtuod	11	6	5	7.68
Buhangin				
Waan	2	0	2	5.75
Tigatto	7	0	7	8.35
Cabantian	28	14	14	11.66
Communal	9	4	5	5.79
Indangan	9	1	9	13.04
Bunawan				
Mudiang	20	11	9	15.84
Tibungco	15	6	9	11.70
Mahayag	19	6	13	17.09
San Isidro	23	6	17	22.40
Lasang	11	0	11	15.96
Panabo City				
J. P. Laurel	1	1	0	1.43
Total	**331**	**144**	**188**	**237.76**

Source: JICA Study Team

13.10.1.4 Impact on Livelihood

Table 13.10-14 and **Table 13.10-15** show the estimated number of trees and crops (banana hills) that will be affected by the Project per Sub-District. Note that valuation used is based on Davao City's Ordinance No. 040-07, Series of 2007 which took effect in 2009, entitled Ordinance Fixing the Schedule of Fair Market Values (SFMV) of Real Properties within the Territorial Jurisdiction of Davao City for the 2008 General Revision.

[2] Section 201 of the Local Government Code of 1991 and Article 291 of its Implementing Rules and Regulations (IRR) provide that the Department of Finance (DOF) shall promulgate the necessary rules and regulations for the classification, appraisal, and assessment of real property. For this purpose, the DOF has constituted a Committee composed of the officials and staff of the Bureau of Local Government Finance (BLGF) and Provincial, City and Municipal Assessors to formulate a "Manual on Real Property Appraisal and Assessment Operations", which shall serve as a guide for assessors all over the country. In accordance with Section 1, Chapter III of said Manual, the Provincial, City or Municipal Assessor shall undertake a general revision of real property assessments once every three (3) years, which shall commence upon the enactment of the Schedule of Fair Market Values (SFMV) into an ordinance by the sangguniang (local government law making body) concerned.

TABLE 13.10-14 AFFECTED LOTS AND TYPES OF CULTIVATED CROPS

City/Sub-District/ Barangay	Affected Lots	No. of Lots Dominantly Cultivated with			
		Banana	Mango	Coconut	Various Crops
Davao City					
Toril					
Sirawan	9		2	3	
Marapangi	21	6	8		
Bato	24		3	3	
Alambre	7		2	3	
Bangkas Heights	7				
Mulig	24			10	7
Tugbok					
Mintal	22		3		7
Tugbok	16				
Tacunan	46	2	9	4	4
Talomo					
Magtuod	11	2			
Buhangin					
Waan	2	2	1		
Tigatto	7	1			
Cabantian	28	8	2		
Communal	9	2	1		
Indangan	9	1			
Bunawan					
Mudiang	20		1	4	
Tibungco	15	5		8	
Mahayag	19			9	7
San Isidro	23				6
Lasang	11	8			
Panabo City					
J. P. Laurel	1				
Total	**331**	**37**	**32**	**44**	**31**

Source: JICA Study Team

TABLE 13.10-15 IMPACT ON TREES AND CROPS

City/Sub-District/ Barangay	Fruit Trees		Industrial Crops		Intercropped Trees	
	Total No.	Value (Php)	Total No.	Value (Php)	Total No.	Value (Php)
Davao City						
Toril	2,870	980,780	464	139,200	1,813	453,250
Tugbok	1,190	850,020	128	38,400	1,737	434,250
Talomo	898	54,770	30	9,000	258	64,500
Buhangin	8,341	610,820	38	11,400	141	35,250
Bunawan	4,486	308,460	474	142,200	3,390	847,500
Total	**17,785**	**2,804,850**	**1,134**	**340,200**	**7,339**	**1,834,750**
					Total Davao City	**4,979,800**
Panabo City						
J. P. Laurel	1	950	22	6,600	-	-
Grand Total	**17,786**	**2,805,800**	**1,156**	**346,800**	**7,339**	**4,987,350**

Source: JICA Study Team

13.10.1.5 Project Acceptability

When asked to respondents if they were in favor of the Davao Bypass project, a significant majority (83.1%) responded "Yes" (see **Table 13.10-16**). Among the reasons cited, the following were mentioned the most number of times:

For "Yes" answer:
(i) It will bring economic development to the City;
(ii) Better accessibility; and
(iii) It will improve living conditions in the barangay.

For "No" answer (16.9%):
(i) It will entail loss of land and livelihood derived from it.
Most opponents consist of small scale land owners and they felt anxiety by losing tiny farmlands. However, the opinions were not strongly negative and they will accept the project if they can afford to spend a proper life without moving far from the original site.

TABLE 13.10-16 PROJECT ACCEPTABILITY

Unit: No. of Respondents

Section	South				Center				North		Total	
Sub-District	Toril		Tugbok		Talomo		Buhangin		Bunawan			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Project Acceptability												
Yes	41	24.6	65	38.9	4	2.4	25	15.0	32	19.2	167	83.1
No	12	35.3	9	26.5	0	0.0	5	14.7	8	23.5	34	16.9
Total	**53**		**74**		**4**		**30**		**40**		**201**	**100**

Source: JICA Study Team

13.10.2 Resettlement Policy

The development projects undertaken by the Department of Public Works and Highways (DPWH) must serve the public well and in the design and implementation of such projects, all efforts will be executed to help ensure that Project-affected Persons (PAPs) are not worse off. In addition, the Project should provide an opportunity for the local population to derive benefits from the Project.

The executive agency, however, always takes full care to afford facilities to PAPs, there sometimes arise conflicts between the executive agency and PAPs. **Table 13.10-17** provides a few court cases on resettlement and compensation of national infrastructure projects by DPWH.

TABLE 13.10-17 COURT CASES ON RESETTLEMENT AND COMPENSATION

No.	Project Name	Year Claimed	Main Petitioner	Reason of Claim	Final Court Decision
1	Batangas Port Expansion Project	1993	Claimants 1568 (movers' group)	Request for the movers' right to the land and their sources of living	The case was pending by the court which promoted the petitioner to file a Temporary Restraining Order (TRO). Eventually the movers forced to move the relocation sites which the execution agency
2	EDSA-Shaw Boulevard (Mandaluyong City) Flyover	1996	LECA Realty Corporation	Determination of just compensation by the court in the first trial	• Zonal valuation is simply one of the indices of the fair market value of real estate. By itself, however, this index cannot be the sole basis of "just compensation" in expropriation cases. The standard is not the taker's gain, but the owner's loss.

No.	Project Name	Year Claimed	Main Petitioner	Reason of Claim	Final Court Decision
					• The trial court is hereby ordered to fix the "just compensation" for LECA's property within 6 months from its receipt of decision and afterwards report to the court its compliance, in order to forestall any further delay in the resolution of the case.
3	Pasig River Environmental Management and Rehabilitation Sector Development	2000	Squatters along the Pasig River	Width of easement (DPWH requested 10m easement but squatters claimed 3m enough)	The courts sustained the contention of the executing agency, DENR and MMDA that the 10m easement was required.
4	The Circumferential Road 5 (C-5) Extension Project	2009	Barangay Captain of Matandang Balara, Quezon City	Forcible territory occupation by DPWH (to give damages to the aqueducts)	The court ordered DPWH further study to secure the aqueducts beneath the occupied land. If not, DPWH cannot conduct the project.

Source: JICA Study Team

Note that most court cases regarding resettlement and land issues are on expropriation claimed by the executive agency or the government. In such situation, however, the executive agency and the government shall take a careful consideration to avoid severe claims by the citizens through consensus building, grievance redress etc.

This portion shall provide a tool, which will also help ensure that all PAPs along the road project, regardless of their number, receive the appropriate assistance in a fast and timely manner. For achieving the goal, the Project will follow the principles in accordance with those in LARRIPP, which has been based on the World Bank Policy OP/BP 4.12.

1. The Government of the Republic of Philippines is bound to follow the Project Resettlement Policy (the Project Policy) for the Davao City Bypass Project specifically which is intended to comply with the JICA Guidelines.
2. Where there are gaps between the Republic of Philippines legal framework for resettlement and JICA's Policy on Involuntary Resettlement, practicable mutually agreeable approaches will be designed consistent with Government practices and JICA's Policy.
3. Land acquisition and involuntary resettlement will be avoided where feasible, or minimized, by identifying possible alternative project designs that have the least adverse impact on the communities in the project area.
4. Where displacement of households is unavoidable, all PAPs (including communities) losing assets, livelihoods or resources will be fully compensated and assisted so that they can improve, or at least restore, their former economic and social conditions.
5. Compensation and rehabilitation support will be provided to any PAPs, that is, any person or household or business which on account of project implementation would have his, her or their standard of living adversely affected;
   - Right, title or interest in any house, interest in, or right to use, any land (including premises, agricultural and grazing land, commercial properties, tenancy, or right in annual or perennial crops and trees or any other fixed or moveable assets, acquired or possessed, temporarily or permanently;
   - Income earning opportunities, business, occupation, work or place of residence or

habitat adversely affected temporarily or permanently; or

- Social and cultural activities and relationships affected or any other losses that may be identified during the process of resettlement planning.

6. All affected people will be eligible for compensation and rehabilitation assistance, irrespective of tenure status, social or economic standing and any such factors that may discriminate against achievement of the objectives outlined above.
7. Lack of legal rights to the assets lost or adversely affected tenure status and social or economic status will not bar the PAPs from entitlements to such compensation and rehabilitation measures or resettlement objectives.
8. All PAPs residing, working, doing business and/or cultivating land within the project impacted areas as of the date of the latest census and inventory of lost assets (IOL), are entitled to compensation for their lost assets (land and/or non-land assets), at replacement cost, if available and restoration of incomes and businesses, and will be provided with rehabilitation measures sufficient to assist them to improve or at least maintain their pre-project living standards, income-earning capacity and production levels.
9. PAPs that lose only part of their physical assets will not be left with a portion that will be inadequate to sustain their current standard of living. The minimum size of remaining land and structures will be agreed during the resettlement planning process.
10. People temporarily affected are to be considered PAPs and resettlement plans address the issue of temporary acquisition.
11. Where a host community is affected by the development of a resettlement site in that community, the host community shall be involved in any resettlement planning and decision-making. All attempts shall be made to minimize the adverse impacts of resettlement upon host communities.
12. The resettlement plans will be designed in accordance with Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy (LARRIPP) of DPWH, 2007 and JICA's Policy on Involuntary Resettlement.
13. The Resettlement Plan will be translated into local languages and disclosed for the reference of PAPs as well as other interested groups.
14. Payment for land and/or non-land assets will be based on the principle of replacement cost.
15. Compensation for PAPs dependent on agricultural activities will be land-based wherever possible.
16. Resettlement assistance will be provided not only for immediate loss, but also for a transition period needed to restore livelihood and standards of living of PAPs. Such support could take the form of short-term jobs, subsistence support, salary maintenance, or similar arrangements.
17. The resettlement plan must consider the needs of those most vulnerable to the adverse impacts of resettlement (including the poor, those without legal title to land, ethnic minorities, women, children, elderly and disabled) and ensure they are considered in resettlement planning and mitigation measures identified. Assistance should be provided to help them improve their socio-economic status.
18. PAPs will be involved in the process of developing and implementing resettlement plans.
19. PAPs and their communities will be consulted about the project, the rights and options available to them, and proposed mitigation measures for adverse effects, and to the extent possible be involved in the decisions that are made concerning their resettlement.
20. Adequate budgetary support will be fully committed and made available to cover the costs of land acquisition (including compensation and income restoration measures) within the

agreed implementation period.

21. Displacement does not occur before provision of compensation and of other assistance required for relocation.
22. Sufficient civic infrastructure must be provided in resettlement site prior to relocation.
23. Acquisition of assets, payment of compensation, and the resettlement and start of the livelihood rehabilitation activities of PAPs, will be completed prior to any construction activities, except when a court of law orders so in expropriation cases
24. Livelihood restoration measures must also be in place but not necessarily completed prior to construction activities, as these may be ongoing activities.
25. Organization and administrative arrangements for the effective preparation and implementation of the resettlement plan will be identified and in place prior to the commencement of the process; this will include the provision of adequate human resources for supervision, consultation, and monitoring of land acquisition and rehabilitation activities.
26. Appropriate reporting (including auditing and redress functions), monitoring and evaluation mechanisms, will be identified and set in place as part of the resettlement management system.
27. An external monitoring group will be hired by the project and will evaluate the resettlement process and final outcome. Such groups may include qualified consultants, NGOs, research institutions or universities.
28. Monitoring reports shall be forwarded directly to the JICA.

13.10.3 Legal Framework

Legal framework pertaining to involuntary resettlement consists of the key legal and administrative instruments, currently in force in the Philippines, which govern involuntary resettlement and key aspects of WB/JICA's Policy. Laws that address eminent domain, compensation, responsible parties, and public information, consultation and grievance procedures are included.

13.10.3.1 Philippine Laws, DPWH Guiding Documents and Other Requirements

(1) The Philippine Constitution (1987)

Article III, Section 1: "No person shall be deprived of life, liberty or property without due process of law, nor shall any person be denied equal protection of the law."

Section 9: "Private property shall not be taken for public use without just compensation."

Article XIII, Section 10: "Urban or poor dwellers shall not be evicted nor dwellings demolished, except in accordance with the law and in a just and humane manner. No resettlement of urban or rural dwellers shall be undertaken without adequate consultation and the communities where they are to be relocated."

(2) Republic Act 8974 (R.A. 8974) "An Act to Facilitate the Acquisition of Right-of-Way, Site or Location for National Government Infrastructure Projects (November 2000)"

RA 8974 provides the different basis for land valuation for the modes of acquisition, negotiated sale and expropriation as follows:

- Implementing rules and regulations: The Implementing Agency, DPWH, shall negotiate with the owner for the purchase of the property by offering first the current zonal value issued by the Bureau of Internal Revenue (BIR) for the area where the property is located.

- Valuation of structures and/or improvements on the land: Based on replacement cost defined as the amount necessary to replace the structure or improvement based on current market prices for materials, equipment, labor, contractor's profit and overhead and all other attendant cost associated with the acquisition and installation in place of the affected improvements/installation.
- Methods of negotiation: The following modes in acquiring title to, and ownership of private property, such as: Donation, Quit Claim, Exchange or Barter, Negotiated Sale or Purchase, Expropriation and such other modes of acquisition authorized by law.
- Zonal value as the first offer: In case the mode of acquisition is through a negotiated sale, the first offer shall be the zonal value of the particular land where the property is located. In case the owner rejects the first offer, DPWH shall renegotiate using the values recommended by the Appraisal Committee or Independent Land Appraiser - as procured by MCA-P and the DPWH.
- Standards in determining market value: The market value of the property to be acquired will be determined using the following standards:
  - The classification and use for which the property is suited;
  - The development costs for improving the land;
  - The value declared by the owner;
  - The current selling price of similar lands in the vicinity;
  - The reasonable disturbance compensation for the removal and/or demolition of certain improvements on the land and for the value for improvements thereon;
  - The size, shape and location, tax declaration and zonal valuation of the land;
  - The price of the land as manifested in ocular findings, oral evidence as well as documentary evidence presented; and
  - Such facts and events as to enable the affected property owners to have sufficient funds to acquire similarly-situated lands of approximate areas as those required from them by the government and thereby rehabilitate themselves as early as possible.
- Quit Claim: This mode is applicable to private property or land acquired under the provisions of Special Laws, like Commonwealth Act 141, known as the Public Land Act. Under the provision of this law, especially Sec. 122 thereof, a strip of twenty (20) meters of the property acquired under such law is reserved by the government for public use with damages paid for improvements only. The twenty (20) meter strip had subsequently been increased to sixty (60) meters under Presidential Decree 635, which took effect on January 1975, amending Sec. 122, C.A. 141.
- In cases where PAPs/Project-affected Families (PAFs) are qualified for compensation but are in arrears on land taxes, to facilitate the processing of payment on assets acquired from the PAPs with tax arrears, the DPWH will pay the arrears and deduct the amount to the total compensation cost.
- In cases of expropriation. For Structures: In the event that the PAF rejects the compensation for structures at replacement cost offered by DPWH, DPWH or the PAF may take the matter to court. As such, DPWH will deposit with the court in escrow the whole amount of the replacement cost (100%) which the Department offered to the owner as compensation for his/her assets to allow DPWH to proceed with the works. The PAF will receive the replacement costs of the asset one (1) month following the receipt of the decision of the court.
- For Land: If the owner contests the Department's second offered value for compensation for land, the PAF or DPWH may take the matter to court. DPWH shall immediately deposit 100% of the BIR zonal value in an escrow account. The court shall determine the just compensation within sixty (60) days, taking into account the standards for the

assessment of the values of the land.

(3) DPWH Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples Policy (LARRIPP) (March 2007)

The LARRIP provides uniform standards in resettlement planning. It also contains safeguard instruments for indigenous peoples (IPs) affected by infrastructures implemented by DPWH and both foreign and locally funded. The LARRIP contains policies related to involuntary resettlement, the legal basis for land acquisition and involuntary resettlement, compensation and entitlement, policy framework for IPs, implementation procedures that ensure grievances are appropriately acted upon, and measures to ensure public participation both during RAP preparation and implementation. The document also provides for internal and external monitoring of RAP implementation.

(4) Indigenous Peoples' Rights Act (IPRA) 1997

"Consent" is required from affected indigenous peoples before any land taking and/or relocation from their ancestral domain by the project. The IPRA, together with the Free and Prior Informed Consent (FPIC) Guidelines of 2006, will serve as the guiding framework on addressing IP issues.

13.10.3.2 Other Applicable Laws and Policies: Executive Orders, Administrative Orders, and Department Orders shall govern the Resettlement.

(1) DPWH Department Order (D.O.) No. 34 (series of 2007)) "Simplified Guidelines for the Validation and Evaluation of Infrastructure Right-of-Way Claims"

This provides a step-by-step methodology and guidance to DPWH resettlement staff on how to validate and evaluate infrastructure ROW claims, conduct title searches, and similar activities.

(2) DPWH D.O. No. 327 (series of 2003) "Guidelines for Land Acquisition and Resettlement Action Plan (LAPRAP) for Infrastructure Projects"

- LAPRAP document shall describe the project, expected impacts and mitigating measures, socio- economic profile of PAPs, compensation package, timetable of implementation, institutional arrangements, monitoring and evaluation arrangements, participation, consultation and grievance procedures.
- LAPRAP shall be prepared using inputs from the IROW Action Plan, the census and socioeconomic survey which were conducted, the detailed engineering study, and the parcellary survey results.
- LAPRAP shall be the basis for qualifying and compensating PAPs for lands, structures and/or improvements that are partially or fully affected by the Department's infrastructure projects in accordance with the qualification entitlement, and compensation guidelines.
- Provision of resettlement sites shall be the responsibility of the Local Government Units (LGUs) concerned, with assistance from the concerned government agencies tasked with providing housing. The DPWH shall coordinate with these LGUs and appropriate government agencies for the resettlement and relocation of qualified PAPs. The acquisition, planning, and development of resettlement sites shall be part of the LAPRAPs, with the responsibility resting mainly with the concerned LGUs, Housing and Urban Development Coordinating Council (HUDCC), National Housing Authority (NHA), and other concerned agencies.
- Where relocation is considered necessary, the receiving LGU (under whose political jurisdiction the relocation site will be located) may seek assistance from DPWH for the provision of basic facilities and services.
- An Indigenous People's Action Plan (IPAP) shall be formulated for IPs if they are affected by the Department's infrastructure projects, in coordination with the National Commission of Indigenous People (NCIP) to ensure that the ancestral domain and culture of the IP are secured.

(3) DPWH D.O. No. 5 (series of 2003) "Creation of the Infrastructure Right of Way and Resettlement Project Management Office (IROW-PMO) and the Implementation of the Improved IROW Process"

- The Implementing Office (IO) shall ensure that IROW costs are always included in project budgets.
- The IO shall formulate a ROW Action Plan during the project identification stage. The Action Plan shall contain the estimated budget for all ROW costs including inflation and contingencies, schedule of implementation, and the areas to be acquired.
- The IO shall provide an estimated cost breakdown of each project to the IROW and Resettlement PMO and the Comptrollership and Financial Management Services (CFMS) prior to any disbursement of funds. The first priority of the budget for a project shall be all costs prior to construction.
- If ROW costs differ from the approved ROW budget after detailed design has been finalized, a budget adjustment shall be approved.
- Feasibility Studies shall be conducted for all projects. The level of detail for these studies will vary, depending on the type, size, and complexity of the project.
- The Environmental Compliance Certificate (ECC) shall be secured before detailed design for all projects. However, for projects costing over P3 00 million, the ECC shall be secured before National Economic and Development Authority (NEDA)/Infrastructure (ICC) approval.
- Parcellary Surveys shall be conducted for all projects in accordance with DO 187 series 2002.
- LAPRAP shall be prepared for all projects, whether local or foreign funded, that will require ROW acquisitions, using a standardized compensation package as defined in IROW Procedural Manual..
- The determination of PAPs and improvements shall be based on the cut-off date, which is the start of the census of PAPs and tagging for improvements.
- The IO shall prepare the final as-built ROW Plan upon completion of the project, for submission to the IROW and Resettlement PMO.

(4) DPWH D.O. No. 187 (series of 2002)

This requires all offices to include the cost of ROW acquisition, squatter relocation, and the development of a resettlement site in the total construction cost of any proposed project. The order also details parcellary surveys to be conducted by a geodetic engineer(s) and submitted to the Land Management Bureau of the Department of Environment and Natural Resources (DENR) for approval.

(5) Executive Order No.113 (E.O. 113) 1995

National roads shall have a ROW width of at least 20 meters in rural areas which may be reduced to 15 meters. In highly urbanized areas shall be at least 60 meters in unpatented public lands; ROW shall be at least 120 meters though natural forested areas for aesthetic or scientific value.

(6) Section 23, Presidential Decree No. 17, revised Philippine Highway Act, October 5, 1972

This states that "It shall be unlawful for any person to usurp any portion of a right-of-way, to convert any part of any public highway…. to his private use or to obstruct the same in any manner…"

(7) E.O. 1035 (1985)

This provides the procedures and guidelines for the expeditious acquisition by the government of private real properties or rights thereon for infrastructure and other government development projects: financial assistance to displaced tenants, cultural minorities and settlers equivalent to the average annual gross harvest for the last three (3) years and not less than 15,000 Philippine pesos (Php) per hectare; disturbance compensation to agricultural lessees equivalent to five (5) times

the average gross harvest during the last five (5) years; compensation for improvements on land acquired under Commonwealth Act 141; and the government has the power to expropriate in case no agreement has been reached.

(8) R.A. 7279 (1992)

The "Urban Development and Housing Act" mandates the provision of a resettlement site, and basic services and safeguards for the homeless and underprivileged citizens.

(9) R.A. 7160 (1991)

The "Local Government Code" which allows the local government units to exercise the power of eminent domain for public use.

(10) R.A. 6389 (1971)

This describes disturbance compensation equivalent to five times the average of the gross harvests on landholding during the last five preceding calendar years.

(11) R.A. 7835 (1994)

This describes the National Shelter Program Implementation/ Resettlement Program. The National Housing Authority shall acquire land and develop it to generate serviced home lots for families displaced from sites earmarked for government infrastructure projects, those occupying danger areas such as waterways, railroad tracks and those qualified for relocation and resettlement under RA 7279.

(12) The Philippines Constitution (1987), Section 14 of Article II

This states that "it recognizes the role of women in nation-building, and shall ensure the fundamental equality before the law of women and men."

(13) R.A. 9710 and Implementing Rules and Regulations (series of 2010) known as the "Magna Carta of Women"

This provides for the following, in regards to the rights of women: equal treatment before the law; protection from all forms of violence; participation and representation; equal access and elimination of discrimination against women in education, scholarships and training; equal rights in all matters related to marriage and family relations; comprehensive health services and health information/education; non-discrimination in employment; and other items.

(14) R.A. 7192

"An Act Promoting the Integration of Women as full and Equal Partners of Men in Development and Nation Building and Other Purposes."

(15) E.O. 273

This approved and adopted the Philippine Plan for Gender-Responsive Development (PPGD), 1995-2025; a successor plan of the expired Philippine Development Plan for Women (PDPW) for 1989-1992.

(16) The Harmonized Gender and Development Guidelines (2007)

This aim to provide a common set of analytical concepts and tools for integrating gender concerns into development programs and projects; and help achieve gender equity in, and empower women through projects and programs.

(17) DPWH and World Bank publication, "A Toolkit on Making Road Infrastructures and Related Facilities Gender Responsive"

This presents the principles, approaches and procedures for making road infrastructures and related facilities sensitive to the differing travel needs and patterns of women and men, especially those from low income sectors who rely solely on public and intermediate modes of transport.

13.10.4 Gap Analysis

Although the World Bank and JICA as well as the Philippines have strong protection clauses for PAPs, there are gaps between the policies. **Table 13.10-18** includes a comparison and gap analysis of the policies for some key issues between JICA Guidelines and Philippine relevant regulations.

TABLE 13.10-18 COMPARISON OF POLICIES BETWEEN JICA GUIDELINES AND PHILIPPINE LAWS

JICA Guidelines	Laws and Guidelines of the Philippines	Gap relative to JICA GL	Project Policy
Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. (JICA GL)	Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples' Policy, 2007 (LARRIP), (=WB OP4.12)	None	Same as JICA GL
When population displacement is unavoidable, effective measures to minimize impact and to compensate for losses should be taken. (JICA GL)	LARRIPP	None	Same as JICA GL
People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported, so that they can improve or at least restore their standard of living, income opportunities and production levels to pre-project levels. (JICA GL)	LARRIPP	None	Same as JICA GL
Compensation must be based on the full replacement cost as much as possible. (JICA GL)	LARRIPP	None	Same as JICA GL
Compensation and other kinds of assistance must be provided prior to displacement. (JICA GL)	DO#5 (2003): unless ROW is purchased project notice of award to contractor cannot be issued, i.e. all kind of compensation is paid before project is commenced	None	Same as JICA GL
For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. (JICA GL)	LARRIPP	None	Same as JICA GL

JICA Guidelines	Laws and Guidelines of the Philippines	Gap relative to JICA GL	Project Policy
In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. (JICA GL)	LARRIPP	None	Same as JICA GL
When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. (JICA GL)	LARRIPP	None	Same as JICA GL
Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans. (JICA GL)	LARRIPP	None	Same as JICA GL
Appropriate and accessible grievance mechanisms must be established for the affected people and their communities. (JICA GL)	LARRIPP	None	Same as JICA GL
Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advantage of such benefits. (WB OP 4.12 Para. 6)	LARRIP states the cut-off date as the date of commencement of the census. Resettlement project conducted by LGUs nationwide notifies to public the last day of the census work, and use the date as the cut-off date, so that no eligible PAFs are left uncounted.	None	Affected people are to be identified and recorded as early as possible in order to establish their eligibility through an initial baseline survey (including population census that serves as an eligibility cut-off date, asset inventory, and socioeconomic survey), preferably at the project identification stage, to prevent a subsequent influx of encroachers of others who wish to take advantage of such benefits. The cut-off date for this RAP is the date of commencement of the census. For those who are eligible for compensation but absent during the census work shall be encouraged to communicate with the barangay captains and to attend community consultation meetings to be validated by DPWH.
Eligibility of benefits includes, the PAPs who have formal legal rights to land (including customary and traditional land rights recognized under law), the	Professional Squatters (as defined by Republic Act 7279) applies to persons who have previously been awarded home lots or	Professional Squatters and Squatting Syndicates are not eligible for	All affected people (except professional squatters) will be eligible for compensation and rehabilitation assistance,

JICA Guidelines	Laws and Guidelines of the Philippines	Gap relative to JICA GL	Project Policy
PAPs who don't have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPs who have no recognizable legal right to the land they are occupying. (WB OP 4.12 Para. 15)	housing units by the government but who sold, leased or transferred the same to settle illegally in the same place or in another urban area, and non bona fide occupants and intruders of lands reserved for socialized housing. Squatting Syndicates (as defined by Republic Act 7279) refers to groups of persons who are engaged in the business of squatter housing for profit or gain. Those persons are ineligible for structure compensation, relocation, and rehabilitation/ inconvenience/income-loss assistance in case their structures are to be demolished in resettlement project according to Republic Act 7279. This definition excludes individuals or groups who simply rent land and housing from professional squatters or squatting syndicates.	compensation. They may salvage the structure materials by themselves.	regardless of tenure status, social or economic standing and any such factors that may discriminate against achievement of the objectives of JICA Guidelines. However, those who have previously been awarded home lots or housing units by the government but who sold, leased or transferred the same to settle illegally in the same place or in another urban area, and non bona fide occupants and intruders of lands reserved for socialized housing will not be eligible for compensation.
Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based. (WB OP 4.12 Para. 11)	If feasible, land for land will be provided in terms of a new parcel of land of equivalent productivity, at a location acceptable to PAFs. (LARRIP)	None	Same as WB OP 4.12
Provide support for the transition period (between displacement and livelihood restoration). (WB OP 4. 12, para.6)	* Income Loss. For loss of business/income, the PAF will be entitled to an income rehabilitation assistance to be based on the latest copy of the PAFs' Tax record for 3 months, or not to exceed P 15,000 for severely affected structures. *Inconvenience Allowance The amount of P 10,000 shall be given to PAFs with severely affected structures, which require relocation and new construction.	Upper limit of cash disturbance compensation is limited to Php15,000 according to Philippine laws. The amount of planned Financial assistance and eligibility are explained in the community consultation, Only objection	The Commission of Audit (COA) and DPWH of Philippine government must amend Departmental Order to pay more than Php15,000 of disturbance and other compensation. DPWH will target all PAFs for Livelihood Rehabilitation Assistance. DPWH will conduct quarterly monitoring about the change of living standard of the PAFs before and after the resettlement. When the PAF are found that their

JICA Guidelines	Laws and Guidelines of the Philippines	Gap relative to JICA GL	Project Policy
	*Rehabilitation assistance Skills training and other development activities equivalent to P 15,000 per family will be provided in coordination with other government agencies, if the present means of livelihood is no longer viable and the PAF will have to engage in a new income activity. *Transportation Allowance or assistance. If relocating, PAFs to be provided free transportation. Also, informal settlers in urban centers who opt to go back to their place of origin in the province or be shifted to government relocation sites will be provided free transportation. (LARRIP (April, 2007, p. 18, 19)	given to the Study Team was to change alignment and not to cause loss of farming lands	living standard worsen, or whose present means of livelihood became not-viable, DPWH, in coordination with other appropriate institutions, will provide assistances, such as skills and livelihood trainings
Particular attention must be paid to the needs of the vulnerable groups among those displaced, especially those below the poverty line, landless, elderly, women and children, ethnic minorities etc. (WB OP 4.12 Para. 8)	LARRIPP	None	Same as WB OP 4.12

Source: JICA Guidelines for Environmental and Social Considerations (2010), World Bank Operational Policy 4.12 (2001), Land Acquisition, Department of Public Works and Highways Resettlement, Rehabilitation and Indigenous Peoples' Policy (2007), Republic of the Philippines

13.11 COMPENSATION AND ENTITLEMENT

13.11.1 Assets Inventory

Items and tables regarding assets inventory were already shown as indicated:

- Number of households affected in **Table 13.10-1**.
- Number of land lot affected in **Table 13.10-2**.

