CHAPTER 8

PRELIMINARY DESIGN FOR UPGRADING OF ASUTSUARE–AVEYIME ROAD

Chapter 8 Preliminary Design for Upgrading the Asutsuare – Aveyime Road

8.1 Justification for Upgrading the Asutsuare – Aveyime Road

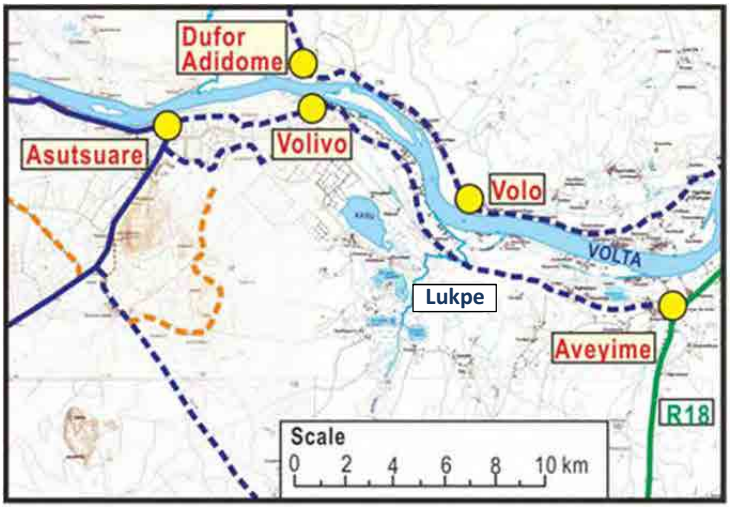
In the first phase of the Study, various positive impacts of upgrading the Asutsuare – Aveyime road were identified: 1) to connect the Green Belt area of Ghana, where there is great potential for agricultural production, particularly rice by an inter-regional standard road and thus facilitate the transportation of agricultural products, 2) to attract more investment in agricultural development along the road, in collaboration with implementation of the APGIP scheme, and 3) to provide direct access between the Eastern Corridor and N1 along the Volta River.

In view of these positive impacts, the Study Team considered that it is worth carrying out the F/S on upgrading the Asutsuare–Aveyime road.

8.2 Preliminary Design of Road

8.2.1 Road Category

According to the GHA, the category of feeder road Asutsuare–Aveyime will be changed in part to an inter-regional road connecting Somanya and N1 via Akuse, Asutuare, and Aveyime after the improvement is completed. The existing feeder road Asutsuare–Aveyime is a gravel road about 6.0 m wide for 24 km. This road passes through the centres of Asutsuare, Volivo and Aveyime townships.



Source: Study Team

Figure 8-1 Location of Asutsuare–Aveyime Road

8.2.2 Horizontal and Vertical Alignment

(1) Design Geometric Standard

After the completion of upgrading, the Asutsuare – Aveyime road will be categorised as an inter-regional road (trunk road) from the current feeder road. Thus, the design geometric

standard is based on the Road Design Guide of Ghana shown in Table 8-1.

The design speed of this road, which lies entirely on flat terrain, was set at 80 km/h based on the Road Design Guide. The proposed horizontal alignment basically follows the centreline of the existing unpaved road, which has been confirmed by the GHA, not only for economic reasons but also to minimise the resettlement of houses and other commercial buildings, and to reduce the impact on existing and future agricultural development schemes. On the other hand, the existing road alignments of sections passing through or beside the townships or communities of Asutsuare, Atrobinya, Volivo and Aveyime differ greatly from the design standard for the design speed of 80 km/h. According to the results of detailed site investigation and topographical survey, the Study Team noted that communities have formed along the existing road, especially in Aveyime Township, and that there are many bend sections in this area. Therefore, the Study Team proposes that the design speed for such sections be decreased to 50 km/h or less.

- Design speed for normal sections: 80 km/h
- Design speed in Aveyime Township: 40 to 50 km/h
- Design speed in other townships: 50 km/h

Table 8-1 Design Geometric Standard

Item		Values			
Design speed (km/h)		80	60	50	40
Minimum curve radius (m)	Desirable	420	220	150	100
	Absolute	230	130	85	50
Radius not requiring transition (m)		580	330	230	150
Minimum curve length (m)	IA > = 7	140	100	80	70
	IA = 2	500	350	300	250
Minimum transition length (m)		44	33	28	22
Curve radius where super elevation is unnecessary (m)		3,500	2,000	1,300	800
Standard gradient (%)		4	5	6	7
Maximum length for gradient (m)		5 (600m)	6 (500m)	7 (500m)	8 (400m)
		6 (500m)	7 (400m)	8 (400m)	9 (300m)
		7 (400m)	8 (300m)	9 (300m)	10 (200m)
K value		30	14	8	4

Source: Road Design Guide of Ghana

(2) Existing Cross Drainage Facilities to be Considered

There are several existing cross drainage facilities to be considered for the preliminary design for upgrading of the Asutsuare–Aveyime road listed in Table 8-2.

Table 8-2 Existing Cross Drainage Facilities between Asutsuare and Aveyime

Station		Existing Drainage Facilities	Remarks
1	No.0+520	B12.0 H1.0	Open drain (KIP)
2	No.0+718	B4.5 H1.0	Open drain (KIP)
3	No.1+747	Pipe D900 @1 L=5.5	
4	No.2+450	Pipe D900 @1 L=5.5	
5	No.3+540	Pipe D900 @1 L=5.5	
6	No.3+920	Pipe D900 @1 L=5.5	
7	No.6+550	Pipe D900 @1 L=5.5	
8	No.8+310	Pipe D900 @1 L=5.5	
9	No.8+950	Pipe D900 @1 L=5.5	
10	No.9+264	Pipe D900 @1 L=5.5	
11	No.9+350	Pipe D900 @1 L=5.5	
12	No.10+300	Pipe D900 @1 L=5.5	
13	N0.14+784	Box B2.5 H3.3 @2 W=10.4m	Lupu River
14	No.15+405	Pipe D900 @2 L=9.1m	
15	No.17+710	Pipe D1700 @2 L=11.8m	Newly built instead of one at No.17+870
16	No.17+720	Pipe D1800@4 L=11.8m	No functioning
17	No.17+932	Pipe D600 @2 L=8.8m	
18	No.18+750	Pipe D900 @1 L=14.8m	
19	No.18+990	Box B1.0 H1.0 @1 L=6.4m	
20	No.21+294	Box B1.0 H1.0 @1 L=6.4m	
21	No.20+937	Box B1.0 H1.0 @1 L=6.4m	
22	No.21+297	Box B1.0 H1.0 @1 L=6.4m	
23	No.21+350	Box B1.0 H1.0 @1 L=6.4m	
24	No.21+658	Box B1.0 H1.0 @1 L=6.4m	
25	No.22+204	Box B1.0 H1.0 @1 L=8.1m	
26	No.22+281	Box B1.0 H1.0 @1 L=6.4m	

Source: Study Team

(3) Crossing Existing Roads to be Considered

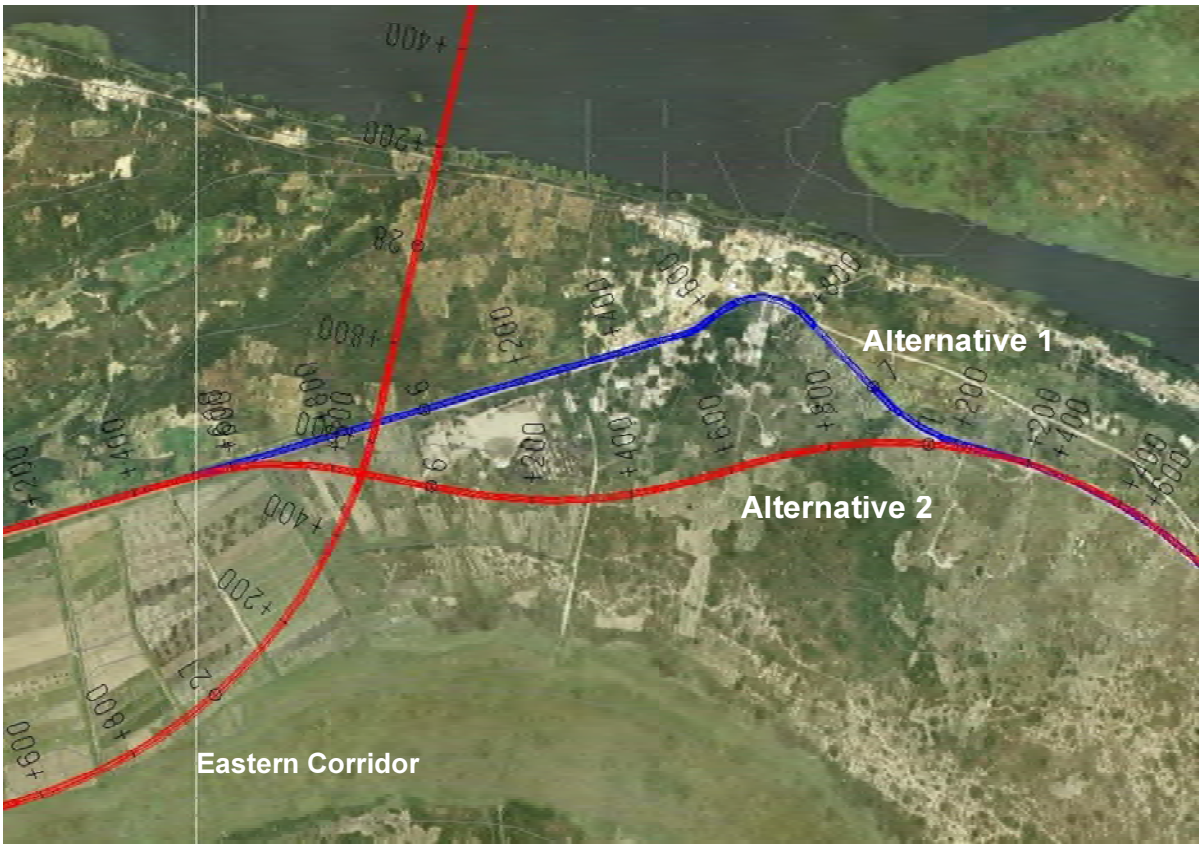
There is no classified cross road other than minor gravel feeder roads.

(4) Comparison of Horizontal Alignment

Although the centreline of the road to be upgraded between Asutsuare and Aveyime basically follows the existing centreline, the Study Team compared the existing alignment (Alternative 1) and a bypass alignment (Alternative 2) around Volivo Township because it would be possible to construct a bypass route to south part of the township to avoid the residential area as shown in Table 8-3.

A bypass route would improve traffic functions as an inter-regional road by applying a radius of curvature corresponding to the design speed of 80 km/h and would increase traffic safety by improving the intersection angle with the Eastern Corridor. It would also reduce the risk of accidents impact on the living environment and construction cost. Thus, the Study Team recommends a bypass alignment (Alternative 2).

Table 8-3 Comparison of Alignments in Volivo Township



Item	Alternative 1 (Blue line)		Alternative 2 (Red line)	
Route (Station)	Following the existing road passing through the residential area (5 km+450 to 7 km+350)		Shifting to the south of Volivo Township to bypass the residential area (5 km+450 to 7 km+200)	
Alignment	R = 120m (50 km/h) Less smooth traffic		R = 600m, 1000m (80 km/h) More smooth traffic	+
Intersection angle with Eastern Corridor	60° Minimum standard		83° Greater traffic safety	+
Traffic accidents	High risk due to passing through the residential area and in front of a school		Low risk	+
Impact on living environment	Direct influence of noise and exhaust gas		Indirect influence of noise and exhaust gas	+
Impact on regional economy	Direct impacts	+	Indirect impacts	
Construction cost (Ratio)	US$1.5 million (1.07)		US$1.4 million (1.00)	+
Evaluation	**1 +**		**5 +**	
	As Alternative 2 is advantageous as an inter-regional road.			

Source: Study Team

8.2.3 Pavement Design

(1) Design Approach

a) Design Criteria

The Ghana Pavement Design Manual presents methods for the pavement design of new roads and rehabilitation of existing ones. This manual is an adaptation of the AASHTO design manual (1993) for local conditions. Thus, the pavement design is examined based on the Ghana

Pavement Design Manual and the AASHTO Design Manual.

b) Type of Works

The Asutsuare–Aveyime road (No. 00 +000 to No. 24 +105) will be upgraded from the existing unpaved road (W=6m) to the paved road (W=11.3m).

c) Design Period

The performance period of a pavement is from the time of construction until the pavement needs to be reconstructed or rehabilitated. It can also be considered as the length of time that it takes for the pavement to deteriorate from its initial serviceability to its terminal serviceability.

The design period (analysis period) is 20 years, from the year of starting traffic service in 2016 to the project development target year of 2036.

(2) Design Conditions

a) Design Traffic

The design traffic for the pavement design is based on the forecast of traffic demand shown in Table 8-4. ADT on the Asutsuare–Aveyime road is 4,216 vehicles per day in 2016 and 5,339 in 2036.

Table 8-4 Design Traffic on the Asutsuare–Aveyime Road

Vehicle Type	2016	2036
	ADT (vehicles per day)	
Passenger Car/Pick-up	1,716	2,397
Minibus	1,478	1,183
Bus	371	370
Medium truck	234	246
Heavy truck	225	515
Trailer	189	621
Others	3	7
Total	**4,216**	**5,339**

Source: Study Team

b) Design ESAL

Design ESAL is calculated based on the design traffic and 80 kN LEF, which is set taking into account the weighted average by type of vehicle running on the trunk road networks in Ghana. The design ESAL for the Asutsuare–Aveyime road is 13.884 E6 shown in Table 8-5.

c) Subgrade Strength (Design CBR)

Subgrade strength defined by the design CBR is calculated based on the results of CBR testing of this upgrading section by the Study Team as follows:

PIT-3 13% (CBR testing)
PIT-4 26% (CBR testing)
PIT-5 15% (CBR testing)
PIT-6 10% (CBR testing)
Design CBR 9% (= 9.0%)

Table 8-5 Design ESAL for the Asutsuare–Aveyime Road

Type	Design Traffic	Load Equivalency Factor	Design ESAL
Passenger Car/Pick-up	7,441,037	0.0600	446,527
Minibus	4,837,384	0.0387	187,207
Bus	1,355,867	0.2120	287,498
Medium truck	875,948	0.7833	686,129
Heavy truck	1,287,833	5.4362	7,000,918
Trailer	1,340,447	3.9346	5,274,163
Others	23,046	0.0600	1,383
Total			**13,883,825**

Source: Study Team

d) Resilient Modulus

Resilient modulus test was carried out in order to determine the effective road soil M_R for the Asutsuare-Aveyime Road by the Study Team with the cooperation of the GHA. From the results of calculation based on the Ghana Pavement Design Manual, the effective road soil M_R obtained 19 Mpa which is equivalent to 2,740 psi

f) Structural Number

The basic formula for the pavement structural number to determine flexible pavement thickness is as follows. The structural number of each section is shown in Table 8-6.

$$\log_{10}(W_{18}) = Z_R \times S_o + 9.36\log_{10}(SN+1) - 0.20 + \frac{\log_{10}\left[\frac{\Delta PSI}{4.2-1.5}\right]}{0.4 + \frac{1094}{(SN+1)^{5.19}}} + 2.32\log_{10}(M_R) - 8.07$$

where:

W_{18} : Number of 80 kN single axle load applications
Z_R : Standard normal deviation corresponding to selected reliability
S_O : Overall standard deviation
SN : Structural number
ΔPSI : Design serviceability loss
M_R : Roadbed soil resilient modulus (psi)

Table 8-6 Structural Number for the Asutsuare–Aveyime Road

Item		Value
W_{18}	Number of 80 kN single axle load applications (million ESAL)	13.884
R	Reliability level (%)	95
Z_R	Standard normal deviation corresponding to selected reliability	-1.645
S_O	Overall standard deviation	0.45
CBR	California Bearing Ratio (%)	9
M_R	Roadbed soil resilient modulus	2,740
P_O	Initial serviceability	4.5
P_T	Terminal serviceability	2.5
ΔPSI	Design serviceability loss	2.0
SN	**Structural Number**	**7.07**

Source: Study Team

(3) Pavement Thickness

a) Minimum Pavement Thickness

The minimum pavement thickness is shown in Table 8-7.

Table 8-7 Minimum Pavement Thickness for the Asutsuare–Aveyime Road

ESAL	Minimum Thickness, mm (in)		
	Asphalt Concrete	Aggregate Base	Sub-base
50,001 - 150,000	50 (2.0)	150 (6.0)	150 (6.0)
150,000 - 1,000,000	50 (2.0)	150 (6.0)	150 (6.0)
1,000,000 - 2,000,000	50 (2.0)	200 (8.0)	200 (8.0)
2,000,000 - 5,000,000	76 (3.0)	200 (8.0)	200 (8.0)
5,000,000 - 9,000,000	102 (4.0)	200 (8.0)	200 (8.0)

Source: Ghana Pavement Design Manual

b) Strength Coefficient

Asphalt concrete wearing a = 0.44
Asphalt concrete binder a = 0.34
Base course (crushed stone) a = 0.14
Cement stabilised sub-base a = 0.28
Subbase a = 0.13

c) Pavement Structure

The Structural Number (SN) is equal to the structural number indicative of the total pavement thickness required, and is given by:

$$SN = a_1 d_1 + a_2 d_2 + a_3 d_3 m_3$$

where:

a_i : i^{th} layer coefficient
d_i : i^{th} layer thickness (inches)
m_i : i^{th} layer drainage coefficient

d) Recommended Pavement Thickness

Option 1 is recommended for the pavement thickness for economic reasons as well as greater durability against the weather thanks to its higher impermeability and strength of sub-base course.

Table 8-8 Recommended Pavement Thickness for the Asutsuare–Aveyime Road

Item	Option 1	Option 2
Asphalt Concrete Wearing	5cm	5cm
Asphalt Concrete Binder	5cm	5cm
Base Course	35cm	25cm
Cement Stabilised Sub-base Course	-	20cm
Sub-base Course	71cm	39cm
SN	7.10 > 7.07…OK	7.12 > 7.07…OK
Cost (ratio)	US$ 47.40 /m^2 (1.00)	US$ 58.73 /m^2 (1.24)
Evaluation	**Recommended**	

Source: Study Team

8.2.4 Road Drainage

a) Planned Facilities

The inner sizes of planned facilities such as road culverts are determined taking into account

the following:

- Compare the inner sizes of existing facilities with the minimum requirement of facilities, and then adopt the planned facilities as shown in Table 8-9.
- Secure an inner size of planned box culverts of at least B1.0 H1.0 and planned pipe culverts of at least D900 considering efficiency of maintenance works.

Table 8-9 Planned Culverts for the Asutsuare–Aveyime Road

Station		Existing Facilities	Minimum Requirement	Planned Facilities	Remarks
1	No.0+520	B12.0 H1.0 (open)	Box B3.1 H2.3	Box B3.1 H2.3	Newly
2	No.0+718	B4.5 H1.0 (open)	Alignment sifted	No required	Filled
3	No.1+747	Pipe D900 @1	Pipe D900 @1	Pipe D900 @1	Newly
4	No.2+450	Pipe D900 @1	Pipe D900 @1	Pipe D900 @1	Newly
5	No.3+540	Pipe D900 @1	Pipe D900 @1	Pipe D900 @1	Newly
6	No.3+920	Pipe D900 @1	Pipe D900 @1	Pipe D900 @1	Newly
7	No.6+550	Pipe D900 @1	Pipe D900 @1	Pipe D900 @1	Newly
8	No.8+310	Pipe D900 @1	Pipe D900 @1	Pipe D900 @1	Newly
9	No.8+950	Pipe D900 @1	Pipe D900 @1	Pipe D900 @1	Newly
10	No.9+264	Pipe D900 @1	Pipe D900 @1	Pipe D900 @1	Newly
11	No.9+350	Pipe D900 @1	Pipe D900 @1	Pipe D900 @1	Newly
12	No.10+300	Pipe D900 @1	Pipe D900 @1	Pipe D900 @1	Newly
13	N0.14+850	Box B2.5 H3.3 @2 W=10.4m	Box B2.5 H3.3 @2	Box B2.5 H3.3 @2	Newly
14	No.15+405	Pipe D900 @2 L=9.1m	Pipe D900 @2	Pipe D900 @2	Newly
15	No.17+710	Pipe D1700 @2 L=11.8m (New),	Pipe D1700 @2	Pipe D1700 @2	Extension
16	No.17+720	Pipe D1800@4 L=11.8m (Old)	-	No required	Removal
17	No.17+932	Pipe D600 @2 L=8.8m	Pipe D900 @2	Pipe D900 @2	Newly
18	No.18+750	Pipe D900 @1 L=14.8m	Pipe D900 @1	Pipe D900 @1	Newly
19	No.18+990	B1.0 H1.0 @1 L=6.4m	Box B1.0 H1.0	Box B1.0 H1.0	Newly
20	No.20+294	B1.0 H1.0 @1 L=6.4m	Box B1.0 H1.0	Box B1.0 H1.0	Newly
21	No.20+937	B1.0 H1.0 @1 L=6.4m	Box B1.0 H1.0	Box B1.0 H1.0	Newly
22	No.21+350	B1.0 H1.0 @1 L=6.4m	Box B1.0 H1.0	Box B1.0 H1.0	Newly
23	No.21+658	B1.0 H1.0 @1 L=6.4m	Box B1.0 H1.0	Box B1.0 H1.0	Newly
24	No.22+174	B1.0 H1.0 @1 L=8.1m	Box B1.0 H1.0	Box B1.0 H1.0	Newly
25	No.22+281	B1.0 H1.0 @1 L=6.4m	Box B1.0 H1.0	Box B1.0 H1.0	Newly

Source: Study Team

8.2.5 Intersection Design

The Volivo Intersection is a new intersection with four arms where the Eastern Corridor and the Asutsuare–Aveyime road cross. The new Volivo Intersection will be opened to traffic in 2016. It is recommended to introduce roundabout at this intersection for ensuring proper traffic handling as mentioned in Chapter 7.

8.2.6 Traffic Safety and Management

(1) Traffic Safety and Management

a) Guardrails

Guardrails are required where there is a high embankment of more than 4 m and at other necessary sections. Since the height of the embankment between Asutsuare and Aveyime is less

than 2 m, guardrails are not required in terms of embankment height.

b) Road Signs and Markings

Appropriate pavement markings are provided to control traffic movement, and to warn and guide motorists and pedestrians. Generally, a broken guiding line is provided as a centreline where the sight distance is adequate. Where the sight distance is inadequate, a continuous full marked centreline is provided. Edge line markings are also provided on both sides of the road.

The following road signs are placed in appropriate locations:

- Danger Warning signs such as Hump Ridge, Pedestrian Crossing, Road Crossing and Traffic Signals
- Regulatory signs such as Maximum Speed Limit
- Information signs such as direction of destination at proper locations

c) Pedestrian Crossing

In large settlements where pedestrians cross the road, apart from the mandatory speed limit sign of 50 km/h, pedestrian crossing points are indicated by zebra stripes and signs.

d) Traffic Calming Measures

The speed of vehicles travelling through populated areas is likely to be one of the most important safety issues. Because one of the main problems will be conflict between vehicles and pedestrians, pedestrian crossing points should be separated from through traffic. This should be done by using speed humps and/or a raised carriageway with pedestrian crossings. Humps should be used on roads with speed limits of 50 km/h or less through town or village areas with many pedestrians on roads. It is recommended that humps should be constructed as trapezoidal humps (4.0 m in width and 75 mm in height) at pedestrian crossings.

e) Bus Bays

Bus bays are provided along the proposed road where necessary such as around Asutsuare, Volivo and Aveyime.

8.3 Implementation Programme for Upgrading the Asutsuare – Aveyime Road

8.3.1 Construction Method and Material/Equipment Procurement

(1) Timing of Construction

Annual rainfall of the project site is approximately 600 mm and monthly rainfall during rainy season from May to September is approximately 100 mm. Under this situation, implementation of major works such as earth works and pavement works should be considered to avoid rainy season.

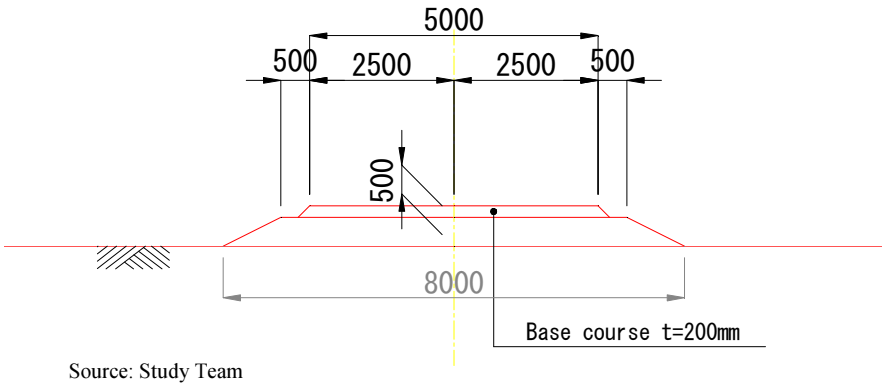
(2) Quality Management of Concrete Works

The project site is tropical climate. Under such warm temperature, there are possibilities to drop slump value of concrete mixtures and bring rapid moisture evaporation, which result in deteriorating concrete quality. Thus, it is recommended to use hot weather concrete in aspects of

quality management of concrete works.

(3) Traffic Control during under Construction

Proposed alignment between Asutsuare and Aveyime basically follows the existing centerline. Although there could be less traffic flows during under construction, it is required to secure proper traffic during under construction by providing detours as shown Figure 8-2.



Source: Study Team

Figure 8-2 Typical Cross Section of Detour

(4) Relocation and Removal

There are some sections to be set electric poles and lines on roadsides. There are possibilities that they are obstacles to constructing the proposed road. Relocation and removal of the existing electric poles and lines are needed if electric poles are within the road width.

(5) Procurement of Construction Materials and Equipment

Same contents as discussed in Chapter 7 (7.4.2).

8.3.2 Implementation Schedule

(1) Construction of Sections

Total road length is 24.1 km, which is no needed to divide sections. Implementation schedule is considered construction period of three years from 2014 to 2016 as same as the construction of the road between Asutsuare Jct. and Asikuma Jct.

(2) Construction Schedule

Overall construction schedule of upgrading the Asutsuare – Aveyime road is shown in Table 8-10.

Table 8-10 Implementation Schedule of Upgrading the Asutsuare – Aveyime Road

Description	1st Year												2nd Year												3rd Year											
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	25	27	28	29	30	31	32	33	34	35	36
Selection of Consultant																																				
Detailed Design																																				
Tender Process for Contractor																																				
Road Works																																				
- Mobilization & Preparatory Works																																				
- Construction of Detour																																				
- Earthworks																																				
- Pavement Works																																				
- Drainage Works																																				
- Road Apparatus Works																																				

Source: Study Team

CHAPTER 9
PRELIMINARY COST ESTIMATION

Chapter 9 Preliminary Cost Estimation

9.1 Unit Prices Adopted in the Study

(1) Methodology

It is required to identify unit prices by work item based on the preliminary design in order to estimate the construction cost. The Study Team obtained lists of the latest unit prices (2012) including manpower and materials which are employed by the Quantity Surveying Division of the GHA as well as price lists of earth works and transportation. The Study Team estimated the construction cost based on those data and information.

(2) Setting Unit Prices

Unit prices for constructing roads and bridges are summarised in Table 9-1. The construction costs of box culverts was estimated by setting an approximation for typical internal dimensions and construction cost because there are many sizes of culvert. The correlation between internal cross section area and construction cost is shown in Figure 9-1.

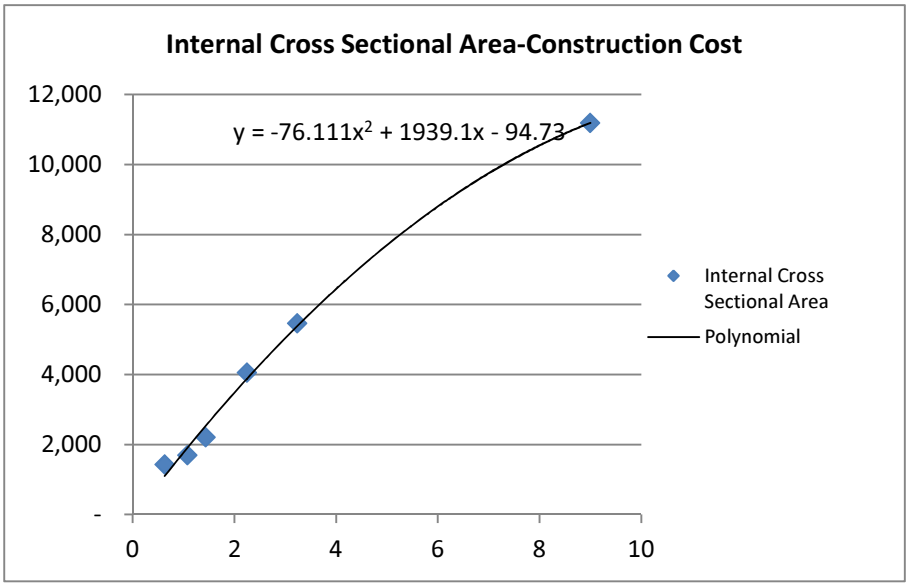
Table 9-1 Unit Prices (1)

Description		Unit	Unit Price (GHS)	Unit Price (US$)
1	Preliminary & general works			
	- Construction cost x 10%	Set	-	-
2	Earthworks			
	- Clear site	m^2	0.37	0.24
	- Excavation	m^3	23.82	15.77
	- Fill (replacement soil)	m^3	34.20	22.65
	- Fill (borrow soil)	m^3	34.20	22.65
3	Pavement			
	(1) Carriageway pavement 1	m^2	108.71	78.46
	- Asphalt surface course : 5 cm	m^2	33.52	22.20
	- Asphalt base course : 5 cm	m^2	33.52	22.20
	- Base course : 25 cm	m^2	4.99	3.31
	- Cement Stabilised Sub-base course : 25 cm	m^2	37.50	24.83
	- Subbase Course : 48cm	m^2	8.94	5.92
	(2) Carriageway pavement 2	m^2	107.71	71.33
	- Asphalt surface course : 5 cm	m^2	33.52	22.20
	- Asphalt base course : 5 cm	m^2	33.52	22.20
	- Base course : 20 cm	m^2	4.67	3.09
	- Subbase course (PCC) : 24 cm	m^2	36.00	23.84
	(3) Carriageway pavement 3	m^2	81.72	59.02
	- Asphalt surface course : 5 cm	m^2	33.52	22.20
	- Asphalt base course : 5 cm	m^2	33.52	22.20
	- Base course : 35 cm	m^2	7.17	5.46
	- Subbase course : 71 cm	m^2	7.51	9.16
	(4) Shoulder pavement	m^2	40.31	26.70
	- Asphalt surface course : 5 cm	m^2	33.52	22.20
	- Base course : 15 cm	m^2	3.58	2.37
	- Subbase course : 15 cm	m^2	3.21	2.12

Table 9-1 Unit Prices (2)

Description		Unit	Unit Price (GHS)	Unit Price (US$)
4	Drainage			
	(1) Pipe culvert			
	- Pipe D900 @1	m	341	226
	- Pipe D900 @2	m	682	452
	- Pipe D1700 @2	m	2,264	1,499
	(2) Box culvert			
	- Box B1.0 H1.0 @1	m	1,800	1,192
	- Box B1.2 H1.0 @1	m	2,200	1,457
	- Box B1.2 H1.2 @1	m	2,600	1,722
	- Box B1.4 H1.0 @3	m	7,500	4,967
	- Box B1.8 H1.3 @1	m	4,100	2,715
	- Box B2.0 H1.2 @3	m	12,400	8,212
	- Box B2.5 H1.0 @1	m	4,300	2,848
	- Box B3.1 H2.3@1	m	9,900	6,556
	- Box B2.5 H3.3 @2	m	21,400	14,172
	- Box B4.0 H2.6 @1	m	11,900	7,881
	- Box B5.0 H2.0 @3	m	35,100	23,245
5	Structure			
	- Concrete σck=24 N/mm^2	m^3	374.00	247.68
	- Formwork	m^2	30.00	198.68
	- Levelling using concrete σck=18 N/mm^2	m^3	250.00	165.56
	- Reinforced bar SD345	kg	2.86	1.89
	- Scaffolding	m^2	90.00	59.60
6	Road Apparatus			
	(1) Traffic sign	unit	350	232
	(2) Pavement marking	km	7,200	4,768
	(3) Traffic signal	unit	4,000	2,649
	(4) Toll booth	unit	1,500,000	993,377
	(5) Bus bay	unit	4,000	2,649
	(6) Rest Stop			
	- Clear site	m^2	0.37	0.25
	- Parking area			
	Asphalt surface course : 5 cm	m^2	33.52	22.20
	Asphalt base course : 5 cm	m^2	33.52	22.20
	Base course : 30 cm	m^2	7.17	4.75
	Subbase course : 35 cm	m^2	7.51	4.97
	- Other area			
	Asphalt surface course : 5 cm	m^2	33.52	22.20
	Base course : 15 cm	m^2	3.58	2.37
	Subbase course : 15 cm	m^2	3.21	2.13
7	Detour W=5.0 m	m^2	39.24	25.99
	- Clearing	m^2	0.37	0.25
	- Fill (borrow soil)	m^3	34.20	22.65
	- Crushed stone t=20 cm	m^2	4.67	3.09

Source: Study Team



Source: Study Team

Figure 9-1 Correlation between Internal Cross-Sectional Area and Construction Cost

9.2 Estimation of Project Cost

(1) Conditions of Estimated Project Cost

The project cost of the road between Asutsuare Jct. and Asikuma Jct. was estimated by multiplying the above unit costs and quantities obtained from the results of the preliminary design of roads and bridges.