13.11.2 Eligibility

Legal owners of residential, commercial and industrial land who have full title, tax declaration or other acceptable proof of ownership shall be eligible for compensation. Owners of structures, on the other hand, whether they are based on legitimate or informal occupation of lands even by a dweller who has no land title, tax declaration or other acceptable proof of ownerships, shall be compensated based on replacement cost, as defined in the IRR of R. A. 8974. LARRIPP also clearly agrees to the part in WB OP 4.12.

For details compensation and entitlement on the project refer to **Table 13.11-1**. Note for PAFs who will lose land and not want to relocate to other place far from the original site, "land for land" option shall be available to continue the production activity without any incontinence (see "LAND" in **Table 13.11-1**).

TABLE 13.11-1 ENTITLEMENT MATRIX

Type of Loss	Application	Entitled Person	Compensation/Entitlements
LAND (Classified as Agricultural, Residential, Commercial, or Institutional) **331 Lots**	**Severe Impact** More than 20% of the total landholding lost or where less than 20% lost but the remaining land holding become economically unviable*: **144 Lots** *e.g. In case farmland is divided by the new alignment and hard to continue product activity.	PAF with Transfer Certificate of Title (TCT) or Tax Declaration (TD, which can be legalized to full title).	PAP will be entitled to: • Cash compensation for loss of entire land in accordance with RA. 8974 as amended and its IRR[3], and the DPWH-LARRIPP. 3-Edition 2007. • If feasible, land for land will be provided in terms of a new parcel of land of equivalent productivity, at a location acceptable to PAFs. • Cash compensation for damaged crops at market value at the time of taking. • If applicable, rehabilitation assistance in the form of skills training equivalent to the amount of Php15, 000 per family, if the present means of livelihood is no longer viable and the PAP will have to engage in a new income activity[4].
		Titleholders of free or homesteads patens under Commonwealth Act (C.A.) 141, also known as Public Lands Act	PAP will be entitled to: • Cash compensation for land improvement only.
		Lessees of agricultural land	PAP will be entitled to: • Disturbance compensation equivalent to 5 times of the average annual gross harvest during the last five preceding calendar years.
		Tenants of agricultural lands: **19 Tenants**	PAP will be entitled to: • Financial assistance equivalent to the average annual gross harvest for the last 3 years and not less that PhP15, 000 per ha.
		Owners of surface land beneath tunnel section	PAP will be entitled to: • Compensation based on fairy valuated price for surface land covered.
	Marginal Impact Less than 20% of the total landholdings lost or where less than 20% lost or where remaining	PAP with TCT or TD (which can be legalized to full title).	PAP will be entitled to: • Cash compensation for affected land. Valuation of compensation shall be the same as described above for PAPs holding TCT or TD, which can be legalized to full title.

[3] For details, see chapter 13.10.3 (2) Republic Act 8974 (R.A. 8974) "An Act to Facilitate the Acquisition of Right-of-Way, Site or Location for National Government Infrastructure Projects (November 2000)"

[4] In this term, "no longer viable" means that if the means of livelihood is land-based, and the area to be acquired is greater than 20% of the total land area (i.e., severely affected), or where less than 20% is acquired but is remaining land will not be suitable for continuing livelihood activity. Viability can only be validated after Parcellary Survey Plan has been completed (i.e., after approval of detailed engineering design).

Type of Loss	Application	Entitled Person	Compensation/Entitlements
	viable for use: **187 Lots**	Titleholders of free or homesteads patens under C.A.141	PAP will be entitled to: • Compensation based on fairy valuated price for surface land covered.
STRUCTURES (Classified as Residential/ Commercial/ Public Infrastructure)	**Severe Impact** More than 20% of the total landholding loss or where less than 20% loss but the remaining structure no longer function as intended or no longer viable for continued use: **71 Structures**	PAP with TCT or TD (which can be legalized to full title): **23 PAPs**	PAP will be entitled to: • Cash compensation for entire structure at replacement cost. • Inconvenience allowance equivalent to PhP10, 000 per PAF who needs to transfer elsewhere as a result of land acquisition.
		PAP without TCT	PAP will be entitled to: • Cash compensation for entire structure at replacement cost.
		PAPs with small scale commercial establishments: **2 PAPs with sari-sari stores** **1 PAP with lumber store** **2 PAPs with poultry**	PAP will be entitled to: • Cash compensation for entire structure at replacement cost. • For loss of business/income, PAPs will be entitled to an income rehabilitation assistance not to exceed P 15,000 for severely affected structures, or to be based on the latest copy of the PAF's Tax record for the period corresponding to the stoppage of business activities.
		Project-affected Owners of structure who are leasing on land occupied: **35 PAPs**	PAP will be entitled to: • Cash compensation for entire structure at replacement cost. • If PAF prefers to be relocated, access to socialized housing shall be offered by Davao City. • Appropriate component of the Livelihood Restoration and Improvement Program.
		Owners of surface land beneath tunnel section	PAP will be entitled to: • Cash compensation for entire structure at replacement cost • Inconvenience allowance equivalent to P10,000 per PAF who needs to transfer elsewhere as a result of land acquisition
	Marginal Impact Less than 20% of the total landholding lost or where the remaining structure can still function and is viable for continued use	PAP with TCT or TD (which can be legalized to full title)	PAP will be entitled to: • Cash compensation for affected portion of the structure to be computed based on replacement cost.
		PAP without TCT	• Cash compensation for affected portion of the structure to be computed based on replacement cost.
		PAPs with small-scale commercial establishments	PAP will be entitled to: • For loss of business/income, PAPs will be entitled to an income rehabilitation assistance not to exceed P 15,000 for severely affected structures, or to be based on the latest copy of the PAF's Tax record for the period corresponding to the stoppage of business activities.
		Owners of surface land beneath tunnel section	PAP will be entitled to: • Cash compensation for affected portion of the structure to be computed based on replacement cost
OTHER	**Severely or**	PAP with or without	PAF will be entitled to:

Type of Loss	Application	Entitled Person	Compensation/Entitlements
IMPROVEMENTS (Other non-dwelling structures)	**Marginally Affected**	TCT, TD, etc. **1 Fence, 1 Chapel (private owner), 5 Storage structures (Bodega)**	• Cash compensation for the affected improvements at replacement cost.
CROPS, TREES		Owners of: **1,118 Mango trees**	• Cash compensation at fair market value based on City Ordinance No, 040-07[5] that took effect in 2009 for agricultural and industrial crops.
		16,648 Banana hills	• Cash compensation at fair market value based on City Ordinance No, 040-07 which took effect in 2009 for agricultural and industrial crops.
		1,156 Coconut trees	• Cash compensation at fair market value based on City Ordinance No, 040-07 that took effect in 2009 for agricultural and industrial crops. • Additional P100 per tree to be cut shall be made to comply with the requirement of the Philippine Coconut Authority when applying for Permit to Cut, in accordance with Coconut Reservation Act of 1995.
		7,339 Intercropped trees (Coconut, mango, pomelo, lanzones, durian, other perennials)	• For fruit-bearing trees and industrial crops: cash compensation at fair market value based on City Ordinance No, 040-07 which took effect in 2009 for agricultural and industrial crops; • For coconut: additional P100 per tree to be cut shall be made to comply with the requirement of the Philippine Coconut Authority when applying for Permit to Cut, in accordance with Coconut Reservation Act of 1995. • For perennial trees: cash compensation current market value as prescribed by the DENR • Disturbance compensation equivalent to 5 times the average of the gross harvest for the past 3 years but not less than Php 15,000

Source: JICA Study Team

13.11.3 Valuation and Compensation for Losses

Valuation for compensating loss of land shall be in accordance with Section 5 of FLA 8974. For dwellings and other structures, it shall be based on replacement cost as defined in Section 10 of its Implementing Rules and Regulations (IRR), and the LARRIPP of DPWH. Small-scale commercial establishments like sari-sari stores, which will incur temporary decrease in income due to limited access/frontage, shall also be provided income rehabilitation assistance. Inconvenience allowance shall be given to PAPs with severely affected structures, which require relocation and new construction.

[5] Crops are considered in the valuation of real property. As such, it is included in the Schedule of Fair Market Values for Davao City effective 2009.

Although there are approximately 35 families who own residential dwellings but are just leasing land, 29 of these are staying with their relatives' land and only six (6) are staying in a non-related lessor of land. Although the owners of land that they are now occupying may decide to allow them to transfer in areas within the same properties, it is considered more advantageous for these families to be relocated in a land that they can own. That is, as mentioned and illustrated in the previous Section, thee area areas in Davao City that are earmarked as 'socialized housing' sites. However the affected families' decision must also be respected if they would opt to continue leasing the land from their relatives. What is important is that they are provided with options which may improve their standards of living.

Assuming that the 35 families opt to be relocated, they should be provided free transportation including those who opt to go back to their province) upon their transfer to the relocation sites.

(1) Principle of Replacement Cost

All compensation for land and non-land assets owned by households/shop owners who meet the cut-off date will be based on the principle of replacement cost. Replacement cost is the amount calculated before displacement needed to replace an affected asset without both depreciation and deduction for taxes and/or costs of transaction.

- Existing regulations, methods and market price survey results of DPWH, DENR, DA and LGUs will be used where ever available for compensation calculations for structures, crops and trees.
- Independent asset assessor is assigned to valuate lands, structures, trees and other compensations.
- Houses and other relating structures based on actual current market prices of affected materials, labor and mark-up costs. Unit cost for the materials is applied to the standard price in the region concerned. Based on the unit costs, total cost including direct and indirect expenditures is computed.
- Annual crops equivalent to current market value of crops at the time of compensation.
- For trees like coconut, cash compensation at replacement cost that should be in line with LGU's regulations, if available, is equivalent to current market value given the type and age at the time of compensation based on the official guidance.

(2) How to Determine Market Price

The following scheme refers to how to determine market value based negotiated sale between DPWH and the PAP/PAF:

- The classification and use for which the property is suited;
- The development costs for improving the land;
- The value declared by the owners;
- The current selling price of similar lands in the vicinity;
- The reasonable disturbance compensation for the removal and/or demolition of certain improvements on the land and for the value for improvements thereon;
- The size, shape and location, tax declaration and zonal valuation of the land;
- The price of the land as manifested in the ocular findings, oral as well as documentary evidence presented; and
- Such facts and events as to enable the affected property owners to have sufficient funds to acquire similarly-situated lands of approximate areas as those required from them by the Government, and thereby rehabilitate themselves as early as possible.

(3) How to Treat Land of Tunnel Section

Although no direct impact is expected on the surface of the tunnel section, which is around 200 meters above the tunnel location, careful consideration must be given to avoid the same fate experienced by the National Power Corporation (NAPOCOR) in 2007 when they lost their case

against the owners of land above their 115-meter deep tunnel through an affirmation of the Court of Appeals' decision (1996 and 2005) by the Supreme Court in 2007.

Although the case of NAPOCOR seems very similar to the tunnel section of the Bypass, it is important to note that there are also glaring differences such as:

NAPOCOR Tunnel Case:

(i) The landowners were never informed that a tunnel will be constructed 115 m below their parcels of land;

(ii) No consultation meeting with the landowners was undertaken by NAPOCOR prior to the construction of the tunnel;

(iii) NAPOCOR maintained that, "the sub-terrain portion where the underground tunnels were constructed does not belong to respondents because, even conceding the fact that respondents owned the property, their right to the subsoil of the same does not extend beyond what is necessary to enable them to obtain all the utility and convenience that such property can normally give";

(iv) NAPOCOR asserted that "respondents were still able to use the subject property even with the existence of the tunnels, citing as an example the fact that one of the respondents had established his residence on a part of the property";

(v) NAPOCOR concluded that "the underground tunnels 115 meters below respondents' property could not have caused damage or prejudice to respondents and their claim to this effect was, therefore, purely conjectural and speculative".

Davao Bypass Case:

(i) Stakeholders concerned were informed that a tunnel will be constructed 200 m below their parcels of land during IEC with LGUs and public consultation meetings;

(ii) Consultation meetings with stakeholders were undertaken, not only once, but for three (3) times as part of the EIS and RAP preparation process;

(iii) DPWH is aware, and as affirmed through the legal framework of this RAP that "the sub-terrain portion where the underground tunnel will be constructed belong to land owners above it by virtue of Article 437 of the Civil Code of the Philippines".

Based on the foregoing, the following recommendations are deemed proper and in the interest of both parties in the Project:

(i) Include lots above the tunnel section in the Parcellary Survey to be conducted during Detailed Engineering Design (DED);

(ii) Considering that said lots were already included in the RAP Budget provided in this Report, provide the same allotment in the ROW cost;

(iii) During ROW acquisition, apply the same modes of acquisition of lands above tunnel in the same manner as those along the main bypass alignment;

(iv) To avoid possible future court cases due to "the tunnels interfering with respondents' enjoyment of their property and depriving them of its full use and enjoyment", as used by NAPOCOR's respondents, expropriate said parcels so that ownership can be transferred to DPWH;

(v) In case an agreement is reached during negotiation that the landowners' preference to stay is granted by DPWH in exchange for compensation, a written agreement must be carefully drafted, or an annotation in the Title be executed to avoid future complaints by heirs of the landowners;

13.11.4 Relocation Site

Based on actual site investigation using approximate ground location of the alignment, no illegal or informal settlers are determined. According to interviews with structure occupants, two types include as leased private and owned lands. For those situated on leased private land, occupants pay rent to their relatives and non-relatives who own the land, respectively.

For structure owners to be relocated who are leasing land, the following actions are appropriate:

(i) Assuming that owners of the land they are leasing would allow them to transfer in areas not affected by ROW acquisition, prompt payment for structures at replacement cost must be made so that they can resettle with minimum disturbance;

(ii) If their relatives would not allow them to transfer in other parts of the affected land, prompt payment for structures at replacement cost must be made so that they can resettle in another site. They should be assisted in order to have easy access to socialized housing sites identified in the 2013-2022 Comprehensive Zoning Ordinance of Davao City (shown in **Figure 13.11-1**). Davao City is mandated by law to identify and allot lands for socialized housing so that in the event there is a requirement to resettle affected people (e.g., as cited in Section 28 of R.A. 7279). The housing sites of Davao City were crafted in accordance with this doctrine, and are to be a possible relocation site for this project. For affected families whose average annual income are below the poverty threshold set by the National Statistical Coordination Board (NSCB) for Davao Region, they should be assisted to have access to a Community Mortgage Program (CMP)[6] of the government so that they can acquire their own land at affordable monthly amortizations; and

(iii) In the case of Item (ii) above, additional disturbance compensation as well as transportation assistance (including financial and physical assistance regarding freight and logistics in case relocation occurs) must be accorded to the affected families, as stipulated in the DPWH LARRIPP Series of 2007.

Davao City has provided shelter to the underprivileged citizens of the city displaced by man-made and natural calamities, demolitions brought about by development as well as provided basic services like water, light, and roads and ensured the security of tenure in resettlement areas. This activity ensures the economic uplift through provision of livelihood opportunities. **Table 13.11-2** shows a case of relocation sites by Davao City to who have to relocate by construction of river bank, open canal and ROW acquisition.

TABLE 13.11-2 RELOCATION SITES WHICH WERE PROVIDED BY DAVAO CITY

No.	Project Area	Total Area (m^2)	No. of Families	Type of Land Occupied	Type of Tenure
1	Mintal Relocation Area Barangay Sto Niño Tugbok District	385,600	1,743	Gov. Land	Amortizing
2	Panacan Relocation Area Barangay Panacan, Bunawan District	105,928	666	Gov. Land	Donation
3	Tibungco Relocation Area Barangay Tibungco, Bunawan District	200,200	1,322	Gov. Land	Amortizing
4	Malagamot Relocation Area	60,700	205	Gov. Land	Amortizing

[6] The Community Mortgage Program (CMP) is a mortgage financing program of the National Home Mortgage Finance Corporation which assists legally organized associations of underprivileged and homeless citizens to purchase and develop a tract of land under the concept of community ownership. The primary objective of the program is to assist informal settlers to own the lots they occupy, or where they choose to relocate to, and eventually improve their neighborhood and homes to the extent of their affordability.

No.	Project Area	Total Area (m^2)	No. of Families	Type of Land Occupied	Type of Tenure
	Bunawan District				
5	Catalunan Grande Relocation Area Barangay Matina Pangi, Talomo District	40,600	243	Gov. Land	Amortizing
6	Tibungco Relocation Area Barangay Tibungco, Bunawan District (Pacifico Dizon Property)	28,098	Unknown	Gov. Land	Amortizing

Source: Davao City Housing Homesites Division (modified by JICA Study Team)

13.11.5 Impact on Gender and Other Vulnerable Groups

The project has to pay particular attention to ensure that women are the recipients of the compensation pertaining to their activities and to ensure that women who are de-facto household heads are clearly listed as beneficiaries of compensation and rehabilitation proceedings under the loan. Special attentions will also be given to identifying and addressing the needs of disadvantaged groups such as the landless, the poor, female-headed households, the elderly and the disabled, through measures included in the RAP to try and improve (over and above cash compensations and restoration of) their livelihoods.

The DPWH, in its latest LARRIP Policy recognizes that the "identities and cultures of IPs are inextricably linked to their physical environment and the natural resources on which they depend". That is why in the said Policy it provided comprehensive guidelines so as to ensure that projects they implement "do no further harm to IPs and leave them worse off with the projects than without" indicates a summary of the recognized impacts along with the corresponding safeguard instruments for IPs and Indigenous Cultural Communities (ICCs), as prescribed by in LARRIPP Policy.

Table 13.11-3 indicates a summary of the recognized impacts along with the corresponding safeguard instruments for IPs and Indigenous Cultural Communities (ICCs), as prescribed by in LARRIPP Policy. Shown in **Table 13.11-4** is the approximate number of families that may be vulnerable to impoverishment if not properly compensated and assisted, particularly those families that are headed by Females, Elderly Males, and most especially Elderly Females, which comprise 23.5%, 8.96%, and 14.93%, of the affected population, respectively. As shown on the table, only a little more than 50% are headed by Male.

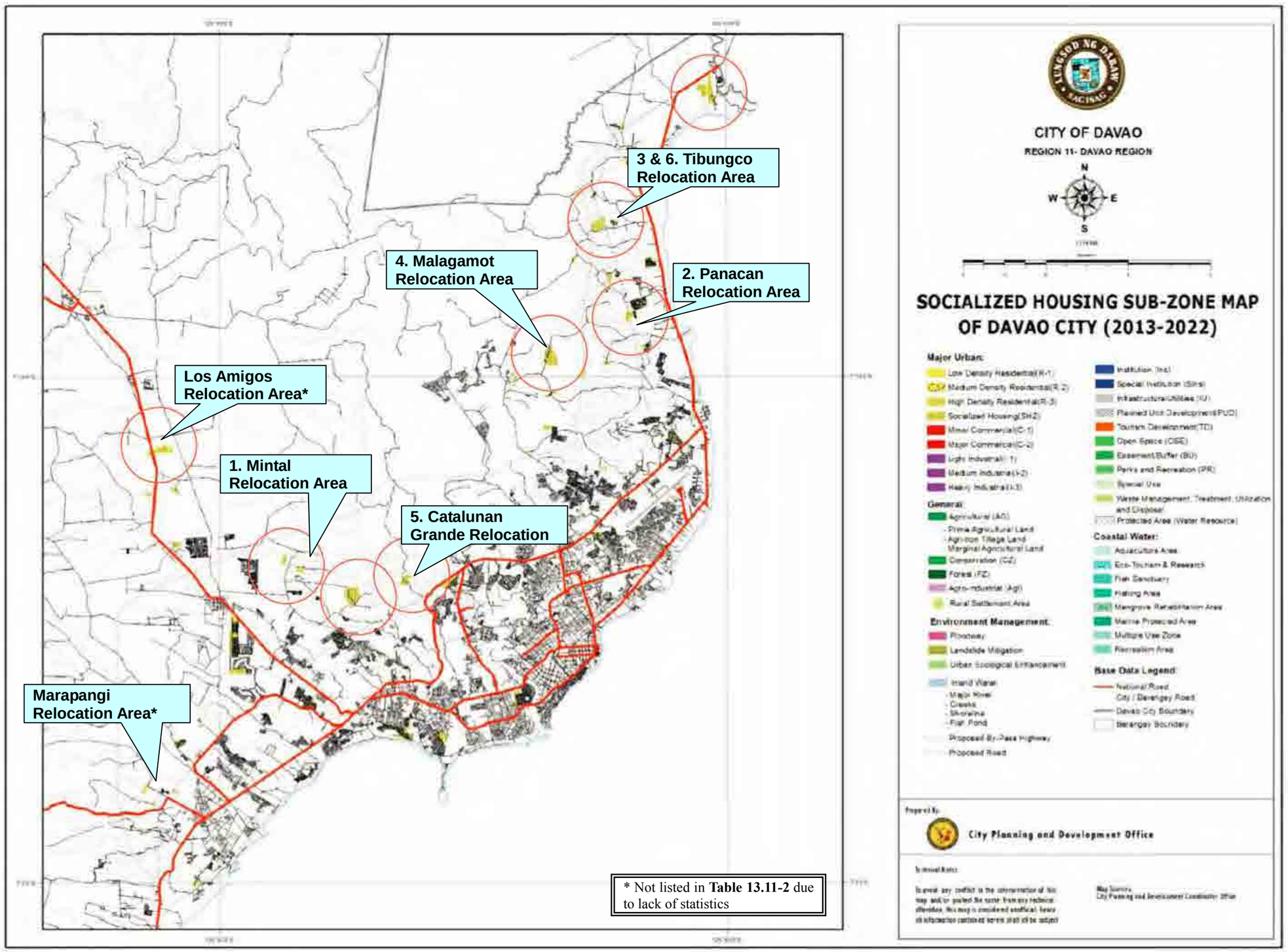


FIGURE 13.11-1 LOCATION OF SOCIALIZED HOUSING SITES IN DAVAO CITY BASED ON ITS 2013-2022 COMPREHENSIVE ZONE ORDINANCE

TABLE 13.11-3 IMPACTS AND SOCIAL SAFEGUARD INSTUMENTS FOR IPS AND ICCS BASED ON THE DPWH LARRIPP

Location of Affected IPs	Impact	Relocation Site and Magnitude of Affected Families to be Relocated	Guiding Framework	Safeguard Instrument
Inside Ancestral Domain	Without resettlement	Not Applicable (NA)	FPIC Guidelines of 2006 and/or possible Memorandum of Understanding (MOU) between the DPWH and the NCIP. For compensation and entitlements, Chapter II and III of the LARRIPP and **Table 13.11-1** of this report. Other than these entitlements, benefits to be enjoyed by the host ICC/IPs shall be spelled out in the Memorandum of Agreement (MOA) to be executed between the affected ICC/IPs, the project proponent, and other related parties as stipulated in the FPIC Guidelines of 2006.	The MOA serves as the IPAP
	With resettlement	Inside ancestral domain	FPIC Guidelines of 2006 and/or the possible MOU between DPWH and the NCIP. For compensation and entitlements, Chapter II and III of LARRIPP and **Table 13.11-1**of this report. Other than these entitlements, benefits to be enjoyed by the host ICCs/IPs shall be spelled out in the MOA.	
		Outside ancestral domain		
		Mixed: Some IPs resettled outside ancestral domain; others remain inside		For those remaining inside the ancestral domain, MOA serves as the IPAP. For those resettled outside the ancestral domain, depending on the magnitude, either a stand-alone IPAP or a special chapter in the resettlement plan.
Outside Ancestral Domain	Without resettlement	NA	For compensation and entitlements, Chapter II and III of LARRIPP and **Table 13.11-1** of this report.	Depending on the number of IP PAFs, either a stand-alone IPAP will be drafted or a special IP section in the abbreviated resettlement plan.
	With resettlement	Whole community or a large portion of the community	LARRIPP Governed by possible MOA between the DPWH and NCIP. Options will be explored to resettle IP-PAFs back to their place of origin. If the identified receiving area were an ancestral domain, an FPIC shall be obtained from the receiving IP community. FPIC Guidelines of 2006 and/or possible MOA between DPWH and NCIP shall apply. For compensation and entitlements, Chapter II and III of	IPAP

Location of Affected IPs	Impact	Relocation Site and Magnitude of Affected Families to be Relocated	Guiding Framework	Safeguard Instrument
			LARRIPP and **Table 13.11-1** of this report.	
		A few families but majority of the IP community remains	Options to resettle IP-PAFs in the immediate vicinity of the IP community will be explored For compensation and entitlements, Chapter II and III of LARRIPP and **Table 13.11-1** of this report.	IPAP to cover both PAFs to be resettled and the IP community that remains.
Outside of ancestral domain; IPs who have been resettled in public domain lands	With or without resettlement	Whole community or a portion	FPIC Guidelines of 2006. For compensation and entitlements, Chapter II and III of the LARRIPP and **Table 13.11-1** of this report.	The MOA serves as the IPAP.

Source: The Environmental and Social Services Office (ESSO) of DPWH, 2007. Land Acquisition, Resettlement, Rehabilitation and Indigenous Peoples Policy, 3rd Edition

TABLE 13.11-4 SUMMARY OF GENDER AND OTHER VULNERABLE GROUPS

Unit: No. of Respondents

Section	South				Center				North		Total	
Sub-District	Toril		Tugbok		Talomo		Buhangin		Bunawan			
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Poverty Threshold among PAPs												
Female	13	24.5	16	21.6	0	0.0	9	30.0	13	32.5	51	23.4
Elderly Female	7	13.2	8	10.8	0	0.0	1	3.3	2	9.0	18	9.0
Male	19	35.8	42	56.8	4	100	16	53.3	21	50.7	102	50.7
Elderly Male	14	26.4	8	10.8	0	0.0	4	13.3	4	14.9	30	14.9
Total	**53**		**74**		**4**		**30**		**40**		**201**	**100**

Source: JICA Study Team

13.12 INSTITUTIONAL ARRANGEMENT

The implementation of the RAP will be pursued by various government offices in cooperation with the PAFs and road concessionaire. In this section, the various players involved in the RAP implementation are named and their respective roles defined. While this project is pursued under the Japan ODA Loan arrangements, the primary responsibility for the implementation of the project still lays with government, specifically the DPWH. This section is based on the Department Administrative Order (DAO) D.O.5, Series of 2003 and the DPWH LARRIPP 3rd Edition.

13.12.1 DPWH UPMO

In accordance with DPWH D.O. 5 and 327 Series of 2003 and the LARRIPP, 3rd Ed. 2007, the Project Implementing Office (IO) shall have the overall responsibility for implementing the project. As such the DPWH Unified Project Management Office (UPMO) shall:

(i) Manage and supervise the Project including land acquisition and resettlement in coordination with other offices within the Department, such as the Infrastructure Right-of-Way office (IROW), the Environment and Social Safeguards Division (ESSD), and the concerned Regional Office (Region XI) as well as other relevant Government agencies (Philippine Coconut Authority (PHILCOA), and LGUs of Davao City and Panabo City);

(ii) Ensure that funds are available so that the RAP can be implemented in a timely manner; and

(iii) Ensure that all funds disbursed in relation to RAP implementation is properly accounted for.

13.12.2 DPWH ESSD

As stipulated in the LARRIPP, the ESSD shall be responsible for providing technical support, guidance, and assistance to the DPWH Implementing Office wit regards to the implementation of the resettlement plan. Acquisition of the needed ROW, including implementation of the RAP such as verification of PAFs, final inventory of affected assets, and actual payment of compensation to the affected families shall be carried out during the conduct of Detailed Engineering Design by the IROW office, or the respective DPWH District Engineering Offices (DEOs) in Davao City and Panabo City, depending on what will be decided upon after the DED is completed.

Some of the tasks, particularly those that are not under the mandate of DPWH remain in gray areas. Some of these include: (i) acquisition of land for relocation sites[7]; (ii) cutting and transport

[7] In accordance with R.A. 7279, it is the LGU or the National Housing Authority (NHA) who are mandated to provide land for relocation site. Considering that all affected structure owners are leasing land, it is highly possible that they can afford paying amortization under the Community Mortgage Program (CMP).

of coconut trees[8], and (iii) community organizing among affected, and host communities in preparation for integration[9] (i.e., if renters of land opt to be relocated).

13.12.3 DPWH District Engineering Office (DEO)

The concerned DEOs will serve as the major player in the implementation of the RAP with the following functions:

(i) Oversee the staking-out, verification and validation of the PAF's affected assets;

(ii) Conduct inventories of properties that will be affected in coordination with the Detailed Design Consultant;

(iii) Prepare parcellary maps of the project area in coordination with the Detailed Design Consultant;

(iv) Approve disbursement vouchers/payments on PAFs compensation and other benefits;

(v) Submit disbursement reports on payments to PAFs to the Regional/Central Office accounting office and UPMO;

(vi) Submit monthly progress reports to ESSD, Regional Office and UPMO; and

(vii) Serve as an active member of the Resettlement Implementation Committee (RIC) of the City/Municipality.

13.12.4 Regional Office (Region XI) of DPWH

The Regional Office shall act as the liaison between ESSD, ROWO and the District Engineering Offices and shall ensure that the RAP is implemented as planned. Its specific activities include:

- Oversee the activities of DEOs;
- Monitor the RAP implementation and fund disbursement;
- Submit monthly progress reports to ESSD;
- Monitor payments to PAFs; and
- Address grievances filed at its office by the PAFs for speedy resolution.

13.12.5 City Resettlement Implementation Committee (CRIC)

The CRIC shall be composed of representatives from the Regional Office and District Engineering Office, the City/Municipality LGUs, affected barangays, and PAFs/PAPs. No NCIP or ICC/IP representatives are included in the RIC as no recognized ancestral land will be affected by the project alignment. The establishment of the RIC shall be made through the signing of MOU between DPWH and the concerned LGU. The function of the RIC includes:

(i) Assist the project consultants and DPWH staff engaged in RAP preparation activities in (a) validating the list of PAFs; (b) validating the assets of the PAFs that will be affected by the project; (c) assist DPWH in arranging for a suitable relocation facility for the displaced PAFs, and (d) participate in monitoring the RAP implementation;

(ii) Assist the DPWH staff engaged in the RAP preparation in the public information campaign, public participation and consultation meetings;

(iii) Receive complaints and grievances from PAFs and other stakeholders and refer the matter to the appropriate authorities;

[8] This is expected to be done by the Contractor considering that Permit to Cut is applied during construction phase.
[9] The concerned LGU (Davao City) is responsible in coordination with the Presidential Commission for the Urban Poor (PCUP).

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

(v) In coordination with concerned government authorities, assist in the enforcement of laws/ordinances regarding encroachment into the project site or ROW.

13.12.6 Local Inter-Agency Committee (LIAC)

To streamline acquisition of needed ROW and at the same time be compliant with international policies on involuntary resettlement together with the DPWH's own resettlement policy, roles, responsibilities, and efforts of key players and major stakeholders must be well coordinated. In order to achieve this, it is strongly recommended that, a LIAC, which will be based in Davao City be organized.

The LIAC will help ensure that a common direction is being followed to achieve the goals of the RAP. Provided in TABLE 13.12.6 1 is a list of said key players and major stakeholders and their corresponding responsibilities.

TABLE 13.12-1 KEY PLAYERS AND MAJOR STAKEHOLDERS FOR RAP IMPLEMENTATION

Key Player	Key Person	Position in LIAC	Envisaged Role
DPWH UPMO	UPMO Director	Chairperson	Provide direction with regards to implementation of the Davao City Bypass Construction Project (DCBCP)
DPWH ESSD	ESSD Chief	Member	Provide direction with regards to implementation of the RAP for DCBCP
DPWH IROW	IROW Director	Member	Provide direction with regards to DPWH ROW acquisition procedures in relation to RAP implementation
PHILCOA	As deemed appropriate by Agency	Resource Person	Provide guidance regarding technical and other aspects of coconut plantations, particularly when it comes to cutting of trees and transport of coconut lumber
Department of Agriculture (Bureau of Plant Industry)	As deemed appropriate by Agency	Resource Person	Provide guidance regarding technical, economic, and other aspects of banana plantations and other crops classified as agricultural and industrial
Davao City City Housing Board or Equivalent Office	As deemed appropriate by LGU	Member	Provide information and guidance regarding access to socialized housing projects of the City
Major Stakeholders			
LGU of Davao City	City Mayor, City Agriculturist, Livelihood Office	Members	Represent the PAPs of Davao City
LGU of Panabo City	City Mayor, City Planning, Development Coordinator	Members	Represent the PAPs of Panabo City

Source: JICA Study Team

The RAP implementation organization and process are illustrated in **Figure 13.12-1** and **Figure 13.12-2**, respectively.

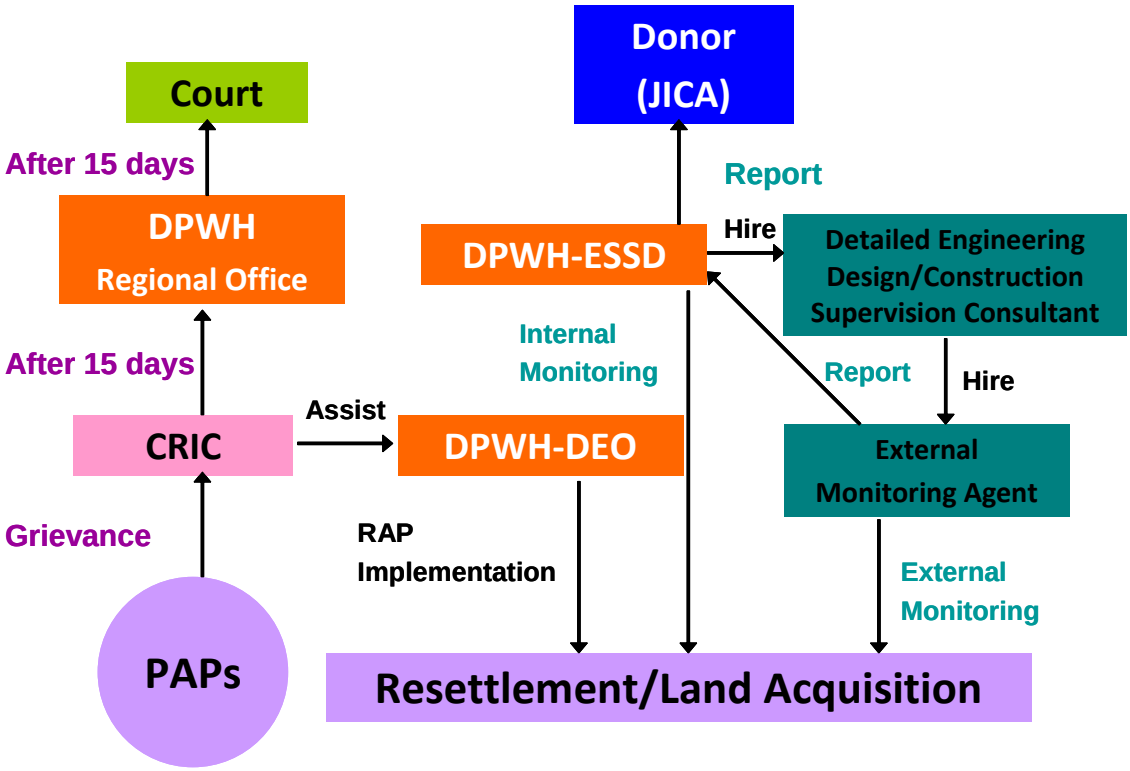
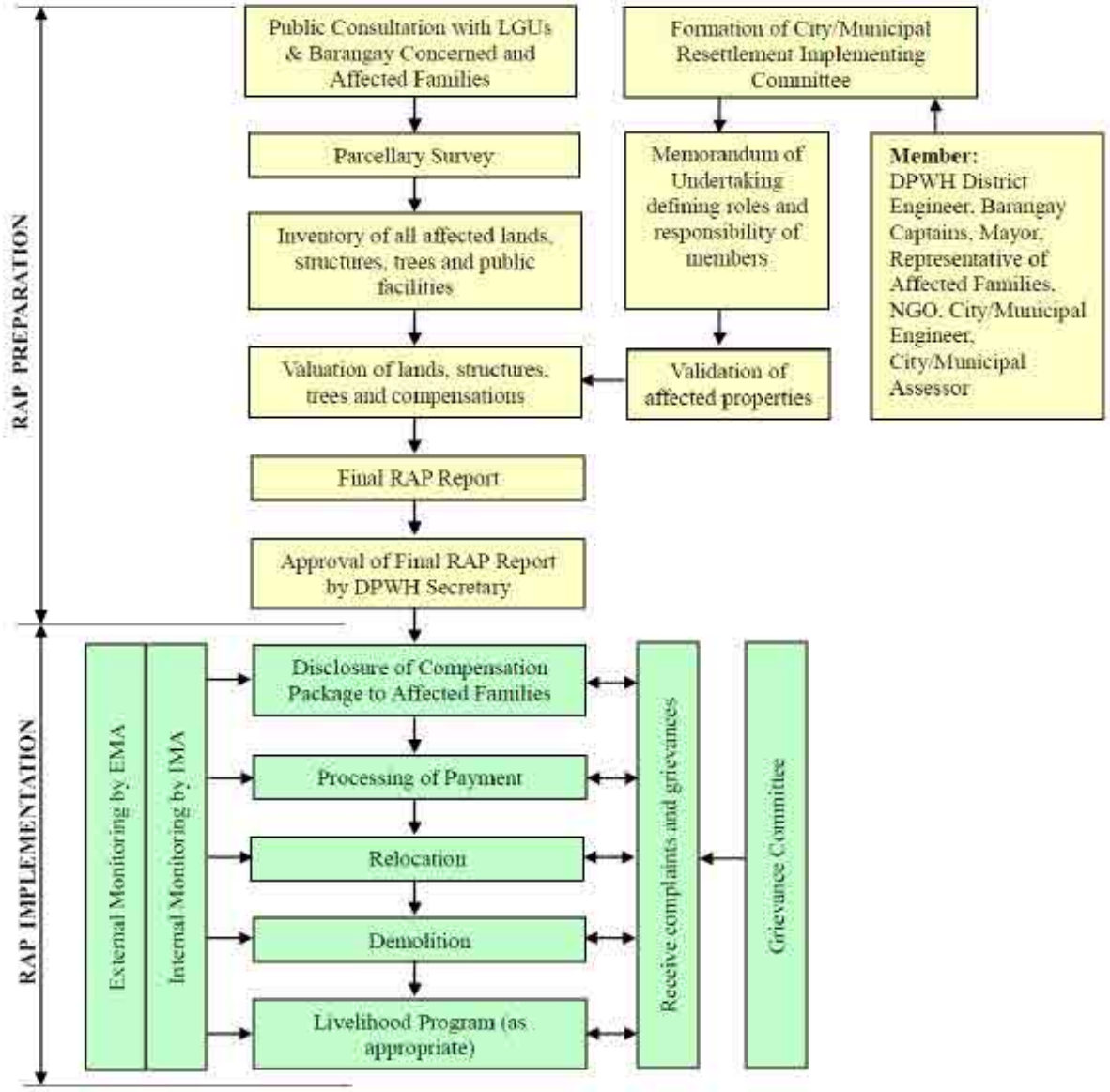


FIGURE 13.12-1 RAP IMPLEMENTATION ORGANIZATION AND PROCESS



Source: JICA Study Team

FIGURE 13.12-2 DETAILED RAP IMPLEMENTATION PROCESS

13.13 CONSULTATION AND PUBLIC PARTICIPATION

13.13.1 Content of Consultation Meetings

PAFs must be fully informed at the earliest possible time. They should be closely consulted and encouraged to participate in any decision-making pertinent to resettlement. Project disclosure and consultation at an early stage provides a good venue for PAFs to express their opinions, apprehensions, and even objections. It opens grounds for discussion, and allows the Implementing Office to address issues raised, most of which can be incorporated into the final design and resettlement plan. This will minimize, if not totally avoid, delay in implementation caused by unforeseen stand-offs.

Consultation meetings shall be conducted at site with the stakeholders. One at least is prior to the preparation of the RAP and others are after. **Table 13.13-1** shows a standard example activity for

consultation meetings to be conducted including future disclosures to be undertaken.

TABLE 13.13-1 ACTIVITES FOR CONSULTATION MEETINGS

Frequency	Milestone and Purposes
1st Consultation	Prior to Preparation of RAP a. To inform the PAPs about: i) the activity to be undertaken during rehabilitation/improvement of the road/bridge; ii) the expected adverse impacts such as displacement of households; iii) that there will be validation after the detailed design to finalize number of PAPs to be affected; iv) the no-worse off policy of JICA and World Bank; and v) the explanation of cut-off date and its announcement b. To encourage PAP's to express their ideas, concerns and apprehensions, and other related issues.
2nd Consultation	After Preparation of RAP a. To inform the PAPs and other stakeholders about the RAP; b. To ask the PAPs to review the RAP; c. To ask the PAPs to give their comments/objections on the RAP; and d. To inform the PAPs that a Resettlement Action Plan Implementation Committee shall be formed and that they should choose (a) representative(s) who would be (a) member(s) of this entity.

13.13.2 1st Consultation Meeting

The 1st consultation meetings (public consultation) were held on June 16 to 19, 2014 at six venues through the designed alignment. Basic information such as date/time/venue, barangays included and participant composition is shown in **Table 13.13-2**, and typical Q&A, comment, note and information are in **Table 13.13-3**, respectively.

TABLE 13.13-2 BASIC INFORMATION ON THE 1ST CONSULTATION MEETING

No.	Date, Time & Venue	Sub-District/Barangay	Participants
1	June 16, 2014, 2:00 PM Marapangi Brgy. Hall, Torril, Davao City	Alambre, Bangkas Bato, Heights, Lubogan, Marapangi, Mulig and Sirawan,	27 males & 20 females (LGU & Brgy official, landowner, possible PAP, industry, farmer, etc.)
2	June 17, 2014, 9:00 AM Tigatto Brgy. Hall, Buhangin, Davao Hall	Tigatto and Waan	14 males a& 3 females (LGU & Brgy official, landowner, possible PAP, industry, farmer, etc.)
3	June 17, 2014, 2:00 PM Cabantian Brgy. Hall, Buhangin, Davao City	Cabatian, Communal and Indangan	12 males & 5 females (LGU & Brgy official, landowner, possible PAP, industry, farmer, etc.)
4	June 18, 2014, 9:00 PM Mahayag Brgy. Hall, Bunawan, Davao City	Lasang, Mahayag, Mudiang, San Isidro and Tibungco,	16 males & 18 females (LGU & Brgy official, landowner, possible PAP, industry, farmer, etc.)
5	June 18, 2014, 2:00 PM J.P. Laurel Brgy. Hall, J.P. Laurel, Panabo City	J.P. Laurel	2 males & 2 females (LGU & Brgy. Official, landowner)
6	June 19, 2014, 9:00 AM Mintal Brgy. Hall, Tugbok, Davao City	Matina Biao, Mintal, Tacunan and Tubok Proper	52 males & 36 females (LGU & Brgy official, landowner, potential PAP, industry, farmer, etc.)

TABLE 13.13-3 SUMMARY OF TYPICAL Q&A, COMMENT, NOTE AND INFORMATION DURING THE 1ST CONSULTATION MEETING

About Project

Attribution	Venue	Question/Comment	Response
Possible PAP	Marapagi	What benefit can the farmers get from the bypass road project?	The bypass will affect the economy of the areas that will be traversed positively by bringing development or improving urbanization and land values of remaining portions will have higher appraisals.
		How true was the rumor that JICA is assisting DPWH with a purpose of locating the buried treasures in the area?	The rumor was proved to be wrong because JICA is an association providing financial assistance to countries through loan just like the World Bank and ADB. Also, JICA does not pay for the land acquisition on the right of way. Only the GoP can acquire rights to land acquisition for road projects.
Possible PAP	Tigatto	Need to clarify the location of the tunnel section.	Tunnel section will only be at Matina Biao and Magtuod areas.
Brgy. official		How will this project affect the existing flood problem in Brgy. Tigatto?	Mitigating measures for flood problems on the affected areas will be considered. The data that will be gathered will be noted in designing the drainage of the bypass. However, the drainage design of the bypass will not be intended to control the existing flood problems in the area, rather it will be designed to prevent aggravating the existing flood problems.
Brgy. captain	Cabantian	On tunnel section, will the GoP pay for the land even if the road will only be built passing through the mountain?	If land owner wants to be paid even if they're not directly affected, the GoP will compensate them for their property and the land owner has to leave their area as it will become a government property or they can negotiate to be compensated a percentage only of the land since the road will be constructed 200m from the ground surface. The Study Team explained the new supreme court ruling on land ownership.
Brgy. official		I emphasize a point for the benefit of the land owners that they cannot name a high value for their property if what has been declared to the BIR is actually lower than that of claimed.	Lot owners can still demand for a higher valuation if they have supporting documents to prove their claim through the expropriation procedure.
Landowner	Mahayag	Will alignment still change?	There are still possible changes in the alignment during the detailed engineering design.
Industry (Holcim)		The alignment will most likely affect the mine life of Holcim for the next five years, if detailed engineering design is available, Holcim can coordinate with the DPWH to design an alignment that would not affect the mine life of Holcim.	JST already visited the Holcim office to set a meeting schedule for discussion on the project's development plans with the company.
		We suggest to change the alignment towards areas of Holcim that is almost mined out and due for rehabilitation (existing	Suggestion will be discussed with the JICA study team.

Attribution	Venue	Question/Comment	Response
		quarry area) to avoid areas of future (3-5 years) mine development.	
Landowner	Panabo City	How far is the proposed bypass from the existing bridge in JP Laurel?	Approximately 200m from Lasang bridge.
		Is it possible for the existing building to be affected by the bypass?	The proposed bypass will not affect the existing building as it will only traverse on the banana plantation beside the clearing.
Landowner	Mintal	What is the purpose of the bypass when there are already existing barangay roads? Furthermore, farmers with small properties will be greatly affected by this project.	Bypass will be constructed to help mitigate traffic congestion on major roads within the city proper and development of the rural areas.
Possible PAP		Will there be a road constructed on the top of the mountain?	There will be no road to be constructed on the top of the mountain, only through the mountain which will be 200meters from the mountain's surface.

Compensation

Attribution	Venue	Question/Comment	Response
Farmer	Marapagi	How will the farmers be compensated with the crops that were bought on credit from PCA?	The crops that will be affected by the project will be compensated by the GoP.
Brgy. captain	Cabantian	Suggests that DPWH should consider compensating for the land based on the market value on the year when the government would acquire the land and not based on the value when the owner had bought their property.	The Provincial Appraisal Committee, if requested by DPWH will update valuation of lands. As a government agency, all DPWH payments require approval from Commission on Audit (COA). COA requires that current prevailing market value should have supporting documentary evidence. Suggests that transactions on land acquisition should be declared to BIR based on the actual transacted value to support the claims on current prevailing market value.
Possible PAP		Will the GoP also pay for the agricultural products on the affected lands?	Aside from structure compensation, there will also be compensation for agricultural and industrial products on the affected land areas.
Landowner	Mintal	Will there be compensation for structures and crops?	There will be compensation to crops and structures that will be affected by the project. For farmers with small properties, JST will suggest on the RAP development for assistance in finding a replacement land for farming considering PAP's desires.
		Structure was built by home owner, who will be compensated for the structure?	The home owner will be paid for the loss of structure and land owner will pay a waiver of rights to structure compensation.

Land Issue/Relocation

Attribution	Venue	Question/Comment	Response
Possible PAP	Marapagi	The tenant had constructed a structure on the area that will be affected by the bypass, who will be held	The tenant will be paid by the GoP and the land owner will sign a waiver that he/she will not have any hold on the payment.

Attribution	Venue	Question/Comment	Response
		responsible for the replacement of the house/structure?	
		Need to know basis for land valuation on land acquisition.	The GoP will first offer the BIR Zonal as basis for land valuation.
		Need to clarify whether the property will be affected or not as there was no survey conducted on their property.	If the land owner received an invitation to the meeting, there is a probability that their property will be affected by the project. Any future changes on the alignment will be communicated to the locals.
Possible PAP	Tigatto	Are there any specific areas as to where the bypass will traverse?	At present, as the invited land owners are the possible PAPs of the project, we can only identify the specific land areas that will be affected during the detailed engineering design on the conduct of parcellary survey.
Brgy. official		Which office can the land owner approach if he/she wants to suggest for their land to be traversed by the bypass?	This can be suggested during the detailed design where the exact alignment will be finalized. However, we should note that there are safety measures that needs to be considered in conducting the detailed engineering design, example road curve shouldn't be a sharp curve for safety purposes
		Hopefully the government will not ask the land owners to donate their land for the project as some land owners that owns only small parcels of land in the area.	Donation as part of the GoP's way of land acquisition for development has been included for transparency. Also there are cases when land owners would offer to donate their lands to the government for development purposes. Land owners with big parcels of land will be requested first to donate some portion of their lands for the project. However, if they would not want to donate their lands, they will be compensated for the parcel of land that will be used for the project. As for those who owns a small parcel of land, they will most likely be by negotiation instead of donation.
Landowner		How long would it take for the land owners to be informed if their properties will be affected by the bypass?	The final list of land owners that will be affected by the project will be determined during the parcellary survey which will be conducted after the detailed engineering design. The detailed engineering design is estimated to be conducted after the bilateral agreement. The final list of land owners will be invited on a meeting after the parcellary survey.
Landowner	Cabantian	If land owners would say 'no' to the project, will the project still push through?	As discussed, the last option that the GoP will take is the expropriation procedure because based on the constitution. The government can take any property for public use with negotiation and compensation.
Representative of Christian society		Are lot owners not allowed to make development on their properties since now?	Private land owners have all the rights to develop their lands.
Landowner		Wish to know about lot owner's assurance that they can still find a similar land to develop as replacement to the land that will be lost.	There is no land for land replacement on the present law. However the team will commit to do their best to recommend for this arrangement for the benefit of PAPs with small properties.
Possible PAP	Mahayag	If property is only 300m^2 and bypass project will have	In accordance with the DPWH LARRIPP, the GoP will buy the entire lot if remaining portion

Attribution	Venue	Question/Comment	Response
		to use 250m^2 of the land, can the government just buy the entire lot instead of leaving a 50m^2?	will not be economically viable.
		If land owners will be compensated, how much of the total value will be left for the land owners as there are some taxes that also needs to be settled during land acquisition?	Land owners will be paying for the Capital gain tax, documentary stamps and transfer tax will be paid by DPWH.
Brgy. official		Which zonal value will be considered for land valuation?	BIR Zonal Value is.
		Very few land owners would sell their land at a very low price, how will they be able to justify this during the negotiation for land valuation?	If land owners have complete legal document that would help support their claims of high land valuation in the area.
		Communities sell their land for a higher value than that of the BIR Zonal Value.	BIR Zonal value is the first offer for land acquisition. Land owners can demand for a higher valuation provided that they have legal documents supporting their claims, during expropriation proceedings.
Brgy. captain		Need to clarify land valuation: if there are discrepancies on deed of sale are there any other basis for land valuation?	The land appraiser will study cases of land valuation to determine the right market value of the land, there will be other basis for land valuation aside from the deed of sale.
Landowner		The property has been converted to Home Owners Association, and some residents have already fully paid the lot area. However the land is still under the name of husband of the person asking, who then will be compensated in the future?	The team suggests that in order to avoid future disputes on land compensation, the land owner should start sub-dividing the lot title to individuals that had fully paid their land. As for the structure, if the home owners built the structures in the area the land owner will sign a waiver of rights to structure compensation.
Landowner	Mintal	Need to know modes of payments to land owners.	Modes of payments to the land owners whether the land is vast or small will be the same, except in cases when big landowners want to donate land.
		Can land owners be compensated if the proof of ownership is only Deed of Sales (DOS)?	Yes, DPWH recognizes the DOS and titled lands.
		If land owner suggests to relocate the home owner within the property of the owner instead of relocating them to the relocation site, is it possible?	If home owner agreed to the suggestion of the land owner, then it's possible.
		How did the group acquire the names of lot owners as the names listed are of those previous owners?	The real land owners will be determined after the parcellary survey. There really are some records in the assessor's office wherein the current land owner's names does not reflect, but the real land owners will be most likely

Attribution	Venue	Question/Comment	Response
			determined after the conduct of parcellary survey.
		About entitlements of renter, buyer and agricultural lessee	Just compensation is entitled to land owners. Renter, tenant and agricultural lessee will receive a financial assistance from the government.
Possible PAP		Lot was sold to a new owner, can new owner be invited to the next meeting instead of the previous land owner?	JST notes the fact.
Industry (Plantation)		Will there be compensation for the land preparation?	Yes, there will be compensation for the land preparation.