The cable-stayed bridge was selected through the preliminary design as the most suitable bridge type. However, there is no experience of constructing this type of bridge in Ghana. Furthermore, various special materials as well as large construction equipment will need to be procured from foreign countries.

(2) Assumption Used to Estimate Project Cost

The following assumptions were used to estimate the project cost.

- Exchange rate: US$ 1 = GHS 1.51 = JPY 78.2
- Price escalation: Foreign currency = 1.6%, Local currency = 0.0%
- Physical contingency: Construction = 5.0%, Consulting = 5.0%
- Taxes: VAT = 15.0%, Import tax = 18.4%
- Administrative cost: 1.5%
- Interest during construction: Construction = 1.4% , Consulting = 1.4%
- Unit man-month rates for international professionals, and Ghanaian professionals and support staff for the consulting services were obtained from JICA and the Quantity Surveying Division of the GHA, respectively.

(3) Cost Breakdown for Construction Works

The results of the cost breakdown for the construction works by each section are shown in Tables 9-2 and 9-3.

Table 9-2 Cost Breakdown of Construction of Road between Asutsuare Jct. and Asikuma Jct. (Eastern Corridor)

Item	Cost		Total
	Foreign (US$ 1,000)	Local (GHS 1,000)	(US$ 1,000)
Section 1 (Asutsuare Jct. – Volta River: 28.3 km)			
Preliminary & general works	382	5,636	4,114
Detour	585	493	911
Earthworks	12,630	10,601	19,650
Pavement	9,581	10,767	16,711
Drainage	129	388	386
Bridge	950	2,688	2,730
Road Apparatus	81	450	379
Total	24,338	31,023	44,883
Section 2 (Bridge across Volta River: 520 m)			
Temporary works	11,480	1,555	12,509
Substructure	1,901	2,674	3,672
Superstructure	49,160	5,118	52,549
Total	62,541	9,347	68,731
Section 3 (Volta River – Asikuma Jct.: 38.4 km)			
Preliminary & general works	544	8,033	5,864
Earthworks	19,814	16,617	30,819
Pavement	12,610	14,272	22,062
Drainage	280	845	840
Bridge	950	2,688	2,730
Road Apparatus	823	1,190	1,611
Total	35,021	43,645	63,925
Total of Whole Section	121,900	84,015	177,539

Source: Study Team

Table 9-3 Cost Breakdown of Construction for Upgrading of the Asutsuare – Aveyime Road

Item	Cost		Total
	Foreign (US$ 1,000)	Local (GHS 1,000)	(US$ 1,000)
Preliminary & general works	169	3,490	1,818
Detour	1,293	2,088	2,014
Earthworks	2,373	1,911	3,539
Pavement	6,432	7,542	11,427
Drainage	182	576	563
Road Apparatus	65	392	324
Total	10,514	13,998	19,784

Source: Study Team

(4) Estimated Project Cost

Estimated project costs are summarised in Tables 9-4 and 9-5.

Table 9-4 Estimated Project Cost of Construction of Road between Asutsuare Jct. and Asikuma Jct. (Eastern Corridor)

Item	Foreign Portion US$ (1000)	Local Portion GHS (1000)	Total US$ (1000)
Section 1			
1. Construction Cost	24,338	31,023	44,883
2. Consulting Services	2,925	3,454	5,212
3. Land Acquisition and Compensation	-	2,972	1,968
4. Other Costs*	5,592	16,564	14,431
Total Project Cost	32,855	54,013	66,494
Section 2			
1. Construction Cost	62,541	9,347	68,731
2. Consulting Services	4,563	5,388	8,131
3. Land Acquisition and Compensation	-	-	-
4. Other Costs*	8,724	25,840	22,513
Total Project Cost	76,828	40,575	99,375
Section 3			
1. Construction Cost	35,021	43,645	63,925
2. Consulting Services	4,212	4,974	7,506
3. Land Acquisition and Compensation	-	4,033	2,671
4. Other Costs*	8,053	23,852	20,781
Total Project Cost	47,286	76,504	94,883
Whole Section	155,969	171,091	260,752

Note: * Other costs include price escalation, physical contingency, administration cost, VAT, import tax, interest during construction, and commitment charge.

Source: Study Team

Table 9-5 Estimated Project Cost of Upgrading of Asutsuare – Aveyime Road

Item	Foreign Portion (US$ thousand)	Local Portion (GHS thousand)	Total (US$ thousand)
1. Construction Cost	10,514	13,998	19,784
2. Consulting Services	2,281	3,219	4,413
3. Land Acquisition and Compensation	-	1,239	820
4. Other Costs*	1,885	8,067	7,228
Total Project Cost	14,680	26,523	32,245

Note: * Other costs include price escalation, physical contingency, administration cost, VAT, import tax, interest during construction, and commitment charge.

Source: Study Team

9.3 Maintenance Cost

(1) Maintenance Activities

Road maintenance activities implemented by the GHA are shown in Tables 9-6 and 9-7. Such maintenance activities have been done mainly by private contract since the early 1980s, and almost all are now done privately, except urgent repair works.

The section between Asutsuare Jct. and Asikuma Jct., and the Asutsuare–Aveyime road will require recurrent works for the first five years, after which routine and periodic maintenance

will be carried out.

Table 9-6 Category of Road Maintenance Activities implemented by GHA

	Maintenance Category	Contents
1	Periodic Work	Large scale works including overlaying of paved road, paving for unpaved road and confirming the standard
2	Routine Work	Small scale works including cleaning of roadside ditches and culverts, and patching of pavement
3	Recurrent Work	Cutting down weeds and cleaning gutters by private contracts six times a year

Source: JICA Preparatory Survey for Programme on the Eastern Corridor in Ghana, September 2010

Table 9-7 Frequency and Method of Road Maintenance Activities

	Maintenance Category	Frequency	Method	Contents
1	Periodic Work	Once every three years	Private contract (two-year contract)	Repair and/or sealing of existing paved road for specified sections (approximately 4 – 5 km)
2	Routine Work	Once a year	Private contract (two-year contract)	Monitoring of potholes and patching works
3	Recurrent Work	Six times a year	Individual contract (one-year contract)	Cutting down weeds and cleaning gutters for large sections of 30 km or small sections of 5 km

Source: JICA Preparatory Survey for Programme on the Eastern Corridor in Ghana, September 2010

(2) Estimated Maintenance Cost

The maintenance costs for the road section between Asutsuare Jct. and Asikuma Jct., and the Asutsuare–Aveyime road are shown in Table 9-8.

Table 9-8 Estimated Maintenance Cost

Section		Routine Maintenance	Periodic Repairs	Periodic Inspection of Bridges	Total	
			For Twenty Years	Every 5 years	US$ 1,000	GHS 1,000
Asutuare Jct. – Asikuma Jct.						
Section 1	Asutsuare – Volivo	418,496	29,515,360	7,658	29,942	56,290
Section 2	Volivo – Dufor Adidome (Bridge Accross Volta River)	—	—	50,027	50	94
Section 3	Dufor Adidome – Asikuma Jct.	575,432	40,583,620	7,658	41,167	77,393
Total		993,927	70,098,980	65,343	71,158	133,778
Asutsuare–Aveyime road		768,678	12,807,557	—	13,576	25,523

Source: Study Team

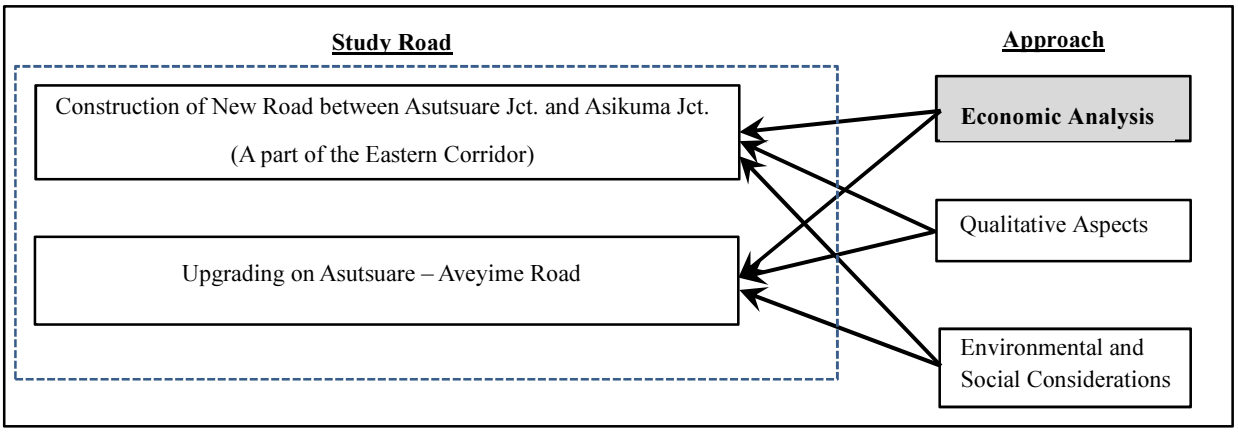
CHAPTER 10
ECONOMIC ANALYSIS

Chapter 10 Economic Analysis

10.1 Methodology for Economic Analysis

10.1.1 Methodology by HDM-4 Model

The project evaluations on both the construction of the new road between Asutsuare Jct. and Asikuma Jct. on the Eastern Corridor and upgrading of the Asutsuare – Aveyime road were carried out from three points of view: i) Economic Analysis, ii) Qualitative Aspects and iii) Environmental and Social Considerations. Of these evaluations, this chapter describes the economic analysis.



Source: Study Team

Figure 10-1 Project Evaluation Approach

In order to analyse the economic feasibilities of the projects, the economic analysis was conducted by using the "Highway Development and Management model (HDM-4)", which was produced by the WB and is widely used for economic evaluation and other studies to support decision-making by implementing agencies. This model is based on a comparison of costs and benefits under two scenarios: "With the project" and "Without the project". All costs and benefits are valued in monetary terms and expressed in economic prices. The results are expressed in terms of Economic Internal Rate of Return (EIRR) and Net Present Value (NPV).

10.1.2 Opportunity Cost of Capital and Discount Rate

The opportunity cost of capital, which is used as the cut-off ratio to judge the economic viability of projects and as the discount rate to calculate NPV, is set at 12.0% in accordance with the indication by the WB. This rate is commonly used for development projects in Ghana.

10.1.3 Economic Benefits

Economic benefits are directly generated from a project in general. In the Study, those quantitative benefits were defined as i) Savings in Road User Costs, ii) Savings in Maintenance Costs and iii) Induction of agricultural development. The expected benefits produced by this project are described below.

(1) Savings in Road User Costs

Savings in road user costs mainly consists of travel time and vehicle operation costs, which are incorporated in economic benefits in this study.

a) Savings in Travel Time Cost

The new road will connect Asutsuare Jct. to Asikuma Jct. and consequently allow vehicles to move faster due to the high-standard road design as an international corridor. In addition, the new bridge across the Volta River will enable freight trucks with long trips to divert from the Central Corridor to the Eastern Corridor, which is impassable for heavy vehicles at present due to deterioration of the Adomi Bridge. Furthermore, upgrading of the Asutsuare – Aveyime road will also shorten the travel time due to the use of high-performance asphalt pavement with a smooth surface.

The savings in vehicle Travel Time Cost (TTC) were calculated in comparison with the time values under the two scenarios, “With the Project” and “Without the project”. The applied traffic models are described in Chapter 10.2.2.

b) Savings in Vehicle Operating Cost

Vehicle Operating Cost (VOC) will also decrease as a result of the road surface improvement and use of shorter routes. The VOC in each scenario was estimated in consideration of fuel, oil, and tyre consumption and other relevant items. Consequently, the saving in VOC for the respective scenarios.

(2) Decrease in Road Agency Cost

The development of the proposed new Eastern Corridor is expected to cause traffic to divert from the central corridor and will lead to a decrease in road maintenance frequency and cost on the central corridor and to an increase in maintenance cost on the Eastern Corridor. The savings/additional costs are included as benefits or costs within the model. Road agency costs including project and maintenance costs under each scenario on the defined road network are estimated and compared in the study.

(3) Induction of Agricultural Development

The soil along the new road section between Asutsuare Jct. and Asikuma Jct. is good for cultivation. In particular, 25,000 ha. of arable land with Vertisols soil, which is one of the best soils for cultivation, on the northern side of the Volta River has not been developed mainly due to the lack of an access road to transport agricultural products, as described in Section 2.7.1. Since private companies are interested in this area, if a new bridge is constructed, economic benefits arising from agricultural development in this area can be considered as one of the benefits for the economic evaluation.

10.2 Assumptions and Calibration

10.2.1 Basic Assumptions

The analysis period of the projects was determined to be 20 years plus the construction period of the respective projects. Both roads are assumed to be opened to traffic in 2016 following the

construction period of three and two years. The basic assumptions of each project are shown in the table below.

Table 10-1 Basic Assumptions

Item	Construction of New Road between Asutsuare Jct. and Asikuma Jct.	Asutsuare – Aveyime Road
Project Type	New Construction	Upgrading
Cost Estimation Year	2012	2012
Construction Period (Years)	3	2
Construction Start Year	2013	2014
Construction End Year	End of 2015	End of 2015
Open to Traffic	2016	2016
Number of Links	With: 10, Without: 9	1
Main Difference of Scenarios	With: Network including the new road Without: Network excluding the new road	With: Paved Road Without: Gravel Road

Source: Study Team

10.2.2 Calibration

Pavement and traffic conditions are affected by many factors such as climate and traffic loading. Therefore, calibration was done to identify actual conditions in Ghana by considering the following factors.

(1) Climate

Pavement performance is greatly affected by climate, especially temperature and rainfall. To calibrate the climate condition, meteorological data from 2002 to 2011 at Ho and Akuse Meteorological Stations were analysed and climate factors to be applied were defined as shown in Table 10-2.

Table 10-2 Applied Climate Aspects

Item	Akuse	Ho	Ave.	Applied
Mean Monthly Precipitation (mm)	79.04	114.69	96.865	97
Mean Temperature (ºC)	28.60	27.87	28.235	28
Maximum average (ºC)	32.95	32.35	32.65	33
Minimum average (ºC)	23.6	22.95	23.275	23
Avg. temperature range (ºC)	4.675	4.7	4.6875	5
Days with temperature >32ºC	23	2	12.5	13

Source: Study Team based on data provided by Ghana Meteorological Agency

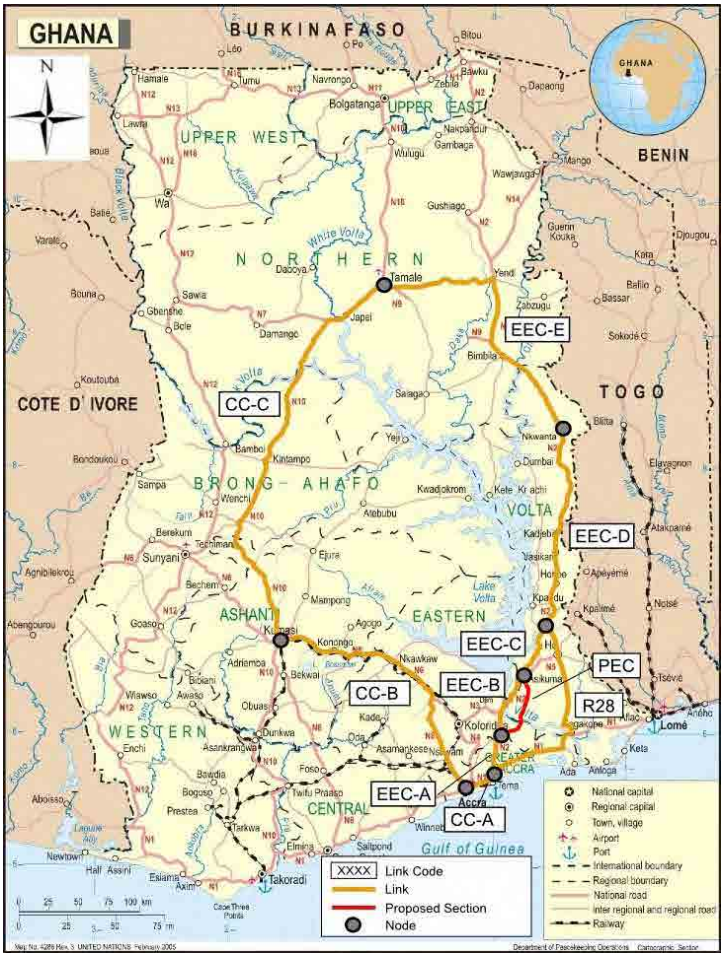
(2) Road Network

a) Analysis of the Proposed New Eastern Corridor

According to the traffic demand forecast described in Chapter 4, the characteristics of traffic on the proposed new Eastern Corridor (PEC) were identified. This traffic is mostly generated by the diversion of heavy vehicles from the central corridor (CC) and the R28 route via N1 (R28) as well as the diversion of light vehicles from the Asutsuare Jct. – Asikuma Jct. section on the existing Eastern Corridor (EEC-B) in addition to the two routes.

In consideration of the traffic aspects, the road network for economic analysis on the proposed new Eastern Corridor was determined as shown in Figure 10-2. Data of the links such as road length and condition are set based on “Road Condition Registry 2011” and are

calculated using the weighted average method. The settings for each link are shown in Appendix 8.



Source: Study Team

Figure 10-2 Road Network for the Proposed New Eastern Corridor Economic Analysis

b) Analysis of the Asutsuare – Aveyime Road

The road network used for the analysis is the Asutsuare – Aveyime section with a length of around 24 km. The study investigated the difference in benefits and costs caused by upgrading the road surface from gravel to asphalt pavement.

(3) Traffic Volume

a) Analysis of Proposed New Road between Asutsuare Jct. and Asikuma Jct.

While the traffic demand forecast was carried out on the road network including almost all roads in the study area and trunk roads outside the study area, the road network for this HDM-4 is limited in order to identify the differences in benefits and costs caused by the new road development only. Therefore, traffic volumes on the respective links were determined based on the results of traffic demand forecasts for both the "with" and "without" project cases as well as the estimated traffic diversion from the CC, EEC-B and R28 routes to PEC.

The traffic volumes used for the analysis are summarized in the following table.

Table 10-3 Summary of Traffic Volumes Used for Economic Analysis (Proposed New Road between Asutsuare Jct. and Asikuma Jct.)

Unit: Vehicles/day

Link	Without-Project Scenario			With-Project Scenario	
	2013	2016	2036	2016	2036
EEC-A	8,856	9,134	11,263	12,544	18,085
EEC-B	8,856	9,134	11,263	4,381	7,182
EEC-C	3,664	3,758	4,458	7,168	11,280
EEC-D	5,640	5,956	8,712	8,127	12,495
EEC-E	1,428	1,590	3,557	3,761	7,340
CC-A	2,483	2,631	4,560	461	777
CC-B	2,483	2,631	4,560	461	777
CC-C	2,483	2,631	4,560	461	777
R28	3,693	4,019	7,189	2,780	4,150
PEC	N/A	N/A	N/A	8,163	10,903

Note 1: N/A is Not Applicable

Note 2: Some of the above numbers do not precisely coincide with the results of traffic demand forecasts due to the difference in scope of the target network.

Note 3: The same traffic volume is applied to the three CC sections in order to investigate the impact caused only by traffic diversion from the Central Corridor to the new road between Asutsuare Jct. and Asikuma Jct.

Source: Study Team

b) Analysis of Asutsuare – Aveyime Road

It is assumed that construction of the new bridge across the Volta River will increase the traffic volume from the without-project scenario to the with-project scenario. In consideration of the assumption and the purpose of the analysis, which is to investigate the difference by pavement type, traffic volume on this section for the economic analysis was set based on the "With the project" case in the traffic demand forecast.

Table 10-4 Summary of Applied Traffic Volume (Asutsuare – Aveyime Road)

Unit: Vehicles/day

Section	With-Project Scenario	
	2016	2036
Asutsuare – Aveyime	4,216	5,339

Source: Study Team

(4) Economic Unit Cost of Vehicles

The market prices of items related to vehicle fleets have been collected through interviews with automobile dealers, fuel stations, workshops and the GHA. These prices, considered as financial prices, were converted into economic prices. Firstly, transfer items such as taxes and import duties were subtracted from the financial prices. Secondly, the prices were multiplied by a conversion factor by type of item. The Standard Conversion Factor (SCF) of 0.9603 described in the following section was applied to products such as new vehicles and tyre replacement costs. The values of passenger working time and non-working time were based on the numbers in the ORIO project conducted in 2012. Cargo holding value was estimated using import/export amount and volume, inflation rate and deposit interest rate in Ghana.

The financial and economic unit costs of vehicles are summarized in Table 10-5 and Table 10-6, respectively.

Table 10-5 Summary of Vehicle Fleet Unit Costs (Financial)

No.	Vehicle Category	Representative Vehicle	New Vehicle (US$, no tyres)	Replacement Tyres (US$)	Fuel (US$/ltr)	Lubricants (US$/ltr)	Maintenance Labour (US$/h)	Crew Wages (US$/h)
1	Cars/Taxis	Nissan Sunny	14,772.53	143.62	0.92	5.54	1.84	0.09
2	Pick-up	Nissan Pickup 2.7	20,906.38	373.40	0.92	5.54	1.84	0.09
3	Small Bus	Nissan Urvan 3.0	39,158.94	185.27	0.92	5.54	1.15	0.52
4	Med. Bus	Nissan Civilian	78,938.30	356.17	0.94	3.47	1.15	0.78
5	Large Bus	Nissan Civilian	78,938.30	356.17	0.94	3.47	1.15	0.78
6	Light T.	Mercedes Benz	87,537.55	257.07	0.94	3.47	1.15	0.95
7	Medium T.	Mercedes Benz	87,537.55	257.07	0.94	3.47	1.15	0.95
8	Heavy T.	Mercedes Benz	121,716.17	666.38	0.94	3.47	1.15	1.09
9	L. Semi T.	Mercedes Benz	171,405.11	666.38	0.94	3.47	1.61	1.09
10	H. Semi T.	Mercedes Benz	171,405.11	666.38	0.94	3.47	1.61	1.09
11	Truck T.	Mercedes Benz	171,405.11	666.38	0.94	3.47	1.61	1.09
12	Others	Mercedes Benz	187,293.51	728.14	0.94	3.47	1.61	1.09

No.	Vehicle Category	Representative Vehicle	Annual Overhead	Annual Interest (%)	Passenger Working time (US$/h)	Passenger Non-Working Time (US$/h)	Cargo Holding Value (US$/h)
1	Cars/Taxis	Nissan Sunny	400	27	0.5	0.125	0
2	Pick-up	Nissan Pickup 2.7	400	27	0.5	0.125	0
3	Small Bus	Nissan Urvan 3.0	500	27	0.34	0.085	0
4	Med. Bus	Nissan Civilian	700	27	0.34	0.085	0
5	Large Bus	Nissan Civilian	700	27	0.34	0.085	0
6	Light T.	Mercedes Benz	700	27	0.34	0.085	0.10
7	Medium T.	Mercedes Benz	700	27	0.34	0.085	0.10
8	Heavy T.	Mercedes Benz	800	27	0.34	0.085	0.30
9	L. Semi T.	Mercedes Benz	800	27	0.34	0.085	0.50
10	H. Semi T.	Mercedes Benz	800	27	0.34	0.085	0.50
11	Truck T.	Mercedes Benz	800	27	0.34	0.085	0.50
12	Others	Mercedes Benz	800	27	0.34	0.085	0.30

Source: Study Team

Table 10-6 Summary of Vehicle Fleet Unit Costs (Economic)

No.	Vehicle Category	Representative Vehicle	New Vehicle (US$, no tyres)	Replacement Tyres (US$)	Fuel (US$/ltr)	Lubricants (US$/ltr)	Maintenance Labour (US$/h)	Crew Wages (US$/h)
1	Cars/Taxis	Nissan Sunny	11,600.40	119.93	0.42	4.15	1.84	0.09
2	Pick-up	Nissan Pickup 2.7	16,384.50	311.81	0.42	4.15	1.84	0.09
3	Small Bus	Nissan Urvan 3.0	30,787.71	154.71	0.42	4.15	1.15	0.52
4	Med. Bus	Nissan Civilian	61,964.14	297.42	0.55	2.60	1.15	0.78
5	Large Bus	Nissan Civilian	61,964.14	297.42	0.55	2.60	1.15	0.78
6	Light T.	Mercedes Benz	68,829.63	214.67	0.55	2.60	1.15	0.95
7	Medium T.	Mercedes Benz	68,829.63	214.67	0.55	2.60	1.15	0.95
8	Heavy T.	Mercedes Benz	95,487.31	556.46	0.55	2.60	1.15	1.09
9	L. Semi T.	Mercedes Benz	134,343.59	556.46	0.55	2.60	1.61	1.09
10	H. Semi T.	Mercedes Benz	134,343.59	556.46	0.55	2.60	1.61	1.09
11	Truck T.	Mercedes Benz	134,343.59	556.46	0.55	2.60	1.61	1.09
12	Others	Mercedes Benz	146,796.59	608.03	0.55	2.60	1.61	1.09

No.	Vehicle Category	Representative Vehicle	Annual Overhead	Annual Interest (%)	Passenger Working time (US$/h)	Passenger Non-Working Time (US$/h)	Cargo Holding Value (US$/h)
1	Cars/Taxis	Nissan Sunny	400	12	0.5	0.125	0
2	Pick-up	Nissan Pickup 2.7	400	12	0.5	0.125	0
3	Small Bus	Nissan Urvan 3.0	500	12	0.34	0.085	0
4	Med. Bus	Nissan Civilian	700	12	0.34	0.085	0
5	Large Bus	Nissan Civilian	700	12	0.34	0.085	0
6	Light T.	Mercedes Benz	700	12	0.34	0.085	0.10
7	Medium T.	Mercedes Benz	700	12	0.34	0.085	0.10
8	Heavy T.	Mercedes Benz	800	12	0.34	0.085	0.30
9	L. Semi T.	Mercedes Benz	800	12	0.34	0.085	0.50
10	H. Semi T.	Mercedes Benz	800	12	0.34	0.085	0.50
11	Truck T.	Mercedes Benz	800	12	0.34	0.085	0.50
12	Others	Mercedes Benz	800	12	0.34	0.085	0.30

Note 1: Tax on fuel is based on data for 2005.
Note 2: The same data are used for some categories due to the limitation of data availability.
Source: Study Team based on data collected through interviews.

(5) Maintenance Unit Cost

The HDM-4 model can compute lifecycle costs on the designated network in accordance with road conditions or assigned schedules. The maintenance unit costs were provided by the GHA and converted into economic costs with the conversion factor of 0.85 given by the MRH. The unit costs and intervention criteria of maintenance are shown in Table 10-7.

Table 10-7 Unit Costs and Intervention Criteria of Maintenance

Item	Unit	Intervention	Financial		Economic
			Unit Cost (GHS)	Unit Cost (US$)	Unit Cost (US$)
Unpaved Road Maintenance					
Grading	km	Once a year	3,322.2	1,767.1	1,502.1
Spot Gravel	m^3	Gravel thickness < 100 mm	19.4	10.3	8.8
Gravel Resurfacing	m^3	Gravel thickness < 50 mm	19.4	10.3	8.8
Paved Road Maintenance					
Crack Sealing	m^2	Wide structural cracking > 10%	5.69	3.0	2.6
Pothole Patching	m^2	No. of holes/km > 10	34.07	18.1	15.4
Overlay @ 50mm	m^2	IRI* = 8 and total carriageway cracked > 5%	N/A	72.2	61.3
Reconstruction	km	IRI = 12 and total carriageway cracked > 5%	N/A	1,464,832	1,245,107

* IRI = International Roughness Index

Note 1: Exchange Rate US$ 1=GHS 1.88, Conversion factor from financial to economic cost is 0.85 based on factor provided by Ministry of Roads and Highways.

Note 2: The unit costs of overlay and reconstruction are based on actual projects in Ghana and their exchange rates were set at the rates as of the contract dates.

Source: Study Team based on the unit cost data 2012 provided by the GHA.

10.2.3 Project Cost in Economic Value

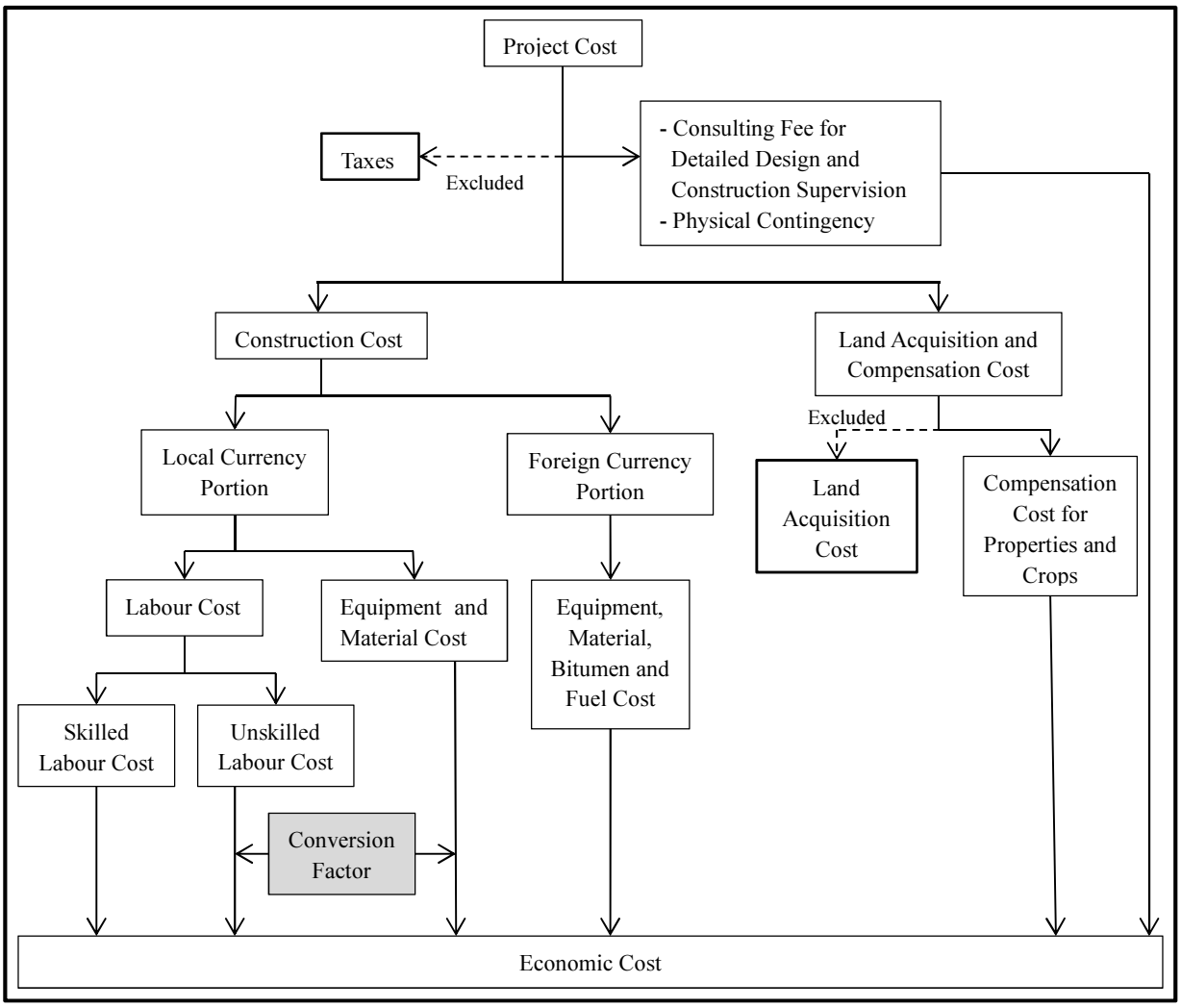
(1) Classification of Project Cost

The construction cost is defined as the project cost in this HDM-4 analysis. Since the project cost prepared by a cost estimator is expressed in financial prices, it should be converted into the economic price to conduct the economic analysis. The construction cost consists of four main categories: civil work cost, land acquisition cost, taxes and other costs such as consultancy and engineering fees and physical contingency. The structure of road agency costs is shown in Figure 10-3.

The civil work cost is divided into the local currency portion (LCP) and the foreign currency portion (FCP), the shares of which are approximately 70% to 30% in this project. Furthermore, the LCP is classified into labour cost and equipment and material costs, the proportions of which were estimated at 50% and 50%. This machine and material cost contains some irrelevant elements for economic activities, therefore, the SCF was applied to the costs in order to convert to economic costs. Meanwhile, labour cost can be separated into skilled and unskilled labour costs. Only the unskilled labour portion, which is around 20% in the study, is to be converted by using a conversion factor, while the skilled labour cost can be used in the analysis without conversion. The land acquisition cost is made up of land, property and resettlement assistance costs. Within these three items, the land cost was subtracted from the project cost since land

itself does not affect economic activity whereas property does. The structure of the project cost is shown in Figure 10-3.

Each procedure of conversion is described in the following sections.



Source: Study Team

Figure 10-3 Structure of Project Cost

(2) Exclusion of Transfer Items and Price Escalation

Taxes, customs duties, loan interest, government subsidies, etc. are not inherent cost items accrued by the project. These items are called transfer items and should be excluded from the project cost. For instance, VAT of 12.5% and National Health Insurance Levy (NHIL) of 2.5% are deducted from the local currency portion. The other portions are also transfer items subtracted from the estimated financial costs if included.

The estimation of the project cost includes inflationary cost elements which are expected to be incurred during the construction period. These elements are excluded in the economic analysis since these are external factors for the project.

(3) Conversion Method from Financial to Economic Cost

a) Equipment and Material Costs

The equipment and material costs within the local currency portion should be converted into

economic prices because these prices are distorted due to the inefficient markets and limited information in the country. Consequently, they do not reflect international market prices. The distorted prices are adjusted by applying the SCF, which is set at 0.9603 in the Study. The SCF is calculated using the following formula:

$SCF = (M + X) / \{(M + Tm) + (X - Tx + Sx)\}$

where,

M: Imports (CIF Price: Cost Insurance Free)

X: Exports (FOB Price: Free On Board)

Tm: Import Taxes

Tx: Export Taxes

Sx: Import Subsidies

b) Unskilled Labour Cost

While the skilled labour price is generally determined under full free-market principles, the price of unskilled labour is distorted due to the lack of liquidity of workers. For example, the surplus of workers caused by the high rate of unemployment or potential unemployment can decrease the unskilled labour rate in economic value. However, the actual market rate is usually higher than the economic value since the rate is elevated by the social environment such as the minimum wage regulation and disproportionate existence of supply. Therefore, the actual wage rate of unskilled labour should be revaluated to be the opportunity cost in the economic analysis.

Although there is no recent data on the unemployment rate in Ghana, the average rate from 2001 to 2005 was 12% according to Trading Economics[28]. Meanwhile, the average labour participation rate from 2000 to 2009 was 74.5% which means a labour non-participation rate of 25.4%. Considering the situation, the current unemployment rate in Ghana is assumed at 15% in this study. As a result of the unemployment assumption and bibliographic survey, the conversion factor of unskilled labour from financial to economic price is set at 0.8.

c) Land Acquisition Cost

The land uses along the study road were categorised into three types: agricultural, residential and no-use. In this economic analysis, all the land costs were excluded from the land acquisition cost since land itself does not contribute to economic activities. Agricultural land was evaluated as the gross revenues of products which were to be the opportunity cost of the land. Regarding residential land, the cost of property was utilised for the economic value of the land. No-use land was excluded from the land acquisition cost since only land transactions are assumed to occur.

(4) Economic Cost of the Project

The economic cost of constructing the proposed new road between Asutsuare Jct. and Asikuma Jct., and upgrading the Asutsuare – Aveyime road were calculated in light of the

[28] http://www.tradingeconomics.com/

above-mentioned categorisation and conversions based on the project cost estimates.

10.2.4 Agricultural Development Value

(1) Target Land

The target land for agricultural development following construction of the proposed new road between Asutsuare Jct. and Asikuma Jct. was determined to be 25,000 ha, as described in Section 2.7.1

(2) Development Value

The estimated benefit per year was incorporated in the benefits in the economic analysis. The following assumptions were applied in this study:

- All target land is used for cultivating cassava
- 50% of earnings is the benefit

The estimated agricultural development value arising from construction of the proposed new road between Asutsuare Jct. and Asikuma Jct. is shown in Table 10-8.

Table 10-8 Agricultural Development Value

Crop	Average Yield	Production Amount	Unit Price per MT	Harvest Revenue per Year	Harvest Revenue per Year	Benefit Ratio	Estimated Benefit per Year
Unit	MT/ha	MT	GHS/MT	GHS/Year	US$/Year	%	US$/Year
Cassava	15.78	394604.55	223.57	88,221,739	46,926,457	50.0%	23,463,229

Source 1: Major Crops of Average Yield in Volta Region from Production Estimates 2011, MoFA
Source 2: Nominal Weighted Average Rural Wholesale Price (GHS) Per MT in 2010 from Agriculture in Ghana Facts and Figure 2010 issued by MoFA
* US$ 1 = GHS 1.88

10.3 Results of Economic Analysis

10.3.1 Construction of the New Road between Asutsuare Jct. and Asikuma Jct.

In running the HDM-4 model, all economic values were computed by scenario. The cost stream comparison is summarized in Table 10-9.

The road agency costs were estimated to reduce significantly because of the diversion of traffic from the Central Corridor to the Eastern Corridor, thus reducing the maintenance cost on the Central Corridor, whereas maintenance costs on other roads increased slightly over the study period. The decrease in road user costs was also computed, especially from 2021 when the average roughness of the entire network of the “with-project” case was lower than that of the “without” case except for 2027 and 2028.

The EIRR including agricultural development benefits is determined to be 26.1% while the EIRR without the benefit is 19.6%, both of which exceed the cut-off ratio of 12%. The NPV of the project, which is the monetary value of the net costs subtracted from the net benefits, is estimated to be US$ 273.57 million at a discount rate of 12%.

Table 10-9 Summary of Cost Stream Comparison on the Proposed New Road between Asutsuare Jct. and Asikuma Jct.

(Unit: US$ million)

Year	Increase in Road Agency Costs		Decrease in Road User Costs		Net Benefits	Development Benefit	Net Benefits including Development Benefit
	Capital	Recurrent	VOC	TTC			
2013	41.65	0.00	0.00	0.00	-41.65	0.00	-41.65
2014	70.63	0.00	0.00	0.00	-70.63	0.00	-70.63
2015	70.63	0.00	0.00	0.00	-70.63	0.00	-70.63
2016	0.00	0.00	15.82	1.19	17.01	23.46	40.47
2017	0.00	0.00	19.50	0.82	20.32	23.46	43.78
2018	0.00	0.00	19.58	0.21	19.78	23.46	43.24
2019	0.00	0.00	16.60	-0.62	15.98	23.46	39.44
2020	187.47	-1.45	11.26	-1.65	-176.41	23.46	-152.95
2021	0.00	-1.44	126.51	4.61	132.56	23.46	156.02
2022	-74.77	-0.76	124.58	5.52	205.62	23.46	229.08
2023	-112.70	0.29	88.39	2.49	203.29	23.46	226.75
2024	0.00	0.10	59.60	1.66	61.15	23.46	84.61
2025	43.69	-0.05	62.87	1.18	20.41	23.46	43.87
2026	-382.85	2.47	101.78	4.25	486.40	23.46	509.86
2027	30.07	3.77	-57.59	-4.32	-95.75	23.46	-72.29
2028	168.76	1.41	-38.18	-4.31	-212.66	23.46	-189.20
2029	112.70	1.47	47.70	1.13	-65.34	23.46	-41.88
2030	0.00	1.11	121.56	4.36	124.80	23.46	148.26
2031	-21.57	1.37	118.78	5.04	144.03	23.46	167.49
2032	0.00	0.84	107.78	5.20	112.14	23.46	135.60
2033	-74.77	-0.76	109.68	5.63	190.84	23.46	214.30
2034	65.26	0.90	60.37	0.23	-5.57	23.46	17.89
2035	30.07	-0.52	110.11	4.11	84.67	23.46	108.13
2036	-224.99	1.45	135.19	6.29	365.02	23.46	388.48
TOTAL	-70.70	10.20	1,361.87	43.01	1,465.38	492.66	1,958.04
				EIRR	19.62%	EIRR	26.13
				NPV@12%	147.30	NPV@12%	273.57

Source: Study Team

10.3.2 Upgrading on Asutsuare – Aveyime Road

The HDM-4 model was run for the scenario of upgrading from gravel to paved road. The cost stream comparison is summarized in the table below.

A significant decrease in road user cost is expected due to the difference of road surface roughness. The roughness on the upgraded paved road fluctuated between 2 and 8 in International Roughness Index (IRI) while that on the non-upgraded gravel road ranged from 18 to 21.

The EIRR of the project was estimated to be 51.5% over the cut-off ratio of 12%. The NPV at 12% was US$ 66.29 million.

Table 10-10 Summary of Cost Stream Comparison on Asutsuare – Aveyime Road

(Unit: US$ million)

Year	Increase in Road Agency Costs		Decrease in Road User Costs		Net Benefits
	Capital	Recurrent	VOC	TTC	
2014	7.55	-0.05	0.00	0.00	-7.49
2015	13.76	-0.06	-1.52	-0.41	-15.63
2016	0.00	-0.06	11.41	2.38	13.84
2017	-0.19	-0.05	11.81	2.44	14.49
2018	0.00	-0.06	10.20	1.99	12.24
2019	0.00	-0.06	11.96	2.40	14.41
2020	-0.19	-0.05	12.34	2.46	15.05
2021	0.00	-0.06	10.58	2.02	12.66
2022	0.00	-0.06	12.31	2.42	14.79
2023	-0.19	-0.01	12.63	2.48	15.32
2024	0.00	0.05	10.76	2.04	12.75
2025	0.00	-0.06	12.58	2.44	15.08
2026	-0.19	-0.01	12.89	2.50	15.59
2027	0.00	0.05	10.91	2.06	12.92
2028	0.00	-0.02	12.79	2.44	15.25
2029	-0.19	0.05	13.08	2.48	15.71
2030	0.00	0.02	11.05	2.03	13.06
2031	0.00	0.02	13.00	2.38	15.36
2032	-0.19	0.03	13.32	2.39	15.88
2033	10.87	-0.06	11.11	1.91	2.20
2034	0.00	-0.06	16.62	2.54	19.23
2035	-0.19	-0.05	17.14	2.61	19.99
2036	-2.15	-0.06	15.01	2.20	19.41
TOTAL	28.68	-0.62	261.96	48.22	282.12
				EIRR	51.50%
				NPV@12%	66.29

Source: Study Team

10.3.3 Sensitivity Analysis

Sensitivity analyses were performed for both projects to determine the effect of possible changes in parameter values on the economic viability. The considered parameters and extent of their variations are shown in Table 10-11.

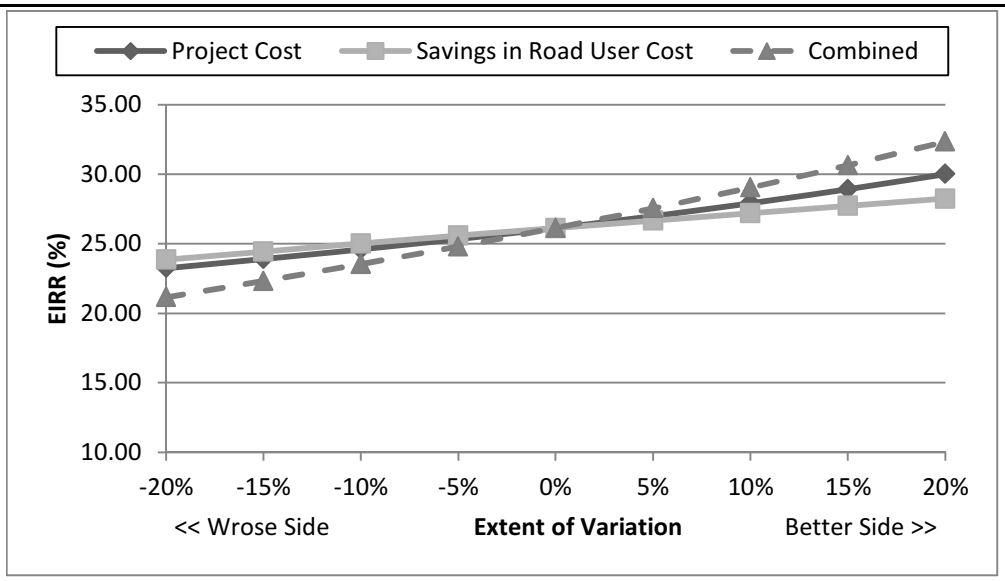
Table 10-11 Parameters and Extent of Variation for Sensitivity Analysis

	Worse Side	Better Side
a) Project Cost	+20%	-20%
b) Savings in Road User Cost	-20%	+20%
c) Combined	a: +20%, b: -20%	a: -20%, b: +20%

Source: Study Team

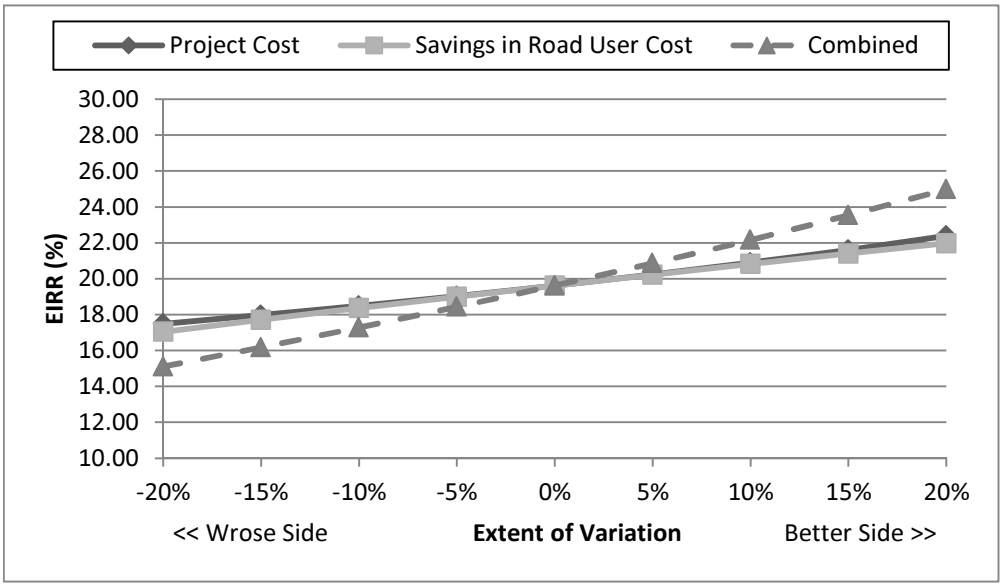
(1) Construction of New Road between Asutsuare Jct. and Asikuma Jct.

The results of sensitivity analysis both including and excluding agricultural development benefits are shown in Figure 10-4 and 10-5, respectively.



Source: Study Team

Figure 10-4 Results of the Sensitivity Analysis (Inc. Agricultural Development Benefits)



Source: Study Team

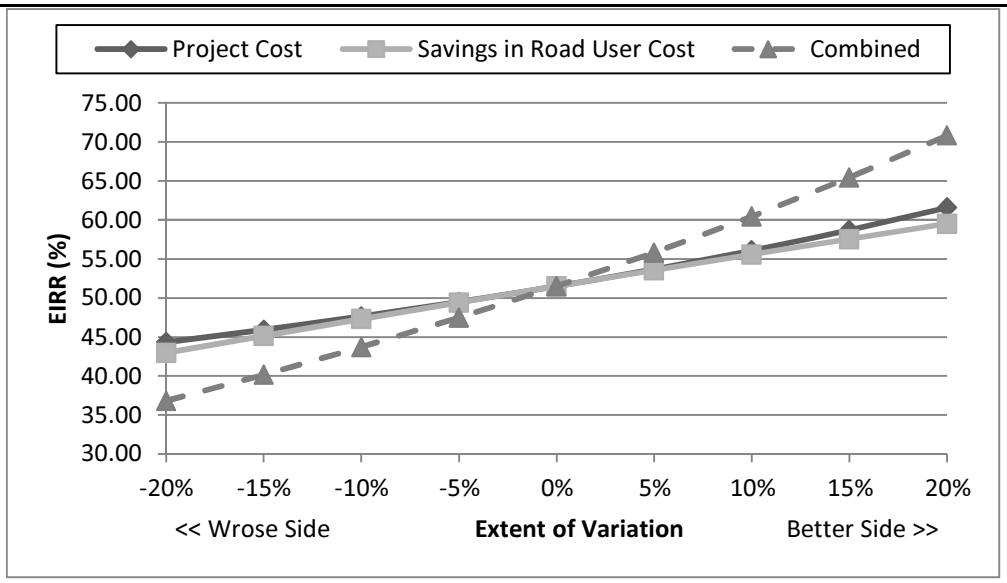
Figure 10-5 Results of the Sensitivity Analysis (Exc. Agricultural Development Benefits)

The impact on EIRR by variation in project cost is slightly greater than that in road user costs, the extent of which is -2.9% to +3.9%. In the combined case, the EIRR of the worst scenario is 21.2% and that of the best scenario is 32.3% while the base case is 26.1%. The EIRRs without agricultural development benefits change from 15.1% to 25.0% in the combined case while the base case is 19.6%.

Therefore, EIRRs were expected to remain higher than the cut-off ratio of 12% under all the cases set above.

(2) Upgrading on Asutsuare – Aveyime Road

The results of sensitivity analysis on the upgrading in the Asutsuare –Aveyime road project are shown in Figure 10-6.



Source: Study Team

Figure 10-6 Results of the Sensitivity Analysis in Upgrading Project

The variation of two factors causes a larger impact on EIRR than the new construction project which considers the effects on the surrounding road network. In the combined case, the difference was between -14.7% and +19.3% under this study scenario while the base case is 51.5%. However, EIRRs in all cases far exceed the cut-off ratio of 12%.

CHAPTER 11

ENVIRONMENTAL AND SOCIAL CONSIDERATIONS

Chapter 11 Environmental and Social Considerations

Regarding Ghanaian policies and Japanese ODA policies, Chapter 11 gives the initial evaluation of the proposed project with the "JICA Guidelines for Environmental and Social Considerations, April 2010" (JICA Guideline) for JICA's further consideration of assistance.

11.1 Legal Framework for Environmental and Social Considerations

11.1.1 National Legal Framework

(1) The constitution of the Republic of Ghana

The same as any country, the constitution of the Republic of Ghana (1992) is the basis of all laws and regulations in Ghana. It is comprised of 26 chapters and the following chapters in particular govern all laws and regulations related to environmental and social considerations in Ghana. Considering any aid programme, the following chapters shall be respected and taken into account including common and/or customary laws and traditional practices. Some of them such as chieftaincy are unfamiliar for Japanese.

Chapter 5. FUNDAMENTAL HUMAN RIGHTS AND FREEDOMS

20. Protection from Deprivation of Property

(1) No property of any description or interest in or right over any property shall be compulsorily taken possession of or acquired by the State unless the following conditions are satisfied.
  (a) the taking of possession or acquisition if necessary in the interest of defence, public safety, public order, public morality, public health, town and country planning or the development or utilization of property in such a manner as to promote the public benefit; and
  (b) the necessity for the acquisition is clearly stated and is such as to provide reasonable justification for causing any hardship that may result to any person who has an interest in or right over the property.

(2) Compulsory acquisition of property by the State shall only be made under a law which makes provision for:
  (a) the prompt payment of fair and adequate compensation; and
  (b) a right of access to the High Court by any person who has an interest in or right over the property whether direct or on appeal from other authority, for the determination of his interest or right and the amount of compensation to which he is entitled.

(3) Where a compulsory acquisition or possession of land effected by the State in accordance with clause (1) of this article involves displacement of any inhabitants, the State shall resettle the displaced inhabitants on suitable alternative land with due regard for their economic well-being and social and cultural values.

26. Cultural Rights and Practices

(1) Every person is entitled to enjoy, practice, profess, maintain and promote any culture, language, tradition or religion subject to the provisions of this Constitution.

(2) All customary practices which dehumanise or are injurious to the physical and mental well being of a person are prohibited.

Chapter 6. THE DIRECTIVE PRINCIPLES OF STATE POLICY

36. Economic Objectives

(6) The State shall afford equality of economic opportunity to all citizens; and, in particular, the State shall take all necessary steps so as to ensure the full integration of women into the mainstream of the economic development of Ghana.

(7) The State shall guarantee the ownership of property and the right of inheritance.

(8) The State shall recognise that ownership and possession of land carry a social obligation to serve the larger community and, in particular, the State shall recognise that the managers of public, stool, skin and family lands are fiduciaries charged with the obligation to discharge their functions for the benefit respectively of the people of Ghana, of the stool, skin, or family concerned and are accountable as fiduciaries in this regard.

(9) The State shall take appropriate measures needed to protect and safeguard the national environment for posterity; and shall seek cooperation with other states and bodies for purposes of protecting the wider international environment for mankind.

(10) The State shall safeguard the health, safety and welfare of all persons in employment, and shall establish the basis for the full deployment of the creative potential of all Ghanaians.

37. Social Objectives

(1) The State shall endeavour to secure and protect a social order founded on the ideals and principles of freedom, equality, justice, probity and accountability as enshrined in Chapter 5 of this Constitution; and in particular, the State shall direct its policy towards ensuring that every citizen has equality of rights, obligations and opportunities before the law.

(2) The State shall enact appropriate laws to ensure -

(b) the protection and promotion of all other basic human rights and freedoms, including the rights of the disabled, the aged, children and other vulnerable groups in development processes.

(3) In the discharge of the obligations stated in clause (2) of this article, the State shall be guided by international human rights instruments which recognize and apply particular categories of basic human rights to development processes.

39. Cultural Objectives

(1) Subject to clause (2) of this article, the State shall take steps to encourage the integration of appropriate customary values into the fabric of national life through formal and informal education and the conscious introduction of cultural dimensions to relevant aspects of national planning.

(2) The State shall ensure that appropriate customary and cultural values are adapted and developed as an integral part of the growing needs of the society as a whole; and in particular that traditional practices which are injurious to the health and well-being of the person of the person are abolished.

Chapter 21. LANDS AND NATURAL RESOURCES

All clauses under the following section are particularly important and directly related to environmental and social considerations. Detailed descriptions are given in the following sections of Environmental Policy Framework (11.1.2) and Involuntary Resettlement Policy Framework (11.1.3).

Public Lands

257. Public Lands and other Public Property

258. Lands Commission

260. Regional Lands Commission

264. Tenure of Office of Members of Land Commission

265. Independence of Lands Commission

Stool and Skin Lands and Property

268. Parliamentary Rectification of Agreements Relating to Natural Resources

Protecting Natural Resources

268. Parliamentary Rectification of Agreements Relating to Natural Resources

269. Natural Resources Commissions

Chapter 22. CHIEFTAINCY

270. Institution of Chieftaincy

(1) The institution of chieftaincy, together with its traditional councils as established by customary law and usage, is hereby guaranteed.

(2) Parliament shall have no power to enact any law which-

(a) confers on any person or authority the right to accord or withdraw recognition to or from a chief for any purpose whatsoever; or

(b) in any way detracts or derogates from the honour and dignity of the institution of chieftaincy.

277. Definition of Chief

In this Chapter unless the context otherwise requires, "chief" means a person, who, hailing from the appropriate family and lineage, has been validly nominated, elected or selected and enstooled, enskinned or installed as a chief or queen mother in accordance with the relevant customary law and usage.

(2) Relevant National Legal Frameworks for Environmental and Social Considerations

Considering the environmental legal frameworks in Ghana, the Environmental Protection Agency Act (Act 490), 1994 is considered as the principal environmental law in Ghana. Act 490 comprises two parts: Part one: Environmental Protection and Part Two: Pesticide Control and Management. Part One covers: 1) establishment of EPA, 2) enforcement and control of environmental protection, 3) national environment fund, and 4) administration of EPA. Under 2) enforcement and control of environmental protection, the following four articles define the

obligations of environmental protection and give the EPA power to ensure environmental protection.

Article 12. Environmental impact assessment: requirement to conduct environmental impact assessment (EIA) and EPA's power to control other governmental bodies' issuance of licences, permits, approvals or consent for activities under their jurisdiction without environmental consideration,

Article 13. Enforcement notice: EPA's power to prevent or stop any activities posing a serious threat to the environment or to public health as well as impose penalty fines and/or imprisonment for those who violate the EPA's enforcement notice,

Article 14. Powers of Minister: enforcement of EPA's enforcement notice (Article 13) and assurance of its enforcement with the police and other responsible agencies,

Article 15. Environment protection inspectors: appointment of environmental protection inspectors and their power to inspect relevant activities without any obstacle as well as offenders' liabilities of fines and imprisonment for violations.

Under the power of Act 490, the EPA has the principal authority for enforcing environmental protection in Ghana. Presently, the EPA is one of the core departments and agencies under the Ministry of Environment Science and Technology (MEST) and advises the GoG on all matters concerning the environment.

Based on the EPA's "Ghana Legal Environmental information, the EPA categorises legal frameworks for environmental matters into the following ten groups. The groups of acts and regulations particularly related to the proposed road projects are listed in Table 11-1. Some of the important acts listed in Table 11-1 are briefly described in this section and Environmental Assessment Regulations (LI 1652 and LI 1703) and Land related legislations are separately described in the following section.

As a part of its commitments to the international community, Ghana participates in 43 international conventions or protocols including amendments and has applied them to its legal frameworks. Some of the most relevant conventions and protocols concerning the environment for the proposed road development and improvement projects are shown in Table 11-2.

In addition to the EPA Act 490, some of the most relevant legislations related to the proposed road projects are shown as follows.

a) Wetlands Management (RAMSAR Sites) Regulations, 1999

As the national response to the enforcement of the "Convention on Wetlands of International Importance Especially as Waterfowl Habitat", the Wetlands Management Regulations designate six Ramsar Sites: 1) Muni-Pomadze, 2) Densu Delta, 3)Sakumo, 4) Songor, 5)Keta Lagoon Complex, and Owabi Wildlife Sanctuary (Figure 11-1).