Livelihood Restoration

Attribution	Venue	Question/Comment	Response
Possible PAP	Marapagi	What is effect of the bypass on livelihood of local farmers?	The GoP will be providing assistance to the PAPs; a survey will be conducted to identify the types of livelihood of PAPs which will need such assistance from the government as mandated by law.
Brgy. official	Tigatto	Will there be job opportunities for the locales?	As mandated by the law all affected barangays, especially a family member of the directly affected land owners will be the priority for employment during construction.
Possible PAP	Mintal	Rights of Indigenous people on areas affected by the project.	There is no ancestral domain that would be affected by the project as confirmed by the NCIP Davao City Office.
		I concern compensation for opportunity loss.	There will be no compensation for opportunity loss.
Industry (Plantation)		We concern income loss after crop land provision.	There is no law to compensate for income loss, only for the agricultural and industrial crops at present.

Note/Information

Attribution	Venue	Question/Comment	Response
Brgy. captain	Cabantian	Clarified for the benefit of the land owners that the property owner cannot say no if their property will be needed by the government for public use.	The survey team noted the comment.
Brgy. official		Suggests to have an intensive information dissemination for the PAPs so that PAPs will understand that this government project is for the development of their area and that land owners would not be surprised of the processes that the government might be taking in the future.	The team explained the main purpose of conducting the meeting is to properly inform the affected community of the project and processes that the government will be taking into consideration - in line with the national laws as part of developing the project.
Representative of Christian society		Ambassadors for Christ are planning to extend church building.	The team notes it.
Landowner	Panabo City	I express that the project is a good plan for development.	JST notes the comment.

Basic policy for compensation and livelihood restoration was explained during the 1st consultation meeting. In the 2nd meeting to be held in Oct 2014, the Study Team will show the results of socio-economic survey and concrete plan for compensation and assistance to brush up based on opinions from the PAPs.

Figure 13.13-1 shows the atmosphere during the 1st consultation meeting.

	
Photo-1 A representative of a land owner in Brgy. Lubogan (2nd from left) asking the implementation schedule of the proposed bypass project.	Photo-2 Brgy. Chairman of Cabantian expressing his full support to the proposed bypass project and expecting that the just compensation will be accorded to the affected land owners.
	
Photo-3 Leader of JST's contractor explaining the compensation procedure of the affected land owners in Baquirel of Mahayag.	Photo-4 A banana plantation owner from Brgy. Tacunan asking if cost for the preparation of the land will be included in the compensation.

FIGURE 13.13-1 ATMOSPHERE DURING THE 1ST CONSULTATION MEETING

13.13.3 2nd Consultation Meeting

The 2nd consultation meeting was held on October 8 to 9, 2014 at three venues through the designed alignment. Basic information such as date/time/venue, barangays included and participant composition is also shown in **Table 13.13-4**, and typical Q&A, comment, note and information are in **Table 13.13-5**, respectively.

TABLE 13.13-4 BASIC INFORMATION THE 2ND CONSULTATION MEETING

No.	Date, Time & Venue	Sub-District/Barangay	Participants
1	October 8, 2014, 9:53 A.M Barangay Hall, Mahayag, Bunawan, Davao City	Mahayag, Mudiang, San Isidro, Tibungco, J.P Laurel (Panabo City)	14 males & 22 females (LGU & Brgy official, landowner, possible PAP, industry, farmer, etc.)
2	October 8, 2014, 2:00 P.M. Barangay Hall, Cabantian, Buhangin, Davao City	Cabantian, Indangan, Tigatto, Waan	16 males & 6 females (LGU & Brgy official, landowner, possible PAP, industry, farmer, etc.)
3	October 9, 2014,9:00 AM Marapangi Brgy. Hall, Torril, Davao City	Alambre , Bangkas Heights, Bato, Lubogan, Marapangi, Mintal, Sirawan, Tacunan, Tugbok Proper	25 males & 35 females (LGU & Brgy official, landowner, possible PAP, industry, farmer, etc.)

TABLE 13.13-5 SUMMARY OF TYPICAL Q&A, COMMENT, NOTE AND INFORMATION DURING THE 2ND CONSULTATION MEETING

About Project

Attribution	Venue	Question/Comment	Response
Landowner	Bunawan	Will there be an emergency exit for vehicles in the tunnel section?	Only a pedestrian emergency exit will be available in the tunnel section.
		Will buses be allowed to pass through the tunnel section?	Yes.
		Some land owners travels frequently, how will they be informed if their presence is needed for ROW acquisition?	Letters will be sent to individual land owners to their permanent address by DPWH.
Landowner	Cabantian	Clarification: If the bypass road will traverse through Brgy. Acacia.	No. Only along the boundary of Indangan.
		If accessibility from farm to market is the concern, why should the bypass be constructed in Barangay Cabantian when the Barangay has many farms to market roads? The bypass should well be constructed on some remote areas of Davao City.	•One of the main reasons for constructing the bypass road is to ease the traffic congestion within the city proper. •All options were already considered and this area in Cabantian is the only feasible area for the bypass and most economical. •Comment from Brgy. Capt. Of Cabantian: This project of the government is intended for development. Sacrifices are necessary in developing an area and if we are envisioning our Barangay to be a more developed area, then this is one of the sacrifices that we had to take for the betterment of the majority and so that Davao •Resettlement policy says it has to be land for a land. However, DPWH can only be allowed to purchase a land for infrastructure projects •The team will suggest such assistance for the land owners •No. As of now the Davao Bypass is being proposed as a national highway •As of the present survey data, there are no structures to be affected by the alignment in Brgy. Cabantian. However, these information shall be finalized during the parcellary survey

Attribution	Venue	Question/Comment	Response
			to be conducted during the DED
		Clarification: No compound will be affected?	None.
		There were some surveyors that did not introduce themselves and said that it was a private project.	Topographic surveyors for the bypass road project were instructed to always introduce themselves properly; maybe the surveyors being referred to are from another entity.
Brgy. Chairman	Cabantian	Will this be a toll road?	No. As of now the Davao Bypass is being proposed as a national highway.
		Info: a Taiwanese company had bought a Gacasan property, however construction of their facility has been delayed as they found out that the Gacasan properties will be affected by the bypass project.	Noted.
Alson's Dev.	Cabantian	The presented alignment is most probably the final alignment?	This can only be known after detailed design stage.
		Clarification: Will this project not affect the existing projects of Alsons?	The bypass was already realigned to avoid an existing project of Alsons.

Compensation

Attribution	Venue	Question/Comment	Response
Landowner	Bunawan	If an affected structure has no building permit, will it still be compensated?	•Any affected structure will be compensated unless it is owned by a professional squatter. •If the structure owner is not paying taxes for his structure, a certification from the barangay chairman may serve as a basis of proof of ownership.
		How soon will the affected land and structure owners receive the compensation for the affected properties?	Project construction will not start without the Right of Way acquisition. Delay on compensation only happens whenever there are problems such as incomplete requirements to show proof of ownership.
Landowner	Cabantian	If a structure will be affected, won't the government replace it also with a structure?	The government will not construct a house for the owner in replacement of the one that will be displaced. Instead, the replacement cost for constructing a house will be included on the compensation that the owner will receive.
Landowner	Mintal	Who will own the cut-down trees?	Trees that had naturally grown in the area will be given to DENR.

Land Issue/Relocation

Attribution	Venue	Question/Comment	Response
Brgy. Chairperson	Bunawan	Who are the members of RIC?	All chairpersons of the affected barangays.
		What will be the assurance of the affected tenants that they would be able to acquire their own land and construct a house?	We will take note of such concerns as part of RAP. Also with the help of Davao City, tenants may be able to avail of the socialized housing project where they will pay for a house and lot based on their capacity to pay.

Attribution	Venue	Question/Comment	Response
Landowner	Bunawan	Will there be an advanced initial payment for the land owners?	Under the proposed amendment of the law, if all requirements will be complied with, an initial payment will be given to the land owners and the remainder will be paid after transfer of title to the government.
		How will the properties be compensated if the land has already been converted into a housing and some structures are already built in the area?	If subdivision plan is already approved by the DENR it would be reflected on the parcellary survey to be prepared during Detailed Engineering Design; compensation would be for each subdivided property.
Landowner	Cabantian	The BIR Zonal value is too cheap when in truth the properties in the area are sold at a much higher price than what has been set on BIR Zonal Value.	Noted.
		How will the land owners be compensated if the BIR Zonal Value is cheaper than the prevailing market value of the land?	There has to be a proof such as recent deed of sale that is duly registered, to be provided so that it can be used as basis for setting prevailing market value of land.
		Will the compensation of the government for the affected properties be enough for the land owner to buy another property of the same kind?	The land owner will be given a compensation option for their properties if they refused to donate a parcel of their land. Basis for compensation will be the first offer is BIR Zonal Value and the second offer will be fair market value by appraisal committee.
		Suggestion: Government should replace land for land.	Resettlement policy says it has to be land for a land. However, DPWH can only be allowed to purchase a land for infrastructure projects.
		Hopefully the government would give assistance on land replacement.	The team will suggest such assistance for the land owners.
Brgy. Chairman	Cabantian	Clarification: Most of the Gacasan properties are with structures, are you sure that there are no structures that will be affected in Barangay Cabantian?	As of the present survey data, there are no structures to be affected by the alignment in Brgy. Cabantian. However, these information shall be finalized during the parcellary survey to be conducted during the DED.
		Clarification: If the Indian School will also be affected.	No.
Landowner	Mintal	If the land has been sold through installment payments and is not yet fully paid but the buyer, who will receive the compensation fort the structures?	Whoever owns the structure will be paid for their structure (if he is not landowner, landowner must sign a waiver) and the land will be paid to the rightful owner. Whoever's name indicated in the title or deed of sale would be the recognized owner.
		The land owner had bought the land a long time ago, but was not able to register it under his name for lack of budget. At present, the land is being sold in parcel in terms and the buyers have	•It would be best if the owner would register the land under his name first because the government will have to ask for legal documents as a proof of ownership of the land. •Disputes such as that mentioned would be best resolved among the land owner and those that had paid in terms to avoid further delay on

Attribution	Venue	Question/Comment	Response
		not paid the full amount yet. I insist to receive the compensation for the land as I am still the rightful owner	compensation in the future.
		Where will we get a list of requirements for the land acquisition?	A list of requirements is available at the DPWH Davao City 2nd District Engineering Office.
		If who will process the change title of lands that would be marginally affected?	DPWH will take care of processing of changes/annotations of the land titles.

Livelihood Restoration

Attribution	Venue	Question/Comment	Response
Brgy. Chairwoman	Bunawan	Should the workers strictly be from the directly affected barangays or the Barangay Chairman may be allowed to recommend some friends?	Employment opportunities during the project construction would not be limited to the directly affected barangays, rather, they will be the priority for employment. The barangay chairmen may recommend some workers whether or not they live in one of the affected barangays.
Brgy. Chairman		Will DPWH hire local workers upon the construction of the project?	Affected persons shall be given priority to employment during construction as mandated by the law.
PICPA representative	Mintal	Point person or office in-charge of the grievances.	At present, there are no point persons or offices that the land owners may approach for their grievances until the project has been approved by NEDA for implementation, DED has been completed and R-O-W acquisition has commenced.
Landowner	Mintal	•Implication of the respondent's response on the question pertaining to the project's acceptability being asked on the survey	•The question on the survey form was only intended to measure the perception of the people about the project. •If the land owner refused to allow the government the use of his land the government's first step would be to send a letter for negotiation to the land owner. If the land owner still refuses to negotiate, then the last resort that the government will undertake will be expropriation.

Figure 13.13-2 shows the atmosphere during the 2nd consultation meeting.

Photo-1
A meeting scene in Bunawan, on Oct 8, 2014

Photo-2
A meeting scene in Cabantian, on Oct 8, 2014

Photo-3
A meeting scene in Mintal, on Oct9, 2014

FIGURE 13.13-2 ATMOSPHERE DURING THE 2ND CONSULTATION MEETING

Decision making of the project acceptability is proceeding not only through these consultation meetings but also interviews with PAPs, focus group discussion and individual consultation. In the consultation meetings, most PAPs are thought to agree with the project because of no negative or adverse opinions to the project. Since positive decision making with all PAPs regarding the project implementation should be essential, it will be continued mainly through monitoring of the RAP activity.

13.14 GRIEVANCE REDRESS MECHANISM

If there will be grievances arising from any aspect of the Project, these will be handled through negotiations following the succeeding procedures.

In accordance with the LAPRAP Tracking Manual of DPWH, a Grievance Handling Committee (GHC) shall be formed within the City/Municipal Resettlement Implementing Committee (CRIC/MRIC-GHC) to facilitate the resolution of the PAPs' grievances. The CRIC's/MRIC's Chairperson shall head this Committee. Each representative from concerned barangay government shall be his Co-Chairperson(s). The GHC shall consist of the following:

(i) Legal Officer from the Legal Service (DPWH Central);

(ii) IROW Engineer;

(iii) IROW Agent;

(iv) Land Management Section Chief/Representative (DENR Regional/Provincial Office);

(v) City/Municipal Assessor;

(vi) Community Environment and Natural Resources Officer (CENRO);

(vii) RP Preparer (from DPWH-UPMO their Consultant);

(viii) Representatives of PAPs; and

(ix) Representatives of NGOs

This procedure is initiated once the letters from PAFs, expressing their grievances are received by the CRIC-GHC. The deadline for submitting letters of grievances shall be set 30 days after the date of public disclosure; with a maximum extension of another 15 days, if request was made by more than ten percent (10%) of the PAFs.

A Grievance Action Form (GAF), as prescribed in the said LAPRAP Tracking Manual shall be used during the detailed design stage to cover the various aspects of property acquisition based on validation of the RP. The GAF shall, at the very least, contain the following:

(i) Basic information on PAPs (Name, Address, Contact Number);

(ii) Date of last disclosure meeting;

(iii) Category of grievance filed (Legal, Technical/Engineering, Social, and Financial); and

(iv) Type of action taken (Resolved at the CRIC level, or referred to higher authorities.

Respective barangay captains, as co-chairperson of the GHC shall be the first recipient of the GAF. All GAFs shall be consolidated by the CRIC/MRIC chairperson and presented to the CRIC/MRIC for deliberation and appropriate action, on a weekly basis. Unresolved grievances at the CRIC/MRIC level shall be elevated to the respective District Engineering Offices for resolution of complaints. Recommendations of the District Engineer shall be elevated to the Regional ESSD for approval and final action. If there are still unresolved grievances, a case shall be filed in the proper courts.

PAPs shall be exempted from all administrative and legal fees incurred in pursuant to the grievance redress procedures.

Grievance redress process was shown in **Figure 13.12-1** as a part of RAP implementation process.

13.15 IMPLEMENTATION SCHEDULE

13.15.1 Tentative Implementation Schedule

Implementation of RAP Activities is presented in **Table 13.15-1**. Note that timing of the first disclosure shall take place upon completion of the Parcellary Survey. During updating of the RAP actual measurements of structures in the field must be undertaken to have more accurate basis for compensation. In addition it is also during updating of the RAP when target relocation sites are inspected and assessed in terms of acceptability and potentials for sustainable livelihood (i.e., if the affected renters of private land would opt to be resettled).

Note that English is the only language to craft the RAP report and relating documents. The English version of RAP is opened to the public.

TABLE 13.15-1 SCHEDULE FOR IMPLEMENTATION RAP ACTIVITIES

Activity	2016				2017				2018				2019				2020				2021			
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
First Disclosure																								
Parcellary Survey																								
Updating of RAP																								
Formation of the CRIC/MRIC																								
Disclosure of Updated RAP to PAPs																								
Notification of PAPs																								
Compensation																								
Provision of Replacement Land (OPTIONAL)																								
Relocation to Replacement Land (OPTIONAL)																								
Income Restoration																								
Civil Works																								
Monitoring & Evaluation																								
Internal Monitoring																								
External Monitoring & Evaluation																								

13.16 COST AND BUDGETS

13.16.1 RAP Implementation Budget

(CONFIDENTIAL)

13.17 MONITORING

13.17.1 Monitoring Activity

13.17.1.1 Internal Monitoring

In accordance with D.O. 58 of DPWH, ESSD shall be responsible for conducting the in-house monitoring of implementation of the RAP and IPAP (for affected IPs outside the ancestral domain) , and as such shall be alternately referred to as the Internal Monitoring Agent (IMA). Tasks of the IMA include:

(i) Regular supervision and monitoring of the RAP implementation in coordination with concerned Regional Offices (ROs), DEOs, and RICs. Finding are documented in a quarterly report and shall be submitted to the IO/PMO;

(ii) Verifying whether the re-inventory baseline information on all PAPs have been carried out and whether the valuation of assets lost or damaged, provision of compensation and other entitlements, and relocation, if any, have been carried out in accordance with the respective RPs and the LARRIPP;

(iii) Ensuring that the RAP and IPAP are implemented as designed and planned;

(iv) Verifying that funds for implementing the RAP, MOAs, and IPAPs are promptly provided by the IO/PMO and in sufficient amounts; and

(v) Recording all grievances and their resolution and ensuring that all complaints are promptly addressed.

13.17.1.2 External Monitoring

To obtain an independent appraisal of the RAP implementation, an independent External Monitoring Agent (EMA) shall be commissioned by the DPWH-UPMO to undertake monitoring and evaluation. The EMA can either be a qualified individual or a consultancy firm with qualified and experienced staff. Prior to engagement, DPWH shall submit to JICA for its concurrence, the Terms of Reference for the EMA. The tasks of EMA generally consist of:

(i) Verifying the results of internal monitoring (i.e., undertaken by ESSD);

(ii) Verifying and assessing the results of the information campaign for PAPs' rights and entitlements; Verifying that the compensation process has been carried out in accordance with procedures communicated with the PAPs during consultations;

(iii) Assessing whether resettlement have been met, particularly with regards to livelihood and restoration and/or enhancement of living standards;

(iv) Assessing the efficiency, effectiveness, impact and sustainability of resettlement and implementation, drawing lessons as a guide to future resettlement and policy making and planning;

(v) Establishing whether the resettlement and entitlements were appropriate to meet the objectives, and whether these objectives were appropriate to PAP conditions;

(vi) If necessary, recommending modifications to the implementation procedures of the RAP, to achieve the principles and objectives of JICA guideline, and the DPWH's LARRIPP;

(vii) Reviewing how compensation rates were established; and

(viii)Reviewing whether compliance and grievance cases were properly handled

Though there are no designated indigenous and ethnic groups in the project area, situation of minority group (s) such as Islamic group shall be monitored and adequate assistance and coordination shall be given if necessary, in order to avoid the project would serve as a trigger to conflict of interest.

Internal and external monitoring scheme and flows of report are as indicated in **Figure 13.13-1**.

13.17.2 Monitoring Indicator

Monitoring indicators are shown in **Table 13.17-1**.

TABLE 13.17-1 MONITORING INDICATORS

Monitoring Indicators	Basis for Indicators/Check List
1. For the IMA	
1. Budget and Timeframe	• Have all land acquisition and resettlement staff been appointed and mobilized for the field and office work on schedules? • Have capacity building and training activities been completed on schedule? • Are resettlement implementation activities being achieved against agreed implementation plan? • Are funds for resettlement being allocated to resettlement agencies on time? • Have resettlement offices received the scheduled funds? • Have funds been disbursed according to RAP? • Has the social preparation phase taken place as scheduled? • Has all land been acquired and occupied in time for project implementation?
2. Delivery of Compensation and Entitlements	• Have all PAFs received entitlements according to numbers and categories of loss set out in the entitlement matrix? • Have PAFs received on time? • Have PAFs losing from temporary land borrow been compensated?

Monitoring Indicators	Basis for Indicators/Check List
	• Have all received the agreed transport costs, relocation costs, income substitution support and any resettlement allowances, according to schedules? • Have all replacement land plots or contracts been provided? Was the land developed as specified? Are measures in train to provide land titles to PAFs? • How many PAFs households have received land titles? • How many PAFs have received housing as per relocation options in the RP? • Does house quality meet the standards agreed? • Have relocation sites been selected and developed as per agreed standards? • Are assistance measures being implemented as planned for host communities? • Is restoration proceeding for social infrastructure and services? • Are the PAFs able to access schools, health services, cultural sites and activities? • Are income and livelihood restoration activities being implemented as set out in income restoration plan? For example utilizing replacement land, commencement of production, numbers of PAFs trained and provided with jobs, micro-credit disbursed, numbers of income generation activities assisted? • Have affected businesses received entitlements including transfer and payments for net losses resulting from lost business and stopped of production?
2. For the EMA	
1. Basic Information on AP Households	• Location • Composition and structures, ages, education and skill levels • Gender of household head • Ethnic group • Access to health, education, utilities and other social services • Housing type • Land and other resources owning and using patterns • Occupation and employment patterns • Income sources and levels • Agricultural production data(for rural households) • Participation in neighborhood or community groups • Access to cultural sites and events • Value of all assets forming entitlements and resettlement entitlements
2. Restoration of Living Standards	• Were house compensation payments made free of depreciation, fees or transfer costs to the AP? • Have AFs adopted the housing options developed? • Have perceptions of "community" been restored? • Value of all assets forming entitlements and resettlement entitlements
3. Restoration of Livelihoods	• Were compensation payments free of deduction for depreciation, fees or transfer costs to the AP? • Were compensation payments sufficient to replace lost assets? • Was sufficient replacement land available of suitable standard? • Did transfer and relocation payments cover these costs? • Did income substitution allow for re-establishment of enterprises and production? • Have enterprises affected received sufficient assistance to re-establish themselves? • Have vulnerable groups been provided income-earning opportunities? Are these effective and sustainable? • Do jobs provided restore pre-project income levels and living standards?
4. Levels of PAP Satisfaction	• How much do PAFs know about resettlement procedures and entitlements? Do PAFs know their entitlements? • Do they know if these have been met? • How do PAFs assess the extent to which their own loving standards and livelihood have been restored? • How much do PAFs know about grievance procedures and conflict resolution procedures?
5. Effectiveness of Resettlement	• Were the AFs and their assets correctly enumerated? • Was any land speculators assisted? • Was the time frame and budget sufficient to meet objectives?

Monitoring Indicators	Basis for Indicators/Check List
	・ Were entitlements too generous? ・ Were vulnerable groups identified as assisted? ・ How did resettlement implementers deal with unforeseen problems?
6. Other Impacts	・ Were there unintended environmental impacts? ・ Were there unintended impacts on employment or incomes?

13.18 RECOMMENDATION ON ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

Some recommendations are shown below after detailed design stage from the view of environmental and social considerations.

Measurement, forecast and evaluation of vibration

1) It is recommended that traffic vibration survey, quantitative forecast and evaluation is conducted during detailed design stage by DPWH

2) Environmental and social considerations for new development of disposal site(s)
It is recommended that adequate environmental and social considerations is conducted when the new disposal site(s) are developed or expanded existing disposal site by DPWH

3) Adequate assistance and coordination for minority religious group in the project area.
It is recommended that appropriate monitoring, assistance and coordination for minority religious group(s) such as Moslem are conducted during and after construction not to create conflicts between religions.

4) Appropriate announcement for stakeholder meetings
It is recommended that appropriate announcement for stakeholder meetings are informed to all citizens in the project area through proper media such as newspaper and radio prior to the meeting.

5) Soft grounds with risks of liquefaction are expected at the short section near the north of Davao City and Tagum City. During the detailed design stage, comprehensive underground investigations should be undertaken and risks should be assessed based on the assessment, proper countermeasures should be designed and implemented during construction.

CHAPTER 14

OPERATIONS AND MAINTENANCE OF THE PROJECT

CHAPTER 14
OPERATIONS AND MAINTENANCE OF THE PROJECT

14.1 OPERATION AND MAINTENANCE OF THE TUNNEL

14.1.1 O&M Activities for Tunnel

Major O & M activities are classified as follows;

MAJOR O&M ACTIVITIES

1) Inspection
2) Maintenance; tunnel structure and facilities
3) Monitoring of traffic movement, traffic accident, fire incident, etc.
4) Immediate actions when some incidents are found or reported
5) Vehicle Control (vehicles carrying hazardous materials, vehicle height, and overloaded trucks.

14.1.2 Inspection

Inspection of a tunnel must be undertaken daily by an inspection team, and check the following:

- Facilities inside the tunnel such as lighting facility, jet fans, etc. are properly functioning.
- Cleanliness of the tunnel wall, road surface, facilities, etc.
- Any cracks on concrete lining and pavement, water seepage from concrete lining, etc.
- Drainage facility (no clogging, etc.)
- Deformation of the tunnel arch.
- Any other problems.

Inspection items for civil work components and electrical/communication facilities are shown in **Table 14.1-1.**

TABLE 14.1-1 INSPECTION ITEMS

Component			Inspection Items
Civil work Component	Road Surface	Pavement	(1) Surface roughness, (2) Cracks, (3) Joint failure, (4) Heaving, (5) Pumping, (6) Local settlement
	Tunnel Portion	Tunnel Portal	(1) Cracks, (2) Drainage, Water Flow, (3) Any deformation, (4) Slope condition
		Lining	(1) Cracks, (2) Leakage of water, (3) Free Lime, (4) Delamination, (5) Difference at a joint
		Interior Wall	(1) Damage, (2) Damages to the accessories
		Drainage	(1) Clogging, (2) Damage
Electrical/ Mechanical/ Communication Component	Jet Fans		Abnormal noise, vibration, cable connection and voltage. Interlocking with visibility index (VI) sensors and carbon dioxide (CO_2) sensors
	Lighting Facilities		Intensity of illumination. As for distribution board, checking abnormal heating, looseness and breaking of wire etc. by visual check and check with measuring instrument.
	Power receiving and distribution equipment and standby generator		Appearance (dirt, damage), looseness, breaking of wire, oil leakage, pipe damage, abnormal noise and vibration etc. by visual check and check with measuring instrument.

Component		Inspection Items
	Information collection and provision equipment	Performance, communication and appearance (dirt, damage) of each equipment. Facility/equipment which also defined as information collection and provision should be inspected.
	Emergency Equipment	Performance and appearance (dirt, damage) of each equipment. As for signal receiving and control board, abnormal noise and heating etc. are checked by visual check etc.

Source: NEXCO-WEST and JICA Study Team

14.1.3 Maintenance of Tunnel

Routine maintenance activities are summarized in **Table 14.1-2.** Routine maintenance should be implemented based on the findings of inspection and regular requirements.

TABLE 14.1-2 ROUTINE MAINTENANCE ACTIVITIES

Component			Routine Maintenance Activity
Civil work Component	Road Surface	Pavement	(1) Crack sealing, (2) Joint repair, (3) repair of heaving, pumping and local settlement (4) Road surface cleaning
	Tunnel Portion	Tunnel Portal	(1) Crack sealing, (2) Cleaning of drainage facilities, , (3) Repair of Slope protection work
		Lining	(1) Lining cleaning, (2) Crack sealing, (3) Water leakage prevention, (4) Reinforcement work for the cavity at the back of lining, (5) Joint repair, (6) Delamination repair
		Interior Wall	(1) Wall cleaning
		Drainage	(1) Drainage cleaning
Electrical/ Mechanical/ Communication Component	Jet Fans		(1) Cleaning, (2) Replacement of aged jet fan
	Lighting Facilities		(1) Cleaning, (2) Replacement of aged lighting facility
	All kinds of Signboards		(1) Cleaning, (2) Replacement of aged facility
	Fire Hydrant, Fire Detector, Fire Extinguisher, etc.		(1) Cleaning, (2) Functioning or not, (3) Replacement of aged facility
	CCTV, Emergency Equipments in Traffic Control		(1) Functioning or not, (2) Replacement of aged facility
	Other Equipment such as CO_2 sensor, Visibility Index Sensor		(1) Functioning or not, (2) Replacement of aged facility
	Standby Generator		(1) Functioning or not, (2) Fuel Amount, (3) Replacement of aged facility

Source: JICA Study Team

14.1.4 Monitoring Traffic Movement, Traffic Accident, Fire Incidents, etc.

This work must be undertaken for 24-hours a day for 365 days a year. Traffic movements are monitored through CCTV, report from a patrol group and road users. Information shall be compiled at a traffic control center of the Tunnel Management Office, and necessary actions shall be quickly decided and informed to proper agencies and the action team.

Monitoring will be focused on the following:

- Reckless driving
- Overtaking
- Over speeding

- Stopped (stalled)/parked vehicles
- Vehicle breakdown
- Obstacles dropped from vehicles
- Accident
- Fire

Information collected shall be properly recorded and necessary information shall be provided to road users through Variable Information Signboards and a Loudspeaker.