Table 11-1 Groups of Environmental Legislation in Ghana

1. Air Pollution (+ 1 regulation) • Environmental Protection Agency Act, 1994 (Act 490)
2. Coastal & Marine Environment (+ 1 act) • Fisheries Act, 2002 • Wetlands Management (RAMSAR Sites) Regulations, 1999
3. Energy and Mineral Resources (10 acts)
4. Flora and Fauna (+ 7 acts) • Economic Plants Protection Act, 1979 • Timber Resource Management Regulation Act, 1998 • Tree and Timber Act, 1974 • Timber Resource Management Regulations, 1998 • Wild Animals Preservation Act 1961 (Act 43)
5. Human Development and Settlement (+ 23 acts) • Concessions Act, 1939 • Concessions Act, 1962 • Town and Country Planning 1945 (Cap 84)
6. Hazardous Substances/Chemicals (1 act)
7. Land Management (+ 2 acts) • Lands Commission Act, 1994 • Lands Miscellaneous Provision Act, 1963 • Land Planning and Soil Conservation Act, 1953 • Land Registry Act, 1962 • Lands (Statutory Wayleaves) Act, 1963 • Land Title Registration Act, 1986
8. Noise Control (no specific act or regulation)
9. Solid Waste Management (+ 3 acts) • Environmental Assessment Regulations 1999, (LI 1652)
10. Water Management and Pollution (+ 3 acts) • Environmental Protection Agency Act, 1994 (Act 490) Part I & II • Rivers Act, 1903 • Water Resources Commission Act, 1996 (Act 522)

Source: Ghana EPA < http://www.epa.gov.gh/ghanalex/acts/index.html >

Table 11-2 Groups of Environmental Legislation in Ghana

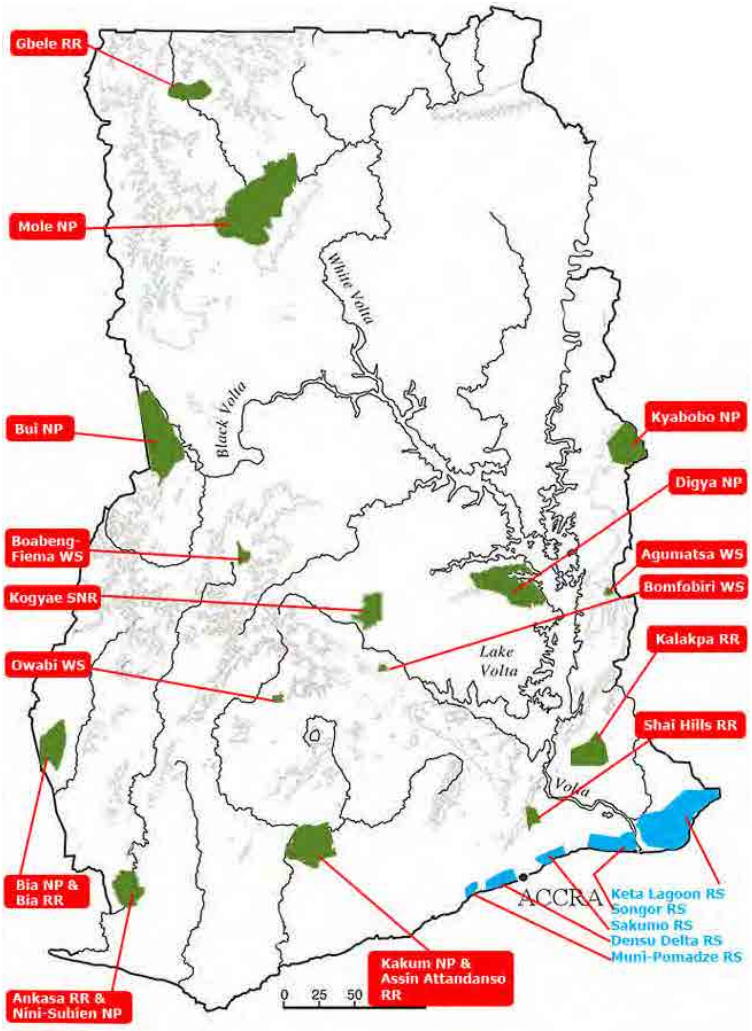
Convention/Protocol	Date of Accession/ Ratification
African Convention on the Conservation of Nature and Natural Resources, 1969 *Ghana is yet to ratify the Revised version of this Convention which is yet to come into force.	17 May, 1969
Convention on Wetlands of International Importance Especially as Waterfowl Habitat, Ramsar, 1971	22 February, 1988 (Ac)
Convention Concerning the Protection of Workers against Occupational Hazards in the Working Environment Due to Air Pollution, Noise and Vibration, Geneva, 1977	27 May, 1986

Source: Ghana EPA < http://www.epa.gov.gh/ghanalex/multilateral/index.html>

The regulation regulates activities in the Ramsar Sites and principally prohibits any activities in designated “Core area of Ramsar Sites.” The regulation also designates fines and imprisonment for offences against the Wetland Management Regulations.

b) Criminal Code (Act 29) Section 296-297, 1960

Act 29 prevents the accumulation and exposure of filth and refuse of all kinds and the prohibition of activities, which may endanger public health or cause damage to lands, crops, cattle or goods. Any project activities that pose a danger to health and safety would be infringing on this law.



RS: Ramsar Site,

NP: National Parks

RR: Resource Reserves

WS: Wildlife Sanctuaries

Source: Ghana Wildlife Division <http://www.wildlifeghana.com/wildlifeMain/map.html>

Figure 11-1 Protected Wildlife Areas in Ghana

c) Water Resources Commission Act 522, 1996

Act 522 provides for the preparation of comprehensive plans for the regulation, utilisation, conservation, development and improvement of water resources and develops a policy framework for water resources management in the country. Act 522 also grants rights to exploit water resources.

d) Wildlife Reserve Regulations (LI 710), 1971

LI710 sets the creation of wildlife reserves and prohibition of water pollution within reserves. LI710 would be particularly relevant where the road passes through or near a Game Reserve-protected area (Figure 11-1).

e) Local Government Act 462, 1994

Act 462 sets the responsibilities of District Assemblies for the development, improvement and maintenance of human settlements and the environment at the district and local levels. Act 462 also assigns the Assemblies' responsibilities for the management and maintenance of the

roads within their respective jurisdiction.

f) Town and Country Planning Cap 84, 1945

Cap 84 rearranged the functions and power of town and country planning from the Town and Country Planning Board to the Minister (presently the Minister of Environment, Science and Technology(MEST)) and local governments in 1945. Cap 84 gives the principal roles and power to the designated authorities to plan district layout plans, protection and preservation of amenities, and public services such as drainage, roads, refuse disposal, sewerage and water supply.

(3) Environmental Assessment Regulations LI 1652, 1999 and (Amendment) LI 1703, 2002

Environmental Assessment Regulations, 1999 (LI 1652) and its amendment in 2002 (LI 1703) are the fundamental guidelines for environmental impact assessment in Ghana for all activities that could potentially have an impact on the environment and society. As specified by the EPA Act 490 and said regulations, the EPA is responsible for giving guidance on the whole EIA process, issuing environmental permits and certifications, and monitoring the environmental impacts of the permitted activities. LI 1652 is considered as the primary guideline for any EIA as LI 1703 only revised the fees and charges for environmental permits and certificates in 2002. LI 1652 comprises three parts, Part I: Environmental Permit, Part II: Preliminary Environmental Report and Environmental Impact Statement, Part III: Miscellaneous Provisions, and five schedules, supplemental specifications and forms (Table 11-3).

As LI 1652 focuses on actual activities rather than policy or master plan development, the strategic environmental assessment (SEA), a widely-used management tool for policy making and large-scale area development, is not specified in LI 1652 or any other legislation at this moment. However, the GoG adopted the SEA in public policy processes in the GPRS II. Details of the SEA are described in the following section.

a) Environmental Permit

Under LI 1652, it is required to acquire an environmental permit from the EPA for 30 major activities (specified in schedule 1) before the commencement of construction or such activities. After the initial evaluation by the EPA, some projects are required to conduct an EIA. It is mandatory for 17 activities specified in Schedule 2 to conduct an EIA and acquire approval for the EIA before acquiring the environmental permit. Highway and road construction is one of the 17 activities listed in Schedule 2 and so an EIA is mandatory in Ghana. Detailed procedures and requirements of the EIA are described in the following section.

The proponent of a project requiring an environmental permit is required to pay three different fees: 1) environmental processing charges, 2) permit fees, and 3) environmental certificate fee to obtain an environmental permit and environmental certificate. Detailed fees and charges are listed in schedule 2A, 2B, and 2C of LI 1703. If a project's total development cost exceed US$ 10 million, the required fees and charge are:

Table 11-3 Contents of Environmental Assessment Regulations LI 1652, 1999

PART I - ENVIRONMENTAL PERMIT
1. Undertaking requiring registration and issuance of environmental permit
2. Existing undertakings
3. Environmental impact assessment
4. Application for environmental permit
5. Initial assessment by screening of application
6. Screening report
7. Registration and issuance of environmental permit
8. Fees for and publication of grant of environmental permit
PART II PRELIMINARY ENVIRONMENTAL REPORT AND ENVIRONMENTAL IMPACT STATEMENT
9. Preliminary environmental report
10. Environmental impact statement
11. Scoping report
12. Draft terms of reference
13. Action on scoping report
14. Matters to be addressed in environmental impact statement and publication of notice of environmental impact statement
15. Advertisement of scoping notice
16. Consideration and review of environmental impact statement and publication of notices of environmental impact statement
17. Public hearing
18. Review of environmental impact statement after public hearing
19. Finalisation of environmental impact statement and granting of environmental permit
20. Period for determination of an application
21. Validity of environmental permit
22. Requirement for an environmental certificate
23. Funds for reclamation
24. Environmental management plan
PART III MISCELLANEOUS PROVISIONS
25. Submission of annual environmental report
26. Suspension, cancellation or revocation of permits and certificates
26. Complaints by aggrieved persons
27. Gazette publication
28. Offenses and penalties
29. Interpretation
Schedule 1 (Regulation 1(1)) undertakings requiring registration and environmental permit for agricultural related services
Schedule 2 (Regulation 3) undertakings for which environmental EIA is mandatory
Schedule 3 (Regulation 15 (2)) EIA) scoping notice (application header page form)
Schedule 4 (Regulation 16) the environmental impact statement (EIS) (header page form)
Schedule 5 (Regulation 30 (2)) environmentally sensitive areas

Source: Environmental Assessment Regulations 1999 (LI 1652)

1) environmental processing fee: 25% of 0.1% of the total development cost or 25% of US$ 50,000 whichever is the smaller, with upfront payment
2) permit fees: 75% of 0.1% of the total development cost or 25% of US$50,000 whichever is the smaller
3) environmental certificate fee: GHS 3,000 (GHS30 million)

In the case of a public project, permit fees/approval fees are exempt.

Once the EPA grants the environmental permit, the EPA must publish it in the Gazette and the mass media within 3 months of the date of issue of the permit. Presently, on the EPA web site (EPA home/EPA Publications), some environmental impact statements (EIS) and final EIA reports can be accessed under sub categorises such as Environmental Audit and Assessment, Oil and Gas. <http://www.epa.gov.gh/index.php?option=com_docman&Itemid=73>

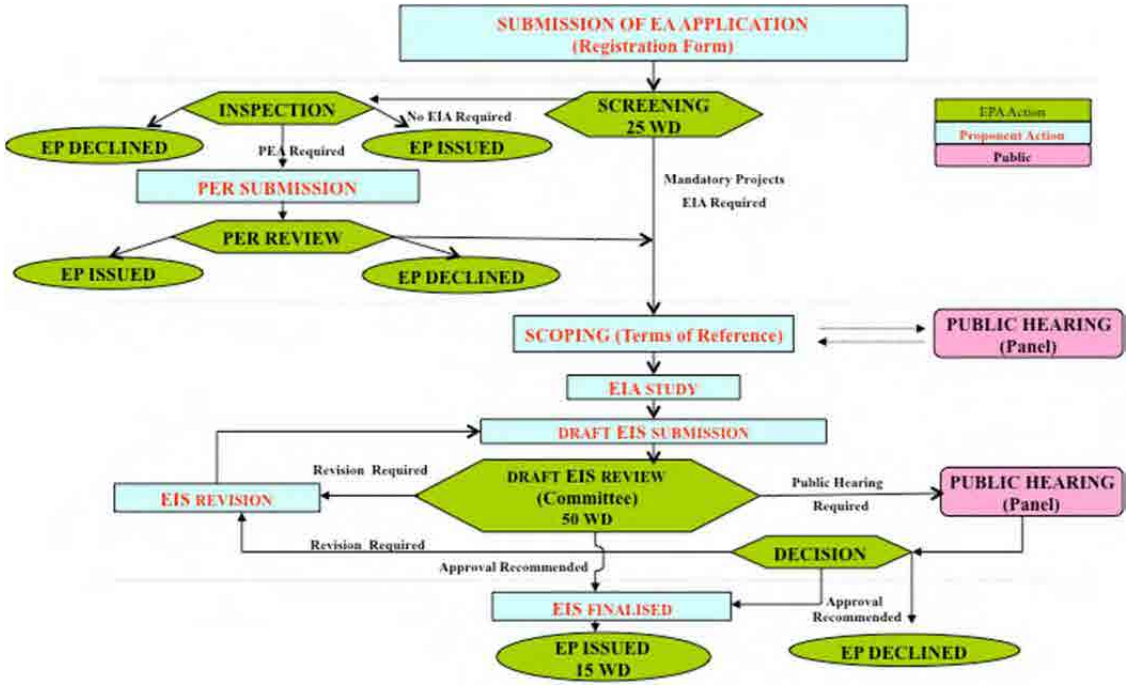
b) EIA Process

As described above, an EIA is mandatory for 17 types of activity classified as environmentally critical and an Environmental Permit (EP) is required. The construction of roads and highways is one of these critical undertakings and therefore an EIA and EP are mandatory for the proposed project. The Figure 11-2 illustrates the EIA and process of acquiring a permit. In the case of the road and highway projects, the procedures for an EIA and responsible entities are as follows.

Table 11-4 Procedure of EIA and Responsible Entity

Item	EPA	MRH/GHA
Registration		X
Screening		X
Preliminary Environmental Assessment (PEA)		X
Scoping Report/Terms of Reference (TOR)	X	
Environmental Impact Assessment (EIA)		X
Public Notices and Public Hearing		X
Review of Environmental Impact Statement (EIS: the EIA report)	X	X
Environmental Permitting and Certification	X	
Environmental Management Plan (EMP)		X
Annual Environmental Report (AER)		X

Source: Study Team



EIA: Environmental Impact Assessment
EIS: Environmental Impact Statement
PER: Preliminary Environmental Report
PEA: Preliminary Environmental Assessment
EA: Environmental Assessment
EP: Environmental Permit
PH: Public Hearing
WD: Working Days for Review
Source: GHA

Figure 11-2 The EIA Procedure in Ghana

c) Contents of Environmental Impact Statement (EIS)

Regulation 12 (Draft terms of reference) and Regulation 14 (Matters to be addressed in environmental statement) give general guidelines for the EIS (Tables 11-5 and 11-6).

Table 11-5 Frameworks of Environmental Impact Statement (Terms of Reference)

1. A description of the undertaking (projects/activities)
2. An analysis of the need for the undertaking
3. Alternatives to the undertaking, including no undertaking
4. Matters on site selection including a statement of the reasons for the choice of the proposed site and whether any other alternative site was considered
5. An identification of existing environmental conditions including social, economic and other aspects of major environmental concern
6. Information on potential, positive and negative impacts of the proposed undertaking from the environmental, social, economic and cultural aspects in relation to the different phases of development of the undertaking
7. The potential impact on the health of people
8. Proposals to mitigate any potential negative socio-economic, cultural and public health impacts on the environment
9. Proposals to be developed to monitor predictable environmental impact and proposed mitigating measures
10. Contingency plans existing or to be evolved to address any unpredicted negative environmental impact and proposed mitigating measures
11. Consultation with members of the public likely to be affected by the operation of the undertaking
12. Maps, plans, tables, graphs, diagrams and other illustrative material that will assist with comprehension of the contents of the environmental impact statement
13. A provisional environmental management plan
14. Proposals for payment of compensation for possible damage to land or property arising from the operation of the undertaking
15. An indication whether any area outside Ghana is likely to be affected by the activities of the undertaking
16. Changes in social, cultural and economic patterns relating to the undertaking
17. Vehicle traffic generation and potential for increase in road accidents

Source: Regulation 12 Draft terms of reference, Environmental Assessment Regulations 1999 (LI 1652)

Table 11-6 General Guidelines on Impact Statements in EIA

1. Concentrations of pollutants in environmental media including air, water and land from mobile or fixed sources
2. Any direct ecological changes resulting from such pollutant concentrations as they relate to communities, habitats, flora and fauna
3. Alteration in ecological processes such as transfer of energy through food chains, decomposition and bio-accumulation which could affect any community, habitat or species of flora or fauna
4. Ecological consequences of direct destruction of existing habitats from activities such as dumping of waste and vegetation clearance and fillings
5. Noise and vibration levels
6. Odour
7. Vehicle traffic generation and potential for increase in road accidents
8. Changes in social, cultural and economic patterns relating to the undertaking
9. Decline in existing or potential use of valued resources arising from matters referred to in items (1) to (4) above
10. Direct or indirect employment generation
11. Immigration and resultant demographic changes
12. Provision of infrastructure such as roads, schools and health facilities
13. Local economy
14. Cultural changes including possible conflict arising from immigration and tourism
15. Potential land use in the area of the proposed undertaking

Note: Impact statements for pre-construction, construction, operation, decommissioning and post-decommissioning phases are required.

Source: Regulation 14 Matters to be addressed in EIS, Environmental Assessment Regulations 1999 (LI 1652)

d) Information Disclosure and Involvement of Stakeholders

Regulation 15 (Advertisement of scoping notice), Regulation 16 (Considerations and review of EIS and publication of notices of EIS) and Regulation 17 (Public hearing) define the requirements for information disclosure and involvement of stakeholders to improve the EIS. The applicant/proponent of the EIS project is required to:

1) give notice of the projects/activities to the relevant Ministries, government departments and organisations and the relevant Metropolitan, Municipal or District Assembly,

2) advertise in at least one national newspaper and a local newspaper around the proposed project sites, and

3) make the scoping report available for the general public in the locality of the proposed project sites.

Once the applicant of an EIA submits the draft EIS, the EPA will direct it to sector Ministries, government departments and organisations of relevance to the proposed projects. The EPA will publish for 21 days a notice of the EIS in the mass media and also post it at appropriate place. Any comments and suggestions from the general public, relevant public agencies, organisations, NGOs, Metropolitan, Municipal and District Assemblies and local communities shall be accepted by the EPA.

Apart from the applicant's public hearing, the EPA shall hold a public hearing in case of:

1) great adverse public reaction to the commencement of the proposed undertaking,

2) dislocation, relocation or resettlement of communities,

3) extensive and far-reaching effects on the environment according to the EPA's evaluation.

e) Objection Procedures

In order to ensure the stakeholders' rights to raise objections, Regulation 27 (Complaints by aggrieved) defines the objection procedures for those (Complainant) having objections against the EPA's decisions or actions. A Complainant shall directly submit a complaint in writing to the Minister of Environment and Science, within 30 days of the EPA's decision or action. It shall:

1) state the issues objected to,

2) have attached a copy of the decision objected to, and

3) have attached all documents relevant for considering and making a decision on the complaint.

A general outline of the procedures is shown in Table 11-7.

f) Strategic Environmental Assessment (SEA)

The EPA and the National Development Planning Commission (NDPC[28]) initiated a Strategic Environmental Assessment (SEA) process in 2003 as one of several crosscutting studies for GPRS. From 2004 to 2005, the SEA was instrumental in the process of developing the GPRS II.

[28] The National Development Planning Commission is a body created by articles 86 and 87 of the 1992 Constitution of the Republic of Ghana and established by Acts 479 and 480 (1994) of Parliament with the mandate to advise the President on development planning policy and strategy.

Then, the GoG formally adopted[29] SEA in 2005 as a strategic instrument of "Public policy management and public sector reforms" in the GPRS II.

Table 11-7 Objection Procedures for EPA's Decision or Action

1. A complainant submits a complain to the Minister of Environment and Science.
2. Within 14 days, the Minister shall appoint a panel composed of representatives from each of:
   - Ministry of the Environment and Science not below the rank of Director
   - Attorney-General's Department not below the rank of Senior State Attorney
   - Ministry with responsibility for the undertaking
   - two persons specialising in the relevant field of the undertaking concerned
3. The Minister shall refer the complaint to the panel and the panel shall give a fair hearing to all parties and determine the issue as it considers appropriate.
4. After hearing from all the parties, the panel may
   - alter the decision of the EPA
   - request the EPA to make a decision on the application where applicable within a specified period
   - give any other orders as it considers necessary
5. The panel shall determine the matter and report to the Minister within 60 days from the Minister's request to the panel. The proceedings of the panel shall be fully documented together with reasons for the panel's decision.

Source: Regulation 27 Complaints by aggrieved, Environmental Assessment Regulations 1999 (LI 1652)

In order to address the inconsistent consideration of the environment in public policy processes, the GoG decided to institutionalize the mainstreaming of sustainable development principles and to use the SEA in public policy processes. Although there are few descriptions of the SEA in the GPRS, it is clearly stated[30] in 2010 in the GoG's medium-term national development policy framework: Ghana Shared Growth and Development Agenda (GSGDA), 2010-2013.

Presently the SEA's consolidated directories can be found on the EPA's SEA website (http://www.epa.gov.gh/index.php?option=com_docman&task=cat_view&gid=108&Itemid=116). Currently, there are five categories under the SEA page and reference guidelines and SEAs are accessible from the directories (Table 11-8).

Table 11-8 SEA Related Directories on EPA Website

Category	Contents
SEA District Reports	In total, 37 SEAs for all regions in Ghana except Greater Accra and Eastern region
GPRS	No references as of September 2012
Energy	Advisory note for energy sector
Final SEA	SEA Manual, SEA of the Ghana Poverty Reduction Strategy GPRS II, Advisory note
Transport	SEA Report on Transport, SEA Report on Urban Transport, Advisory note

Source: http://www.epa.gov.gh/index.php?option=com_docman&task=cat_view&gid=104&Itemid=116

Although the given SEA Manual (Table 11-8) was prepared for the GPRS, it could be considered as the main reference for SEA in Ghana. Section 5 of the manual describes the seven key aspects of sectoral- and district-level SEA:

1) Define the sector/district assembly objectives of SEA

[29] Section 5.5.5 Public Policy Management and Public Sector Reform and APPENDIX 1IC: Good Governance and Civic Responsibility / VI. Public Policy Management and Public Sector Reforms

[30] section 4.2.2 The Vision for the Environment and Natural Resource Sector (GSGDA)

2) Targets and indicators

3) Strategic action

4) Analyse strategy/plan elements and their alternatives and assess potential impacts

5) Develop and apply public consultation processes

6) Prepare SEA report and present to decision-makers

7) Proposed monitoring and evaluation

For the application of SEA in the road development sectors, the Ministry of Roads and Highways and the EPA firstly applied SEA to their RSDP in accordance with the SEA tool for the GPRS. Based on the first Transport SEA report, the MRH then used SEA to:

- Develop a tool to mainstream the environment into transport planning, linking transport planning to air quality, noise nuisance and climate change,
- Identify and develop appropriate policies, regulatory and institutional mechanisms and capacities required to ensure sound and sustainable environmental management practices within the transport sector and the integration of these mechanisms into current and future transport policies, plans and programmes in Ghana,
- Introduce strategic environmental assessment approaches to the current transportation planning processes and through that develop strategic alternatives for transport systems in Ghana.

Based on the first Transport SEA, the MRH generally considers SEA as "a key tool for ensuring sustainable development by considering economic, socio-cultural and environmental issues at the policy plan and programme levels of decision making. The institutional frameworks are also considered as an essential part of the SEA process. The general concept of SEA and transport policy making process were given in the first Transport SEA (Figure 11-3).

Strategic Decision Making Stages: Policy		Environmental Inputs: SEA
Identify aim of Transport Policy	←	• Include environmental/ sustainability issues • Identify relevant targets and indicators
↓		
Identify alternative ways to achieve aim and solve problem areas	←	• Describe environmental baseline • Identify problem areas • Propose (more sustainable) alternatives
↓		
Choose between alternatives	←	• Predict and evaluate impacts of alternative • Propose environmentally preferred alternative
↓		
Fine-tune chosen alternative	←	• Mitigate impacts of chosen alternatives • Include EIA/SEA for lower-level actions where relevant
Formal decision and announcement	←	• SEA report containing recommendations and advisory notes
↓		
Implement and monitor strategic action	←	• Establish environmental guidelines (environmental management plan) for implementation • Monitor environmental impacts of strategic action

Note: The stages are not necessarily sequential. For instance, the identification of alternatives may show that other aspects of the environmental baseline need to be analysed. Like the EIA, SEA is an iterative process.

Source: Transport SEA, EPA/Ministry of Roads and Highways

Figure 11-3 General Concept of SEA and Transport Policy-Making Process

The first Transport SEA was conducted according to the following nine steps:

- Step 1: Screening/Understanding the Context,
- Step 2: Scoping,
- Step 3: Defining the Baseline Conditions,
- Step 4: Policy Analysis,
- Step 5: Predicting Effects,
- Step 6: Developing Indicators,
- Step 7: Considering Alternatives,
- Step 8: Considering the Scope for Mitigation,
- Step 9: Monitoring and Evaluation.

Although no formalized SEA guidelines are available in Ghana at present, the GoG is likely to apply SEA where it is effective and desirable to coordinate the stakeholders and to define appropriate policies followed by actual projects or programmes in a timely manner.

(4) The State Lands Act 1962 (Act 125 as Amended) and Relevant Legislations

a) The State Lands Act 1962 (Act 125 as Amended)

This is the principal law under which private lands can be compulsorily acquired. The Law empowers the President to acquire any land for the public benefit.

The Act and its Regulation, that is, State Lands Regulation 1962 L1 230, details the mechanism and procedure for compulsorily acquiring lands. It is a mandatory requirement that a copy of the instrument of acquisition be served on any person having an interest in or possession of such lands or be affixed at a convenient place on the land and be published three times in a newspaper circulating in the district where the land is situate.

The Act emphasises the payment of compensation to the victims of acquisition made under the Act. The basis of the said Compensation should be either the market value or replacement value. Costs for disturbance and incidental expenses or other damage suffered are to be considered in awarding compensation.

One critical limitation of the Act is that not much premium has been given to the issue of public involvement in the acquisition process. Community consultations and involvement are therefore not mandatory. To ensure that implementation for the project achieves the desired results, the acquiring agency will conduct thorough consultations with all the stakeholders especially the communities that will be affected, at every stage of project implementation

b) State Lands (Amendment) Act, 2000 (Act 586)

This Act amends the Act 125 as follows:

Repeal of section 3 and insertion of Determination by High Court of the right or interest of any person

i) where there is a dispute as to the right or interest being claimed

ii) where the person is dissatisfied with the compensation assessed by the Lands Commission

Substitution of Section 4 with the following: Claims of Compensation

1) ….any person with a claim, shall submit in writing within 6 months from the date of publication of the instrument to the Lands Commission:
   i) particulars of his claim or interest in the land
   ii) the manner in which his claim has been affected
   iii) the extent of damage done, and
   iv) the amount of compensation claimed and the basis for the calculation of the compensation
2) The Lands Commission shall upon receipt of the claim, cause to be assessed the payment of fair and adequate compensation by the government for the land acquired to the owner.
3) In assessing the compensation for the land, regard shall be had to:
   i) The market or replacement value of the land
   ii) The cost of disturbance or any other damage suffered
   iii) The benefits to be derived by the people of the area in which the land is situated from the use for which the land is acquired.

c) Administration of Lands Act 1962 (Act 123)

Act 123 of 1962 was enacted to facilitate the management and administration of stool lands (and other lands). The Act empowers the Minister responsible for lands to manage stool lands in accordance with the provision of the law.

By section 7 of Act 123 the President of the Republic may by Executive Instrument declare any stool land to be vested in trust and accordingly the State could administer such land as a trustee for the stool involved. In such situation the legal rights to sell, lease, collect rent, litigate and manage generally is taken away from the customary land owners and vested in the State. However, the equitable right in the land, which is the right to enjoy the benefits, is retained by the land owner.

Similarly the Act provides in section 10 that "the President may authorise the occupation and use of any land for any purpose which, in his opinion, is conducive to public welfare or the interest of the State". It is a requirement that a public notice shall be published in the Gazette giving particulars of the lands to be taken and the use to which they will be put. Persons whose interests are affected by "reasons of disturbance as a result of the authorization" so made are entitled to be paid.

The entitlements are however to be assessed by giving due consideration to the values of the land (and other losses suffered) and the benefits to be derived by the people in the area (by way of the use to which the State is going to put the land).

The difficulty of this law is that the nature of interest taken is not expressed in definite terms. Again stakeholder consultation and community involvement is not highlighted. It must be noted that the State does not normally use this section of the Act and thus occupation of lands is rarely exercised.

d) Lands Statutory Wayleaves Act 1963 (Act186)

The Lands Statutory Wayleaves Act 1963 Act 186 was enacted to facilitate the entry onto any

land for the purposes of construction, installation and maintenance of public utility works and creation of right of ways and other similar rights for such works.

Works for which right of ways may be created are "highways or works for purposes of, or in connection with any public utility works". Highways have been defined in the Act as "any road, street, path, pavement, or square and includes any bridge, or other structure associated therewith".

The Act and its accompanying Regulation, the Lands Statutory Wayleave Regulation 1964 (LI 334), provides the modalities and procedures for the acquiring statutory right of ways. Thus, the mechanism of entry for survey works and construction has been spelled out in detail. The owner/occupier is required to be given formal notification at least one week in advance about the intent to enter, and at least 24 hours prior to actual entry.

A right of way is legally established by the publication of an executive instrument. Losses and damages suffered are to be compensated for in accordance with the State's procedures for compensation. Provision has also been made for restoration of affected lands where that is possible. In assessing compensation to be paid consideration must be given to the increases of land values as a result of the installation or construction of works. The right of appeal by an aggrieved person is also provided for.

Clearly the desired issue of community consultation has not been given serious consideration. Again the provision for compensation assessment is unfair, especially the exemption from payment of compensation in cases where the land affected does not exceed 20% of the affected persons total land holding.

e) The Ghana Land Policy 1999

In 1999, the GoG put in place the above policy to serve as a broad framework and policy guidelines for land administration and utilisation.

The main objective is to provide guidelines aimed at enhancing land management systems, land use, conservation of land resources and enhancing environmental quality. All these are intended to ensure coordinated and orderly use of land, a vital resource, by present and future generations.

Ultimately, the policy seeks to give protection to proprietary rights and promote the concept of prompt payment of adequate compensation for compulsorily acquired lands and also create an enabling environment for community participation in sustained land management.

11.1.2 Environmental Policy Framework for the Proposed Project

The MRH prepared an Environmental and Social Management Framework (ESMF) with a set of the Resettlement Policy Framework (RPF) in 2007 to be used as guidelines for the "Transport Sector Development Program" (TSDP) funded by the WB focusing on "Road Sector" projects among all agencies under the MRH.

The ESMF and RPF represent statements of policy, guiding principles and procedures, as well as environmental and social safeguards, as instruments of reference for any road sector

project, compatible with all key stakeholders such as the EPA, the WB Operational Policies (OP), the MRH and the implementing Agencies.

The purpose of the ESMF and RPF is to provide the corporate environmental, social and resettlement safeguard policy frameworks, institutional arrangements and capacity required to identify and mitigate the potential safeguard issues and impacts of each sub-project. It is envisaged that preparing and using these documents/guidelines, national and local environmental and social requirements will be met, which will also be consistent with the WB's OP4.01, OP4.12 and other applicable safeguard policies.

The provisional Environmental Social Impact Assessment (ESIA) study would be conducted within the framework of the ESMF and RPF of the Road Sector. If any road project requires involuntary resettlement, the MRH requires the responsible agencies to prepare a resettlement action plan (RAP) specified by the RPF. Details of the RPF are described in the following section.

The ESMF comprises eight chapters:

1) Introduction
2) Existing Policy, Legal, and Administrative Frameworks
3) Road Sector and Infrastructure
4) The Transport Sector Policy and Programme
5) Description of Baseline Conditions
6) Potential Environmental and Social Impacts
7) Environmental and Social Mitigation Principles
8) ESMF Implementation and Management

Considering the applicability of the ESMF for the proposed project and compatibility with the Guidelines for Environmental and Social Considerations (JICA 2010), Chapters 6, 7 and 8 would be the most relevant for JICA's evaluation purpose. The extraction of key components and relevant frameworks are shown below, as well as attached in Appendix 9.

(1) Potential Environmental and Social Impacts (Chapter 6 of ESMF)

Table 11-9 Road Sector Sensitivity Screening Criteria – Environmental (Table 6.1, ESMF)

Types of Road Project (Infrastructure / Service)	Environmental Sensitivity Criteria	Screening Outcome (Level of EA)
Routine maintenance: • Patching of potholes • Light grading • Clearing of trees and bush • Cleaning of gutters, drains and culverts Periodic maintenance, minor rehabilitation and minor improvement: • Spot improvement • Repair and resurfacing short stretches of roads • Upgrading of gravel to bituminous roads Major rehabilitation: • Reconstruction of heavy degraded road section • Upgrading • A/C overlay • Repair and construction of bridges • Repair and construction of culverts and other structures Road construction Asphalt plant Bituminous plant Construction camp	**- Non-environmentally sensitive site/route, single or few component activities** Maintenance / installation / culvert, etc. projects Labour-intensive (limited use of equipment) - Impacts generally localised, less severe, and scope of impacts narrow, short-term and reversible. - Mitigations are easy to design and implement. No need to generate much primary data, especially as baseline.	Sectoral Environmental Assessment
	- Within/bordering or < 0.5 km from an area declared by law as Wildlife Conservation Areas (including National Parks, Resource Reserves, Wildlife Reserves, Strict Nature Reserves, Ramsar Sites and Wildlife Sanctuaries), or Forest Reserves or Globally Significant Biodiversity Areas	Environmental Impact Assessment
	- Within/bordering or < 0.5 km from an area constituting the natural habitat of any threatened (endangered, data deficient and vulnerable), rare or endemic flora and fauna	
	- Within/bordering or < 0.5 km from hilly area with gradient > 45 degrees and prone to erosion, rock fall, mudslide or landslide	
	- Within/bordering or < 0.5 km from an area susceptible to erosion, flooding or geological hazards (including earthquake, tremor and landslide)	
	- Within/bordering or < 0.5 km from an area constituting the head water region of a river or stream or the bank of the drainage channel of a water body	
	- Within/bordering or < 0.5 km from low-lying are acting as natural buffer against shore erosion, strong winds or storm floods	
	- Program or Plan-like Proposals ✓Many phases involved, precise locations may not yet be fully known; ✓Many activities/sub-projects (but type of sub-projects not yet fully determined); and ✓Diverse impacts affecting other sectors implementation/ construction spread over long periods.	Strategic Environmental Assessment

Source: ESMF

Table 11-10 Road Sector Sensitivity Screening Criteria - Social (Table 6.2, ESMF)

Types of Road Project (Infrastructure/ Service)	Social Sensitivity Criteria	Screening Outcome (Level of EA)
Routine maintenance: • Patching of potholes • Light grading • Clearing of trees and bush • Cleaning of gutters, drains and culverts	**Non-socially sensitive site/route, single or few component activities** - Maintenance / installation / culvert, etc. projects - Labour-intensive (limited use of equipment) - Impacts generally localised, less severe, and scope of impacts narrow, short-term and reversible. - Mitigations are easy to design and implement. - No need to generate much primary data, especially as baseline.	Sectoral Environmental Assessment
Periodic maintenance, minor rehabilitation and minor improvement: • Spot improvement • Repair and resurfacing short stretches of roads • Upgrading of gravel to bituminous roads Major rehabilitation: • Reconstruction of heavy degraded road section • Upgrading • A/C overlay • Repair and construction of bridges • Repair and construction of culverts and other structures	**Within/bordering or < 0.20 km from** a known historical, archaeological or scientific site or infrastructure	Environmental Impact Assessment
	Within/bordering or < 0.20 km from a cultural resource or site (e.g. cemetery, sacred grove, shrine, church, mosque)	
	Within/bordering or < 0.20 km from a medical or health facility (e.g. a hospital or clinic)	
	Within/bordering or < 0.10 km from an educational or research facility	
	Within/bordering or < 0.20 km from a human settlement or community or township	
	Involving resettlement or relocation or compensation of more than 20 different persons or families	
Road construction Asphalt plant Bituminous plant Construction camp	**Program or Plan-like Proposals** ✓Many phases involved, precise locations may not yet be fully known; ✓Many activities/sub-projects (but type of sub-projects not yet fully determined); and ✓Diverse impacts affecting other sectors, implementation/ construction spread over long periods.	Strategic Environmental Assessment

Source: ESMF

Table 11-11 Environmental and Social Issues Common to Road Sector Activities and their Degree of Significance (Table 6.3, ESMF)

No.	Issues that are Common (in decreasing order)	No.	Issues that are Significant (in decreasing order)
1	Dust	1	Dust
2	Tree& vegetation removal	2	Water contamination
3	Top soil removal	3	Public safety
4	Pits/trenches near road	4	Tree& vegetation removal
5	Noise	5	Run off
6	Inadequate drains along roads	6	Pits/trenches near road
7	Road construction waste generation & disposal	7	Top soil removal
8	Induced development	8	Resettlement
9	Stream diversion / blocking	9	Compensation issues/agreement
10	Run off	10	Inadequate drains along roads
11	Compensation issues/agreement	11	Flooding
12	Flooding	12	Noise
13	Cultural concerns	13	Cultural concerns
14	Water contamination	14	Stream diversion / blocking
15	Habitat disruption	15	Road accidents
16	Road accidents	16	Forestry concerns (e.g. access)
17	Public safety	17	Wildlife concerns
18	Extensive construction (impact) corridor	18	Habitat disruption
19	Forestry concerns (e.g. access)	19	Road construction waste generation & disposal
20	Wildlife concerns	20	Archaeological losses
21	Resettlement	21	Induced development
22	Archaeological losses	22	Extensive construction (impact) corridor

Source: ESMF

Table 11-12 Common Impacts to be Addressed in Any Environmental Assessment under ESMF

1) HIV/AIDS
2) Health and Safety Impacts
   - Injuries
   - Public Health Impacts
   - Health Damage from Air Pollution
3) Water Resources Impacts
4) Landscape Alteration Impacts
5) Impacts on Soil
6) Land Acquisition and Property Loss
7) Communities and Economic Activities Impacts
8) Noise and Vibration Impacts
9) Impacts on Cultural Resources
10) Habitat Destruction and Disruption (flora and fauna impacts)
11) Waste Generation and Disposal Impacts
12) Traffic Disruption and Diversion Impacts
13) Utility Disruption Impacts

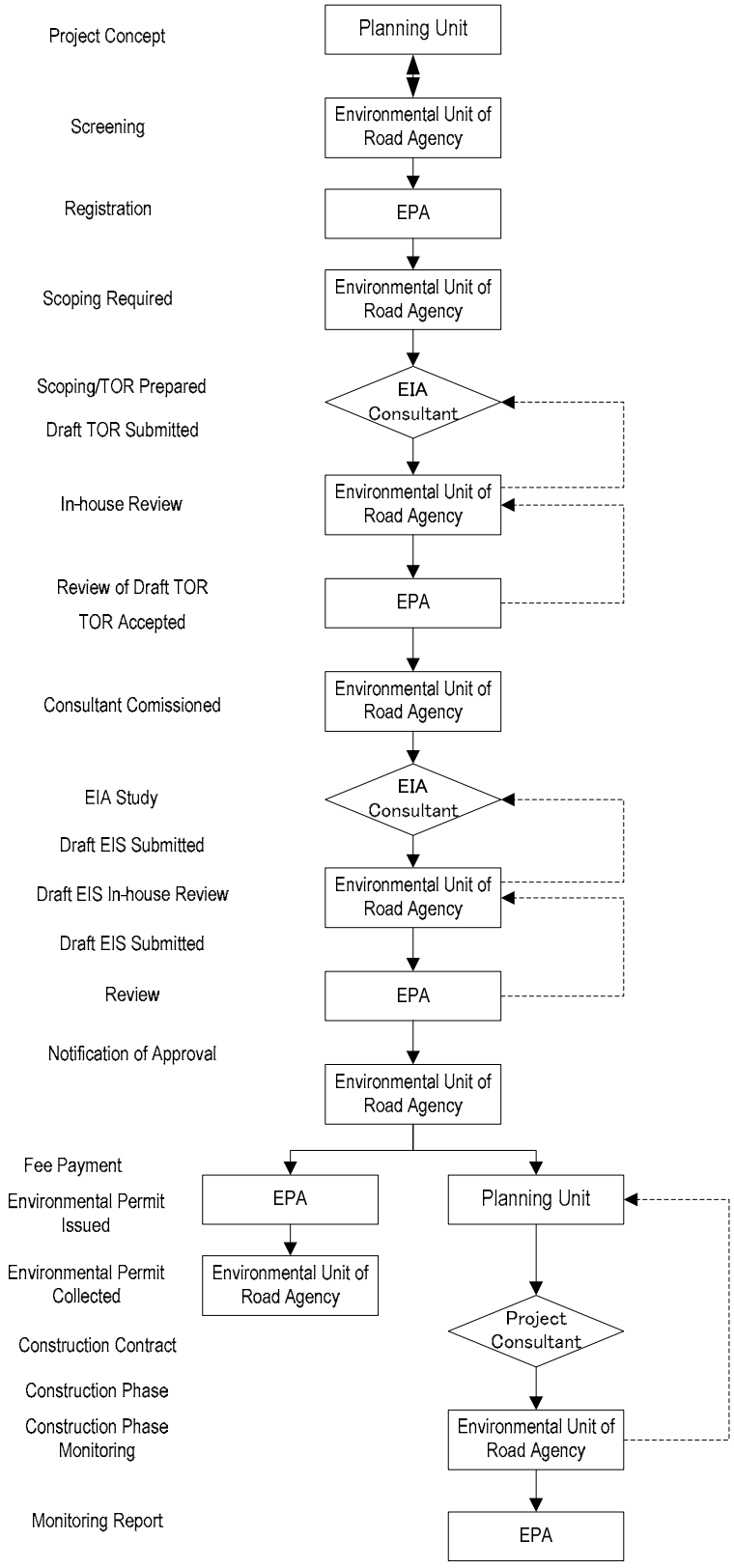
Source: ESMF

(2) Environmental and Social Mitigation Principles of the ESMF (Chapter 7 of ESMF)

Chapter 7 of the ESMF provides common mitigation measures/good practices for each common adverse impact shown in Table 11-2 as a guideline. Appendix 8 of the ESMF also summarises the potential environmental and social impacts associated with the road transport sector and common mitigation measures.

(3) ESMF Implementation and Management (Chapter 8 of ESMF)

The implementation structure of the EIA is shown in Figure 11-4.



Source: ESMF, MRH 2007

Figure 11-4 Environmental and Social Planning Management Structure for EIA

11.1.3 Involuntary Resettlement Policy Framework for the Proposed Project

(1) Legal Basis

a) Constitution of the Republic of Ghana

As shown above, the Constitution of the Republic of Ghana (1992) upholds the principle of private ownership of land. Adequate safeguards against deprivation of private property rights have been provided for, in the 1992 Constitution. Even the State's inherent powers to compulsorily acquire private property rights have been reconsidered and somewhat controlled. Article 20 of the constitution prescribes that under no circumstance should private properties be compulsorily taken unless there are important and justifiable grounds for such acquisition, which invariably must be in the public interest.

It is expressly provided in Article 20 that "No property of any description or interest in or right over any property shall be compulsorily taken possession of or acquired by the State unless the following conditions are satisfied" (cf. 8.1.1 (1) Chapter 5. Fundamental Human Rights and Freedoms). An important provision in the constitution includes the giving back of lands to the owners when such lands are not used for the purpose for which they were compulsorily acquired in the public interest.

b) The State Lands Act 1962 (Act 125 as Amended), State Lands (Amendment) Act (Act 586)

This is the principal law governing the acquisition of land in Ghana. All state agencies are required to follow the procedures specified in the latest acts. (The Land Commission and Land Valuation Boards are to be reorganized in the near future.)

(2) Resettlement Policy Framework (RPF)

The resettlement Policy Framework (RPF) was originally developed and used for the TSDP funded by the WB in 2007. As a result, the RPF is fully compatible with the WB's involuntary resettlement policy (WB OP4.12). Presently, the RPF is the sole resettlement policy framework for any project under the MRH. The RPF aims to continuously improve the nation's rural and urban road network with sustainably, environmentally, and socially sound ways. This objective will be met through improved road maintenance as well as a rehabilitation and construction programme.

MRH is responsible for formulating policies and overall strategies on roads and vehicular transport. The GHA, DFR and DUR are the organisations under the MRH which actually implement the road policies. The GHA is responsible for 14,900 km of roads about 65% of which are gravel roads. The current project falls within the jurisdiction of the GHA.

Specifically, the Road Sector Policy seeks to:

- Achieve sustainable improvements in the performance of trunk, feeder and urban roads and road transport services in all regions of Ghana.
- Strengthen the capabilities for management and implementation in the Road Sector.

- Establish management systems that will ensure the upgrading and preservation of an improved road system and the use thereof in an environmentally, socially and financially sustainable fashion.

The development of the N-2 road project by the GHA and JICA is expected to involve some land take for expansion and for new alignment (in areas where there is no existing road). Much of the land take will involve community and individual property and Ghana laws provide that involuntary acquisition of private property must be done in accordance with laid-down statutory procedures. In the area of land administration one of the critical policies of the GoG is that fair and adequate compensation is paid or in alternative resettlement assistance is provided for eligible people who for the sake of national interest, have to surrender their interest in land or landed properties to the State for development.

a) Principles Governing the Resettlement Policy Framework

The principles of the RPF on the MRH and its agencies are summarised as follows:

1) Involuntary resettlement should be avoided where possible; where population displacement is unavoidable, it should be minimized by exploring all viable project options.
2) Persons affected by land acquisition and facing relocation or loss of incomes associated with a change in land use due to the project should be given compensation so that they can improve or at least maintain their former standard of living.
3) The estimation of the compensation cost and/or benefit should be based on an appropriate method so that the cost of land and other properties taken and demolished are accounted for. This will ensure that the living standards of project-affected persons are maintained or raised to a substantial level.
4) Project-affected persons should be given full information on the qualification (eligibility), mode of compensation, plan for restoring production income, and the project's progress and be involved in the enforcement of resettlement arrangements (community participation).
5) The land and/or property affected should be taken only when the PAPs are satisfied with the compensation arrangements.
6) The implementing agency should supervise the resettlement activities including the payment of compensation as well as monitoring and evaluation

b) Comparison of Ghanaian laws with WB Policies

As the RPF adopted the WB's operational policies, there are no differences between the RPF and the WB's operational policies. For reference, Ghanaian laws and the WB's operational policies are compared in Table 11-13.

c) Categories of Land in Ghana

As a road project, the N-2 development triggers the RPF which spells out the various interests and titles to particular pieces of land that may be impacted as well as the different laws on land that come into focus.

Table 11-13 Comparison of Ghanaian Laws with WB Policies (Table 1, RPF)

Topic	Ghanaian Laws	WB Policy Requirement
Timing of compensation payment	Prompt	Prior to displacement and relocation
Calculation of compensation	Fair and adequate	Full replacement cost
Squatters	No provision, they are deemed not to be eligible	Are to be provided supplementary assistance
Resettlement	In situations where inhabitants have to be displaced, the state is to resettle all on "suitable land with due regard for their economic well being and social and cultural values"	Affected persons who are physically displaced are to be provided with residential housing, or housing sites, or as required, agricultural sites…at least equivalent to their old site. Preference to be given to land-based resettlement for displaced persons whose livelihoods are land-based.
Resettlement Assistance	No specific provision with respect to additional assistance and monitoring	Affected persons are to be offered support after displacement, for a transitional period
Information and consultation	The owner/tenants on the land must be formally notified at least one week in advance of the intent to enter, and be given at least 24 hours notice before actual entry.	Displaced persons and their communities …are provided timely and relevant information, consulted on resettlement options, and offered opportunities to participate in the planning, implementation and monitoring of resettlement
Grievances	Formal and informal mechanisms and formal access to court of law.	Appropriate and accessible grievance mechanisms to be established.

Source: Study Team

Five main interests in land are discussed in the RPF as follows:

1) Allodial Title

2) Customary Freehold

3) Customary Tenancies

4) Common Law Freehold

5) Leasehold

1) Allodial Title

In the Ghanaian context, this is the highest interest capable of being held in land. The allodial title is customarily communally owned and is generally held or vested in stools or skins. In some traditional areas, it is held by clans, families or individuals. Being generally in the form of communal interest in land it accrues to the entire community and is administered by the recognised traditional authority. The owner of the allodial title has complete and absolute freedom to use and dispose of the land only subject to the restrictions, limitations or obligations as may be imposed by the general laws of the country.

The mode of acquisition of the allodial title is by: discovery by hunters or pioneers of the stool etc. of unoccupied land and subsequent settlement thereof and use by the subject; conquest, purchase or gift.

2) Customary Freehold

The customary freehold is an interest or title which a member of the larger community which holds the allodial title acquires in the communal land. It is an interest which is held as of right by virtue of being a member of the community. It is of indefinite duration and thus potentially

subsists forever.

The member who holds such interest has the right of beneficial occupation and unfettered use (also subject to the laws of the country). Upon death, the interest devolves on his/hers successors in title ad infinitum. This interest prevails throughout the country including the allodial title from which it was derived. The customary freehold may however be terminated by the occurrence of any of the following: failure of successors; compulsory acquisition by the State; sale or gift by owner; or abandonment or forfeiture in rare circumstances where, for example, the holder denies the absolute title as the allodial owner.

3) Customary Tenancies

These are lesser interests in land and are created by the holder of the allodial title or customary freehold (or common law freehold). These types of tenancies are by nature share-cropping arrangements. They are quite common in Ghana and occur when a tenant-farmer gives a specified portion of the farm produce to the land owner at each harvest time in consideration for use of the land. The two popular tenancy arrangements are the 'Abusa' and 'Abunu' schemes.

There are other forms of customary tenancies in which the consideration from the tenant is not sharing of crops but cash or a combination of crops and money. The customary tenancy is in this category.

4) Common Law Freehold

This is an interest held for an indefinite period. It is derived from the rules of common law. The holder of this interest has the right of beneficial occupation and may be subject to the laws of land use in any manner.

This type of freehold is created only by express grant. The grantor may thus impose terms on the grantee provided such terms are reasonable and not contrary to public policy or unconscionable. Currently, the laws of the land forbid non-Ghanaians from acquiring freehold in lands in Ghana.

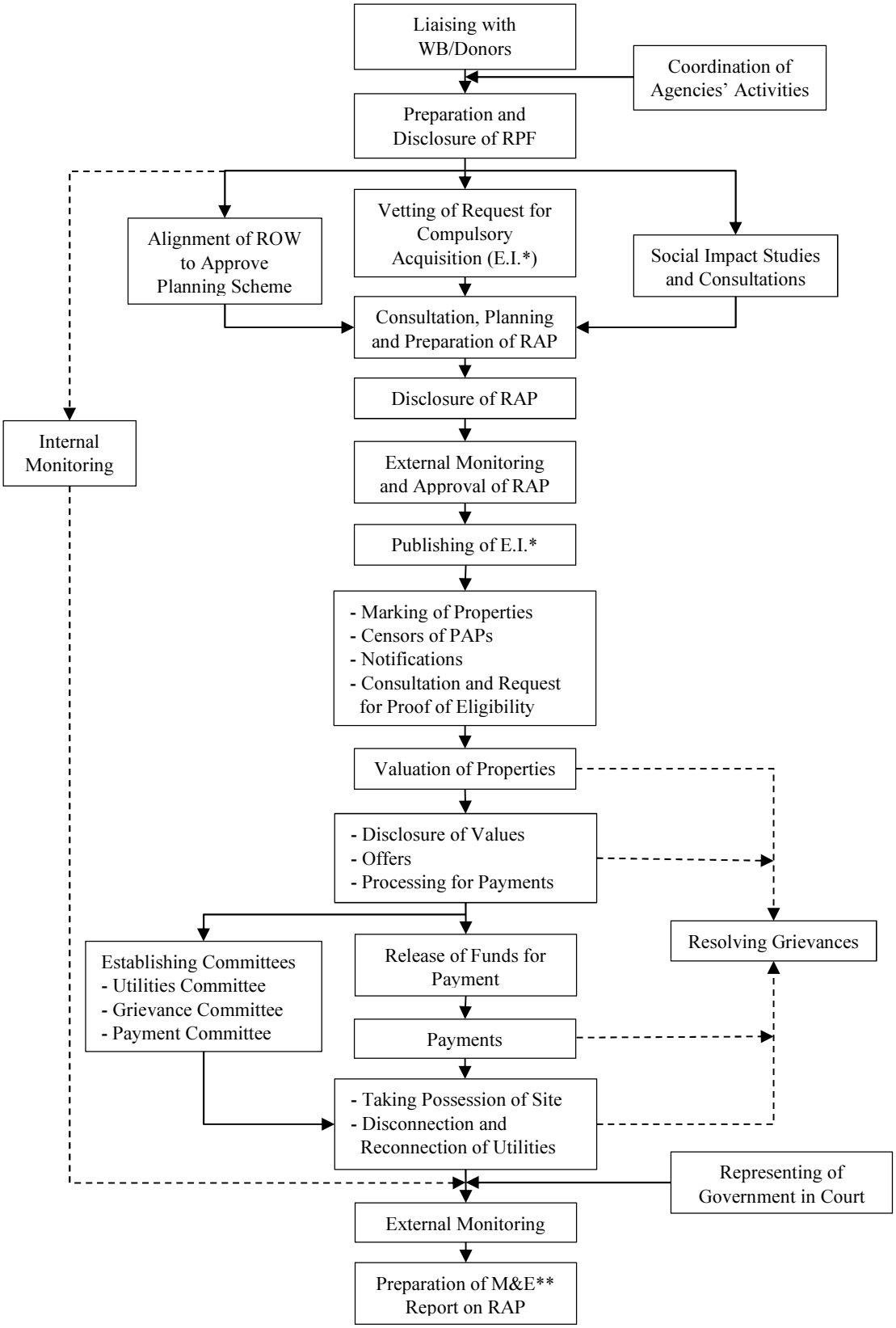
5) Leasehold

This type of interest is also a creation of the common law and not Ghanaian customary law. It is an interest in land for a specified period. The leasehold may be granted by the allodial holder in respect of lands in which no conflicting interest exists; or by a customary freeholder; or by a common law freeholder.

In Ghana, leasehold may be for a maximum duration of 99 years. (Again, non-Ghanaians can only acquire leases of up to 50 years.) Various terms and conditions may be imposed by the grantor including the payment of rent as consideration for the grant.

d) Land Acquisition Process

The Land Acquisition Process is shown in Figure 11-5.



*E.I.: Executive Instrument - Vetting of Request for Compulsory Acquisition, **M&E: Monitoring and Evaluation
Source: Resettlement Policy Framework, MRH, 2007.

Figure 11-5 Land Acquisition Process in Ghana

e) Eligibility of Entitlement

As RPF adapted all the conditions of the WB's operational policies in addition to the legal frameworks in Ghana, eligibility and entitlement are identical to those of WB OP4.12. Tables 11-13 and 11-14 show the principal guidelines of eligibility and entitlement.

In the case of affected persons with no formal or recognized legal rights, the RPF adopted alternative means including:

- Affidavit signed by landlords and tenants,
- Witnessing or evidence by recognized traditional authority, customary heads, community elders, family heads and elders and the general community.

Table 11-14 Type of Loss and Eligible Persons (Table 2, RPF)

Type of Loss	Eligible persons
Loss of Land (Urban or Rural)	Various interests and rights – allodial title holders, freeholders, leaseholders, tenants, licensees
Loss of Structure	Various interests and rights – freeholders, leaseholders
Business Losses - Loss of business income - Loss of business goodwill - Loss of rent income - Loss of wage income - Loss of fees from trainees or apprentices	 - Business owners/operators - Business owners/operators - Landlords/Lessors - Business employees/attendants - Trainers/persons offering apprenticeship job training
Loss of Business, Residential or Industrial Accommodation or Room	- Residential/commercial/industrial tenants - Owners of buildings during the reinstatement period
Loss of location for temporary structure	- Owners of temporary structures
Loss of training or apprenticeship	- Apprentices/Trainees
- Loss of economic or perennial trees - Loss of food crops - Loss of grazing land	Various rights and interest holders – Sharecroppers, Licensees, Lessees

Source: RPF

f) Monitoring and Evaluation

In order to ensure the enforcement of the RPF and relevant safeguard measures, the RPF adopts: 1) internal monitoring, 2) external monitoring, and 3) completion audit.

1) Internal monitoring: internal monitoring will be undertaken by the MRH and its agencies. The frequency of monitoring will be defined in the resettlement action plan (RAP).
2) External monitoring: external monitoring will be done by the EPA (national and regional offices). In addition, the involvement of NGOs will be considered in the external monitoring.
3) Completion audit: A completion audit will be done to evaluate the design and its implementation and effectiveness of the mitigation measures. The audit will verify the initial plan in the RAP, all physical inputs delivered, and all services provided and evaluate their desired effects. The baseline conditions of the PAP before the project will be used as the basis for restoring their socio-economic situation to tat after the resettlement. The completion audit will take place after all RAP activities have been completed.

Table 11-15 Entitlement Matrix (Table 3, RPF)

Type of Loss	Eligibility Criteria	Entitlement
Loss of Land (Urban or Rural)	Various interests and rights – allodial title holders, freeholders, leaseholders, tenants, licensees	Compensation – Capital Market Value of Asset
Loss of Structure	Various interests and rights – freeholders, leaseholders	Compensation – Capital Market Value of Asset
Business Losses - Loss of business income - Loss of business goodwill - Loss of rented income - Loss of wage income - Loss of fees from trainees/ apprentices	 - Business owners/operators - Business owners/operators - Landlords/Leasers - Business employees/attendants - Trainers/Persons offering - Apprenticeship job training	Supplementary Assistance based- - Average net monthly profit - Monthly rent passing - Equivalent of rent advance to be refunded - Monthly wages earned - Training fees to be refunded Calculated for a specific period taking into consideration the reinstatement period.
Loss of Business, Residential or Industrial Accommodation or Room	- Residential/commercial/industrial tenants - Owners of buildings during the reinstatement period	Supplementary Assistance based: - Comparable open market rent for alternative accommodation based on specific period (reinstatement period) - Transportation rates for the transfer of chattels or movable properties
Loss of location for temporary structure: - expense for moving structure - Loss of utility service line	Owners of temporary structures Squatters	Supplementary Assistance based on: - Transportation rates for the transfer of structures - Disconnection of utility service lines at old site - Reconnection of utility service lines at new site
Loss of training or apprenticeship	- Apprentice/Trainee	Comparable fees for alternative training
- Loss of economic or perennial trees - Loss of food crops - Loss of grazing land	Various rights and interest holders – Sharecroppers, Licensees, Lessees	Open market value for assessed crops/plants

Source: RPF

11.1.4 Comparison of JICA Guidelines for Environmental and Social Considerations and Ghanaian Policy

(1) JICA Guidelines for Environmental and Social Considerations

The GoJ has clear policies on ODA with sustainable means. As the principal aid agency of the GoJ, JICA drew up "new" guidelines for environmental and social considerations in 2010 after the merge of the former aid agency, JICA, and the former government bank, the Japan Bank for International Cooperation (JBIC) in 2008. JICA evaluates any programme under JICA technical cooperation, ODA loan, or grant aid to confirm the compatibility of Japanese ODA policies and to give advice on necessary actions if the requested assistance programme or projects need further considerations to meet Japan's policies.

Following are extracts of JICA's environmental policy and objectives of the "JICA Guidelines for Environmental and Social Considerations, April 2010" (JICA Guideline).

a) JICA Environmental Policy

As stated in the "Law on General Rules of Japan International Cooperation Agency," JICA's mission is to "contribute to the promotion of international cooperation and to the sound development of Japan and the international socioeconomy by contributing to the development or reconstruction of the economy and society, or economic stability of overseas regions which are in the developing stage," particularly to global environmental protection in compliance with environmental laws and regulations. Furthermore, in order to prevent and reduce negative environmental impacts that result from JICA's activities, JICA will utilize an environmental management system and shall work continuously to improve it. The system will be based on the following policies:

1) Promotion of environmental measures through international cooperation activities
2) Promotion of activities for general environmental awareness
3) Promotion of environmentally friendly activities within JICA offices and other JICA facilities
4) Compliance with environmental laws and regulations

This Environmental Policy will be communicated to all employees and personnel who work in or on behalf of JICA, and also be publicized (1st November, 2008).
http://www.jica.go.jp/english/our_work/social_environmental/policy/index.html

b) JICA Guideline Objectives

The objectives of the guidelines are to encourage Project proponents, etc. to have appropriate consideration for environmental and social impacts, as well as to ensure that JICA's support for and examination of environmental and social considerations are conducted accordingly. The guidelines outline JICA's responsibilities and procedures, along with its requirements for project proponents etc., in order to facilitate the achievement of these objectives. In doing so, JICA endeavours to ensure transparency, predictability, and accountability in its support for and examination of environmental and social considerations.

In order to avoid unnecessary complexity and efforts to understand Japan's specific environmental and social safeguard policies for those willing to use JICA's assistance, the JICA Guideline is designed to be compatible with the most common guidelines: the WB Operational Policies (WB OPs). In addition, internationally recognized standards, international treaties & declarations, and good practices of developed nations are also referred to where necessary.

When JICA recognizes significant inferiorities of the laws and regulations applied to the proposed programme/project, JICA encourages project proponents to make further considerations and commitments to mitigate the adverse impacts in a regionally and/or internationally reasonable manner. For loan aid, grant aid, and technical cooperation programme/projects, JICA takes the outcomes of its environmental reviews and proponents' further commitments to environmental and social considerations into account when it makes a decision on assistance. If appropriate environmental and social considerations are not

undertaken, JICA may not undertake loan aid, grant aid, or technical cooperation projects.

JICA's seven most important principles for the JICA Guideline are summarised in Table 11-16.

Table 11-16 JICA's Seven Most Important Principles for the JICA Guideline

1) Attention to a wide range of impacts	The types of impacts addressed by JICA cover a wide range of environmental and social issues.
2) Application of the JICA Guideline from an early stage to a monitoring stage	JICA applies a Strategic Environmental Assessment (SEA) when conducting Master Plan Studies etc., and encourages project proponents, etc. to ensure environmental and social considerations from an early stage to a monitoring stage.
3) JICA's responsibility for accountability for assistance	JICA ensures accountability and transparency when implementing cooperation projects.
4) Stakeholders' participation	JICA incorporates stakeholder opinions into decision-making processes regarding environmental and social considerations by ensuring the meaningful participation of stakeholders in order to consider environmental and social factors and to reach a consensus accordingly. JICA replies to stakeholders' questions. Stakeholders who participate in meetings are responsible for what they say.
5) Information disclosure	JICA itself discloses information on environmental and social considerations in collaboration with project proponents, etc., in order to ensure accountability and to promote the participation of various stakeholders.
6) Enhancement of organizational capacity	JICA makes efforts to enhance the comprehensive capacity of organizations and operations in order for project proponents etc., to have consideration for environmental and social factors, appropriately and effectively, at all times.
7) Serious attempts at promptness	JICA addresses requests to accelerate the implementation of projects while undertaking environmental and social considerations.

Source: JICA

The requirements of the JICA Guideline are shown in Appendix 10.

Useful links:

The new "JICA guidelines for environmental and social considerations"	http://www.jica.go.jp/english/our_work/social_environmental/guideline/pdf/guideline100326.pdf
References (Screening Form, Environmental Checklists, Monitoring Form)	http://www.jica.go.jp/english/our_work/social_environmental/guideline/ref.html
The new "Objection Procedures"	http://www.jica.go.jp/english/our_work/social_environmental/guideline/pdf/objection100326.pdf
Frequently Asked Questions (FAQs) and JICA's answers	http://www.jica.go.jp/english/our_work/social_environmental/guideline/pdf/faq.pdf
JICA Environmental and Social Considerations portal	http://www.jica.go.jp/english/our_work/social_environmental/index.html

(2) Comparison of JICA Guidelines and Ghanaian Policies

Since the National Environmental Frameworks was prepared and optimised based on the WB's Environmental Policy Framework, there is no contravention of the JICA Guidelines. Hence, the Resettlement Policy Framework (2007) prepared by the MRH is used in the Study.