Monitoring is quite important to assure safe operation of a tunnel and to protect road users' lives.

Emergency actions shall be made in accordance with the instructions of the head of the monitoring team.

14.1.5 Immediate Actions when some incidents are found or reported

The head of the monitoring team shall immediately decide what to do when some incidents are found or reported from road users. He must decide whether a case must be informed to Action Team, Fire Department and/or Police.

Major incidents are as follows;

- Traffic accident
- Fire
- Vehicle breakdown
- Obstacle dropped from vehicles
- Parked/stopped (stalled) vehicles

Actions to be taken during emergency cases are illustrated in **Figure 14.1-1.**

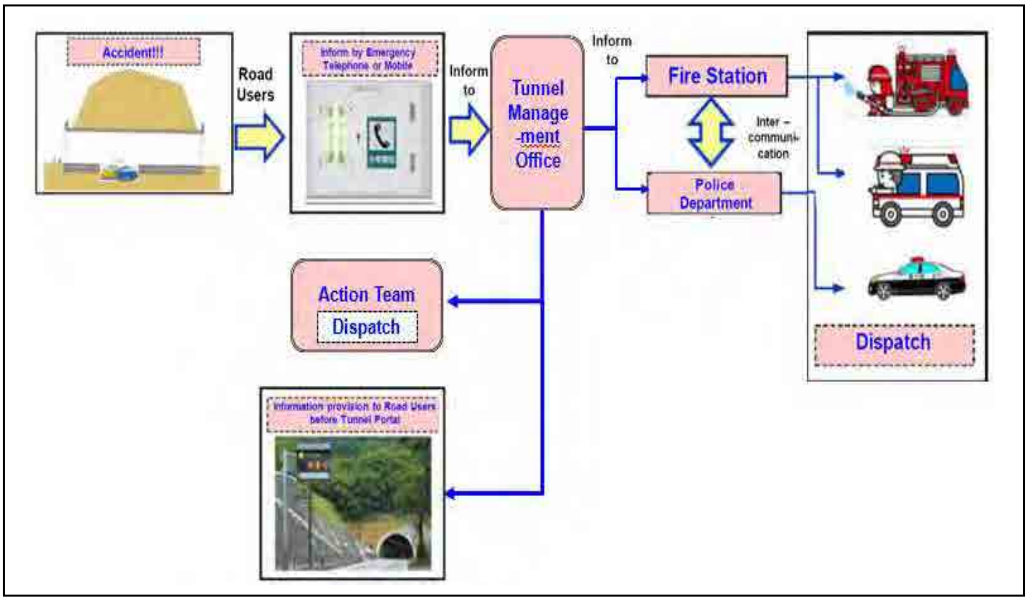


FIGURE 14.1-1 ACTIONS TO BE TAKEN DURING EMERGENCY

14.1.6 Vehicle Control

The following vehicles should not be allowed to use a tunnel, thus these vehicles should be controlled before entering a tunnel;

- Motorbikes – high incidence of traffic accident
- Vehicles carrying hazardous materials – when these get an accident or a fire, it will be disastrous to people and tunnel facilities
- Overloaded trucks – high risk of vehicle breakdown
- Vehicles of which height is higher than the limit (5m) – these will damage jet fans and other facilities.

14.1.7 Equipment Needed for Tunnel O&M

Table 14.1-3 shows the equipment needed for tunnel O&M.

TABLE 14.1-3 EQUIPMENT NEEDED FOR TUNNEL O&M

Name of Equipment		No. of Unit	Remarks
Maintenance Work	Road Sweeper	1	
	Wall Cleaning Vehicle	1	
	Water Supply Equipment for Cleaning	1	
	Aerial Work Platform	1	
	Station Wagon	1	
	Inspection Machinery and Tools	1 set	
Traffic Monitoring and Information Provision	Tunnel Monitoring Facilities	1 set	
	Patrol Car	2	
	Traffic Control Devices	1 set	
Emergency Case	Towing Vehicle	2	
	Air Jack	2	
	Truck for Transport of Air Jack	2	
	Fire Truck	2	
	Ambulance Car	2	
Vehicle Control	Weight Scale (Mat Type)	2	
	Height Restricting Device (Gate Type)	2	

Source: JICA Study Team

14.2 TUNNEL O&M ORGANIZATION, COST AND FUND SOURCE

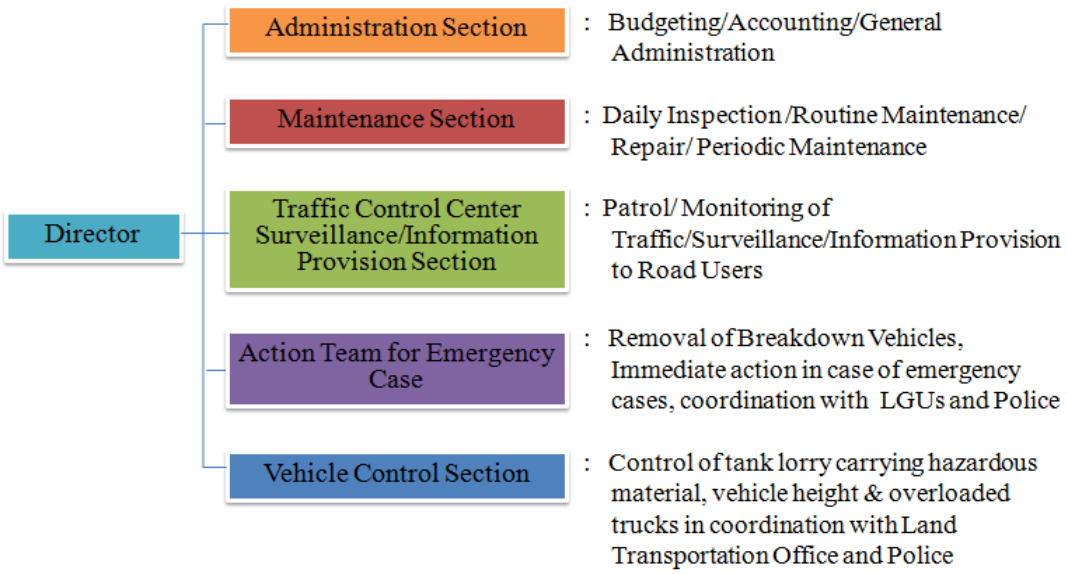
14.2.1 Tunnel O&M Organization

Davao Bypass Tunnel will be the first long tunnel exceeding 500m in the Philippines, there is no organization which has an experience of tunnel O&M, thus the Government is required to create responsible organization for tunnel O&M.

In order to assure safe operation inside a tunnel and to save road users' lives in case of critical incidents, the **"Tunnel Management Office"** must be established. The proposed structure of Tunnel Management Office is shown in **Figure 14.2-1.**

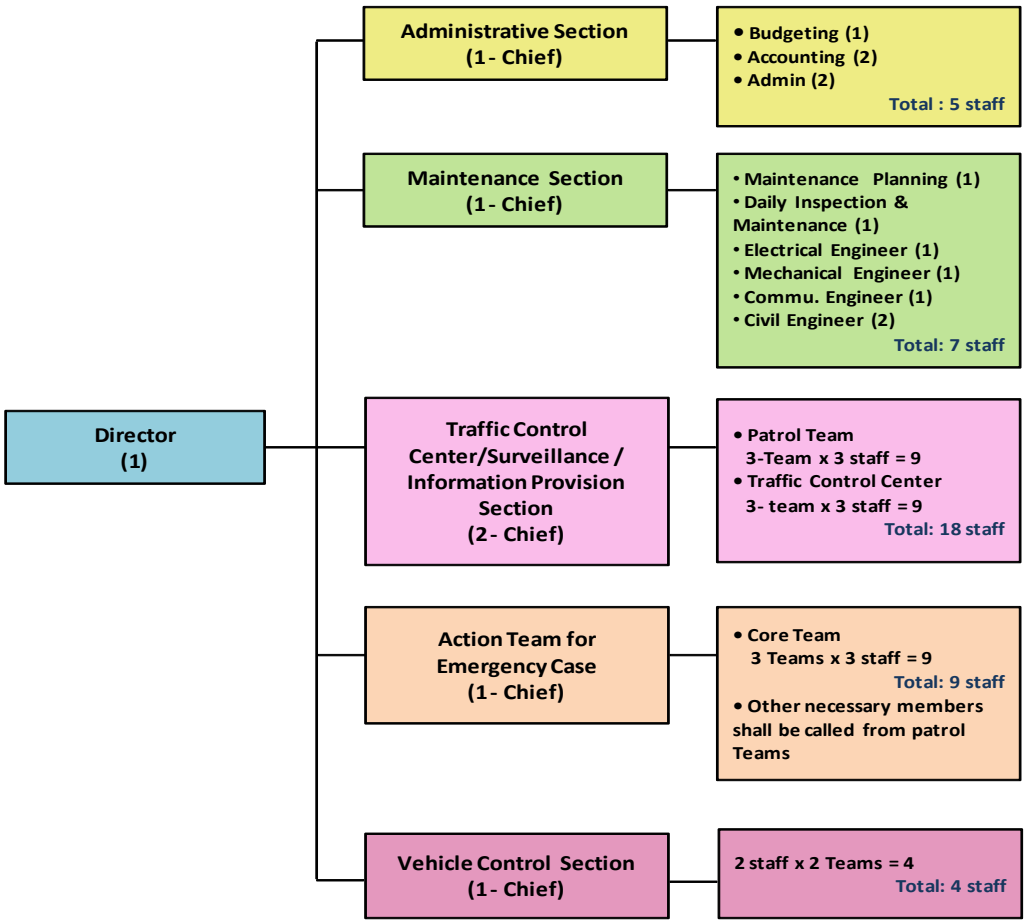
If a toll is collected to produce fund for tunnel O&M cost, **Toll Collection Section** must be organized.

Number of staff required will be fifty (50) comprising of one (1) Director, six (6) Chiefs and forty three (43) staff as shown in **Figure 14.2-2.** If toll is collected, additional 26 staff is required.



Source: JICA Study Team

FIGURE 14.2-1 PROPOSED ORGANIZATION OF TUNNEL MANAGEMENT OFFICE



No. of Staff: 1 Director, 6 Chiefs, 43 Staff

Total Staff = 50 staff

Note: if toll is collected, additional 26 staff is required.

Source: JICA Study Team

FIGURE 14.2-2 ESTIMATED STAFF REQUIREMENT

14.2.2 O&M Cost Estimate

(CONFIDENTIAL)

14.2.3 Fund Source of Tunnel O&M Cost and Tunnel Management Office Operator

(1) Options for Fund Sources and Tunnel Management Office Operator

Options for fund sources and Tunnel Management Office (TMO) operators are as follows;

Fund Source Options:

Option-1: DPWH maintenance fund comprising of Motor Vehicle Users Charge (MVUC) and budget from General Appropriation Act (GAA)
Option-2: A toll is collected from tunnel users.

TMO Operator Options:

Case-1: Operated by DPWH Region XI Office
Case-2: Operated by the Private Sector.

Fund source and TMO operator are inter-related and following alternatives can be considered;

Alternatives for Fund Source and TMO Operator

	Fund Source	TMO Operator
Alternative-1	MVUC + GAA	DPWH Region XI
Alternative-2	Toll is collected by DPWH Region XI (or DPWH Region XI outsources toll collection work to the private sector)	DPWH Region XI
Alternative-3	Private Sector	Private Sector

Alternative-1:
- DPWH Region XI receives maintenance fund of 833 Million Php in 2014. If this trend continues, tunnel O&M cost consumes about 5% of the maintenance fund which may become a burden to maintenance work of other national roads.
- DPWH Region XI must recruit about 50 new staff for tunnel O&M. they must be trained prior to opening of the tunnel.
- The Government is trying to reduce number of staff, thus employment of new additional staff may be difficult to justify.

Alternative-2:
- DPWH Region XI must recruit about 76 new staff for tunnel O&M and toll collection. If toll collection is outsourced to the private sector, DPWH Region XI has to undertake selection of a private company and monitoring of toll collection work.
- DPWH Region XI has no know-how on toll collection.
- The Government is trying to reduce number of staff, thus employment of new staff may be difficult to justify.

Alternative-3:
- Many private companies are quite active to infrastructure business and they are obtaining know-how on how to do business of public

infrastructure-related work.

- A private company can joint venture with a foreign with a foreign company which is doing tunnel O&M to obtain technical know-how of tunnel O&M.

In view of above, it is recommended that Alternative-3 be selected and tunnel O&M be undertaken by the private sector.

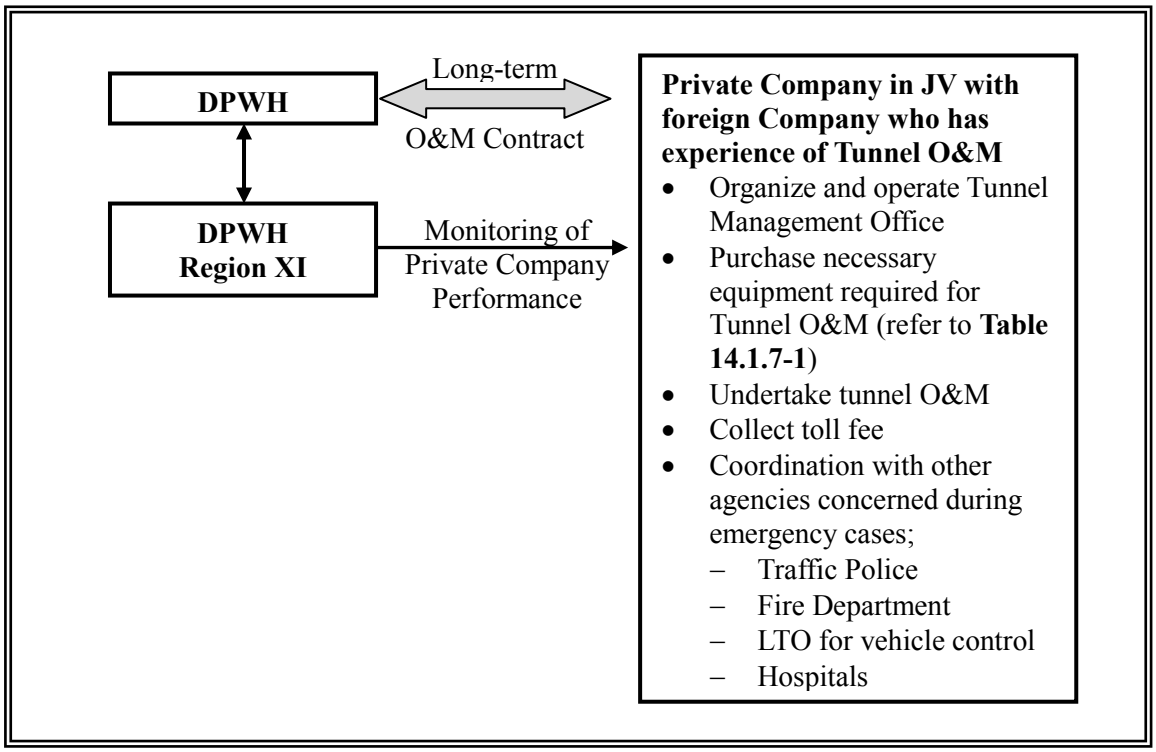


FIGURE 14.2-3 TUNNEL O&M ARRANGEMENT

The tunnel O&M arrangement is shown in **Figure 14.2-4**.

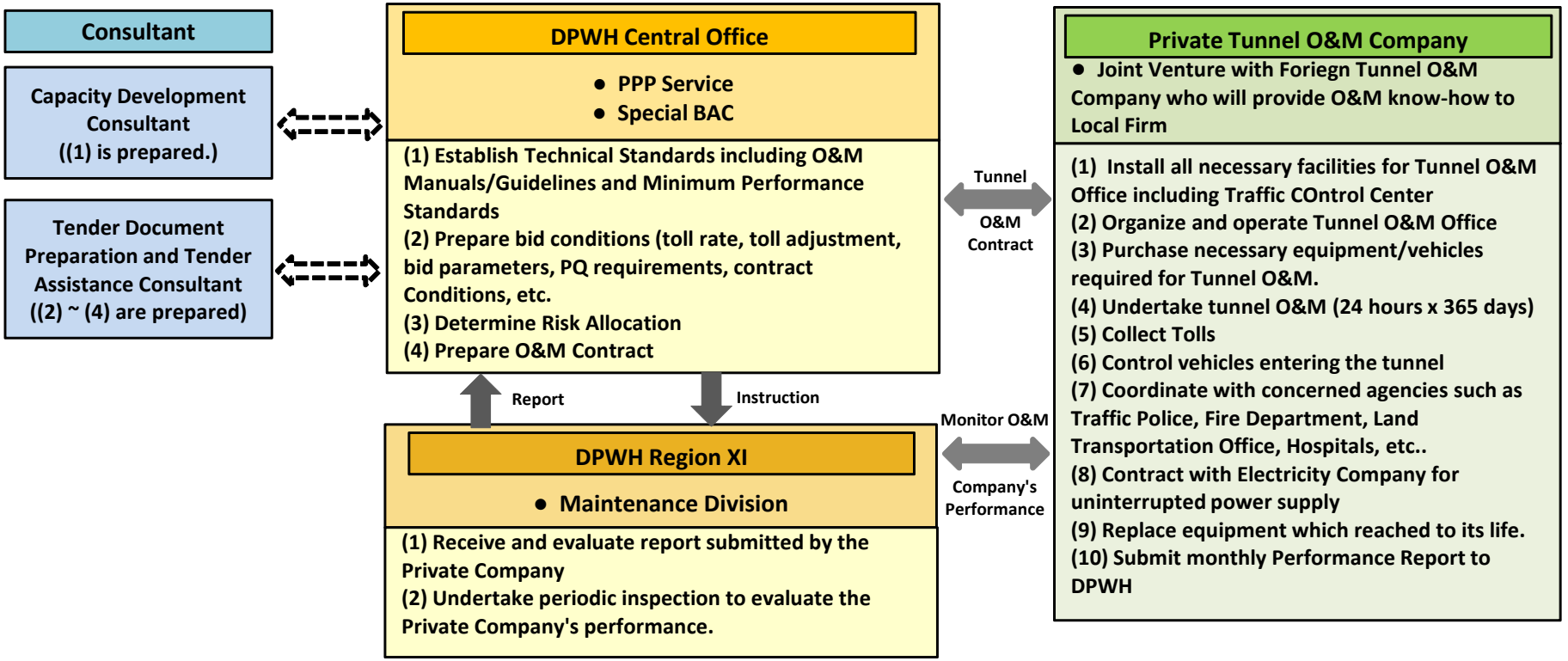


FIGURE 14.2-4 TUNNEL O&M ARRANGEMENT

14.2.4 Capacity Development of Tunnel O&M for DPWH Staff

Capacity development (CD) of DPWH staff for Tunnel O&M shall be undertaken in due consideration of the following;

NEEDS OF CD PF DPWH STAFF FOR TUNNEL O&M

a) Davao Bypass Tunnel will become the first long tunnel in the Philippines. DPWH staffs have no experience in tunnel operation and maintenance.
b) Actual O&M is planned to be implemented by a Private Company.
c) DPWH has also to establish the minimum standards and requirements for tunnel O&M and monitor performance of a Private Company
d) In order for DPWH staff to be able to perform c) above, the capacity development of DPWH shall be made under this Capacity Development Program.
e) Tender documents for procurement of a Private Company must be prepared reflecting this Capacity Development Program.

CD Program shall include the following;

1) Understanding of Legal Aspects in relation to Tunnel O&M

In relation to a safe operation of a tunnel, it is quite important to know what can be done by the Tunnel Management Office (TMO) and what must be relied on by other authorities. The following shall be made clear;

- Violation of traffic rules (coordination with traffic police)
- Traffic accident (coordination with traffic police)
- Fire incident (coordination with Fire Department of LGUs)
- Vehicle control (coordination with Land Transportation Department and Police Department)
- What can be done legally by the staffs of Tunnel Management Office and what must be relied on other agencies.

2) Inspection of Maintenance Work

- Responsibilities of the Maintenance Section and coordination with other sections.
- Inspection frequency
- What to inspect and how to record findings of inspection
- Preparation of Inspection and Maintenance Manual
- Traffic Control/Management during maintenance work

3) Traffic Monitoring and Information Provision

- Responsibilities of Patrol Teams and Traffic Control Center
- What kinds of equipment installed and functions of each equipment
- What to be monitored by Traffic Control Center and Patrol Teams
- What information to be collected and what information to be provided to tunnel users
- What actions to be made when some irregularities are found
- What to be coordinated with other sections/teams and traffic police/fire department of LGUs/hospitals
- What communication systems to be established with other sections, traffic police, concerned LGUs/hospitals

4) Actions to be taken during Emergencies

- What to be done and how to do these during emergencies (traffic accident, fire incident, vehicle breakdown, obstacles dropped from vehicles and parked/stopped vehicles.
- Coordination required with other sections, traffic police and LGUs.

5) Safety Driving Campaign to Drivers

- Safety driving campaign inside a tunnel for private car drivers, bus drivers and truck drivers.

6) Drills for Emergency Cases

- Drills for emergency cases to be undertaken prior to opening of a tunnel.

7) Training in Japan

- Actual practices in Japan will be experiences for proposed staff to be assigned to the Tunnel Management Office.

14.2.5 Tender Document Preparation of O&M Operator Procurement

It is proposed that the scope of work of tender document preparation of O&M operator procurement shall be included in one of Yen Loan components.

Private companies in the Philippines have no experience in tunnel O&M. it is recommended that a local company will joint venture with a foreign company who has enough experience in Tunnel O&M. A foreign company shall be responsible for capacity development of local staff. In the Tender Documents requirements for a local company to joint venture with an experienced foreign company shall be clearly specified.

14.2.6 Financial Evaluation of Tunnel O&M

Tunnel O&M will be undertaken by a private company. Financial viability to check if a private company can be attracted to the project was undertaken.

(1) Input Data

(CONFIDENTIAL)

(2) Parameters for Financial Evaluation

(CONFIDENTIAL)

(3) Evaluation Results

Project FIRR

Project FIRR which considers all costs including construction cost, consultancy cost, ROW acquisition cost and O&M cost is **-7.42%** which implies that the private sector investment is not financially viable. The project up to completion of the facilities is planned to be invested by the Government, and only the tunnel O&M is undertaken by the Private Company.

FIRR for Special Purpose Vehicle (SPV)

FIRR for SPV which considers only O&M cost to be invested by the private company is **26.0%**.

WACC is estimated to be 11.5%, thus O&M project is financially viable and will be attractive to the private sector.

Equity IRR

Equity IRR is estimated to be **38.9%** which is high enough for the private sector to be interested.

14.2.7 Uninterrupted Power Supply for Tunnel O & M

Uninterrupted power supply for tunnel O & M is quite important to assure safe operation of tunnel.

A dedicated power line shall be constructed from the substation to the tunnel management office.

DPWH shall closely coordinate with the Department of Energy (DOE), Trans CO as well as Electric Cooperatives (ECs) in Davao City in order to assure adequate and sustainable electricity supply for tunnel O & M.

Costs for construction of dedicated transmission line for tunnel O & M should be included in the proposed Yen loan as a provisional sum. The selected Civil Work Contractor should outsource the work to a sub-contractor who is duly accredited by a local ECs and/or the Trans Co. Construction supervision shall supervise the work in close coordination with the ECs and/or Trans Co.

14.3 MAINTENANCE OF ROAD/BRIDGE SECTIONS

14.3.1 Maintenance Budget

(CONFIDENTIAL)

14.3.2 Offices in-charge of Davao Bypass Maintenance

(CONFIDENTIAL)

CHAPTER 15

PROJECT IMPLEMENTATION PLAN

CHAPTER 15
PROJECT IMPLEMENTATION PLAN

15.1 KEYS FOR SUCCESSFUL CONSTRUCTION OF DAVAO BYPASS TUNNEL

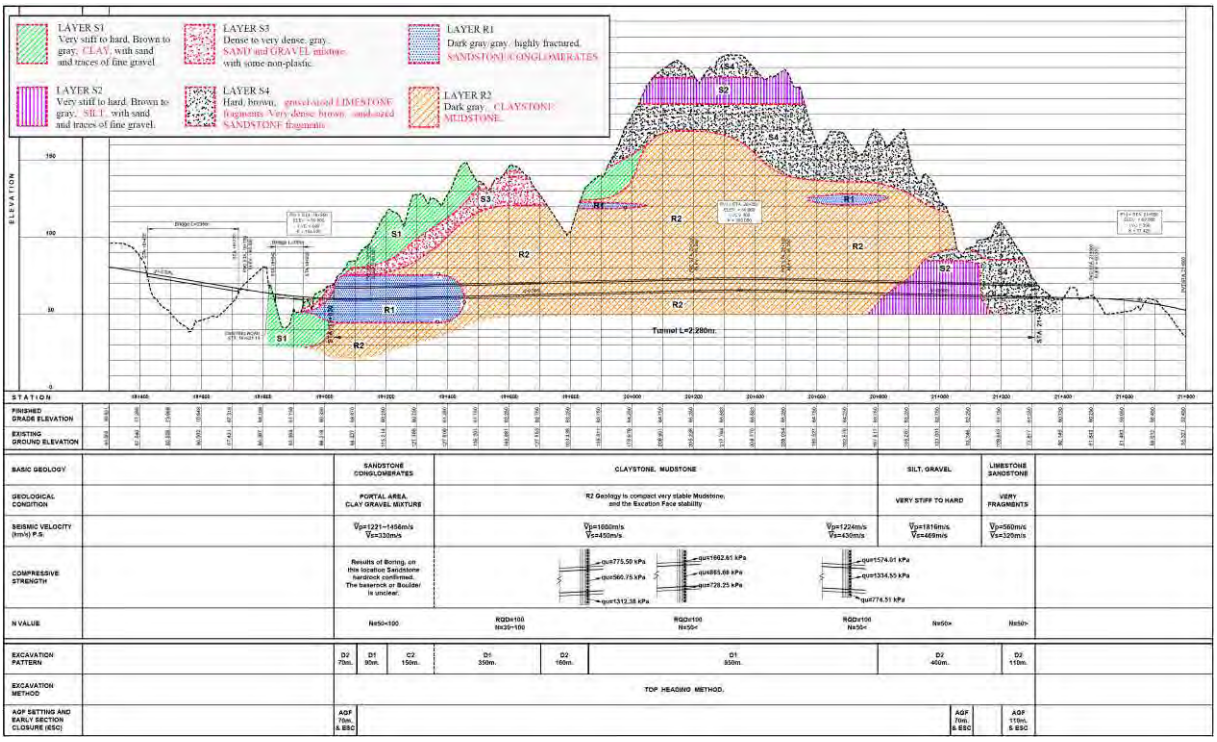
15.1.1 Utilization of Japan's Tunneling Technology

- Japan has successfully constructed **9,700 tunnels** (as of year 2011) of which **length extends for 3,526 km** (as of 2008).
- The government of Japan has been spending **huge amount of budget** for tunnel construction. Since 1989, over **2,000 billion yen (or about 20 Billion USD) has been annually spent** for tunnel construction.
- The huge government spending for tunnel construction enabled the **construction industry to develop innovative methods** of tunnel construction and suitable construction equipment.
- In addition to road tunnels, there are 4,805 railway tunnels of which length reached to 3,705km.
- The geological condition of the Philippines is **very similar** to that of Japan. There develop **many faults, fractured zones and soft rock zones** in both countries due to similar tectonics. In these zones, the most advanced technologies are required **for safer, faster and higher quality of construction.**

15.1.2 Requirements for Tunneling Method

(1) Geological Features of Davao Bypass Tunnel

- Rock classification: Claystone/mudstone/sandstone



(2) Geological Features at Quarry Site near Davao Bypass Tunnel

- Rock classification: Claystone/mudstone/sandstone

Excavated condition at Quarry Site (about 1km away from Tunnel Section.

(3) Geological Survey Results

- Unconfined Compression Strength: qu=0.6~1.3 N/mm^2
  (in case of hard rock, qu is usually more than 80 N/mm^2)
- Elastic Wave Speed(EWS): 0.7~1.8km/sec.
  (in case of hard rock, EWS is more than 3.5km/sec.)