11.2 Preliminary Impact Assessment of the Proposed Alternatives

11.2.1 Description of Proposed Project

As a critical section development of the Eastern Corridor (Figure 11-6), GoG's high priority route development under the Road Sector Medium-Term Development Plan, MRH requested JICA's support:

- To select the optimum route, with a new bridge across the Volta River, among alternative routes between Asutsuare Jct. and Asikuma Jct. on the Eastern Corridor (N-2), and to confirm the viability of the road and bridge construction project,
- To confirm the viability of the upgrading the Asutsuare - Aveyime road

Source: Study Team

Figure 11-6 Major Transport Corridors and Gateway Ports

As the response to the request, the Study Team conducted a comprehensive study to cover the requested objectives in the southeast regions of Ghana namely Greater Acura Region, Eastern Region, and Volta Region (Figure 11-7). Outline of the proposed two projects are shown in Table 11-17 below.

(1) The Construction of Road between Asutsuare Jct. and Asikuma Jct. (red line in Figure 11-7)

- Section one: Upgrading the existing feeder road between Asutsuare Jct. and Asutsuare town, and construction of new road the intersection of the existing regional road and the south approach of the new bridge across the Volta River.
- Section two: The new bridge across the Volta River.
- Section three: Construction of new road from the north approach of new bridge across the Volta River to Asikuma Jct. with a medium span bridge across the Alabo River.

(2) Upgrading of Asutsuare – Aveyime Road (green line in Figure 11-7)

- Upgrading the existing feeder road between Asutsuare town and Aveyime to the inter-regional road with/without a small bypass

Source: Study Team

Figure 11-7 Environmental Study Area and Proposed Projects

to avoid township(s) with a shot span bridge adjacent to east end of Asutsuare town to cross a small canal.

Table 11-17 Project Outline

(1) Project Name	Feasibility Study on the Eastern Corridor Development Project in Eastern Accra, Volta, and Eastern Regions
(2) Project Purpose	i) Construction of a new road between Asutsuare Jct. and Asikuma Jct., including a new bridge across the Volta River ii) Upgrading the existing Asutsuare – Aveyime road (feeder road)
(3) Target Road (Figure 11-7)	i) New road between Asutsuare Jct. and Asikuma Jct.: 67km ii) Asutsuare - Aveyime road: 24km
(4) Right of Way (ROW)	i) 90m: National road (Asutsuare Jct. - Asikuma Jct.) ii) 60m: Inter-regional road (Asutsuare town to Aveyime town)
(5) Bridge	i) New road between Asutsuare Jct. and Asikuma Jct.: A long span bridge across the Volta River and some short span bridges across the Alabo River and irrigation canals (number is depending on the location of alignment) ii) Asutsuare – Aveyime road: one shot span bridge across a small canal adjacent to east end of Asutsuare town
(6) Project Affected District	Dangme West, Greater Accra Regions North Tongu, Volta Regions Asuogyaman, Eastern Regions
(7) Responsible Authorities	MRH, GHA

Source: Study Team

11.2.2 Baseline of Natural and Social Environment in the Study Area

The followings summarises the baseline of natural and social environment in the Study Area, while details are attached in Appendix 11.

(1) Project Area of Influence

a) Construction of New Road between Asutsuare Jct. and Asikuma Jct.

The project road traverses three districts, namely Dangme West in the Greater Accra Region, North Tongu in the Volta Region and Asuogyaman in the Eastern Region. The main townships along the road include Asutsuare, Osuwem, Dufor Adidome, and Asikuma.

b) Upgrading of Asutsuare – Aveyime Road

The project road traverses two districts, namely Dangme West and Asuogyaman in the Eastern Region. There are only three main townships along the project road, Asutsuare, Volivo and Aveyime.

Table 11-18 Main Towns in Proposed Project Area

Region	District	District Capital	Main Township on Road
Greater Accra	Dangme West	Dodowa	Asutsuare, Volivo, Osuwem
Eastern	Asuogyaman	Atimpoku	Asikuma
Volta	North Tongu	Adidome	Aveyime, Dufor Adidome

Source: Study Team

c) Overview of Land Use and Livelihoods

In general along the proposed road projects, the land use of existing road and proposed alignments are:

- Food crop farms, mainly cassava and rice

- Cash crop farms, mainly oil palm, mango, woodlots, and banana plantations
- Cattle grazing fields (mostly north of the Volta River between Dufor Adidome and Asikuma Jct.)
- Natural or original vegetation

Other livelihoods specifically related to the Volta river are:

- Aquaculture in the Volta River (very limited but popular)
- Shell mining for white paint raw material or construction material
- Canoe ferries offering transport services

(2) Profiles of Potentially Affected Districts

Profiles of potentially affected districts are summarised below.

a) Dangme West District

- The Dangbe West is part southeast coastal plain of Ghana, which encompasses the project area, is one of the hottest and driest parts of the country and rainfall is generally very low with most of the rains, very erratic in nature.
- In the area forms the central portions of the Accra plains, the relief is generally gentle and undulating, a low plain with heights not exceeding 70 m. The plains are punctuated in isolated areas by a few prominent inselbergs, isolated hills, outliers and knolls scattered erratically over the area.
- At present, the area is widely used for the cultivation of rice, sugar cane and vegetables.
- The very seasonal nature of most of the streams caused by high temperatures and equally high insolation levels have encouraged the construction of a number of artificial dams and ponds of varying size, used for irrigation and for watering of livestock.
- The predominance of rural population is reflected in the occupational distribution, with agriculture being the main occupation.
- The district has about 252 km of road network, of which 40% is paved and the rest are feeder roads. Major towns in the district including Dodowa, Prampram, Asutsuare, Dawhenya, Afienya, Dorymu, Old Ningo, Kordiabe, New Ningo and Agomeda have electricity. A total of 18 towns have access to piped water, with the remaining towns depending on wells, boreholes and other sources.

b) North Tongu District

- The mean temperature is 27º C and the maximum and minimum vary from 22º C to 33º C. respectively. The average annual rainfall varies from 900mm to 1100mm with more than 50 per cent of it falling in the major season.
- North Tongu is dominantly medium to moderately coarse textured alluvial soils along the Volta River. These soils are also very difficult to cultivate because they have low water holding capacity. They are however, suitable for rice, sugarcane, maize and vegetable cultivation under irrigation.

- The main form of land use in the project area is agriculture. The land is mainly used for the cultivation of food crops and cattle rearing.
- In the rainy season, these streams overflow their banks, causing damage to roads and farms. Sources of water for domestic use are pipe borne, boreholes, streams and wells.
- The road network in the district is in a poor state, although efforts are being made to improve roads and make them more motorable. The current supply of hydroelectric power is limited to Adidome, Akyemfo, Battor, Mepe, Mafi Kumase Asiekpe and Juapong.

c) Asuogyaman District

- This part of the project area in this the Asuogyaman district lies within the Dry Equatorial Climate Zone which experience substantial amount of precipitation.
- The low lying areas along the Volta Lake, the soil type falls within the Savannah Greisol and Aluviosols. Because of its structure, the soil is liable to temporary flooding in times of high water levels. Its nutrients status is moderate but to ensure sustained yield of crops it requires the use of fertiliser.
- The project road traverses a number of farming villages and towns in this district and the main form of land use is agriculture.
- Sources of water for domestic use are pipe borne, boreholes, streams and wells.
- Crop farming is predominant, with maize, cassava, plantain, vegetables and yam being the major crops. Fishing in Lake Volta is an important economic activity along the 141 km shoreline.
- The Ghana Water Company supplies piped water to towns and villages along the major trunk road and the Volta River Authority supplies water to Akosombo. Other towns and villages depend on deep wells, hand-dug wells and streams.

(3) Water Quality

- Water sampling and analysis was conducted. There are no indicators exceeding EPA guideline values.

(4) Air and Noise Quality

- Air quality sampling was conducted at the representative locations of proposed two projects. Results shows presently all sampling locations are below the EAP guide line for residential area.
- Generally, the noise levels recorded at the various locations along the projects were low.

(5) Flora and Fauna

a) Flora

- The predominant vegetation type found in this South is of the short grass savannah interspersed with shrubs and short trees, a characteristic of the Sub- Sahelin type. The vegetation is dense along the Volta River and along the stream basins.

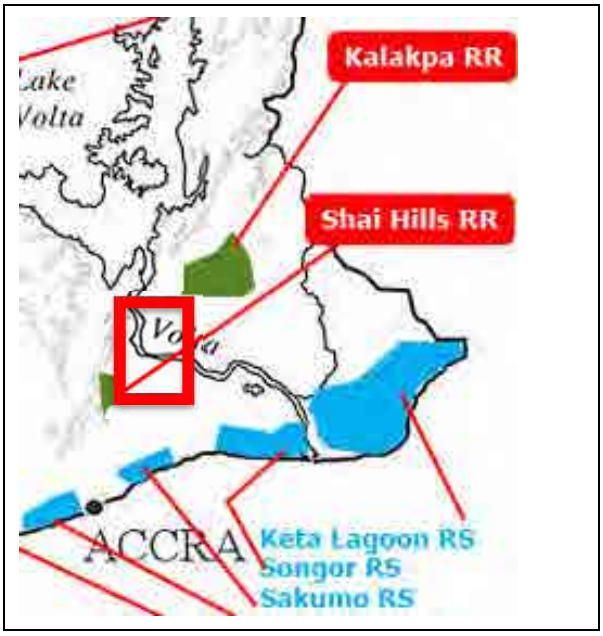
b) Fauna

- Harvesting of trees for lime and charcoal production in the area and also poaching activities has caused wildlife, which included elephants, antelopes, monkeys, hogs etc to flee left for other reserves close to the project area. Partridges are however still common in the area.

(6) Environmentally Sensitive Area around Proposed Project Area

Figure 11-8 shows the location of proposed projects (red square) and environmentally sensitive areas. Proposed project does not affect the sensitive area but are located adjacent to Shai Hills resource reserve (RR) and Kalakpa RR.

Presently Shai Hills RR is well managed by Ghana Wildlife division and attracts eco tourists. On the contrary, due to the limited access to the Kalakpa RR, it has been left with minimal care. Table 11-19 shows a summary of the two adjacent protected areas.



Source: Ghana Wildlife Division
<http://www.wildlifeghana.com/wildlifeMain/map.html>

Figure 11-8 Protected Wildlife Areas around Proposed Project Area

Table 11-19 Summary of Adjacent Protected Areas

	Shai Hills Resource Reserve	Kalakpa Resource Reserve
Objectives	• The area contains habitats which are managed to provide conditions essential to the well-being of selected species for the sustained production of wildlife products (meat, timber, pasture, fruits, honey, and other non-timber forest products). • The areas are used for cultural practices, tourism, and trophy hunting. • Conservation priorities involve the manipulative management of species and their habitats to ensure the protection and propagation of the target species, including introduced indigenous and exotic species. • Management is to be conducted in such a way as to preserve the areas' natural aspect as far as possible. • Other forms of land use compatible with these goals are allowed. • These areas may be managed by a central authority or, through agreement, by other levels of government, special trusts, or local community institutions as appropriate under the overall supervision of the Wildlife Division (WD) of Ghana Forestry Commission.	
Authority	WD	Ho District, Volta Region supported by WD
Designation	L.I. 710-WILDLIFE RESERVES REGULATIONS, 1971	L.I. 1022-WILDLIFE RESERVES (AMENDMENT) REGULATIONS, 1975
Type of RR	Woodland Savannah	Coastal Savannah
Reference	www.fcghana.org/library.php?id=22	www.moongateassociates.com/documents/KalakpaFinal.pdf

Source: WD of Ghana Forestry Commission, Ghana Forestry Commission, Ghana Country Environmental Analysis (WB, 2006)

11.2.3 Scope of the Project Impacts and Term and Reference of Environmental and Social Survey

Expected impacts of the selected alternative in the previous section are summarized in Tables 11-20 and 11-21.

Table 11-20 Scope of the Project Impacts

(Construction of New Road between Asutsuare Jct. and Asikuma Jct.) (1)

Category		Environmental Items	Stages			Remarks
			p	c	o	
Environmental	**1**	Air pollution	D	C -	C -	P: No relevant activities are expected. C: Temporal impacts are expected from the construction activities and construction machineries and trucks. O: Compared to the existing few impacts condition, continuous impacts are expected from the passing vehicles.
	2	Water pollution	D	C -	D	P: No relevant activities are expected. C: Temporal impacts are expected form the high turbidity runoff from construction sites and bridge construction site in the river. Also, temporal impacts are expected from construction camps in case of improper treatment. O: No impacts are expected.
	3	Soil pollution	D	B -	D	P: No relevant activities are expected. C: Temporal impacts are expected from construction wastes. O: No impacts are expected.
	4	Waste	D	B -	C	P: No relevant activities are expected. C: Temporal impacts are expected from construction activities and construction camps. O: No impacts are expected.
	5	Noise and vibrations	D	C -	C -	P: No relevant activities are expected. C: Temporal impacts are expected from construction activities. O: continuous impacts are expected from the passing vehicles.
	6	Ground subsidence	D	D	D	P: No relevant activities are expected. C: No relevant activities are expected. O: No relevant activities are expected.
	7	Odors	D	B -	D	P: No relevant activities are expected. C: Temporal impacts are expected from wastes and sewage water of construction camp in case of improper treatment. O: No impacts are expected.
	8	Sediment	D	B -	D	P: No relevant activities are expected. C: Temporal impacts (erosion/deposit) are expected from bridge construction. O: No impacts are expected.
Natural Environment	**9**	Protected areas	D	D	D	P: No relevant activities are expected. C: No impacts are expected in the adjacent two protected area. O: No impacts are expected in the adjacent two protected area.
	10	Ecosystem	D	C -	D	P: No relevant activities are expected. C: Permanent impacts are expected by land clearance for new route construction. No impacts are expected for existing sections. O: No impacts are expected.
	11	Hydrology	D	B -	D	P: No relevant activities are expected. C: Permanent impacts are expected by bridge construction. O: After the initial impacts, no further impacts are expected.
	12	Topography and geology	D	C -	D	P: No relevant activities are expected. C: Permanent impacts are expected by new route construction. O: After the initial impacts, no further impacts are expected.
Social Environment	**13**	Resettlement	C -	C -	D	P: Limited resettlements are expected before the construction. C: Some safeguards/further assistance are expected after the resettlement. O: No further impacts are expected.
	14	Poverty group	C -	C +	B +	P: Poverty group are expected in PAPs. Special attention might be required for income restoration plan. C: Temporal income opportunities are expected relevant to the construction work. O: Improvement of accesses to social eservices, markets and new job opportunities led by new route construction are expected.
	15	Ethnic minorities and indigenous peoples	D	D	D	P: Small communities having unique tradition led by traditional chiefs are common in Ghana. No special attentions are necessary. C: No special attentions are necessary. O: No special attentions are necessary.
	16	Working conditions	B -	B +	A +	P: Limited business, particularly street benders, are required to relocate C: Temporal construction work and additional commodity sales are expected during construction. O: New job opportunities led by the new agricultural development in the region.
	17	Land use and natural resources	B -	B -	A +	P: Some farmers and oyster shell miners are required to relocate for ROW clearance. C: Permanent impacts are expected to supply construction materials in the region. O: Commercial farming activities are expected in the cattle field or non used land area.

Table 11-20 Scope of the Project Impacts

(Construction of New Road between Asutsuare Jct. and Asikuma Jct.) (2)

Category		Environmental Items	Stages			Remarks
Social Environment	**18**	Water use/rights	D	C -	C -	P: No relevant activities are expected. C: Temporal impacts are expected from high turbidity water by bridge construction. O: Continuous impacts are expected from the runoff.
	19	Existing social infrastructures and services	D	B +	A +	P: No social infrastructures and services are expected in ROW. C: Limited but additional social services for construction works may improve the access to such services. O: Accessibilities to the necessary social infrastructures and services will be improved.
	20	Local government and its function	D	D	D	P: No relevant activities are expected. C: No relevant activities are expected. O: No relevant activities are expected.
	21	Imbalance of damages and benefits	D	D	B -	P: No relevant activities are expected. C: No imbalance are expected. O: Some imbalance are expected due to expected new agricultural development activities and connectivity to the new route.
	22	Interest opposition	D	D	D	P: No impacts are expected. C: No impacts are expected. O: No impacts are expected.
	23	Cultural heritage	D	D	D	P: No relevant activities are expected. C: No relevant activities are expected. O: No relevant activities are expected.
	24	Landscape	D	B -	A +	P: No impacts activities are expected. C: Temporal/permanent change are expected from construction work. O: new bridge could be new land mark/tourist spot of the area.
	25	Gender	D	D	B +	P: No impacts are expected. C: No impacts are expected. O: Some skill job opportunities rather than common activities are expected from new farm development projects and other businesses.
	26	Rights of child	D	D	D	P: No impacts are expected. C: No impacts are expected. O: No impacts are expected.
	27	Transmittal diseases, HIV/AIDS	D	B -	B -	P: No relevant activities are expected. C: Spread of transmittal diseases brought by immigrant workers are expected without proper safety management program. O: Spread of transmittal diseases through relevant services and visitors are expected without proper safety management program.
	28	Occupational health and safety	D	B -	D	P: No impacts are expected. C: Continuous attention is necessary throughout the construction work. O: No relevant activities are expected.
Others	**29**	Accidents	D	B -	B -	P: No impacts are expected. C: Accidents relevant to construction work, traffic are expected. O: Occasional traffic accidents are expected due to the high speed traffic.
	30	Trans-boundary impacts and/or climate change	D	D	D	P: No relevant activities are expected. C: No impacts are expected. O: No impacts are expected.

Notes- p: planning stage, c: construction stage, o: operation stage

A+/-: Significant positive/negative impact is expected. B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses) D: No impact is expected.

Source: Study Team

Table 11-21 Scope of the Project Impacts (Upgrading of Asutsuare – Aveyime Road) (1)

Category		Environmental Items	Stages			Remarks
			p	c	o	
Environmental	**1**	Air pollution	D	C -	C +	P: No relevant activities are expected. C: Temporal impacts are expected from the construction activities and construction machineries and trucks. O: Reduction of dust is expected due to the paved road.
	2	Water pollution	D	C -	D	P: No relevant activities are expected. C: Temporal impacts are expected form the high turbidity runoff from road improvement work. Also, temporal impacts are expected from construction camps in case of improper treatment. O: No impacts are expected.
	3	Soil pollution	D	B -	D	P: No relevant activities are expected. C: Temporal impacts are expected from construction wastes. O: No impacts are expected.
	4	Waste	D	B -	D	P: No relevant activities are expected. C: Temporal impacts are expected from construction activities and construction camps. O: No impacts are expected.
	5	Noise and vibrations	D	C -	C -	P: No relevant activities are expected. C: Temporal impacts are expected from construction activities. O: Continuous impacts are expected from the more frequent passing vehicles.
	6	Ground subsidence	D	D	D	P: No relevant activities are expected. C: No relevant activities are expected. O: No relevant activities are expected.
	7	Odors	D	B -	D	P: No relevant activities are expected. C: Temporal impacts are expected from wastes and sewage water of construction camp in case of improper treatment. O: No impacts are expected.
	8	sediment	D	D	D	P: No relevant activities are expected. C: No relevant activities are expected. O: no impacts are expected.
Natural Environment	**9**	Protected areas	D	D	D	P: No relevant activities are expected. C: No relevant activities are expected. O: No relevant activities are expected.
	10	Ecosystem	D	C -	D	P: No relevant activities are expected. C: Permanent impacts are expected by land clearance for new reroute at Volivo. No impacts are expected for existing sections. O: No impacts are expected.
	11	Hydrology	D	D	D	P: No relevant activities are expected. C: No relevant activities are expected. O: No relevant activities are expected.
	12	Topography and geology	D	D	D	P: No relevant activities are expected. C: No impacts are expected. O: No impacts are expected.
Social Environment	**13**	Resettlement	C -	C -	D	P: Limited resettlements are expected before the construction. C: Some safeguards/further assistance are expected after the resettlement. O: No further impacts are expected.
	14	Poverty group	C -	C +	B +	P: Poverty group are expected in PAPs. Special attention might be required for income restoration plan. C: Temporal income opportunities are expected relevant to the construction work. O: Improvement of accesses to social eservices, markets and new job opportunities led by new route construction are expected.
	15	Ethnic minorities and indigenous peoples	D	D	D	P: Small communities having unique tradition led by traditional chiefs are common in Ghana. No special attentions are necessary. C: No special attentions are necessary. O: No special attentions are necessary.
	16	Working conditions	B -	B +	A +	P: limited business, particularly street benders, are required to relocate C: Temporal construction work and additional commodity sales are expected during construction. O: New job opportunities led by the new agricultural development in the region.
	17	Land use and natural resources	B -	B -	B +	P: Some farmers and oyster shell miners are required to relocate for ROW clearance. C: Permanent impacts are expected to supply construction materials in the region. O: Commercial farming activities are expected in or connected area.

Table 11-21 Scope of the Project Impacts (Upgrading of Asutsuare – Aveyime Road) (2)

Category		Environmental Items	Stages			Remarks
			p	c	o	
Social Environment	**18**	Water use/rights	D	D	D	P: No relevant activities are expected. C: No relevant activities are expected. O: No relevant activities are expected.
	19	Existing social infrastructures and services	D	B+	A+	P: No social infrastructures and services are expected in ROW. C: Limited but additional social services for construction works may improve the access to such services. O: Accessibilities to the necessary social infrastructures and services will be improved.
	20	Local government and its function	D	D	D	P: No relevant activities are expected. C: No relevant activities are expected. O: No relevant activities are expected.
	21	Imbalance of damages and benefits	D	D	D	P: No relevant activities are expected. C: No imbalance are expected. O: No imbalance are expected.
	22	Interest opposition	D	D	D	P: No impacts are expected. C: No impacts are expected. O: No impacts are expected.
	23	Cultural heritage	D	D	D	P: No relevant activities are expected. C: No relevant activities are expected. O: No relevant activities are expected.
	24	Landscape	D	B-	D	P: No impacts activities are expected. C: No impacts activities are expected. O: No impacts activities are expected.
	25	Gender	D	D	B+	P: No impacts are expected. C: No impacts are expected. O: Some skill job opportunities rather than common activities are expected from new farm development projects and other businesses.
	26	Rights of child	D	D	D	P: No impacts are expected. C: No impacts are expected. O: No impacts are expected.
	27	Transmittal diseases, HIV/AIDS	D	B-	B-	P: No relevant activities are expected. C: Spread of transmittal diseases brought by immigrant workers are expected without proper safety management program. O: Spread of transmittal diseases through relevant services and visitors are expected without proper safety management program.
	28	Occupational health and safety	D	B-	D	P: No impacts are expected. C: Continuous attention is necessary throughout the construction work. O: No relevant activities are expected.
Other	**29**	Accidents	D	B-	B-	P: No impacts are expected. C: Accidents relevant to construction work, traffic are expected. O: Occasional traffic accidents are expected due to the higher spped vehicles and motorcycles.
	30	Trans-boundary impacts and/or climate change	D	D	D	P: No relevant activities are expected. C: No impacts are expected. O: No impacts are expected.

Notes- p: planning stage, c: construction stage, o: operation stage
A+/-: Significant positive/negative impact is expected. B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses) D: No impact is expected.
Source: Study Team

Based on the above scope of impacts, IEE level environmental survey is conducted, especially to clarify the extent of negative impact for unknown items "C."

11.2.4 Result of Environmental and Social Environmental Survey

The identification of the potential impacts and the search for appropriate mitigation has been confirmed with the projects' aspects where impacts from this project will be similar to those experience under many similar to projects throughout Ghana and the particular concerns of the local communities that have been consulted.

From baseline information gathered at the fieldwork phase and issues that transpire during the consultation with stakeholders, the impacts of the project particularly during the construction phase are assessed on the following (details are attached in Appendix 11):

- Water Resources
- Soil Erosion and Sedimentation
- Air Quality
- Noise and Vibrations
- Expropriation of farmlands and Forest Reserves
- Establishment of Borrow pits
- Flora and Fauna
- Construction Waste
- Construction Camps
- Employment and Income
- Gender Issues
- Road Safety, Accidents and Comfort
- Vehicle Operation Costs

11.2.5 Assessment of the Impacts

Based on the environmental and social environmental survey above, assessment of the proposed projects are summarised in Tables 11-22 and 11-23.

Table 11-22 Project Impacts (Construction of New Road Between Asutsuare Jct. and Asikuma Jct.) (1)

Category		Environmental Items	Scoping			Impact Assessment			Remarks
			p	c	o	p	c	o	
Environmental	1	Air pollution	D	C-	C-	D	B-	B-	c: Due to the limited economic activities, it is confirmed that baseline of the proposed project area is very clean. Temporal impacts are expected from the construction activities. o: Compared to the existing few impacts condition, continuous impacts are expected from the passing vehicles.
	2	Water pollution	D	C-	D	D	B-	D	c: Turbidity of the Volta river is very low. Construction of bridge is likely to generate high turbidity runoff. Within a construction camp for another N-2 section, wastewater is well managed by the contractors supervised by GHA environmental auditors. With GHA's supervision, wastewater from construction camp shall not contaminate residential water use.
	3	Soil pollution	D	B-	D	D	B-	D	c: Limited impacts are expected from construction wastes. With GHA's supervision, impacts on soil shall be limited to the road construction area.
	4	Waste	D	B-	C	D	B-	B	c: Temporal impacts are expected from construction activities and construction camps. o: Minor impacts are expected from passing vehicles such as food and package litter, rubbish, and burst tyres. Minor impacts are also expected from the new residents along the new road.
	5	Noise and vibrations	D	C-	C-	D	B-	B-	c: Temporal impacts are expected from construction activities. o: Compared to present no traffic condition, base line would be changed to the common highway environment in Ghana.
	6	Ground subsidence	D	D	D	D	D	D	N/A
	7	Odors	D	B-	D	D	D	D	c: Based on the GHA's another construction site situation, odor shall not be expected neither construction site nor camps.
	8	Sediment	D	B-	D	D	B-	D	c: Due to the fast river flow, sedimentation is not expected. However, erosion of the river bank shall be carefully monitored during the construction.
Natural Environment	9	Protected areas	D	D	D	D	D	D	p/c/o: Although the proposed project is located between two protected area (Shai Hills RR and Kalakpa RR), few negative impacts are expected due to the present condition of isolation by the existing road networks and the stable and strong flow of the Volta River.
	10	Ecosystem	D	C-	D	D	B-	D	c: No virgin land is impacted. No significant eco system will be impacted.
	11	Hydrology	D	B-	D	D	B-	D	c: The effect of the bridge bases shall be negligible. Effects of the construction equipment during the bridge construction shall be monitored.
	12	Topography and geology	D	C-	D	D	B-	D	c: Especially, new route construction through two hills at Oswem community, minor topographical modification would be required. The impact is expected to be minimal.
Social Environment	13	Resettlement	C-	C-	D	B-	B-	D	p: 19 immovable buildings are fully or partially affected by the ROW (90m) acquisition. two movable property, container bender shops are fully affected by ROW. Requirement of the relocation is less than two hundreds PAPs. c: Cash compensation is common and preferred by PAPs. Land is also available for compensation adjacent to the project sites.
	14	Poverty group	C-	C+	B+	B-	B+	B+	p: It is confirmed that project affected communities are generally low income communities, but it is common situation in rural communities in Ghana. Without special request from the PAPs, special attention might not be required for income restoration plan. c: Resettlement assistances for low income group are quite common practices for GHA, so compensation and follow up shall not be issue. Job opportunities related construction are likely to provide temporal income as well as on the job training for skill labours. o: Improvement of accesses to social eservices, markets and new job opportunities led by new route construction are expected.
	15	Ethnic minorities and indigenous peoples	D	D	D	D	D	D	N/A

Table 11-22 Project Impacts (Construction of New Road Between Asutsuare Jct. and Asikuma Jct.) (2)

Category		Environmental Items	Scoping			Impact Assessment			Remarks
			p	c	o	p	c	o	
	16	Working conditions	B-	B+	A+	B-	B+	A+	p: Very limited number of street venders are confirmed to be affected under present ROW. Some farm lands are also affected, but none of the farmers are required to relocate for farming. The impact of the land acquisition could be also compensated by higher yield farming practices. c: Temporal construction work and additional vender opportunities are expected for construction workers during construction period. o: New job opportunities/skilled and unskilled labour jobs would be available along the proposed project. Capacity development/skill training for such opportunity for locals would greatly increase the chances for locals. However, after the bridge construction, river-crossing operators using canoes will be required to relocate their crossing area or change occupation utilising new job opportunities. Necessary support for relocation and occupational training shall be provided.
Social Environment	**17**	Land use and natural resources	B-	B-	A+	B-	B-	A+	p: Even farm land, farmers tend to prefer farm land to cash for the compensation as very limited impact by the ROW for each farmer. It is easy for oyster shell miners to get another concession from adjacent land owners or authorised persons, who are most likely to be the chief of the community. c: The impacts of rock and sand sources shall be carefully assessed during the detailed design stage. o: Commercialized farming would greatly improve the productivities of the land use in the region.
	18	Water use/rights	D	C-	C-	D	B-	D	c: Due to the fast river flow, the impact of the bridge construction shall be limited without impacts on residential water use. However, the impacts greatly depend on the location of the bridge bases and construction methodologies. Practical monitoring plan shall be considered during the detailed design stage. o: Due to the abundant water flow in the Volta river, it is unlikely to impact the water quality of the river by runoff.
	19	Existing social infrastructures and services	D	B+	A+	D	B+	A+	c: Limited but additional social services for construction works may improve the access to such services. o: The new road would greatly improve the access to the better services within the communities as well as some central facilities in Tema or Accura.
	20	Local government and its function	D	D	D	D	D	D	N/A
	21	Imbalance of damages and benefits	D	D	B-	D	D	B-	o: Some communities would easily attract agribusinesses and others may have difficulties to attract agribusinesses simply due to commercial viabilities. Good strategies for regional deployment and land use plan shall be well designed to avoid large imbalance within the communities.
	22	Interest opposition	D	D	D	D	D	D	N/A
	23	Cultural heritage	D	D	D	D	D	D	N/A: Because there is no recognised cultural heritage in and around the project area, no impacts are expected throughout the project cycle.
	24	Landscape	D	B-	A+	D	B-	A+	c: Temporal/permanent change are expected from construction work. o: New bridge could be new land mark/tourist spot of the area.
	25	Gender	D	D	B+	D	D	B+	o: There are no segregation between male and female in the project area. However, education level shows that educational levels are generally higher for male. Some of the reason would be traditional customs taking care of cooking and giving birth in very young age. Expected new skill labour may promote/lead new work style for female labours in the region.
	26	Rights of child	D	D	D	D	D	D	N/A
	27	Transmittal diseases, HIV/AIDS	D	B-	B-	D	B-	B-	c: Spread of transmittal diseases brought by immigrant workers are expected without proper safety management program. As it is common in Ghana, implementation of educational safety programme shall not be difficult in Ghana. NGO's are available fro all project affected districts for such purpose. o: Even after the construction work, many visitors are expected through the constructed new road. Local communities' continuous awareness programme would be effective.
	28	Occupational health and safety	D	B-	D	D	B-	D	c: Continuous attention is necessary throughout the construction work.