Geological Survey Results at Proposed Tunnel Section

Tunnel Boring Hole No.	TBH-1	TBH-2	TBH-3	TBH-4	TBH-5	TBH-6	TBH-7	TBH-8
Unconfined compression strength (N/mm^2)	-	-	-	0.78 0.56 1.31	1.62 0.87 0.72	1.57 1.33 0.77	-	-
Elastic Wave speed (EWS) (km/sec.)	-	1.2 ~ 1.4	0.7	1.6	-	1.2	1.2~1.8	0.6~0.9

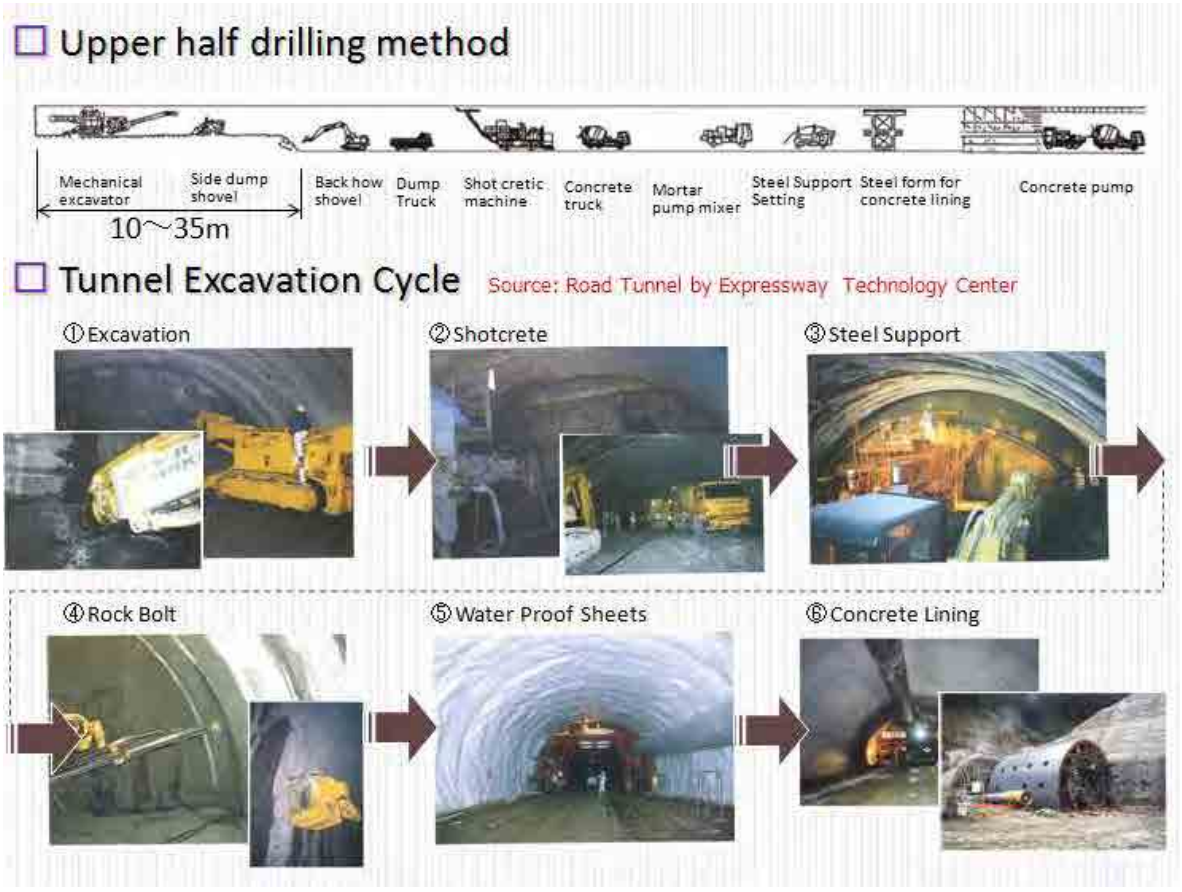
(4) Geological Features: Summary

- Rock classification : Claystone/ Mudstone / Sandstone
- Unconfined Compression Strength: qu=0.6~1.3 N/mm^2
  (in case of hard rock, qu is usually more than 80 N/mm^2)

- Elastic Wave Speed(EWS): 0.7~1.8km/sec.
  (in case of hard rock, EWS is more than 3.5km/sec.)
- Rock classification is “Soft Rock”
- No faultline nor fractured zone was observed.

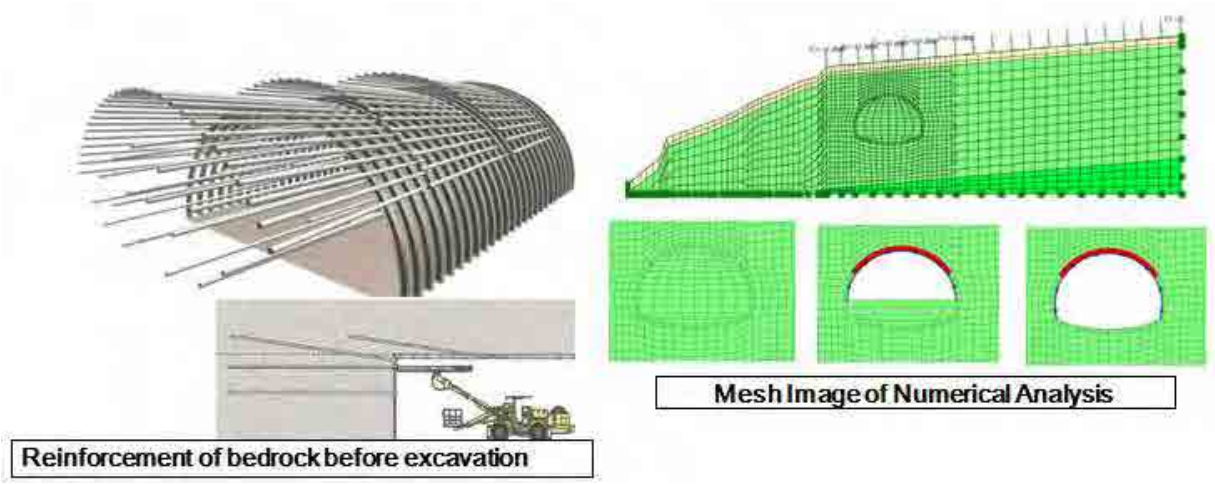
(5) Tunneling Method Required

- Tunneling at soft rock area requires special technology to prevent collapse of tunnel face and tunnel arch portion.
- Soon after ① excavation→②shotcrete → ③ installation of rock bolts→ ④ installation of steel H shaped frame→ ⑤ secondary shotcrete→ ⑥ installation of water proof sheets → and ⑦ concrete lining must be implemented as fast as possible while excavated arch portion is still stable.
- Another important consideration is that a full-face excavation should be avoided, instead the upper half portion should be excavated first, then followed by the excavation of lower half portion.



(6) Safety and economical construction technology under soft rock condition

- To restrain the displacement of ahead bedrock is very important to realize the safety and economical tunnel construction, as a mountain tunnel is not stable at cutting face.
- Especially in case of soft rock condition, Auxiliary method is required to restrict frontal loosing.
- It is also important to use a design technology by numerical analysis in order to design a more economical auxiliary method.



- If this Japan Technology is not utilized under the soft rock condition, large-scale soil improvement will be required. It is not economical and long construction period occurs.

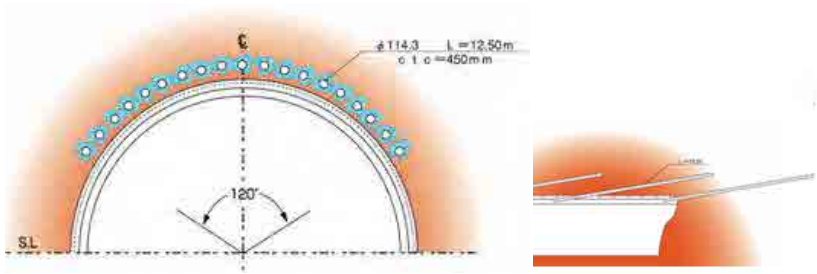
15.1.3 Auxiliary Method at Tunnel Portal

(1) Required Technology

– How to excavate the poor soil layer portal site and shallow earth cover of 20meters or less?

(2) Japan Technology

– AGF (All Ground Fasten) Method



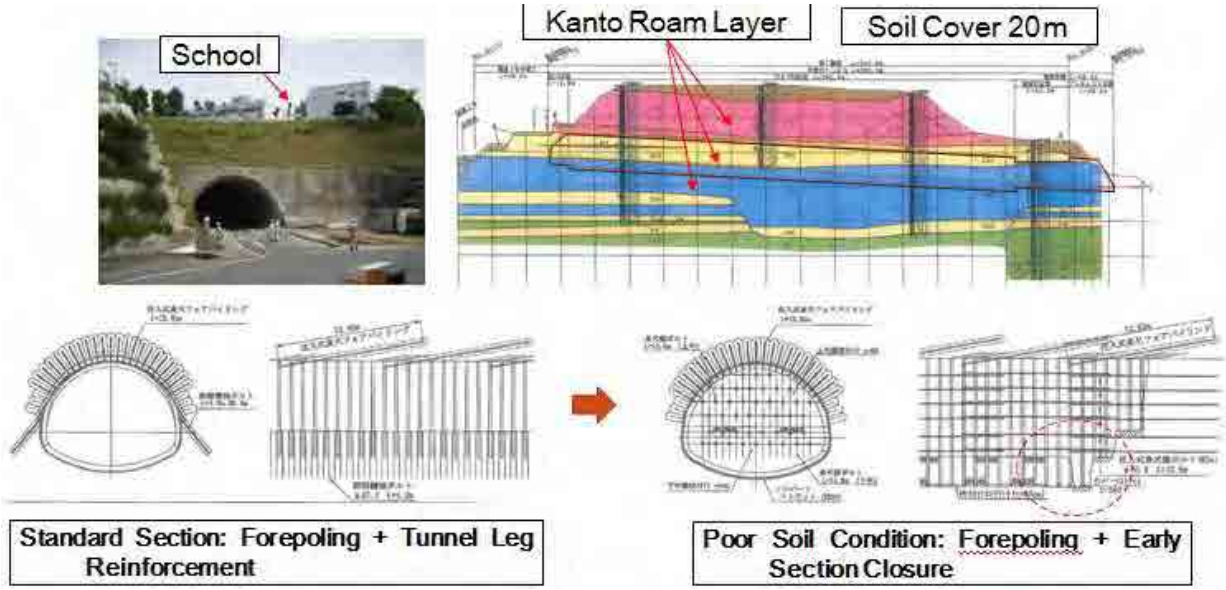
Long steel tubes (app. Φ 100mm) are driven into outer circumferential part of the working face. Then silicate resin is injected to form improved zone between the steel tubes to stabilize the working face and to restrict frontal loosening.

(3) Effect

– Safety construction to stabilize the working face restricting frontal loosening

(4) Japan' Technology: Example

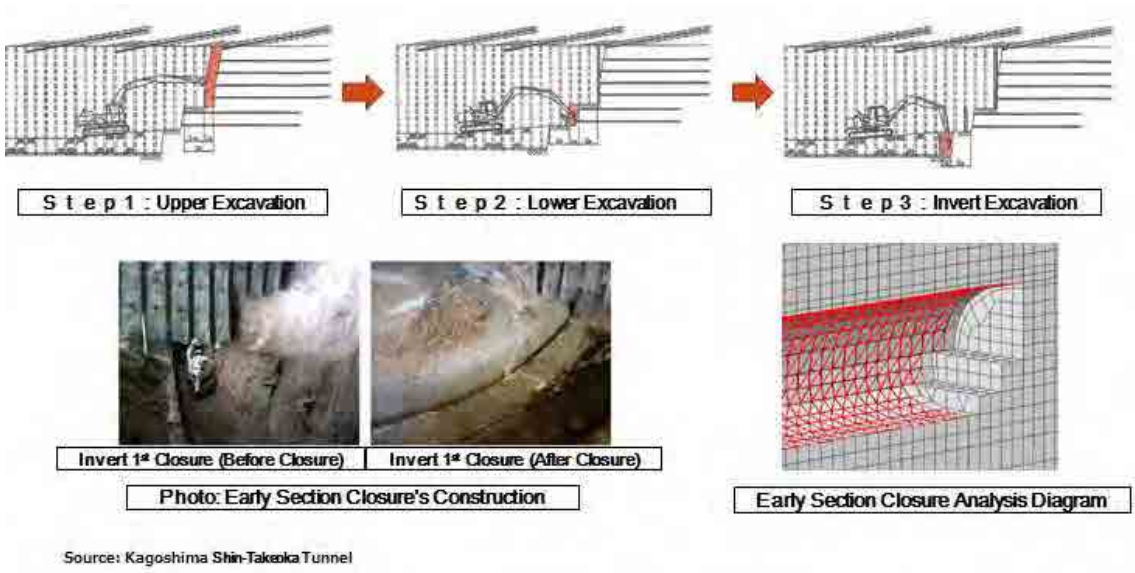
- Case: Tunnel Construction under the Kanto Roam Layer which is one of the famous soft rock layer in Japan. It requires not only economical and safe tunnel construction but also restraining settlement due to the presence of school above the tunnel.



- It applies optimum auxiliary method technology with combination of advanced auxiliary method technology depending on each topographical and geological condition.

(5) Japan' Technology: Early Section Closure, Example

- In order to restrain the loosening of bedrock, it is important to close (shotcrete and rockbolt) the tunnel section as early as possible near the working face during tunnel excavation.
- In Japan, it is developed at the early section closure technology near the working face for a safer tunnel excavation.



15.1.4 Tunnel Construction Machine

(1) Required Technology

- How to construct faster and safer?

(2) Japan Technology

- Utilization of tunnel construction machine developed by Japan

(3) Effect

- Safety construction (to minimize the workers at excavation site).
- High quality construction work and construction management

Road Header S-200 Type, Total Power 302.5Kw

Drill Jumbos with Hydraulic Drive System

Shotcrete Machine

15.1.5 Steel Support and Rock Bolt

(1) Required Technology

- Processed steel materials for tunnel support and rock bolts are needed. These materials are not produced in the Philippines.

(2) Japan Technology

- H-type Steel Support
- Rock bolt which is a void steel bar. Top of rock bolt are needed for special process due to cement, mortar injection.

(3) Effect

- Support Tunnel from earth pressure

H type Steel Support

Rock Bolt

15.1.6 Concrete Lining

(1) Required Technology

- To prevent crack occurrence, and
- Material separation due to lack of concrete compaction at arch portion.

(2) Japan Technology

- Medium performance concrete specially developed for tunnel.
- Steel Form for concrete lining

(3) Effect

- High quality concrete (less cracks)

General Concrete

Medium Performance Concrete

Steel Form Concrete Lining

15.1.7 Concrete Pavement

(1) Required Technology

- It is not easy to repair or replace the pavement inside tunnel space.
- Maintenance free pavement will be desirable.

(2) Japan Technology

- Reinforced concrete pavement
- Slip Form Construction Method utilizing Slip Form Paver

(3) Effect

- Long life pavement
- High quality concrete pavement, higher compaction and flat pavement
- Maintenance free pavement
- High quality construction management

Slip Form Paver

15.1.8 Tunnel Facilities

(1) Required Technology

- A tunnel ventilation fan is required to exhausts polluted air in the tunnel and outside fresh air in the tunnel and outside fresh air into the tunnel. To minimize the electricity cost, high performance ventilation system and lighting will be necessary.

(2) Japan Technology

- Jet Fan controlled automatically based on the data from VI (Visibility Index), CO sensor, Wind Velocity Meter
- LED for Tunnel Lighting

(3) Effect

- Savings in O&M cost
- Safer and reliable tunnel operation

Jet Fan Inside Tunnel

LED Inside Tunnel

15.2 IMPLEMENTATION STRATEGY

Davao City Bypass has three sections, namely South Section, Center Section and North Section.

The estimated Construction Cost and ROW Acquisition Cost are as follows.

（CONFIDENTIAL）

The implementation priority of the Davao City Bypass was studied as shown in the following section: section 15.3. The study result shows that the south section and the center section combined have the implementation priority over the north section, while the north section can still wait for its implementation until some more traffic demand increases.

It is suggested that the **South and Center Section shall be the Project Section by Japan's ODA Loan** and later on the North Section by local fund.(see **Figure 15.2-1**)

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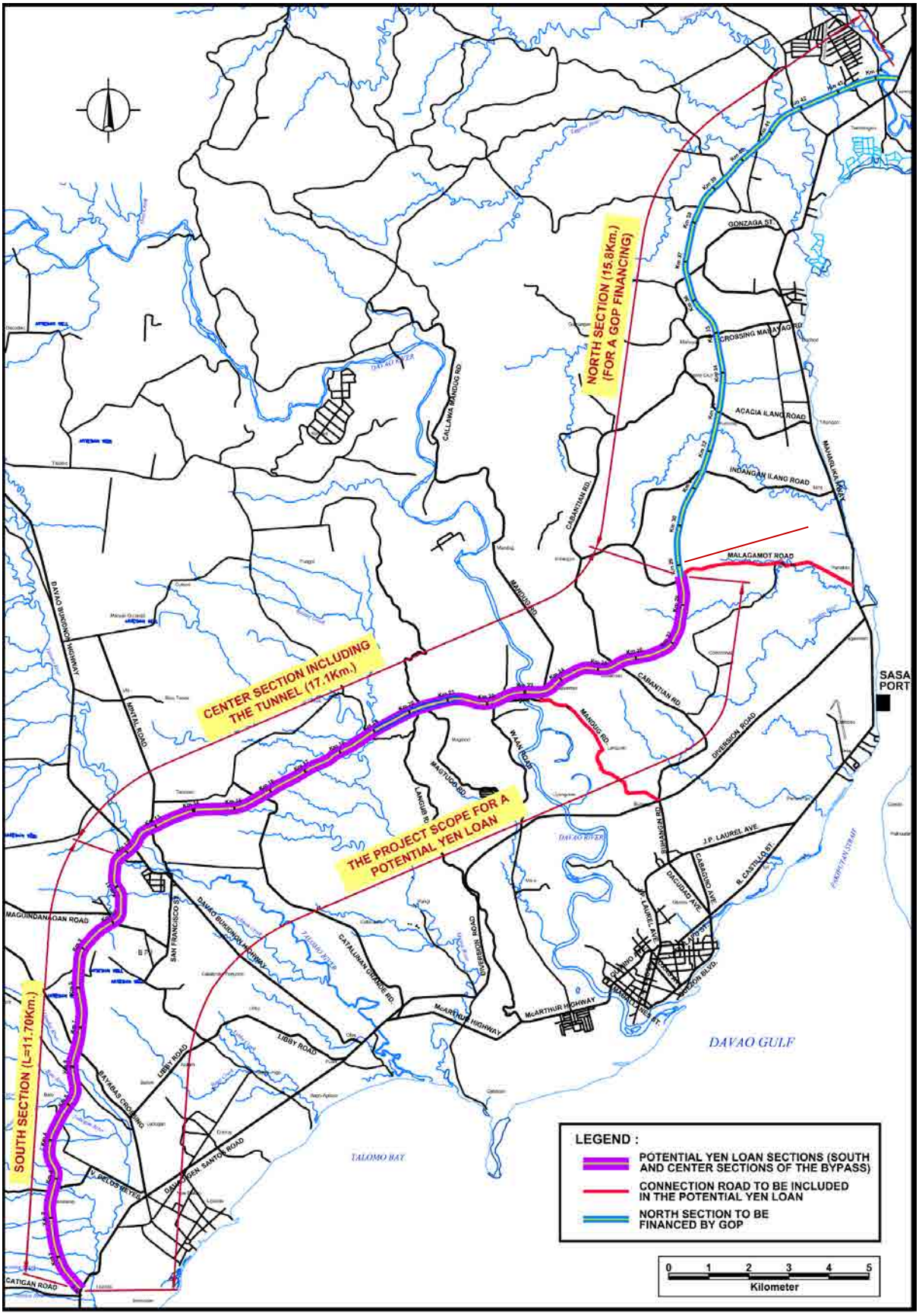


FIGURE 15.2-1 PROJECT FINANCING BY SECTION

15.3 STUDY OF IMPLEMENTATION PRIORITY OF DAVAO BYPASS SECTION

(1) Objective of Package Study

- Estimated Cost based on the Preliminary Design is a huge amount of 11.95 Billion Php.
- It is necessary to acquire the 60m RROW of 44.58km (approx. 2,500,000 sq.m.)
- The Bypass was divided into three (3) sections (South 11.7km, Center 17.1km and North 15.8km)
- Which sections have implementation priority and has greater impact for initial stage?

(2) Case Study

- The following four cases were studied: (see **Figure 15.3-1**)
  - Case-1 Center Section (including Tunnel portion)
  - Case-2 South and Center Section (including Tunnel Portion)
  - Case-3 North Section
  - Case-4 Whole Section

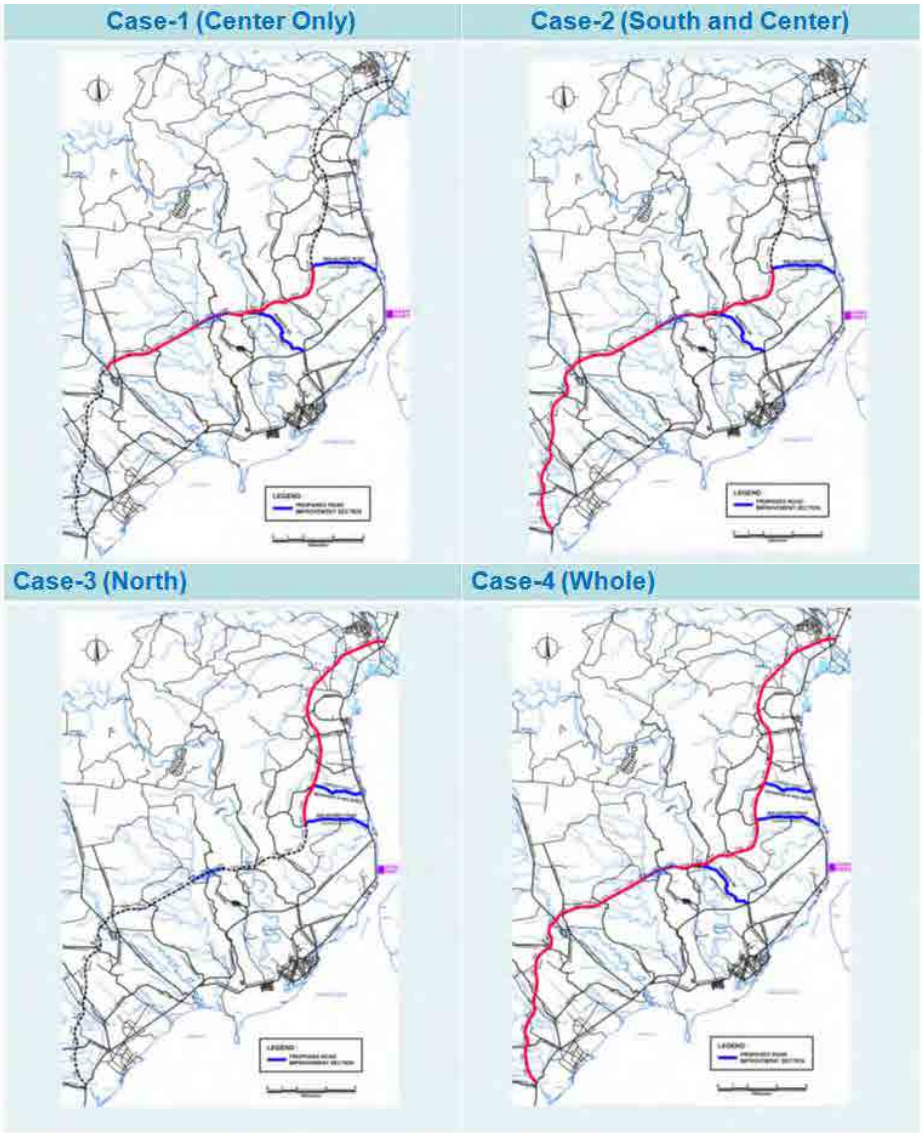


FIGURE 15.3-1 CASE STUDY MAP OF DAVAO BYPASS IMPLEMENTATION PRIORITY

(3) Case Study Result

Based on the Case Study Results, Case-2 (South Section and Center Section) is the most urgent needs for Implementation.

TABLE 15.3-1 CASE STUDY RESULT

	Case-1	Case-2	Case-3	Case-4
Bypass Section	**Center (Tunnel)**	**Center + South**	**North**	**Whole**
Bypass Length (km)	17.1	28.8	15.8	44.6
Const. Cost (Bil.Php)				
Const. Cost per km (M.Php)				
Impact of major Improvement	Davao-Bukidnon Road from/ to Sasa Port and Davao Poblacion access will be improved (O)	Davao-Bukidnon Road and Digos, south of Davao from/ to Sasa port and Davao Poblacion access will be improved (◎)	Davao North area from/ to Sasa Port and Davao Poblacion access will be improved (△)	Davao-Bukidnon Road , Panabo and Digos, south of Davao from/ to Sasa Port and Davao Poblacion access will be improved (◎)
Traffic Attracted Y2018 (veh./day)	5,600 (O) (at Tunnel)	6,500 (◎) (at Tunnel)	3,100 (△)	6,700 (◎) (at Tunnel)
Total Travel Time Reduction (Veh*hr. day)	5,511	11,581	1,105	15,125
EIRR (>15.0%)	12.7% (×)	20.7% (◎)	1.7% (×)	18.8% (O)
Social Impact. No. of affected Structures	46 (O)	69 (O)	37 (◎)	106 (△)
Japan's Technology	Tunnel Const. (O)	Tunnel Const. (O)	Not Necessary (×)	Tunnel Const. (O)
Evaluation	3rd	**1st Recommended**	4th	2nd

(4) Recommendation

- **Case-2 (South and Center Section) is the best scheme** for the initial stage of Bypass Construction.
- South and Center Sections can have efficient bypass function as traffic going from/to Sasa Port and Urban Center can avoid to pass through the urban center.
- Since Daang Maharlika Highway of North Section can still accommodate some more traffic, implementation of North Section is not so urgent and can be deferred in 2-3 years.
- Access roads (Malagamot Road, Mandug Road) to Sasa Port and Davao Central City should be improved with Bypass Construction, although they are currently City Roads.