Table 11-22 Project Impacts (Construction of New Road Between Asutsuare Jct. and Asikuma Jct.) (3)

Other	**29**	Accidents	D	B-	B-	D	B-	B-	c: Accidents relevant to construction work, traffic are expected. o: Due to the bad condition of the roads, motorcycles are quite common in the project site. However, some of the driver do not have a licence and very poor skill to avoid accidents. It is highly recommendable to improve such drivers skills to avoid accidents.
	30	Transboundary impacts and/or climate change	D	D	D	D	D	D	N/A

Notes- p: planning stage, c: construction stage, o: operation stage
A+/-: Significant positive/negative impact is expected. B+/-: Positive/negative impact is expected to some extent.
C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses)
D: No impact is expected.
Source: Study Team

Table 11-23 Project Impacts (Upgrading of Asutsuare – Aveyime Road) (1)

Category		Environmental Items	Scoping			Impact Assessment			Remarks
			p	c	o	p	c	o	
Environmental	**1**	Air pollution	D	C-	C+	D	B-	B+	c: Due to the limited economic activities, it is confirmed that baseline of the proposed project area is very clean, except dusts from gravel roads. Temporal impacts are expected from the construction activities. o: Compared to the existing dusty condition, air quality shall be improved by paved road even with expected additional traffics.
	2	Water pollution	D	C-	D	D	B-	D	c: Temporal impacts are expected form the high turbidity runoff from road improvement work. Within a construction camp for another N-2 section, wastewater is well managed by the contractors supervised by GHA environmental auditors. With GHA's supervision, wastewater from construction camp shall not contaminate residential water use.
	3	Soil pollution	D	B-	D	D	B-	D	c: Limited impacts are expected from construction wastes. With GHA's supervision, impacts on soil shall be limited to the road construction area.
	4	Waste	D	B-	C	D	B-	D	c: Temporal impacts are expected from construction activities and construction camps.
	5	Noise and vibrations	D	C-	C-	D	B-	B-	c: Temporal impacts are expected from construction activities. o: Compared to present no traffic condition, base line would be changed to the common interregional road environment in the region.
	6	Ground subsidence	D	D	D	D	D	D	N/A
	7	Odors	D	B-	D	D	D	D	c: Based on the GHA's another construction site situation, odor shall not be expected neither construction site nor camps.
	8	Sediment	D	D	D	D	D	D	N/A
Natural Environment	**9**	Protected areas	D	D	D	D	D	D	p/c/o: Although the proposed project is located adjacent to the protected area (Shai Hills RR), few negative impacts are expected due to the present condition of isolation by the existing road networks and active farming along the Shai Hills RR.
	10	Ecosystem	D	C-	D	D	B-	D	c: No virgin land is impacted. No significant eco system will be impacted.
	11	Hydrology	D	D	D	D	D	D	N/A
	12	Topography and geology	D	D	D	D	D	D	N/A
Social Environment	**13**	Resettlement	C-	C-	D	B-	B-	D	p: 10 immovable buildings are fully or partially affected by the ROW (60m) acquisition. 7 movable properties, container bender shops are fully or partially affected by ROW. Also, one tomb would be fully affected by ROW. Requirement of the relocation is less than 200 PAPs. c: It is confirmed that cash compensation is common and preferred by PAPs. Land is also available for compensation adjacent to the project sites.
	14	Poverty group	C-	C+	B+	B-	B+	B+	p: It is confirmed that project affected communities are generally low income communities, but it is common situation in rural communities in Ghana. Without special request from the PAPs, special attention might not be required for income restoration plan. c: Resettlement assistances for low income group are quite common practices for GHA, so compensation and follow up shall not be issue. Job opportunities related construction are likely to provide temporal income as well as on the job training for skill labours. o: Improvement of accesses to social eservices, markets and new job opportunities led by new route construction are expected.
	15	Ethnic minorities and indigenous peoples	D	D	D	D	D	D	N/A
	16	Working conditions	B-	B+	A+	B-	B+	A+	p: 6 street venders are confirmed to be affected under present ROW. Some farm lands are also affected, but none of the farmers are required to relocate for farming. The impact of the land acquisition could be also compensated by higher yield farming practices. c: Temporal construction work and additional vender opportunities are expected for construction workers during construction period. o: New job opportunities/skilled and unskilled labour jobs would be available along the proposed project. Capacity development/skill training for such opportunity for locals would greatly increase the chances for locals.

Table 11-23 Project Impacts (Upgrading of Asutsuare – Aveyime Road) (2)

Category		Environmental Items	Scoping			Impact assessment			Remarks
			p	c	o	p	c	o	
	17	Land use and natural resources	B-	B-	B+	B-	B-	B+	p: Even farm land, farmers tend to prefer farm land to cash for the compensation as very limited impact by the ROW for each farmer. It is easy for oyster shell miners to get another concession for the shell mining in the community. c: The impacts of rock and sand sources shall be carefully assessed during the detailed design stage. o: Commercialized farming would greatly improve the productivities of the land use in the region. However, compared to the N-2 bypass development project, positive out puts would be limited due to limited land availability along the existing road.
	18	Water use/rights	D	D	D	D	D	D	N/A
	19	Existing social infrastructures and services	D	B+	A+	D	B+	A+	c: Limited but additional social services for construction works may improve the access to such services. o: The new road would greatly improve the access to the better services within the communities as well as some central facilities in Tema or Accura.
	20	Local government and its function	D	D	D	D	D	D	N/A
	21	Imbalance of damages and benefits	D	D	D	D	D	D	N/A
	22	Interest opposition	D	D	D	D	D	D	N/A
	23	Cultural heritage	D	D	D	D	D	D	N/A: Due to the no recognized cultural heritage in and around the project area, no impacts are expected throughout the project cycle.
	24	Landscape	D	B-	D	D	B-	D	c: Temporal/permanent change are expected from construction work.
	25	Gender	D	D	B+	D	D	B+	o: There are no segregation between male and female in the project area. However, education level shows that educational levels are generally higher for male. Some of the reason would be traditional customs taking care of cooking and giving birth in very young age. Expected new skill labour may promote/lead new work style for female labours in the region.
	26	Rights of child	D	D	D	D	D	D	N/A
	27	Transmittal diseases, HIV/AIDS	D	B-	B-	D	B-	B-	c: Spread of transmittal diseases brought by immigrant workers are expected without proper safety management program. As it is common in Ghana, implementation of educational safety programme shall not be difficult in Ghana. NGO's are available fro all project affected districts for such purpose. o: Even after the construction work, many visitors are expected through the constructed new road. Local communities' continuous awareness programme would be effective.
	28	Occupational health and safety	D	B-	D	D	B-	D	c: Continuous attention is necessary throughout the construction work.
Other	**29**	Accidents	D	B-	B-	D	B-	B-	c: Accidents relevant to construction work, traffic are expected. o: Due to the bad condition of the roads, motorcycles are quite common in the project site. However, some of the drivers do not have a licence and very poor skill to avoid accidents. It is highly recommendable to improve such drivers' skills to avoid accidents.
	30	Transboundary impacts and/or climate change	D	D	D	D	D	D	N/A

Notes - p: planning stage, c: construction stage, o: operation stage

A+/-: Significant positive/negative impact is expected. B+/-: Positive/negative impact is expected to some extent.

C+/-: Extent of positive/negative impact is unknown. (A further examination is needed, and the impact could be clarified as the study progresses) D: No impact is expected.

Source: Study Team

11.2.6 Environmental Management Plan

In accordance with the MRH's environmental and social management framework (ESMF), followings are the expected environmental management plan.

(1) Key Responsible Players

a) Environmental Management Responsibility of the Key Agencies

Table 11-24 Environmental Management Responsibility of the Public Authorities

Responsible Agency	Responsibilities
EPA	The EPA is the agency with sole responsibility for environmental management in Ghana. The EPA will be responsible for supervision of EMP implementation specified in the EIS, and will conduct external monitoring as the regulatory agency during the construction phase.
GHA	The Environmental Management Unit (EMU) of the GHA will be the principal responsible agency of the implementation agency. The EMU will be responsible for the whole process of the EMP including legal environmental clearance, assurance of mitigation measures and monitoring. It will also be responsible for all monitoring activities throughout the project cycle including the operation phase and the completion audit.
MRH	The MRH will be responsible for supervising the GHA's project implementation including environmental management throughout the project cycle, and for evaluating the project implementation. The evaluation of EMP shall be included in the completion audit.
Land Commission	The Land Commission (LC), a state agency responsible for the management and administration of state and vested lands, is responsible for guiding area development by policy framework development and stakeholder coordination. The LC will be mainly involved in the preparation stage for the area development matters and allocation of land for mitigation measures.
Land Valuation Division	The Land Valuation Division (LVD) of the LC, formerly known as the Land Valuation Board, will be responsible for valuation of project affected properties such as land, buildings, and economic activities for evaluating compensation. The compensation valuation list from the LVD will be forwarded to the acquiring agency for payment processing.
District Assemblies	The Assemblies will be the principal representatives of the project affected persons (PAPs) as well as development of area under the jurisdiction. As representatives of the project affected communities, assembly members of district or commune level officials will be involved in the whole process of the projects throughout the project cycle.

Source: Study Team

b) Environmental Management responsibility of the Consultant

Table 11-25 Environmental Management Responsibility of the Consultant

Project Phase	No.	Consultant's Responsibilities
Design	1	Design the project the least negative environmental impact during the operational life of the road
	2	Design the project prescribing materials with the least negative environmental impact
	3	Incorporate any feasible traffic safety measures within the project design.
	4	Design environmentally friendly road drainage systems
	5	Incorporate all suitable clauses requiring the contractor to execute his work with due diligence and apply environmentally friendly methods. Such requirements must be accompanied by the necessary methods for monitoring and accompanied by the necessary methods for monitoring and enforcement. Clauses with principle contents as minimum requirement.
Implementation	6	The Consultant will supervise and enforce the Contractors performance on all environmental requirements included in the Contract Documents.
	7	The engineer will monitor the overall environmental impact of the projects and recommend additional mitigation measures for implementation when deemed necessary.

Source: Study Team

b) Environmental Management Responsibilities of Contractor

Table 11-26 Environmental Management Responsibilities of Contractor

Project Phase	No.	Contractor's Responsibilities
Mobilisation	1	Ensure that the management as well as site managers and foremen are well informed about all environmental issues of the project.
	2	Ensure that all site managers and foremen trained in environmentally friendly construction methods
	3	Ensure that all equipment mobilised fulfil the environmental requirements of the of the contracts
	4	Properly establish, operate and rehabilitate construction camps.
	5	Obtain necessary approvals for all borrow pits
	6	Establish a waste management plan covering all types of wastes.
Project Execution	7	Apply environmental requirement and construction methods.
	8	Ensure occupational health and safety of all workers and visitors to the site at any time.
	9	Fulfil all environmental requirements of the Contract Documents.
	10	Inform the Engineer if any unforeseen negative environmental impact should occur.
	11	Ensure that all affected project areas have been properly cleaned of waste, graded and re-vegetated
	12	For providing safe passage around or through his work site for all kinds of traffic.
	13	Ensure that all workers at his camp live responsibly with the communities along the road corridor
	14	Responsible for providing potable water to any community whose water source is made unwholesome due to the project activities until the water is made wholesome again.
	15	Responsible for management of all types of waste generated from construction activities, camps, quarries and borrow pits.
Demobilisation	20	Ensure that all affected project areas have been properly cleansed of waste, graded and re-vegetated.

Source: Study Team

c) The Public

The general public has no specific tasks in the environmental Management Plan, but their role is however important. The public must express their concerns of the projects not only in the preliminary designs phase but also whenever they are aware of previously unforeseen impacts or when impacts take a different order of magnitude than expected. The public have an unwritten obligation to inform the Engineer about such developments as early as possible. The public is also the target of awareness raising campaigns to mitigate the negative impacts of the project.

(2) Enforcement Mechanisms

The Contractor's responsibilities are defined in the following clauses, to be incorporated in the Contract Document.

a) General

Clause 1: The Contractor shall be responsible for familiarizing himself with all national and local legislation relating to his/her activities during the construction phase of the project.

Clause 2: The Contractor shall take all necessary measures and precautions and otherwise ensure that the execution of the Works and all associated operations on the Sites or off-site are carried out in conformity with statutory and regulatory environmental requirements of the Government of Ghana and the Standard Specifications, where the more stringent shall apply.

The Contractor shall take all measures and precautions to avoid any nuisance or disturbance arising from the execution of project activities. This shall, wherever possible, be achieved by suppression of the nuisance at source rather than abatement of the nuisance once generated.

b) Waste Disposal

Clause 3: The Contractor shall at all times maintain all sites under his control in a clean and tidy condition and shall provide appropriate and adequate facilities for the temporary storage so as to avoid the unnecessary accumulation of waste;

Clause 4: The Contractor shall be responsible for the safe transportation and disposal of all waste generated as a result of his activities in such a manner as will not give rise to environmental pollution in any form, or hazard to human or animal health. In the event of any third party being employed to dispose of waste, the Contractor shall be considered to have discharged his responsibilities under this clause only when he has demonstrated that the transportation and disposal arrangements have not given rise to pollution or will give rise to health hazard;

Clause 5: The Contractor shall be responsible for the provision of adequate sanitary facilities for his workforce and that of his sub-contractors. The contractor shall not allow the discharge of any untreated sanitary waste to groundwater or any surface watercourse. The Contractor shall provide details of sanitary arrangements to the Engineer for approval after satisfying himself that the proposed facilities are adequate and are unlikely to pollute water resources.

c) Water Resources

Clause 6: All water and other liquid waste products shall be collected and disposed of at locations on site or off site and in a manner that shall not cause nuisance or pollution.

Clause 7: The Contractor shall take all reasonable measures, at all sites under his control, to prevent spillage and leakage of materials likely to cause pollution of water resources. Such measures shall include, but not be limited to the provision of bunds around fuel and oil storage facilities, and oil and grease traps in drainage systems associated with vehicle and plant washing serving and fuelling areas. Prior to locating of such facilities, the Contractor shall submit details of pollution prevention measures to the Engineer for approval.

d) Replanting of trees

Clause 8: The Contractor shall exercise great effort during the Construction phase to minimize the number of trees to be felled along the road. Four trees of the same species should be planted for every tree felled along the road.

e) Restoration of Borrow Pits

Clause 9: The Contractor shall be responsible for ensuring that any gravel or together borrow pits, working areas and the like are regarded and covered with topsoil or a suitable bio-engineered product to ensure their natural regeneration. This shall be to the satisfaction of the Engineer.

f) Transport of Materials

Clause 10: The Contractor shall ensure that his vehicles do not cause a safety hazard, noise, dust or disturbance to local inhabitants.

g) Traffic Management and Safety during Construction

Clause 11: The contractor shall provide safe and convenient passage for vehicles, pedestrians and livestock needing to pass through the works.

Clause 12: The Contractor shall provide, erect and maintain on the site and at such positions on the approaches, traffic signs and traffic control signals necessary for the direction and control of traffic. The signs shall be reflectorised or adequately illuminated at night in a manner approved by the Engineer and kept clean and legible at all times. The Contractor shall reposition, cover or remove signs as required during the various stages of implementation.

Clause 13: The Contractor shall take reasonable precautions to keep the roads clear of any spillage or materials from his operation to the satisfaction of the Engineer. The Contractor without delay shall clear any spillage.

Clause 14: All vehicles and plant operated by the contractor or his sub-contractors shall at all times be maintained in accordance with the original manufacture's specifications and service manuals, with particular regard to the control of noise and diesel particulate emissions. The Engineer shall have the right to require the contractor to replace or rectify any vehicle or plant, which in his opinion causes excessive noise or emits smoke within 2 days of the contraction being so notified.

h) Noise and Air Pollution

Clause 15: The Contractor shall consider noise as an environmental concern in his planning and during execution of the works.

Clause 16: All vehicles and plant operated by the contractor or his sub-contractors shall at all times be maintained in accordance with the original manufacture's specifications and service manuals, with particular regard to the control of noise and diesel particulate emissions. The Engineer shall have the right to require the contractor to replace or rectify any vehicle or plant, which in his opinion causes excessive noise or emits smoke within 2 days of the contraction being so notified.

Clause 17: The Contractor shall take all necessary measures to ensure that operation of all mechanical equipment and construction processes on and off the site shall not cause any unnecessary or excessive noise, taking into account all applicable environmental requirements. When operating close to residential area sensitive areas such as schools or medical facilities the Contractor's working hours shall be limited to daylight hours.

Clause 18: The Contractor shall employ dust suppression measures such as watering to minimize dust pollution.

i) Health and Safety Provisions

Clause 19: The Contractor shall ensure as far as practicable that the health, safety and welfare

of employees and all other persons on site are secured and protected from hazards created by the Project. The Contractor shall prepare and implement a Health and Safety Plan (HSP), which shall be approved by the Engineer. The HSP shall address, but shall not be limited to, the following:

- Site security, including securing of excavations, hazardous materials, etc.
- Confined space safety procedures
- Excavation and trenching safety measures
- Emergency response plans
- First Aid including facilities, equipment and materials
- On-Site safety publicity
- Safety Training Program for Contractor's (and Sub Contractor's) personnel
- Personal Protective clothing and safety equipment (PPE)
- HIV/-AIDS awareness programme
- Health and safety monitoring and reporting

(3) Staffing Requirement

As part of the construction team of the contractor, an Environmental/Safety Officer is also required. The Environmental/Safety Officer (ESS) will be an employee of the Contractor appointed to monitor and review the on-site environmental and social management plan and implementation of the Environmental Management Plan (EMP). The ESS shall be on site daily throughout the duration of the project construction. The ESS's responsibilities will include the following:

- Assist Contractor in ensuring that the necessary environmental authorizations and permits are obtained;
- Maintain open and direct lines of communication between the Employer, Contractor, Consultant and relevant institutions with regard to environmental matters;
- Undertake regular site inspections of all construction areas with regard to compliance with the EMP.
- Monitor and verify adherence to the EMP at all times and verifying that environmental impacts are kept to a minimum;
- Take appropriate action if the specifications are not followed;
- Assist the Contractor in finding environmentally responsible solutions to problems;
- Undertake and monitor environmental awareness training for all new personnel coming onto site;
- Ensure labour protection equipment is of good quality and is available on site at all times;
- Advise on the removal of person(s) and/or equipment not complying with the specifications;
- Recommend the issuing of fines for transgressions of site rules and penalties for contraventions of the EMP;

- Implement works permit system and ensure the permit conditions for work are followed strictly;
- Keep detailed records of all site activities that may pertain to the environment.
- Undertake a continual review of the EMP and recommending additions; and
- Compile a final audit report regarding the EMP and its implementation during the construction period, after completion of the contract and submitting this report to the Employer.

(4) Training Requirements

There will be a training programme in place for all categories of workers and communities along the project corridors. Construction workers will be taken through safety induction as well as lectures on environmental issues just before commencement of work and follow periodically. Community option leader will also be sensitised through focus group discussion and public lectures.

The Environmental, health and Safety personnel will also require some specialist training in fire safety techniques and first aider will be contacted for such training. Operatives who will undertake sensitive duties such as working from a height, confined spaces, areas near schools and health facilities will be given specialist training in order to avert any environmental damage or accidents. Refresher training programmes will be undertaken periodically after training needs assessment have been conducted. It is expected that operatives after such training programmes will acquire the necessary environmental and safety skills to apply in carrying out their duties.

a) Initial Induction Course

All workmen shall be required to attend a safety induction course prior to undertaking any work in connection with the Works

b) Periodic Training Courses

Periodic safety courses shall be conducted for all Contractor's employees and subcontractor's employees including all operatives and staff involved in supervision and management not less than once every six months. Subcontractor employees will be required to participate in relevant training courses appropriate to the nature, scale and duration of the subcontract works.

(5) Monitoring

Environmental monitoring ensures that the impacts have been accurately predicted and that mitigation measures are being implemented as planned and has the assumed effects. The monitoring exercise will ensure that the remedial actions recommended in the assessment are incorporated in the project and maintained throughout the operation life where appropriate. It will also identify additional remedial measures and corrective measures or redesign remedial measures if they are not sufficiently effective during the construction phase and operation phase. Based on the ESMF, the EMU of the GHA is responsible for supervising the GHA's activities and jurisdiction. However, due to the limited availability of EMU officers and GHA budget, it is recommended to conduct a "post environmental evaluation" by the EMU at the time of the

MRH/GHA's completion audit and when required during the operation phase (see Tables 11-27 and 11-28, and Appendix 15). Operational phase monitoring shall be defined in the following detailed design stage to meet the donor's loan policies; it is outlined in Section 11.2.8 below.

11.2.7 Construction Phase Monitoring Enforcement

All major stakeholders in the project have a monitoring responsibility of some kind. However, only the Supervising Engineer, the Ghana Highway Authority's Environmental Unit, The EPA, and the Contractor are allocated specific and formal monitoring obligations. Traffic Police, Health Authorities and other public authorities will automatically monitor some of the effects of the project during their daily work.

Periodic interview with the beneficiaries of the projects will also be undertaken to assess their opinions about the effect of the implementation of the project.

11.2.8 Enforcement of Operation Phase Monitoring

Due to the limited availability of EMU officers and GHA budget, it may not be practical to maintain the construction phase monitoring during the operation phase. Based on the present practices for other donor projects, it is practical to continue monitoring by a "post environmental evaluation", periodical field observation by maintenance department officials, and environmental monitoring by the EMU when required.

Based on the ESMF and RPF, the GoG conducts a completion audit to check that all aspects of the projects are properly implemented, including environmental and social considerations. As the responsible authority of the GHA's environmental supervision, the EMU shall be responsible for the environmental monitoring at the completion audit. After the completion of the construction, the Maintenance Division of the GHA will take responsibility for physical maintenance of the roads. Therefore, it is reasonable for the GHA to continue the operational phase periodical monitoring through the Maintenance Division's physical monitoring and maintenance work. If there is evidence of potential impacts reported by the maintenance department or a claim, the EMU shall conduct additional environmental monitoring to address the concerns and confirm the potential impacts. Based on the EMU's evaluation, the GHA shall take necessary actions to comply with the environmental permits of the proposed projects.

11.2.9 Public Consultation

As the first public announcement of the GHA/MRH's intention to construct the road between Asutsuare Jct. and Asikuma Jct. and upgrade the existing Asutsuare – Aveyime road, the GHA conducted initial public consultations to describe the back ground and objectives of the proposed projects at Asutsuare on 10th September and at Juapong on 11th September, 2012. As the GoG is going to reach a conclusion on whether to proceed with the proposed projects after this JICA study, the public consultation was conducted mainly to raise public awareness and make preliminary preparations for EIS screening by the GHA.

Table 11-27 Summary of Monitoring Responsibilities and Output

Party Responsible	Parameters to be Monitored	Output
EPA	- Overall Environmental Performance of the Project	- Instructions to contractor and the Engineer
GHA Environment Unit	- Overall Environmental Performance of the Project - Community relations - Payment of appropriate compensation	- Monthly environmental reports
Consultant	- Construction methods and materials - Environmental management of construction sites - Implementation of mitigation measures for air, water, soil, traffic, occupational health and safety, trees etc. - Environmental management of construction camps - Environmental management of borrow pits and quarries - Contractors waste management - Staged rehabilitation of impact areas - Community relations - Environmental performance of contractors equipment - Accidents (traffic, spills etc.) - Environmental performance of mitigation measures	- Monthly environmental reports. - Incident reports as and when required (spills, accidents and the like)
Contractor	- Environmental performance of equipment and plants - Implementation of interim and permanent mitigation measures - Occupational health and safety measures - Base camp management - Air quality - Accidents of any kind	- Maintenance records - Accident reports - Mitigating actions e.g. sprinkling of water, traffic signs, safety barriers
Traffic Police	- Traffic nuisances - Traffic safety measures - Traffic accidents	- Police reports and instructions to contractor
Health Authorities	- Change of frequency of diseases - Occurrence of new diseases in the area	- Health reports.
Local Communities	- Negative environmental impacts - Social disturbance	- Complaints to contractor and supervising engineer

Source: Study Team

Table 11-28 Required Monitoring Items

Environmental Item	Frequency	Parameter	Location	Responsibility
Ambient Noise*	Daily	・ Frequency of disturbance to settlement. ・ Requirement for sound barrier as required	・ Construction site ・ Adjacent settlement	Consultant
Ambient Air Quality*	Monthly test	・ Amount of dust generated ・ Requirement for spraying roads to control dust ・ Items (SO_2, NO_2, CO, TSP, PM_{10})	・ Construction site communities	Consultant
Effluent Water Quality*	Quarterly	・ Water quality of effluents and construction sites' runoff ・ Items (pH, TSS, TDS, BOD, COD, T-N, T-P, mineral oil, oil)	・ Work camp drainage ・ Construction site drainage	Consultant
Sedimentation and erosion	Daily, as required	・ Condition of erosion and sediments by visual check	・ Construction site ・ Borrow pits ・ Cleared land ・ Water channels ・ Volta River banks	Consultant
Natural protected areas	Weekly	・ Field investigation of protected area and surrounding	・ Natural Protected Area	Consultant Forestry Commission
Auxiliary project component	Daily	・ Road traffic and associated issues by visual check	・ Road corridor	Consultant
Waste Management	Daily	・ Generation, transportation, final disposal, onsite treatment by visual check	・ Construction site, camp	Consultant
Occupational health and safety	Daily	・ Provision of appropriate personal protective equipment by visual check ・ Appropriate signage by visual check	・ Construction site, camp	Consultant GHA, as required basis

Note: * - Standards for noise, air quality, and water quality shall be referred to Appendix 13 of Recommended Monitoring Items and Standards for Environmental Quality Monitoring

Source: Study Team

Due to the initial stage of the project development and wide range of the project area, only important public representatives (district chief executives), district and commune level assembly persons, opinion leaders, and chiefs of the project affected areas were officially invited to attend the consultations. However, due to the increasing interest and demand among the communities, the number of attendants was 328 at Asutsuare and 376 at Juapong, including the general public.

Presentations were given in English and two local languages to maintain the accountability of the projects, although English is one of several official languages in Ghana. The meetings started with presentations on the issues and need for road construction by the GHA, followed by the background and objectives of the JICA Study, draft results of the JICA Study including the procedures used to select the routes and conceptual designs of roads and bridges. After the general description of the projects, the initial findings of the environmental and social environmental impact studies were presented.

After all the presentations, the GHA accepted opinions from attendants; most of the initial responses to the public opinions were given by some members of parliament from the area, MRH, and GHA officials. In general, attendants were in agreement with the proposed projects and were keen to see the proposed projects actually go ahead. A summary of each public consultation is attached in Appendix 13.

11.3 Abbreviated Resettlement Action Plan of the Proposed Project

11.3.1 Summary of the Projects and Need of Involuntary Resettlement

After the selection of a desirable route for the F/S, social impact study was conducted for abbreviated resettlement action plan (ARAP) development in accordance of MRH's involuntary resettlement policy framework (RPF).

Based on the GHA's new road development regulation, ROWs are set to 90m for the national highway (Asutsuare Jct. - Asikuma Jct.) and 60m for the inter-regional road (Asutsuare - Aveyime road).

11.3.2 Summary of Legal Framework

(1) Summary of Legal Framework

The MRH has clear policies for both environmental and social impact-ESMF and involuntary resettlement-RPF. Though both ESMF and RPF were originally developed for the TSDP funded by the WB in 2007, MRH and its agencies mandatory apply those policy frameworks for any road sector project. GHA is likely to apply RPF for the proposed project unless JICA disagree with its application. For the comparison purpose, following section shows the JICA's inventory resettlement policy. Since both MRH's RPF and JICA's are fully compatible with WB involuntary resettlement policy (WB OP4.12), RPF and JICA Guideline shall be compatible each other.

(2) JICA's Policy on Involuntary Resettlement

Table 11-29 JICA Involuntary Resentment Policy

I.	Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives.
II.	When population displacement is unavoidable, effective measures to minimize the impact and to compensate for losses should be taken.
III.	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.
IV.	Compensation must be based on the full replacement cost[31] as much as possible.
V.	Compensation and other kinds of assistance must be provided prior to displacement.
VI.	For projects that entail large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.
VII.	In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. when consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people.
VIII.	Appropriate participation of affected people must be promoted in planning, implementation, and monitoring of resettlement action plans.
IX.	Appropriate and accessible grievance mechanisms must be established for the affected people and their communities.
	The above principles are complemented by World Bank OP 4.12, since it is stated in JICA guidelines that "JICA confirms that projects do not deviate significantly from the World Bank's Safeguard Policies". Additional key principles based on World Bank OP 4.12 are as follows.
X.	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 or others who wish to take advantage of such benefits.
XI.	Eligibility of benefits include the PAPS who have formal legal rights to land (including customary and traditional land rights recognized under law), the PAPS who do not have formal legal rights to land at the time of census but have a claim to such land or assets and the PAPS who have no recognizable legal right to the land they are occupying.
XII.	Preference should be given to land-based resettlement strategies for displaced persons whose livelihoods are land-based.
XIII.	Provide support for the transition period (between displacement and livelihood restoration.
XIV.	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.
XV.	For projects that entail land acquisition or involuntary resettlement of fewer than 200 people, an abbreviated resettlement plan is to be prepared.

Source: Appendix 1: Environmental and Social Consideration Required for Intended Projects (JICA Guideline)

11.3.3 Methodology of Socioeconomic Survey

(1) Studies Undertaken for RAP

For the assumptions underpinning this RAP, several studies and activities were carried out which comprised of the following:

- Assessment of project documents
- Census and socio-economic survey
- Institutional identification and capacity assessment of agencies
- PAP asset inventory and valuation
- Primary data collection

[31] Description of "replacement cost" is as follows.

Land	Agricultural Land	The pre-project or pre-displacement, whichever is higher, market value of land of equal productive potential or use located in the vicinity of the affected land, plus the cost of preparing the land to levels similar to those of the affected land, plus the cost of any registration and transfer taxes.
	Land in Urban Areas	The pre-displacement market value of land of equal size and use, with similar or improved public infrastructure facilities and services and located in the vicinity of the affected land, plus the cost of any registration and transfer taxes.
Structure	Houses and Other Structures	The market cost of the materials to build a replacement structure with an area and quality similar or better than those of the affected structure, or to repair a partially affected structure, plus the cost of transporting building materials to the construction site, plus the cost of any labour and contractors' fees, plus the cost of any registration and transfer taxes.

- Data collation and analysis

(2) Assessment of Project Documents

A number of documents were obtained from various organizations and other government agencies. These documents helped to set the project within the relevant background. They included the following:

- Resettlement Policy Framework by Ministry of Transportation
- The 1992 Constitution
- State Lands Act (1962) Act 125
- Administration of Lands Act (1962) Act 123
- Public Conveyance Act (1965)
- Lands Statutory Wayleaves Act (1963) Act 186

(3) Population and Housing Census and Socioeconomic Survey

Population and Housing Census: The GoG conducted a population and housing census in 2010 and has been processing the results. As of September 2012, only a summary report of the final results was available for the general public. The summary report covers both population and housing census results at the regional level and the appendix includes the population at the district level. With the support of the GSS, the Study Team could obtain the population and selected socioeconomic data at the district level to understand the principal structure of the project affected area.

Socioeconomic Survey: A listing of all persons who own land, structures or live and work in the road corridor was undertaken along the two main routes, namely: the N2 also known as the Eastern Corridor and the feeder road from Asutsuare township to Aveyime. In terms of project impact, these are the people likely to lose shelter, business premises and suffer other intangible losses. Data gathered included photographs of PAPs, bio-data, level of education, nationality, ethnicity, religion and status as well as activity in relation to the road.

(4) Institutional identification and capacity assessment of agencies

Institutions that had roles to play in the resettlement were identified and their capacities were assessed through a study of earlier works and a rapid appraisal done by the RAP team.

(5) PAP Asset Inventory and Valuation

In order to establish the extent of PAPs' losses, an asset inventory and valuation has been prepared: the inventory details which structures will be partly or completely demolished or will need to be relocated. In addition, it specifies ownership and other vital information.

(6) Primary Data Collection

In addition to the secondary sources of data, the census, socio-economic survey and the consultations involved a combination of several methods of social research such as Focus Group Discussions (FGDs), in-depth/key informant interviews as well as interviews with individual PAPs.