15.4 IMPLEMENTATION SCHEDULE

Implementation schedule is shown in **Table 15.4-1.**

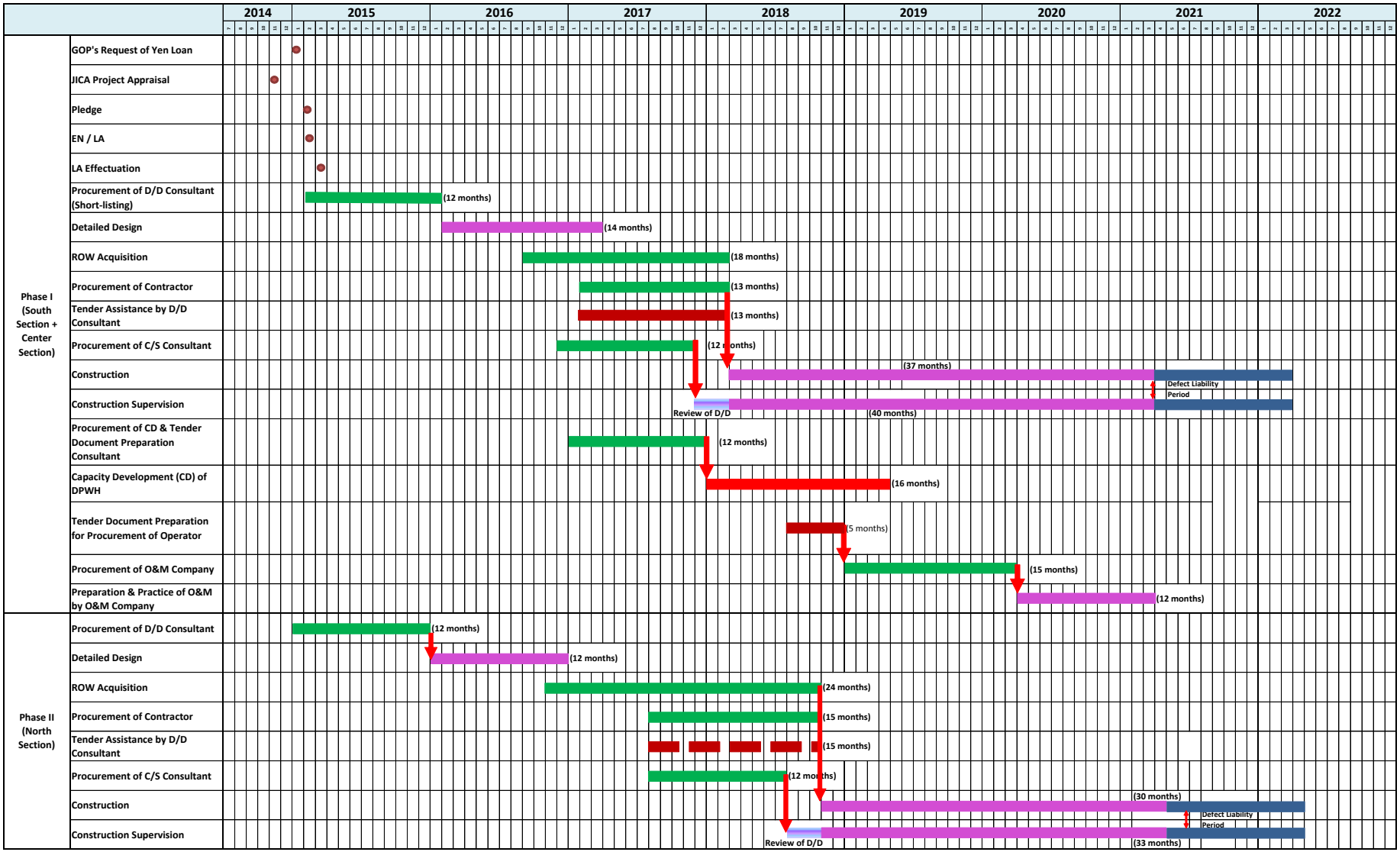
South and Center Section (Japan ODA Section)

- Project Appraisal by JICA is expected in November 2014.
- Loan Agreement is expected to be signed in March 2015.
- Selection of Consultant for the detailed engineering design will start in February 2015 and end in January 2016.
- Detailed engineering design will start in February 2016 and be completed in February 2018.
- ROW Acquisition will start in September 2016 and be completed in March 2018 (18 months)
- Selection of Contractor will start in February 2017 and be completed in February 2018.
- Construction will start in March 2018 and be completed in March 2021 with the construction period of 37 months.
- Selection of Capacity Development Consultant for DPWH and tender document preparation for tunnel operator will start in January 2017 and end in December 2017.
- Capacity Development of DPWH and Tender Document Preparation will start in January 2018 and end in April 2019.
- Before 12 months of the opening month, O&M Company will train their staff for O&M of the Tunnel Section.

North Section (Local Fund Section)

- Soon after the project is approached by NEDA Bored (December 2014), selection of consultant for Detailed Engineering Design will start in January 2015 and ends in December 2015.
- Detailed Engineering Design will start in January 2016 and be completed in December 2016 (12 months)
- ROW Acquisition will start in October 2016 and be completed in September 2018 (24 months)
- Selection of Contractor will start in August 2017 and be completed in October 2018.
- Construction will start in October 2018 and be completed in April with the construction period of 30 months.

TABLE 15.4-1 DAVAO BYPASS OVERALL IMPLEMENTATION SCHEDULE



Source: JICA Study Team

15.5 CIVIL WORK CONTRACT PACKAGING

Number of contract package of South and Center Section is recommended to be one (1) considering the cost, scale of works and cost balance.

15.6 CONSTRUCTION EXECUTION PLAN

15.6.1 Construction Plan

(1) Temporary Camp for Construction

Bridge construction for characteristic activities for the Davao Bypass project are mostly producing numbers of PC girders within each package main camp construction yard and these manufactured PC girders will be transported to the project construction site timely based on implementation schedule. The selection of construction yard for each package is definitely important. There are probable locations of 3 main temporary camp and 1 sub camp for Tunnel construction are located especially within construction site. Since the temporary yard for construction is temporally situation but production activities are large volumes to prepare concrete materials by the concrete batching plant. Selection of temporary yard for construction will be decided during the detail design stage, and the contractor will select proper location for the construction site and its scale during tender procedure. Recommendable Temporary Main Camp and Sub Camp Location and size is shown in **Figure 15.6-1** and **Figure 15.6-2**.

Concrete batching plant within the project temporary camp yards for construction is required the construction yards for each project package, concrete batching plant is the main production

Equipment within the yard and it require the area approximately 2 hectares together with other equipment and facility

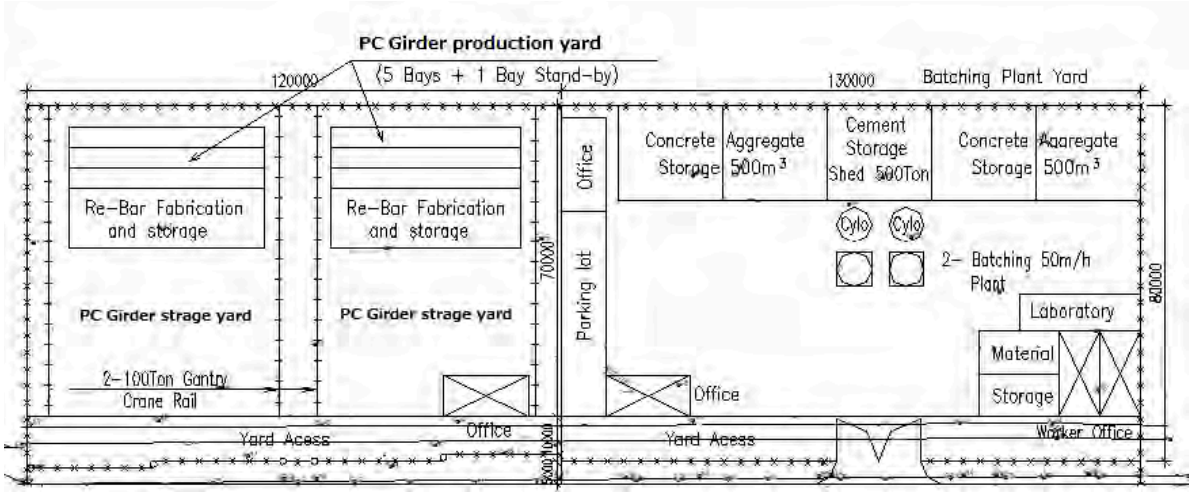


FIGURE 15.6-1 TYPICAL RECOMMENDABLE TEMPORARY YARD FOR CONSTRUCTION

(2) Temporary Road for Construction

Temporary Road for construction will be constructed at within construction area and realign of temporary road is timely nessesary during construction.

Access to from construction site is using existing road and it is necessary to arrange traffic enforcer at entrance of construction site.

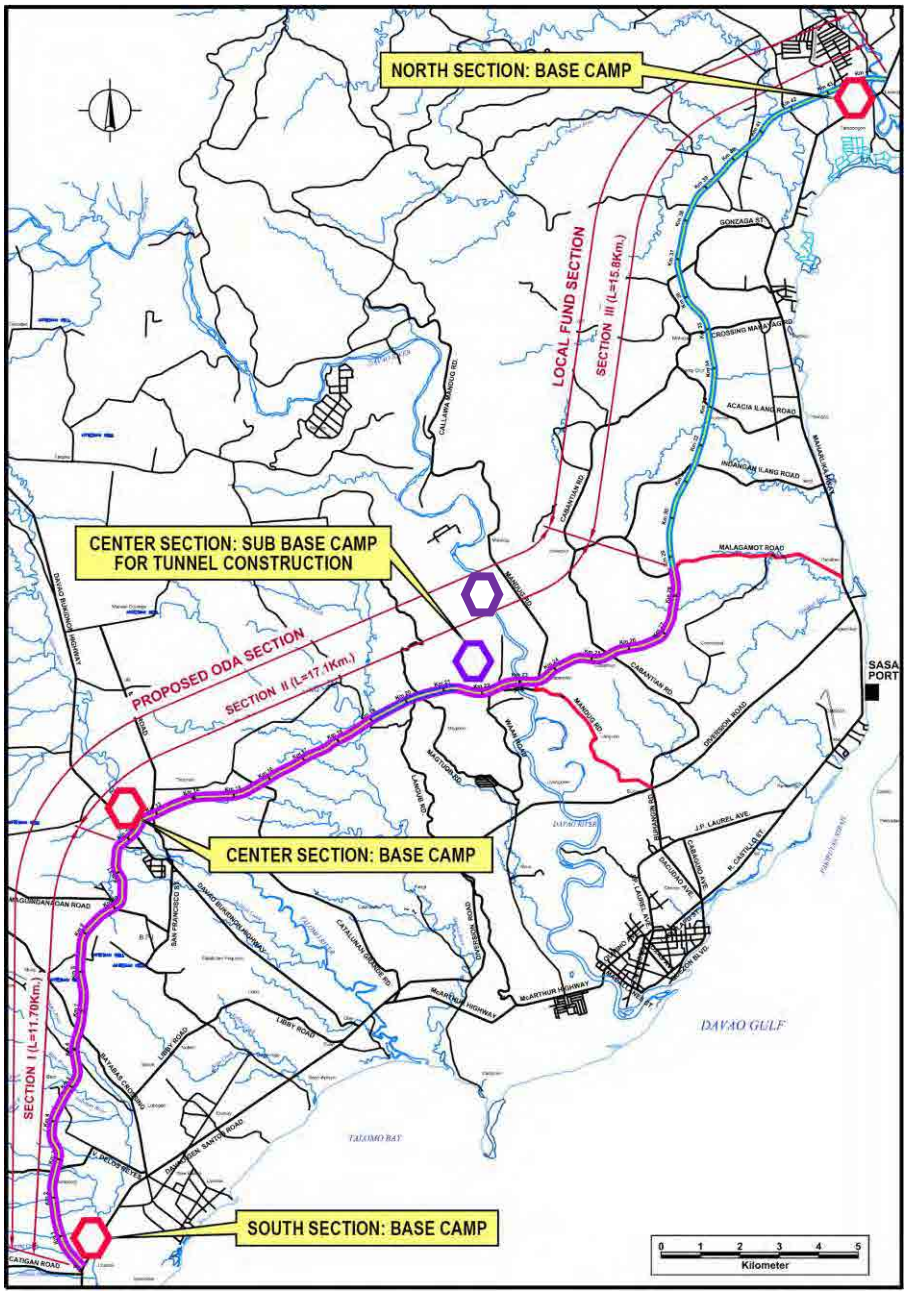


FIGURE 15.6-2 RECOMMENDABLE CAMP YARD FOR EACH PACKAGE

(3) Bridge Construction

Type of Bridge for Davao Bypass project has PC-I girder and continuous PC Box Girder Bridge.

1) PC I Girder Erection by Erection Girder Method

A typical applicable span of this bridge is roughly 20 to 30m and maximum 40m. This type of bridge can be constructed by local contractors. PC I girders are fabricated at main camp yard or at a yard for behind the bridge site, because the transportation of 30m long girder is using temporary road inside construction area.

Election method of PC I Girder is below three type;

- Erection Girder with rail (Draw Out Method)
- Erection Girder with Lift (Lifting Method)
- Erection by Track Crane or Crawler Crane (Crane Method)

Each type of erection for PC I Girder is shown in **Figure 15.6-3** to **Figure 15.6-5**.

Source; Prestress Concrete Construction Association

FIGURE 15.6-3 DRAW OUT METHOD WITH ERECTION GIRDER

Source; Prestress Concrete Construction Association

FIGURE 15.6-4 LIFTING METHOD WITH ERECTION GIRDER

Source; Prestress Concrete Construction Association

FIGURE 15.6-5 ERECTION BY TRACK CRANE

2) Three Span Continuous PC Box Girder Bridge

The long span at mountainous river crossing site is applied Continuous PC box girder. This box girder bridge is constructed by the Balanced Cantilever Construction Method, which is shown in **Figure 15.6-6**.

Source; Prestress Concrete Construction Association

FIGURE 15.6-6 BALANCED CANTILEVER CONSTRUCTION METHOD

(4) Tunnel Construction

- Excavation methods is adopted conventional NATM. (NATM : New Austrian Tunneling method) based on geological survey results of tunnel route consider using Free Section Excavation Machine Method which is Japanese Tunnel Construction Technology.

- Geological condition along tunnel route is considered soft rock ground quality. Therefore, excavation method is adopted upper half drilling machine excavation method for engineering safety.

- Tunnel excavation for soft layer would require further auxiliary methods. In this case require special construction such as tip of the receive method which is also Japanese Tunnel Construction Technology

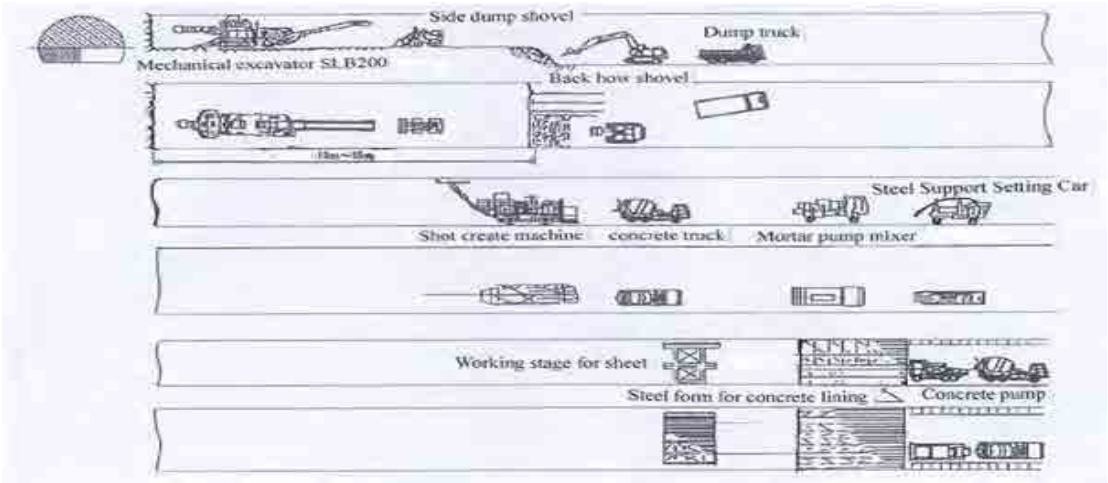


FIGURE 15.6-7 TUNNEL EXCAVATION MACHINE METHOD

1) Temporary yard of facilities and equipments for tunnel construction

Mechanical Excavation using both Road Header and Breaker is planned for tunnel excavation, Standard area of temporary facilities and equipments are shown in **Table 15.6-1**.

TABLE 15.6-1 STANDARD AREA OF TEMPORARY FACILITIES AND EQUIPMENTS

	Item	Size (m)	Area (㎡)	No.	Note
(1)	Compressor Room	4.0 × 7.0	28.00	1	
(2)	Generator power station	8.5 × 24.0	204.00	1	
(3)	Repair shop	7.2 × 9.0	64.80	1	
(4)	Water supply tank	2.0 × 5.0	10.00	1	
(5)	Turbine Pump	2.0 × 2.0	4.00	1	
(6)	Material stock yard	8.0 × 15.0	120.00	1	
(7)	Concrete mixing plant	8.0 × 20.0	160.00	1	
(8)	Sewerage facilities	5.0 × 15.0	75.00	1	
(9)	Rest room	7.2 × 9.0	64.80	1	
(10)	Supervisor office	4.5 × 4.5	20.25	1	
(11)	Ventilation fan	2.0 × 6.0	12.00	1	
(12)	Muck loader yard	10.0 × 15.0	150.00	1	
(13)	Warehouse	7.0 × 10.0	70.00	1	
(14)	Gantry crane yard	7.0 × 10.0	70.00	1	
(15)	Carriage-way space	8.0 × 100.0	800.00	1	
(16)	Muck stock yard	20.0 x 40.0	800.00	1	
Total			2,652.85		

Temporary yard shall be wider than the above area, approximately 30m x 100m = 3,000 ㎡ is necessary for temporary yard.

Typical temporary facility plan for tunnel construction is shown in **Figure 15.6-8**.

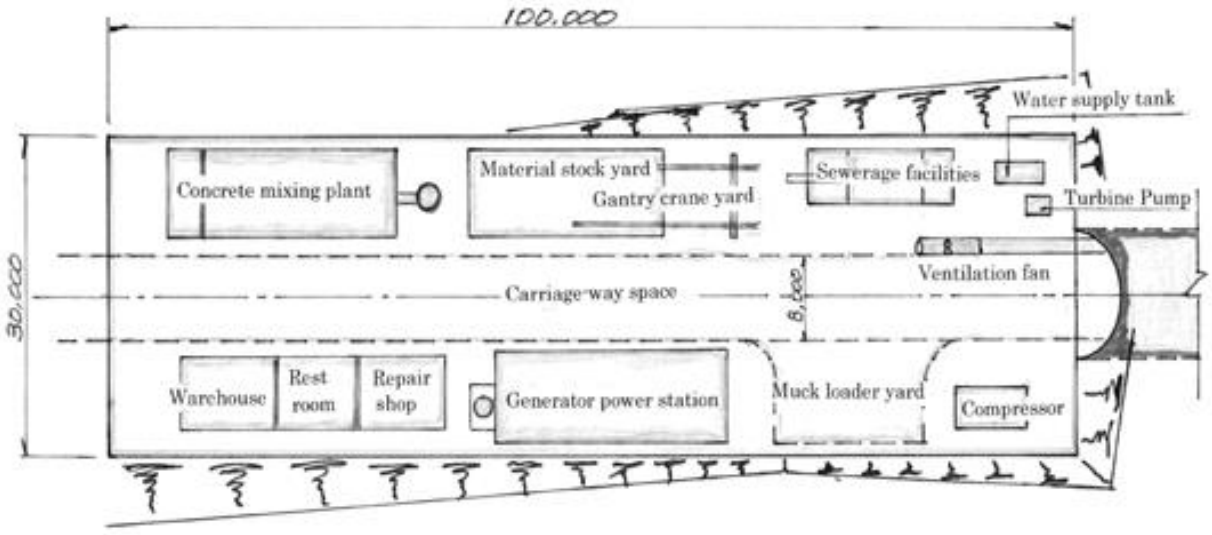


FIGURE 15.6-8 PLAN THE TYPICAL TEMPORARY FACILITIES

2) Auxiliary Method for Excavation of Tunnel Entrance

Entrance of tunnel Construction for mountain area is geologically unconsolidated ground range which is composed of sand, clays and gravels. And it is a necessity to use auxiliary method which is All Ground Fasten (AGF) Method which is Japanese Tunnel Construction Technology.

AGF Method

Long steel pipe approximately φ100mm tubes are driven into outer surround area of excavation face of tunnel. Then SRF is injected to improved zone between the steel pipe and stabilized working face, and also prevent surface ground subsidence. Reliable effect can be expected under various fragile conditions ranging from clayey Soil to finely cracked rock.

15.6.2 Construction Schedule

Schedule of Construction for Davao Bypass Construction Project is estimated. Total construction period for Sections 1 + 2 is 37 months and Section-3 is 30 months. Each Construction Schedule is shown in **Figure 15.6-9** and **Figure 15.6-10**.

Basic Construction Period for Bridge and Tunnel

- 2 Span Bridge Construction : 5 Months
- 3 Span Bridge Construction : 6.5 Months
- Tunnel Excavation for D1: 3.9 m/day
- Tunnel Excavation for D2: 3.75 m/day
- Tunnel Excavation for C2: 4.05 m/day

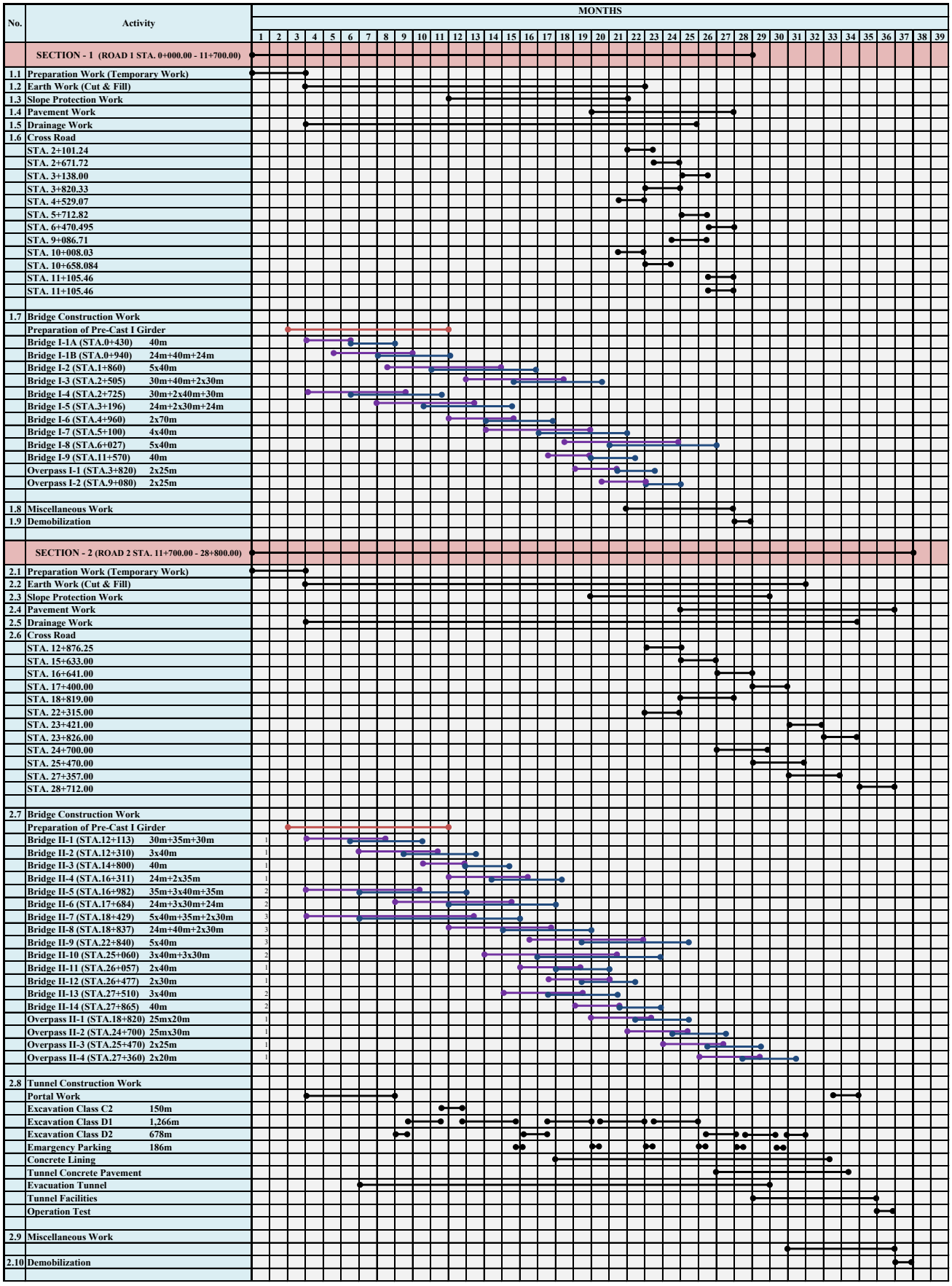


FIGURE 15.6-9 CONSTRUCTION SCHEDULE FOR PACKAGE I-1 AND I-2

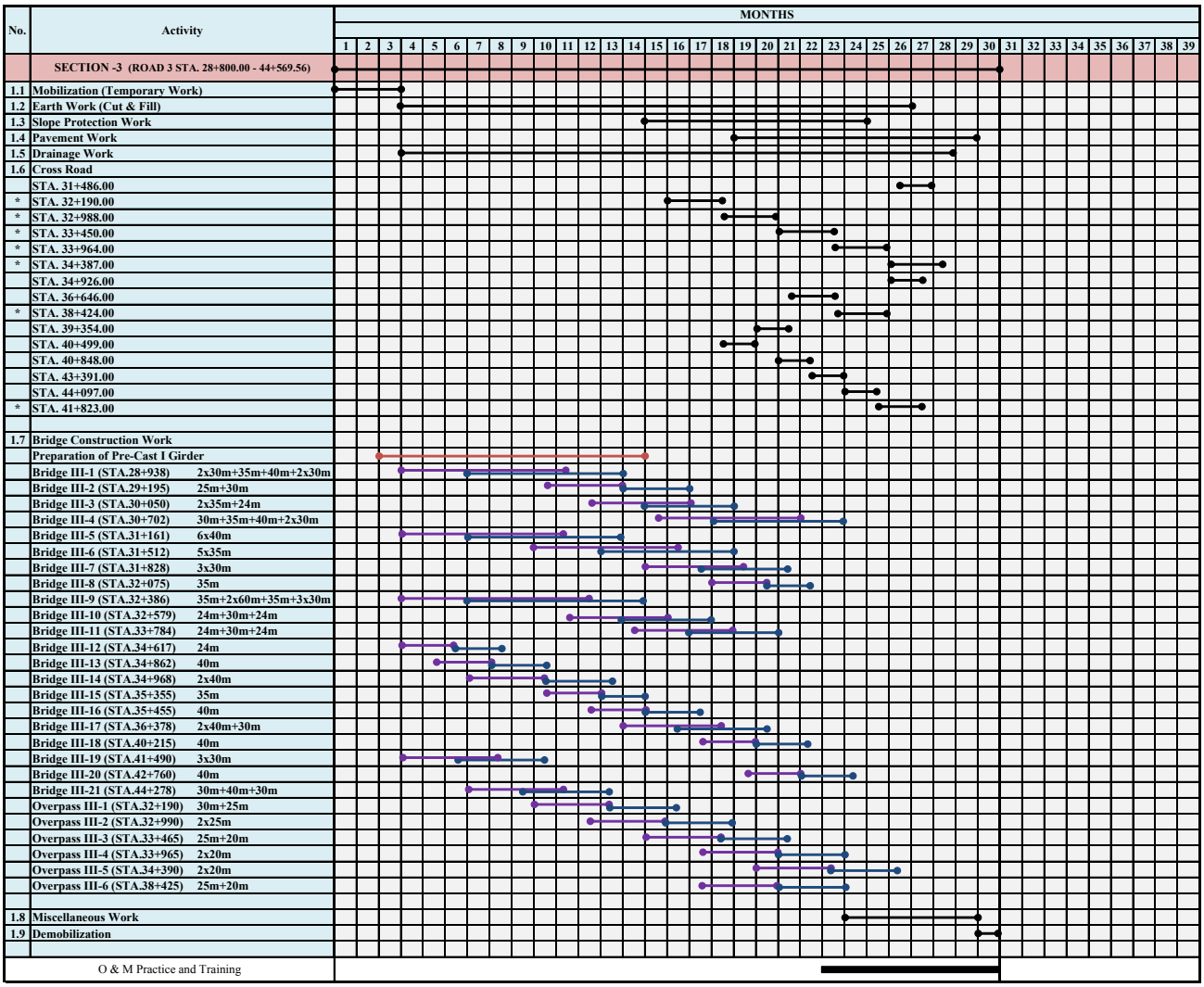


FIGURE 15.6-10 CONSTRUCTION SCHEDULE FOR PACKAGE 3

15.7 CONSULTANCY SERVICES

The following consultancy services are required for the project;

- Detailed Engineering Design
- Tender Assistance for Selection of Contractor
- Construction Supervision
- Capacity Development of DPWH and Tender Document Preparation for Procurement of Tunnel Operator

(1) Detailed Engineering Design

Major scope of work for the consultancy services are as follows;

- Finalization of the highway alignment with due consultation with the concerned land developers.
- Engineering surveys (topographic survey, soils/material survey, geo-technical survey)
- Detailed engineering design
- Preparation of tender documents
- Preparation of RAP

- Parcellary survey

(2) Tender Assistance for Selection of Contractor

- Provide assistance to DPWH in the all process selecting contractor.
- Monitoring of RAP implementation.

(3) Construction Supervision

- Overall construction supervision.
- Keep and compile all records including material test results, inspection results, problems encountered, etc.
- Prepare an asset register in including condition assessment.
- Monitoring of environmental requirements.

(4) Capacity Development of DPWH Staff and Tender Document Preparation for Procurement of O&M Operator

- Preparation of Tunnel O&M manuals and relevant training
- Training in Japan
- Tender Document Preparation for Procurement of Tunnel Operator

15.8 PROCUREMENT PLAN

Consultancy services and civil work contactor will be procured through the following method in accordance with JICA Guideline for procurement under Japanese ODA Loans, March 2009.

(1) Consultancy Services

Consultancy services will be procured by Two (2) steps, Pre-qualification and Tendering under the International Competitive Bidding (ICB) and Quality and Cost- Based (QCBS) method will be adopted.

(2) Civil Work Contractor

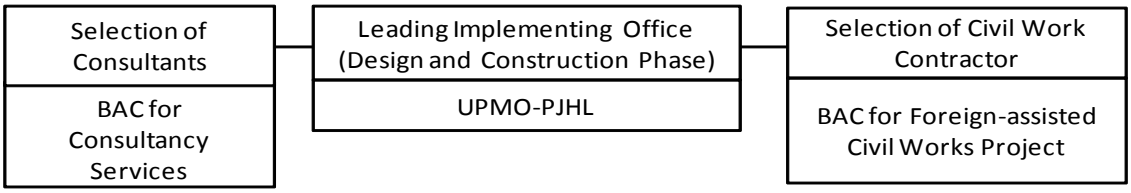
Civil work contractor will be provide by 2 steps, Pre-qualification and Tendering, under the International Competitive Bidding (ICB).

15.9 ORGANIZATIONAL STRUCTURE

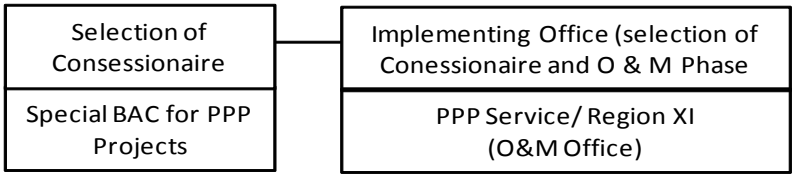
Overall project implementation organization for the South and Center Sections is shown in **Figure 15.9-1**.

The implementing agency is the Department of Public Works and Highway (DPWH) and the implementing office is the project UPMO-PJHL.

For a successful implementation, the DPWH created a DPWH Review Team Headed by the Assistant Secretary for Planning and PPP with member/directors of the Planning Service, Bureau of Design (BOD), ESSD, PPP, Bureau of Construction (BOC), Region XI, and UPMO-PJHL. DPWH also created a Technical Working Group headed by the Chief of Project Preparation Division of Planning Service, with members from BOD, PPP, BOC, and ESSD.



DESIGN AND CONSTRUCTION PHASE



SELECTION OF CONCESSIONAIRE AND O & M PHASE

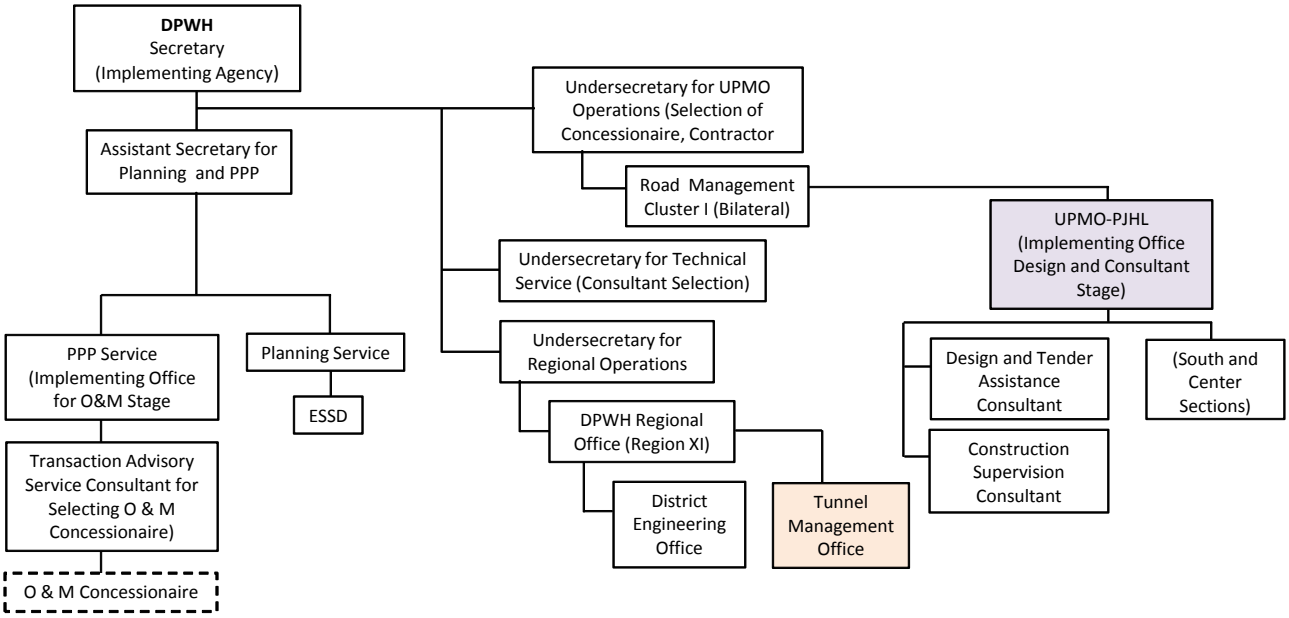


FIGURE 15.9-1 OVERALL PROJECT IMPLEMENTATION ORGANIZATION

15.10 FINANCIAL PLAN

15.10.1 Project Cost

（CONFIDENTIAL）

15.10.2 Annual Fund Requirement

（CONFIDENTIAL）

CHAPTER 16

OPERATION AND EFFECT INDICATORS

CHAPTER 16
OPERATION AND EFFECT INDICATORS

16.1 SELECTED OPERATION AND EFFECT INDICATORS

In order to enable project monitoring and evaluation on the basis of consistent indicators, operation and effect indications are introduced for ODA loan projects.

Operation and effect indicators are basically equivalent to the outcome indicators and performance indicators used by the World Bank. For this study, they are defined as follows:

1) **Operation indicators**: quantitative measure of the operational status of project.
2) **Effect indicators**: quantitative measure of the effects generated by a project.

In order to set the appropriate indicators, the following criteria should be considered.

1) **Validity**: This determines whether the set of indictors would really be able to measure the achievement of the project purpose.
2) **Reliability**: The set indicators data must yield the same results, regardless of how many times they are measured and regardless of who makes the measurements.
3) **Ease of access**: The indicator data set for the project must be easy to access and must not be too many, considering the cost and time required to gather them.

In view of project objective and expected effects, the following indicators were selected:

TABLE 16.1-1 OPERATION AND EFFECT INDICATORS

Operation and Effect Indicators		Data Collection Method
Operation Indicators	Traffic Volume of Davao Bypass (veh./day)	Traffic count survey
	Toll Revenue	Data collection from Operator
Effect Indicators	Travel Time Saving (veh.-hour/day)	Calculation based on Travel Time Survey
	Travel Time Cost Saving (Peso/Year)	Calculation based on Time Cost and Travel Time Survey

The project will definitely contribute to the reduction of traffic accidents. However, it is difficult to estimate present rate of traffic accidents along the Davao Bypass. It is also difficult to estimate how many traffic accidents will be reduced due to this project. Although reduction of traffic accidents is an important indicator, it is not adopted in the study due to the current non-availability of data.

16.2 TRAFFIC VOLUME OF DAVAO CITY BYPASS

Based on the traffic assignment result, future traffic volumes are shown as follows.

TABLE 16.2-1 ESTIMATED TRAFFIC VOLUME OF DAVAO BYPASS, CENTER SECTION

Unit: Vehicle/day

	Y2023	Y2033
Car	5,374	6,090
Jeepney	1,771	1,804
Bus	151	55
Truck	3,321	3,968
Total	**10,617**	**11,917**

Source: JICA Study Team

TABLE 16.2-2 ESTIMATED TRAFFIC VOLUME OF DAVAO BYPASS, SOUTH SECTION

Unit: Vehicle/day

	Y2023	Y2033
Car	5,497	6,868
Jeepney	1,247	1,582
Bus	215	254
Truck	2,867	3,554
Total	**9,826**	**12,258**

Source: JICA Study Team

If a toll is collected at the Tunnel Section, the estimated traffic volumes are as shown below.

TABLE 16.2-3 ESTIMATED TRAFFIC VOLUME OF DAVAO BYPASS, CENTER SECTION (IN CASE OF TOLL COLLECTION AT TUNNEL)

Unit: Vehicle/day

	Y2023	Y2033
Car	4,167	5,515
Jeepney	335	406
Bus	95	41
Truck	2,092	2,976
Total	**6,689**	**8,938**

Source: JICA Study Team

TABLE 16.2-4 ESTIMATED TRAFFIC VOLUME OF DAVAO BYPASS, SOUTH SECTION (IN CASE OF TOLL COLLECTION AT TUNNEL)

Unit: Vehicle/day

	Y2023	Y2033
Car	4,123	5,494
Jeepney	935	1,266
Bus	161	203
Truck	2,150	2,843
Total	**7,369**	**9,806**

Source: JICA Study Team

16.3 TOLL REVENUE OF TUNNEL SECTION

Based on the future traffic and assumed toll rate, toll revenue is estimated.

TABLE 16.3-1 ESTIMATED TOLL REVENUE (Y2023)

	No. of Vehicle (vehicle/day)	Toll Rate	Revenue (Php) (per day)
Class-1 (Car)	4,501	36	162,036
Class-2 (Bus, Truck)	1,853	72	133,416
Class-3 (Trailer)	335	108	36,180
Total	**6,689**		**331,632**

Source: JICA Study Team

16.4 TRAVEL TIME SAVING

If Davao City Bypass will be constructed, the travel time from Barangay Sirawan in Davao City to Sasa Port or Panabo City will be reduced. Based on the travel speed survey and the following assumptions, the travel time is estimated.

- Davao Bypass Average Speed: 55 km/hr
- Approach Road Average Speed: 40 km/hr

TABLE 16.4-1 ESTIMATED TRAVEL TIME FROM SIRAWAN TO SASA PORT

Section: Barangay Sirawan – Sasa Port

Section	Length (km)	Ave. Speed (km/hr)	Travel Time (Hr:Min)	Remarks
Route A[1)] Diversion Road	32.6	22.3	1:27	2013 Data
Route B[2)] Davao Bypass	37.6	47.6	0:47	Assumption

Source: JICA Study Team

TABLE 16.4-2 ESTIMATED TRAVEL TIME FROM SIRAWAN TO PANABO

Section: Barangay Sirawan – Sasa Port

Section	Length (km)	Ave. Speed (km/hr)	Travel Time (Hr:Min)	Remarks
Route C[3)] Pan Philippine Highway and Diversion Road	48.1	27.7	1:44	2013 Data
Route D[4)] Davao Bypass (Full Section)	45.0	55.0	0:49	Assumption

Source: JICA Study Team

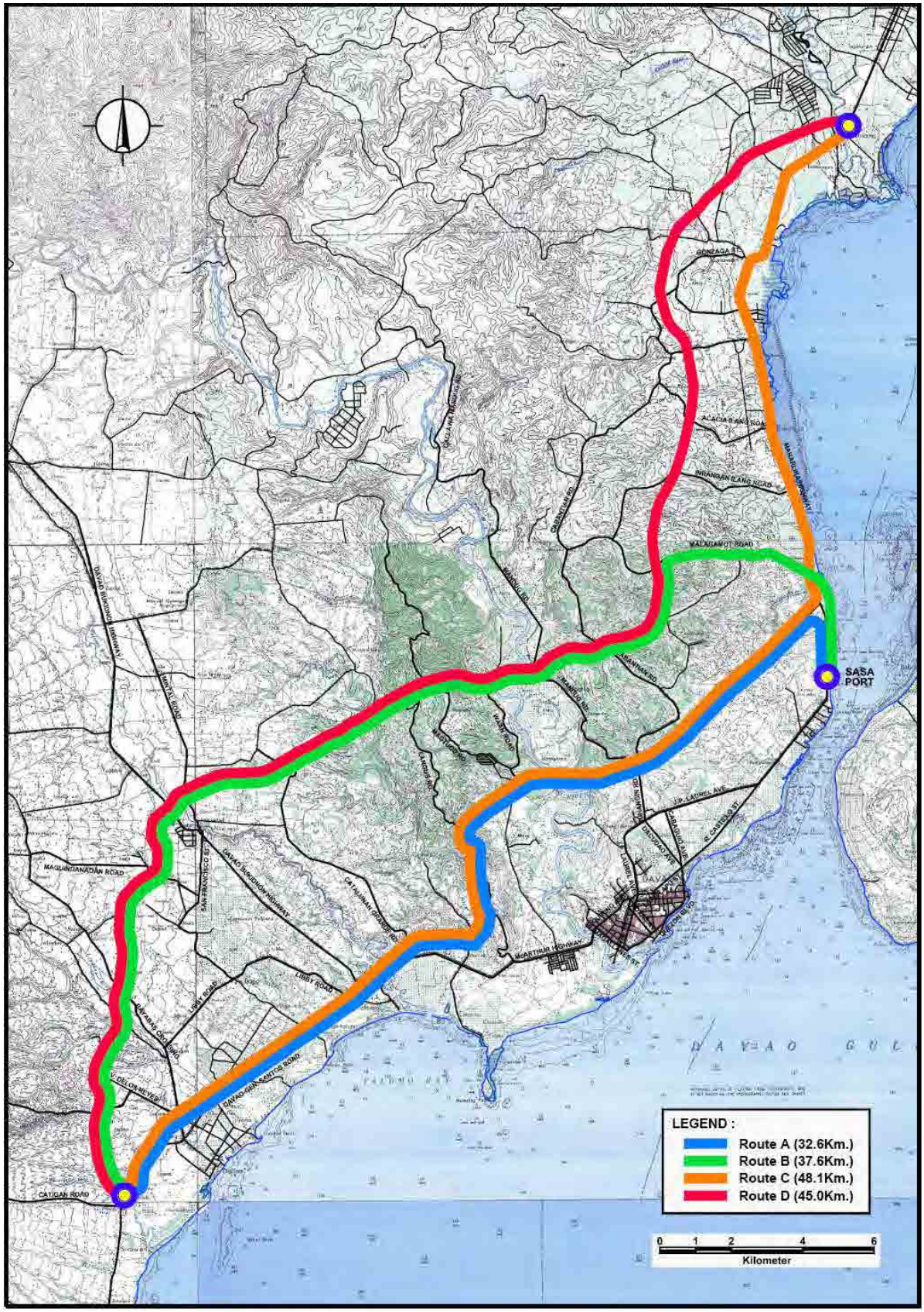


FIGURE 16.4-1 TRAVEL TIME COMPARISON

Based on the above travel time saving and traffic assignment, total travel time saving are estimated as shown in **Table 16.4-3**.

TABLE 16.4-3 MAJOR TRAVEL TIME SAVING

Route	Travel Time Reduction(Y2023)	Conversion Traffic To Davao Bypass	Travel Time Saving
Sirawan to Sasa-port	40min.	5,370 veh./day[1]	3,580 hours/day

Source: JICA Study Team

Travel time savings presented above are only conversion traffic from Diversion Road to Davao Bypass. There is actually other travel time savings from conversion of traffic coming from other roads to Davao Bypass and decongestion of Diversion road and roads in Davao Urban Center. Since it will be difficult to quantify the whole traffic saving time at post fact evaluation, only major travel time savings are estimated.

16.5 TRAVEL COST SAVING

Travel time saving was converted to cost. Unit rate of time cost by vehicle type are as follow:

TABLE 16.5-1 UNIT TRAVEL TIME COST

Vehicle Type	Unit Travel Time Cost(Peso/min/veh)		Vehicle Share (%)
	Year 2014	Year 2023	
Passenger Car	9.39	13.14	60.4 %
Jeepney	10.26	14.35	7.0 %
Bus	38.36	53.66	1.4 %
Truck	1.86	2.60	31.2 %
Average		10.05	

Inflation rate: 3.8% per year
Source: JICA Study Team

Travel time cost saving of 2023 will be 788 Million Peso / year.

*Travel time cost saving = 3580(hrs/day)*10.05 (Peso/min/veh) *60(min)*365(day)*
= 788 Million (Peso/year)

16.6 OPERATION AND EFFECT INDICATORS

Summarized Operation and effect indicators are shown in **Table 16.6-1.**

TABLE 16.6-1 OPERATION AND EFFECT INDICATORS

	Indicators	Road Name	Baseline (2013)	Target (2023)
Operation Indicators	Traffic Volume (vehicle /day) in case of toll collected at tunnel	Center Section(Waan Barangay, Tunnel)	-	6,689
		South Section(Mintal Barangay)	-	7,369
	Toll Revenue (Thousand Peso/day)	Tunnel Section		332
Effect Indicators	Travel Time (hr:min)	Barangay Sirawan – Sasa Port	1:27	Davao BP 0:47
	Travel Time Saving (hours / day)	Due to transferred traffic from Diversion Road to Sasa Port	-	3,580
	Travel Time Cost Saving(Peso/year)		-	788 Million

Note: Opening Year = Year 2021

[1] Traffic consists of not full bypass section users, such as the Sirawan- Davao Central, Davao-Bukidnon road –Sasa port, etc..

CHAPTER 17

HIGH OFFICIAL'S VISIT TO JAPAN AND TUNNEL SEMINAR

CHAPTER 17
HIGH OFFICIAL'S VISIT TO JAPAN AND TUNNEL SEMINAR

17.1 BACKGROUND

There is no long tunnel of more than500m in length in the Philippines, though the first tunnel in the Philippines, which is approximately 300m, was completed in 2013.The responsible agency (DPWH) has little experience in operation and maintenance of a long distance tunnel. The enhancement of knowledge regarding advanced technology on tunnel construction and sound management of the tunnel during and after its construction is important.

Japan resembles the Philippines in that the geology is very fragile, complicated and consists of faults and fractured zone as in the Philippines. However, Japan has rich, safe and reliable road network consisting numerous tunnels in the mountain areas. Japan has so far successfully constructed more than 9000 road tunnels by year 2011. Such achievement and experience have enabled the construction industry to develop innovative methods of tunnel construction.

Under such circumstances, inviting concerned officials of the Philippines to visit actual tunnel construction sites and management centers were planned under this project. The visits have been organized and implemented twice and the outline of these visits is briefly discussed hereunder. Seminar on Japan's Tunnel Technology was also undertaken in the Philippines.

17.2 HIGH OFFICIALS'S VISIT TO JAPAN

17.2.1 First Visit

(1) Period

The first visit was conducted for a period of three days from May14 to May17, 2014.

(2) Objective

The main objectives of the visit are;

i) To enhance understanding of the concerned officials regarding the importance of tunnels,
ii) To understand the technological level of Japanese contractors through observation of tunnel construction sites and operation and maintenance centers, and
iii) To share views with private companies related to construction of tunnels

(3) Participants

The team, headed by Assistant Secretary of Department of Public Works and Highways, was composed of three high ranking officials from three different organizations as listed in **Table 17.2-1**.

TABLE 17.2-1 LIST OF PARTICIPANTS

No.	Organization	Position
1.	Department of Public Works and Highways (DPWH)	Assistant Secretary
2.	Department of Finance (DOF)	Planning Officer
3.	National Economic Development Authority (NEDA)	Infrastructure Staff

(4) Program

The participants belonged to different organizations, DPWH, DOF and NEDA. Therefore the program of the visit included the contents to effectively observe tunnel construction sites and traffic control rooms and to enhance understanding of the role and importance of tunnels in a short period.

TABLE 17.2-2 OUTLINE OF PROGRAM

Date		Program hours	Training items		Stay
Date	Day		Type	Contents	
14, May	Wed	Leave Manila – Arrive in Tokyo			
15, May	Thu	9:00-13:00	Move	To Tochigi Prefecture	Tokyo
		13:00-15:30	Observe	Shimoshiobara 2nd Tunnel Construction Site	
		15:30-17:00	Move	To Tokyo	
16, May	Fri	10:00-15:00	Observe	Metropolitan Expressway Company (Traffic Control Room and Tunnel Construction Site)	Tokyo
		15:00-16:00	-	Courtesy Call on JICA	
17, May	Sat	Leave Tokyo – Arrive in Manila			

(5) Expected Outcome

After completion of the visit, the participants are expected to have;

i) Understood the topographic similarities between the Philippines and Japan and understand the role (importance) of tunnels in the road network,
ii) Experienced advanced tunneling technology of Japan that has been innovated and developed from basic tunneling methods by Japanese contractors for adaptability to the distinct topography, geology, and natural conditions of Japan. Also, observe the construction quality including health and safety control measures during construction

17.2.2 SECOND VISIT

(1) Period

The second visit was conducted for a period of five days from May 19, 2014 till May23, 2014.

(2) Objective

The objectives of the visit were similar to the first visit, except that the main participants of this visit were targeted for the high ranking officials of the Department of Public Works and Highways. Therefore, the objective of the visit was focused on the understanding technical aspects.

(3) Participants

The list of the participants is shown in **Table 17.2-3**. The participants include five directors from various divisions of DPWH; Bureau of Design, Planning Service, UPMO, PPP Service and Region XI.

TABLE 17.2-3 LIST OF PARTICIPANTS

No.	Organization	Position
1	DPWH	Director, Bureau of Design
2	DPWH	Director, Planning Service
3	DPWH	Director, Bilateral Cluster I, UPMO
4	DPWH	Director, PPP Service
5	DPWH	Director, Region XI

(4) Program

The program was focused on visits to tunnel construction sites. The outline of the program is summarized in **Table 17.2-4**.

TABLE 17.2-4 OUTLINE OF PROGRAM

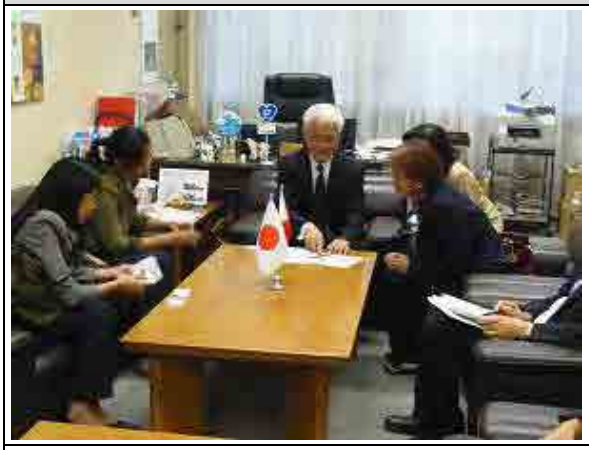
Date		Program hours	Training items		Stay
Date	Day		Type	Contents	
19, May	Mon	Leave Manila – Arrive in Tokyo			
20, May	Tue	9:00-13:00	Move	To Shimoshiobara City, Tochigi Prefecture	Tokyo
		13:00-16:00	Observe	Shimoshiobara 2nd Tunnel Construction Site	
		16:30-17:00	Move	To Tokyo	
21, May	Wed	10:00-12:00	Observe	Central Nippon Expressway Company (Communication Plaza Kawasaki and Traffic Control Center)	Shizuoka
		12:00-15:30	Move	To Shizuoka City, Shizuoka Prefecture	
22, May	Thu	9:15-15:10	Observe	Central Nippon Expressway Company (Tarutoge Tunnel Construction Site)	Tokyo
		12:00-15:30	Move	To Tokyo	
23, May	Fri	10:00-15:00	Observe	Metropolitan Expressway Company (Traffic Control Room and Tunnel Construction Site)	Tokyo
		15:00-16:00	-	Courtesy Call on JICA	
24, May	Sat	Leave Tokyo – Arrive in Manila			

(5) Expected Outcome

After completion of the visit, the participants are expected to have;

i) Understood the topographic similarities between the Philippines and Japan and understand the role (importance) of tunnels in the road network,
ii) Experienced advanced tunneling technology of Japan that has been innovated and developed from basic tunneling methods by Japanese contractors for adaptability to the distinct topography, geology, and natural conditions of Japan. Also, see the construction quality including health and safety control measures during construction, and
iii) Enhanced knowledge on the operation and maintenance of tunnel and understanding in formulation and smooth proceeding of the project.

ACTIVITY PICTURES DURING VISIT TO JAPAN

FIRST VISIT	SECOND VISIT
	
Coutesy call on Minstry of Land, Infrastructure, Transport and Tourism	Briefing on Shimoshiobara 2nd Tunnel
	
At Shimoshiobara 2nd Construction Site	Observation of Tarutoge Tunnel
	
Observation of Metropolitan Expressway Traffic Control Center	Atthe Tunnel Construction Site in Yokohama Circular Northern Route

17.3 TUNNEL SEMINAR IN THE PHILIPHINES

One day Seminar on the Japan's Tunnel Technology was held in the Philippines on June 3, 2014. Japanese tunnel experts including leading tunnel contractors were invited to make presentation on Japan's Tunnel Technology. From the Philippine side, experience of the first tunnel construction was presented. Seminar program is shown in **Table 17.3-1** and participants are shown in **Table 17.3-2.**

Table 17.3-1 SEMINAR PROGRAM ON JAPAN'S TUNNEL TECHNOLOGY

TIME	PROGRAM/TOPICS		SUB-TOPICS
8:30 - 9:00	Registration		-
9:00 - 9:05	Invocation & Philippine National Anthem		-
9:05 - 9:15	Welcome Address		-
9:15 - 9:25	Opening Speech		-
9:25 - 9:35	Introduction of Seminar		1. Objective of Seminar
9:35 - 9:45	*Break Time & Photo Session*		
9:45 - 10:05	Session-1	Japan's Tunnel Construction	2. Outline of Mountain Tunnels in Japan
10:05 - 10:35			3. Japan's Tunnel Technology
10:35 - 11:05			4. Construction Methodology "Mountain Tunneling for Vehicular Road in Japan"
11:05 - 11:15			5. Cooperation for tunnel by JICA
11:15 - 11:45			Session 1 Question/Answer
11:45 - 12:30	*Lunch Time*		
12:30 - 13:00	Session-2	Philippine Tunnel Construction	6.The Davao City Bypass Tunnel
13:00 - 13:30			7. Tunnel Construction Experience in the Philippines
13:30 – 14:00	Session-3	Tunnel Operation And Maintenance	8. Japan's Tunnel Operation and Maintenance
14:00 - 14:30			Session 2 and 3 Question/Answer
14:30 - 14:50	Closing Statement		-
14:50 - 15:00	Wrap-up		Conclusion and Recommendations
15:00 - 15:10	Fill-up Questionnaire		-

Table 17.3-2 PARTICIPANTS

OFFICE	DESIGNATION	No. of Participant
DPWH	UNDERSECRETARY	4
	ASSISTANT SECRETARY	3
	DIRECTOR/OIC-DIRECTOR	5
	ASSISTANT DIRECTOR	1
	REGIONAL DIRECTOR	9
	REGIONAL STAFF	7
	CENTRAL OFFICE STAFF	19
	JICA EXPERT	2
DAVAO CITY	PLANNING OFFICE	2
NEDA	REGION XI	1
DOTC	—	2
EMBASSYOF JAPAN	—	1
JICA PHILIPPINES	—	4
JICA HQ	—	1
JAPANESE SPEAKERS / JAPAN CONTRACTORS	—	8
JICA STUDY TEAM	—	4
TOTAL		73

ACTIVITY PICTURES DURING THE TUNNEL SEMINAR

Group Picture with DPWH Usecs and Asecs

Group Picture with the DPWH Directors

Group Picture with Davao attendees

Group Picture with DPWH Technical Staff