(7) Data Collation and Analysis

The qualitative data from the FGDs and other consultations were manually analysed while the quantitative data analysis was done using the Statistical Package for Social Scientists (SPSS) and Microsoft Excel. The following measures were added:

- Separate census questionnaires were administered to specific categories of PAPs.
- Photographing PAPs with their names indicating the census data collection
- Assignment of unique identification numbers for each PAP within the ROW
- Connecting PAPs to specific structures
- Relating employers to their employees
- Marking of pictures using PAP names and unique identification numbers for enhanced authentication.

11.3.4 Scope of Resettlement Impact

As described above regarding the methodology of the socioeconomic survey, the scope of resettlement impacts is considered based on the updated population and housing census in 2010 as well as socio economic survey by the Study Team and potential impacts of the proposed projects. Summaries of the Population and Housing Census, and socio economic survey are shown in this section. Details of the census and socioeconomic survey results are attached in Appendix 14.

(1) Summary of Population and Housing Census

The following are the key findings of the 2010 population census for the purpose of understanding the socioeconomic setup for the project affected area (Dangbe West District in Greater Accra Region, North Tongu District in Volta Region, and Asuogyaman District in Eastern Region): 1) population, 2) ethnicity, 3) religion, 4) educational level, and 5) economic activities.

Populations of Dangbe West District, North Tongu District and Asuogyaman District were 122,836, 149,188, and 98,046 respectively. The ratio of urban to rural population was roughly 1 to 2 in all districts.

Ethnicity balance of the Greater Accra Region and Eastern Region showed similar ethnicity, headed by Akan (40% or 51%) followed by Ga-Dangbe (18 or 27%) and Ewe (20 or 19%), respectively. That of the Volta Region was headed by Ewe (74%) followed by Gurma (11%).

Religion in all districts was dominated by Christianity (roughly 80-90%), headed by Pentecostal/Charismatic followed by Protestant, Catholic, and other Christian. The three highest shares after Christianity were No religion, Islam and Traditional, with between 3% and 8%.

Educational level was similar in all district, but Asuogyaman District. Showed slightly lower numbers of those who had never attended school, for both males and females. In all districts, primary school was the most common educational level for males followed by junior high school and never attended school, while the majority of females had either never attended school or only attended primary school. Based on the census data, there was no critical gender

segregation in the project area.

Economic activity status was similar among all district and there was no major difference between males and females. The employed status showed the highest proportion (63-68%) followed by not active (29-32%) and unemployed (3-5%). Regarding economic activities by industry, agriculture, forestry and fishery accounted for the highest number in all districts, followed by manufacturing, construction, wholesale/retail, transportation and other services.

(2) Summary of Socioeconomic Survey and Potential Impacts

a) New Road Construction between Asutsuare Jct. and Asikuma Jct.

Based on the proposed ROW (90m), potential project affected households were identified in the preliminary survey, and interviewees and some representative groups such as youths and females were selected with the assistance of commune level assembly men/women. In total, 210 respondents (132 males and 78 females) were interviewed. As the proposed ROW minimised the involuntary resettlement of businesses and residents, the majority of respondents/PAPs were farmers (80%) followed by services (6%), artisans (5%), traders (4%), office workers (2%), and others (3%).

Regarding the potential impacts of land acquisition at this basic design stage, one house (near Asikuma Jct.) will be fully affected by construction of the new road. Another 18 immovable buildings (storages and huts), two movable properties/kiosks and containers/vendor shops will be fully or partially affected by the ROW (90 m) acquisition. Due to the bridge connection between Volivo (south/right bank of the Volta River) and Dufor Adidome (north/left bank of the Volta River), roughly 20 full-time or temporary river canoe operators (all male) will be required to relocate their operation location or change their occupation. All operators used to be fishermen before the Kpong Dam was constructed, but then converted to canoe operators due to sharp decline in fish catches.

Table 11-30 Potentially Affected Properties
(New Road between Asutsuare Jct. and Asikuma Jct.)

Affected Properties	Male	Female	Total
	Number	Number	Number
House	1	0	1
Storage/hut	10	8	18
Farm	99	55	154
Container	1	1	2
Kiosk	1	1	2
Other Land	1	3	4
Wooden Shed	0	1	1
Fish Pond	2	1	3
Total	116	70	186**

Notes: * multiple ownership included

** Unless the ENTIRE DISPLACED PAP is fewer than 200, the category of the project would be B and would require ARAP (WB OP4.12) (cf. paragraph 25). A draft resettlement plan that conforms to this policy is a condition of appraisal (see Annex A, paragraphs 2-21) for projects referred to in paragraph 17(a) above. However, where impacts on the entire displaced population are minor, or fewer than 200 people are displaced, an abbreviated resettlement plan may be agreed with the borrower(see Annex A, paragraph 22). The information disclosure procedures set forth in paragraph 22 apply.

Source: Study Team

Based on the interviewed PAPs, the majority (70.4%) prefer cash compensation followed by replacement of building (25.3%), farmland to farmland (1.5%), combination of cash and building (1.5%), entire relocation (1.0%), and not sure at this moment (0.5%). Due to the lack of income opportunities and traditional land management practices by local chiefs, people in general prefer to take cash compensation and acquire other properties given by the local chiefs.

b) Upgrading the Asutsuare – Aveyime Road

The same as for new road construction, interviewees and some representative groups were selected based on the proposed ROW (60m) assisted by commune level assembly men/women. In total, 112 respondents (72 males and 50 females) were interviewed. In order to avoid community level resettlement, the ROW is set to the minimum required by inter-regional road standard (13.3m) at Asutsuare township and Aveyime township. In order to avoid major separation of a community by an inter-regional level road, a diversion is proposed to avoid Volivo town and its ROW is set to 60 m within farmland. The majority of respondents/PAPs were farmers (57%) followed by traders (20%), artisans (10%), office workers (5%), services (2%), and others (7%). Regarding the potential impacts of land acquisition at this basic design stage, 9 houses (in Aveyime township) will be fully affected by upgrading the existing road. Another 9 immovable buildings (storages and huts) and 7 movable properties (container/vendor shops) will be fully or partially affected by the ROW (60 m or 13.3 m) acquisition.

Table 11-31 Potentially Affected Properties* (Asutsuare – Aveyime Road)

Affected Properties	Male	Female	Total
	Number	Number	Number
House	5	4	9
Farm	45	26	71
Container/Kiosk	1	6	7
Fence wall	0	1	1
Wooden Structure	3	1	4
Total	73	50	113

Note: * multiple ownership included
Source: Study Team

Based on the interviewed PAPs, the majority (77.0%) prefer cash compensation followed by replacement of building (13.9%), entire relocation (6.6%), and farmland to farmland (2.5%). Due to the lack of income opportunities and traditional land management practices by local chiefs, people in general prefer to take cash compensation and acquire other properties given by the local chiefs.

11.3.5 Recommendable Compensation and Resettlement Assistance

(1) Organizational Procedures for the Delivery of Entitlements

Two main public institutions are involved as far as the organizational procedures for the delivery of entitlements on this RAP is concerned. These are the GHA and Land Valuation Division (LVD). The identification of the ROW was done by the GHA while the analysis of structures affected was done by the Consultant's Valuer. The LVD as the statutory body

mandated by the GoG to take care of acquisition on its behalf will again identify and assess the values of the structures before work on the road commences.

In addition to developing valuation procedures for assessing compensation values, the consultant has developed and prepared an Implementation Plan. The Implementation Plan is to help achieve a successful implementation of the resettlement operations. The consultant has undertaken the following activities to attain the goal of successful RAP implementation:

- Preparation of a census register for the PAPs
- Conduct of Socio- economic survey
- Categorization of PAPs by activity and location
- Assessment of properties by type and location
- Preparation of an entitlement Matrix
- Preparation of an Implementation Plan

The population census and socio-economic surveys conducted identified the locations of potential PAPs by communities. The data was gender disaggregated and it also categorized PAPs according to their activities.

(2) Eligibility Criteria

Eligibility will be based on the category of losses suffered as at the cut-off date (which in this case {end of field survey). The category of losses suffered will be identified through the various interests and rights derived from customary laws, common law and international conventions. Eligible persons are presented in the Entitlement Matrix below.

(3) Proof of Eligibility

The GHA and LVD will consider various forms of evidence as proof of eligibility. The proof of eligibility will cover:

Affected persons with formal legal rights, documented in the form of land title registration certificates, leasehold indentures, tenancy agreements, rent receipts, building and planning permits, business operating licenses, and utility bills, among others will be eligible. However unprocessed/unregistered formal legal documents will not bar eligibility. Procedures for confirming authenticity of any such documents are established in this RAP. These affected persons may include house owners and owners of residential plots with no formal or recognized legal rights. The criteria for establishing non-formal, undocumented, unrecognized claims to eligibility are one's (PAP's) presence on the corridor during the PAP census survey.

The entitlement matrix captures all affected parties, the characteristics of the impact, and the types of compensation/reinstatement due them (Table 11-28). Categories in the table overlap because those being offered re-instatement fall into several groupings and the groupings tend to overlap. For instance, some of the owners of permanent and temporary structures own land as well. Again, some of the business operators also own property such as land or structures.

(4) Compensations for the Various Categories of PAPs

a) Property Owners

The project ROW will be compared against the gazetted road reservation; those within the road reservation, who constitute legitimate title holders, will receive the replacement value for their land in the form of land of the same value or cash of the same value, depending on the title holders' preference and availability of such land. All including those within the reserve will be compensated for any civil improvements. All PAPs who own permanent structures shall be entitled to compensation for their structures at replacement cost based on existing market values. Owners of temporary structures will also receive moving allowance. This category of PAPs has been listed in the Property Impact Assessment compiled by the consultant.

b) Residential Tenants and Farmland Tenants

As compensation for losing their residential accommodation because of the project, PAPs in this category will receive one year's rent. This amount is to enable the tenants find alternative places that are similar to what they are losing.

c) Business Operators who Own Structures

Business operators who own permanent structures will receive compensation for the structure as well as compensation for lost business profits for 6 months. In the case of temporary structures, the owners will be paid for the cost of relocating the structures and not the structures themselves. Occupational training shall be provided if necessary for the recovery of business or recovery of income level in another occupations. The necessary training fees shall be paid, and the necessary allowance shall be calculated for a specific period taking into consideration the reinstatement period.

d) Business Operators who Do Not Own Structures

Business operators such as artisans, metal fabricators etc., who do not have structures, will receive moving allowance to remove their chattels from the road corridor. Occupational training shall be provided if necessary for the recovery of business or recovery of income level in another occupations. The necessary training fees shall be paid, and the necessary allowance shall be calculated for a specific period taking into consideration the reinstatement period.

e) Petty Traders

Petty traders sell a wide range of items on table-tops, racks, mats and under umbrellas and canopies within the corridor. They usually move backwards from the road while road construction is underway and then move back into the available spaces after construction is completed. As there is little constraint on available space for business relocation during and after construction, petty traders are not eligible for any compensation.

f) River Canoe Operators

Canoe operators will receive a moving allowance to relocate their operation locations. Otherwise, occupational training shall be provided if necessary for the recovery of business or recovery of income level in another occupation such as a taxi/commuter driver. The necessary

training fees shall be paid, and the necessary allowance shall be calculated for a specific period taking into consideration the reinstatement period.

g) Fish Pond/Aqua Farm

Fish pond/aqua farm owners and tenants will receive temporary compensation to maintain their current fish production level if the construction activities negatively impact fish yield. As contractors are required to avoid contamination of drinking water and other sensitive businesses, aqua farms are unlikely to be damaged. However, fish yield shall be monitored before and during construction for the purpose of environmental management and impact assessment.

11.3.6 Institutional Responsibility for Implementation and Procedures and Grievance Procedures

(1) Institutional Responsibility for Implementation

a) GHA

The GHA is a semi-autonomous body with a responsibility for the provision and management of trunk roads. It was originally established in 1974 as the organisation responsible for the development and administration of the entire national road network. Since GHA Act of December 1997, its role is limited to the administration, control, development and maintenance of trunk roads and related facilities subject to the policies of the MRH.

The GHA has an Environmental Management Unit (EMU) stationing three environmental officers/engineers that have oversight on environmental and social issues of the sector and EMU has direct responsibility for resettlement operations.

b) Lands Commission

This is the state agency charged primarily with the management and administration of state and vested lands. It is responsible for advising on policy framework for development of particular areas so as to ensure that development of such areas is coordinated. The functions of the Commission are spelt out in Article 258 of the 1992 Constitution and the Lands Commission Act (Act 483) 1994.

The Commission's role in the area of compulsory acquisition is that it serves as a Member/Secretary to the site selection committee, a technical committee that considers request for compulsory acquisition by state agencies and recommends its acceptance or otherwise.

The proprietary plan covering the site to be acquired is plotted by the Commission in the government records. Also recommendation on the acquisition is processed by the Commission for the approval of the Minister responsible for lands, before an executive instrument would be issued and gazetted.

c) Land Valuation Division

Formerly known asthe Land Valuation Board (LVB), the Land Valuation Division (LVD) of the Lands Commission was formally set up in 1986 to perform functions related to valuation of various properties for specified purposes.

Table 11-30 Entitlement Matrix for Proposed Projects

Category	SUB-Category	Type of Loss	Compensation for Structure	Compensation for Loss of Other Assets	Compensation for Loss of Income	Moving Allowance	Type of Compensation
Agricultural land/ Customary land/ forestry	Owners of Assets/Property	Plants/Crops Structure/ Location for Structure	Replacement cost for immovable facilities	Pay full market value of Trees, Perennial Crops, Food Crops Pay full replacement cost for resettlement of movables	Where applicable	Coverage of total transport expenses for the removal of chattels	Assets to Cash with Open Market Value Compensation for demolished structures or civil improvement
	Owners of Land (agricultural lands)	Land	Compensation for land at replacement cost based on prevailing market price	-	Where applicable	-	Land to Land or Land to Cash Compensation for lost parcel of land at replacement cost based on open market capital value (land law and related regulations)
	Tenants (farming)	Rental Land	Assistance for relocation to new location of similar type	With or without documents, he/she shall be paid compensation to enable to relocation to a place of similar standard	-	Coverage of total transport expenses for the removal of chattels	Compensation for disturbance.
Residents/House/ Land owners	Owners of structures	Structure/Location for Structure	Replacement cost for immovable facilities	Pay full replacement cost for resettlement of movables	Where applicable	Coverage of full cost for the total transport expenses for the removal of chattels	Compensation for demolished structures or civil improvement
	Owners of Land (residential plots)	Land	Compensation for land at prevailing market price	-	Where applicable	-	Land to Land or Land to Cash Compensation for lost parcel of land at replacement cost based on open market capital value (land law and related regulations)
	Tenants (Residential & Business)	Rental Accommodation	Relocation to New location of similar type	With or without documents he/she will be paid compensation to enable him/her to relocate to a place of similar standard		Coverage of full cost for the total transport expenses for the removal of chattels	Compensation for disturbance. One year rent advance for same type of accommodation
Business	Artisans	Business location	-	Pay full cost of removal and fixing of movables	Payments in lieu of business profits while relocating - six months	Coverage of full cost for the total transport expenses	Compensation for demolished structures or civil improvements OR compensation for relocation of structures
	Large Company/Formal business						
	Trader-large Concern						
	Trader-medium						
	Trader-small						
Petty Trader	Petty trader	None	None	None	None	None	None

Source: Study Team

The LVD is accordingly the statutory agency responsible for the processing of compensation claims on compulsory acquisitions. The LVD will be assisted by GHA to identify and reference permanent and temporary structures and determine compensation values. The compensation valuation list from the LVD is forwarded to the acquiring agency for processing for payment.

d) Metropolitan, Municipal and District Assemblies

The Assemblies play a significant role in the implementation of resettlement schemes and also serve as media for public education and community consultations. Some of the administrative structures of the Assemblies, that is, offices of the Assemblyman and the Unit Committees are normally used to inform and educate people in the project area about the intended projects, their impact and proposed mitigation measures. The Assembly members also act as witnesses for making payment of Supplemental Assistance to PAPs.

e) Town and Country Planning Department (TCPD)

The Department was set up, among others, to ensure that developments are done in an orderly manner and that land use is maximized. It is responsible for the preparation of layouts for towns and cities. It also vets and approves layouts from prospective developers (especially private estate developers) and specifies all reservations based on projected land use plans. The TCPD receives applications for development permits, vets them and recommends their approval or otherwise. The TCPD ensures that the ROW is implemented according to the approved planning schemes on each road.

f) EPA

The EPA was established by the Environmental Protection Agency Act of 1994 (ACT 490). The EPA was charged with the duty of prescribing standards and guidelines relating to environmental protection and/or pollution. The Agency may by notice in writing direct any developer carrying on any project to submit an EIA covering the project. The Environmental Assessment Regulation of 1999 has listed the developments that require clearance with the EPA. Development of road network is one of the undertakings that require the issuance of environmental permit before construction can be done.

g) Utility Agencies

The Utility companies that are likely to play a role in the resettlement schemes are: the Electricity Company of Ghana (ECG); Telecommunication companies and Ghana Water Company Limited (GWCL). These agencies at the appropriate times will disconnect and reconnect PAPs to their services before and after relocation as the case may be. Special consideration has to be given to PAPs so that they are not treated as usual applicants for services to their new places.

h) Attorney General's Department

The Attorney General's Department has redress mechanisms in place for aggrieved persons. Affected persons who are not satisfied with compensation due them are empowered by the constitution to seek redress in the court of law. When this happens, the Attorney General's

Department represents the government in the court's proceedings. The Attorney Generals Department is also responsible for drafting the Executive Instrument for acquiring the needed land for the project.

(2) Operational Procedures

The procedures to be followed for land acquisition and compensation of persons adversely affected by the project will be guided by the Resettlement Policy Framework of the MRH as highlighted in the Table 11-31.

(3) Grievance Procedures

Grievance Procedures have been prepared as a guide for handling all grievances that will occur during the implementation of the RAP.

Grievance Committees will be set up in each affected district. Each committee will have nine members. The members will be one representative each from GHA, EPA, TCPD, DA, GPRTU, Ghana Union of Traders' Associations (GUTA) and three (3) PAPs.

A grievance from a PAP will be reported to the committee either in writing or be recorded by the secretary of the committee.

A complainant is allowed to procure the services of an independent valuer at no cost to the PAP, who would help that person determine an acceptable compensation. This can be presented to the committee as a grievance.

The grievance committee will investigate the compensation complaints as follows:

- Determine if they are PAPs entitled to reinstatement using the database available or if necessary, visit their location and determine if they fall within the ROW.
- Using components applied in the Entitlement matrix to determine compensation/ reinstatement assess if PAP has been adequately compensated.

The Grievance Committee will investigate the reinstatement complaints as follows:

- Determine if they are PAPs entitled to reinstatement using the database available, or if necessary visit their location and determine if they fall within the ROW.
- Determine if the appropriate reinstatement due to the particular category of PAP has been given. For those who do not qualify for particular options they are demanding, explain the basis for giving that particular option.

The Grievance Committee will investigate the complaints concerning processes as follows:

- Determine location and type of activity complainant is involved in using the data base available or visits their business location to determine if their complaint has merit.
- Take into account any special circumstances that require consideration such as extreme incapacitation.
- Where time allotted to vacate corridor is inadequate, the committee will recommend additional time which will meet the principle of reasonableness and consider as appropriate the PAP's particular situation, construction needs and applicable compensation.

Table 11-31 Operational Procedures of Land Acquisition and Responsible Authorities

No.	Activity	Responsibility	Common Timeframe
1	Liaising with Donors	MRH/Agencies	1 month
2	Coordination of Activities of Agencies	MRH/ PPD	3 months
3	Preparation and Disclosure of RAP	GHA/Assemblies	2 – 4 months
4	Alignment of ROW to approved planning scheme	GHA/TCPD	2 weeks
5	Vetting of request for compulsory acquisition of land	Lands Commission/Ministry of Land, Forestry and Mines, Regional Coordinating Office	3 months
6	Social Impact studies (conduct social impact assessment and property impact studies)	GHA through Consultants	2 – 4 months
7	Internal Monitoring	MRH/GHA	Throughout RAP preparation and implementation – 1 year
8	Consultations, planning and Preparation of RAP	GHA	3 months
9	Disclosure of RAP	GHA/MRH/Assemblies	2 weeks
10	External Monitoring and Approval	EPA, NGO, Donors	1 year
11	Gazette/Publishing of E.1	Lands Commission, Attorney General's Office, Ministry of Land, Forestry and Mines	6 months
12	- Marking of affected properties - Inventory of affected properties - Notifications - Request for proof of eligibility - Consultations	GHA, LVD, Local Assembly	6 months
13	Valuation of Properties	LVD, GHA	3 months
14	Establishing of Committees - Utilities Committee to conduct an inventory of properties with utility services - Grievance Committee establish Procedures for dispute resolutions - Payment Committee establish payment modalities	GHA/Utility companies GHA/MRH/ LVD GHA/MRH/LVD	4 months
15	Disclosure of values. Making of offers Processing for payments	GHA/MRH LVD	4 months
16	Release of funds for payment	Ministry of Finance and Economic Planning, GHA/MRH	6 months
17	Payments	Payment Committee (GHA/MRH, LVD)	3 – 4 months
18	Grievance and dispute resolutions	Grievance Committee (GHA/MRH/LVD)	3 – 6 months
19	Taking possession of site	GHA	2 months
20	Disconnect and reconnection of utilities	Utility Committee (GHA, Utility Companies)	6 months
21	External Monitoring	EPA, NGO, Donors	1 year
22	Representing government for any law court redress cases	MRH/GHA, LVD, Attorney General's Office	1 year
23	Preparation of Monitoring and Evaluation Report of RAP and Disclosure	GHA/MRH, EPA	2 months

Source: study team

The Committee will communicate their proposed solution to the complainant and will also forward to GHA Resettlement Office the complaint, the outcome of investigations and their recommendations.

PAPs that are entitled to compensation or additional compensation will receive their entitlements from GHA Accounts Section on the recommendation of the Grievance Committees.

Complaints that relate to the quantum of compensation will be referred to the Land Valuation Division with the accompanying independent valuation report clearly stating the assumptions and rates used to arrive at compensation claims. The independent valuer of the Complainant would be invited to meet the Land Valuation Division on an agreed date to resolve the issues involved in the disagreement. After negotiations the LVD would communicate their recommendations to the Resettlement Office which would in turn inform the claimant of the outcome.

If the LVD recommends payment of the claim, then the Resettlement Office would ensure that it is done before the structure under review is demolished.

Whenever a complainant's claim cannot be resolved satisfactorily, GHA will procure the services of an arbitrator to mediate between the complainant and LVD. It is only after this mediation has failed that a claimant can then exercise the option of going to Court, as provided under Section 20 under Chapter 5 of the Constitution of the Republic of Ghana.

11.3.7 Common Timeframe of Land Acquisition and Resettlement

Consultants/valuers of the GHA will calculate the level of compensation for all assets and prepare inventories of losses in a property impact assessment (PIA). Then, the LVD will undertake its own valuation and validate the value of the assets to be compensated before the actual mitigation measures are implemented. A summary of the key procedures after the RAP preparation is shown below.

(1) Disclosure of RAP

The GHA (Head Office) will disclose the RAP through the news media, the MRH website and inform the PAP through the EPA official in order to publicize the resettlement activity to the public and other stakeholders. In addition, hard copies of the RAP document will be placed in the offices of GHA (head office and relevant assemblies), for public viewing throughout the period of construction of the project.

(2) Setting up of Resettlement Office

GHA will set up a resettlement office within the existing Environmental unit to oversee resettlement activities on the Arterial roads prior to the commencement of project implementation.

(3) Formation of Grievance Committee (GC)

The GHA will prepare a TOR for the Grievance Committee (GC) specifying the number, membership, sitting days. The Grievance Committee membership has been defined in section

11.3.6 (3) above.

(4) Payment of Compensation

LVD will process the compensation for the PAPs and GHA will pay them after GHA has finished processing the necessary documentation. Government of Ghana will deliver the payment through GHA and MLGRDE.

- PAPs due for compensation or additional compensation shall receive their entitlements through the GHA.
- Complaints regarding the amount of compensation to be given for structures shall be referred from the GC to the LDV. A meeting shall be set up between the complainant and his/her valuer and the LDV where the independent valuer shall be required to state the rationale and rates used to arrive at the compensation claim. After the negotiations with the LDV shall forward its decision to the Grievance Committee who shall inform the complainant.
- Once the LDV recommends payment, the GHA shall ensure that payment has been effected before the structure in question is demolished.
- Whenever a complainant's claim cannot be resolved to his/her satisfaction, the GHA shall engage a mediator who shall mediate between the complainant and the LDV. When this mediation fails then the complainant can resort to legal action.

11.3.8 Monitoring Plan

The GHA will supervise the Implementation Program and ensure the timely execution of project activities. To enable GHA effectively undertake the monitoring, a Resettlement Office will be set up at the beginning of the implementation period to coordinate the various facets of the resettlement. Personnel for this office will be drawn from the Environmental Unit of the GHA.

(1) Monitoring Objectives

Objectives of the Monitoring Program are to ascertain that the principles and the specific requirements of the RAP are fully implemented. The monitoring shall ensure that:

- PAPs are successfully relocated to avoid and reduce impoverishment.
- Difficulties facing relocated PAPs at new locations are identified and addressed.
- Record of experiences is kept for future reference.

(2) Monitoring and Evaluation Phase

GHA shall oversee the general monitoring of the RAP by means of both internal and external checks to ensure optimum performance. The internal Performance Monitoring Milestone will afford GHA the chance to judge physical progress against indicators as set out in the Table 11-32.

Table 11-32 Internal Performance Milestone

Indicator Type	Milestone
Input	Notification to PAPs of the deadline for moving out of ROW
	Public meetings held
Output	PAPs in business/residences relocated
Outcome	Grievance redress PROCEDURES established and operational
	Monitoring results produced

Source: Study Team

(3) Internal Monitoring and Supervision

Internal monitoring of the resettlement operations will be undertaken by GHA following the schedules in the RAPs. The day-to-day field supervision will be the responsibility of the GHA Resettlement Office. A record of activities shall be captured in the Monthly and Quarterly Progress Reports (QPR), which are subject to review by MRH. The Resettlement Office will continuously take stock, discuss reports received and assess solutions proposed. Their activities should ensure that the resettlement is successfully implemented. Regular Quarterly Reports shall be produced and submitted to MRH. GHA would bear cost of monitoring.

(4) External Monitoring

Based on the MRH/GHA's RPF, external monitoring will also be conducted by the EPA as well as NGOs familiar with local communities and involuntary resettlement matters. The EPA will conduct the external monitoring as a part of its responsibility to assure the protection of the environment and social safeguards. By common practices, the EPA defines the requirements and contents of the external monitoring as a part of the approval procedures of the EIA. All costs of the EPA's external monitoring shall also be included in the project costs.

On the contrary, there are no specific legal documents defining NGOs' external monitoring except limited descriptions in the RPF. However, due to mistrust in compensation activities for public works in the past, there is a strong demand that the government's activities be monitored by a third-party indirect stakeholder. The MRH/GHA adopted external monitoring by NGOs as a part of its accountability commitment for the RPF in 2007. Once the GHA starts the EIA procedures after the proposed project is formally approved by the GoG, the GHA will assign reliable NGO(s) based on the recommendations of the assigned EIS consultants, environmental officers of the GHA, and other local representatives such as district chief representatives.

(5) Monitoring Indicators

As a means of effectively reporting on the RAP implementation, the following indicators will be watched during project implementation as indicated in Table 11-33.

Table 11-33 Monitoring Indicators

Activity	Monitoring Indicator	Means of Verification
Ascertain arrangements for relocating PAPs	Demolition/removal of structures; disconnection of utility services; closure of businesses	Monitoring completed; report submitted
Supervise relocation	PAPs relocated or being assisted; assistance offered	PAPs traced to new locations; report submitted
Meetings with PAPs to find out any likely difficulties encountered at new locations	PAPS settled; businesses restarted	Interaction completed; problems identified; solutions suggested; report submitted
Follow-up meetings and visits to see how problems at new location can be resolved	PAPS settled; businesses restarted	Interaction completed; problems identified; solutions suggested; report submitted
Determine how far the livelihoods of PAPs have been restored	Business on-going; restored or better	Turnover/sales/profit figures submitted as proof; report submitted

Source: Study Team

(6) Post-Project Evaluation

a) Objectives of the Evaluation

In addition to the periodic evaluation that will be carried out during the planned project period, an audit will be done upon project completion. The audit will

- Appraise the extent of the achievements of the resettlement activities.
- Gauge the satisfaction level of re-located persons.
- Measure the progress of persons who have been relocated.
- Assess the sufficiency of the planned actions carried out.

The following methods shall also be employed to achieve the above objectives:

- Public Forum
- Completion audit of available PAPs

b) Public Forum/Consultation

Quarterly meetings shall be held with all PAPs. Extensive use of the print and electronic media will ensure that as many PAPs as possible will attend. The meetings are expected to mobilize as many PAPs as possible and give a common voice to affected persons.

c) Completion Audit

An audit will be done to determine whether the efforts to restore the living standards of the affected population have been properly designed and executed. This completion audit will verify that all physical inputs earmarked in the RAP have been delivered and all services provided. The audit will also evaluate if the mitigation actions prescribed in the RAP have had the desired effect. The baseline conditions of the affected parties before the relocation will be used as a measure against their socio-economic status after the resettlement.

Questionnaires will be administered to as many PAPs as can be contacted. In addition to the indicators used in the baseline survey, the questionnaires will also identify issues such as:

- Extent of recovery of business

- Structures being used for business
- Any expansion or shrinkage
- Problems encountered
- General perception of relocation

To be effective, the completion audit will take place after all RAP activities have been completed including development initiatives, but before the financial commitments to the program are finished. This will allow the flexibility to undertake any corrective action that the auditors may recommend before the project is completed.

11.3.9 Estimated Cost of Resettlement and Source of Funding

(1) Estimated Cost of Resettlement

Based on the RPF of the MRH/GHA, the resettlement cost shall cover resettlement and compensation cost, relocation and transfer, income restoration plan, and administration costs (Table 8, Chapter 8 of RPF). At the stage of the F/S of the proposed projects, the resettlement costs are not accurately estimated due to the approximate boundary of the ROW. Based on the best available information and assumed centreline of existing roads, the Study Team and its local experts estimated the expected costs of land and other asset compensation without the cost of the income restoration plan as shown below.

Table 11-34 Estimated Values of Project Affected Assets

Land Use Type	Quantity (1,000 m^2)	Value (1,000 GHS)
New Road Construction between Asutsuare Jct. and Asikuma Jct.		
Residential	4.3	144
Agriculture	560	1,733
No active use/Community land/Forest	5,343	4,788
Total	5,906	6,665
Upgrading on the Existing Asutsuare – Aveyime road		
Residential	1.0	56
Agriculture	4.7	14
No-active use/Community land/Forest	1,275	1,103
Total	1,281	1,173

Source: Study Team

As a result of the above socioeconomic survey and PAPs' primary preference for compensation, compensation in the form of cash for assets would be dominant at the actual negotiation stage. However, due to high expectations that construction/upgrading of roads will lead to new business opportunities, the PAPs seemed interested in new business opportunities with occupational training commonly included in the income restoration plan of RAP/ARAP. During the following detailed design stage, it is recommended to develop a reasonable and practical income restoration plan to match the expected economic activities led by the proposed projects and PAPs' interests and capabilities.

(2) Source of Funding

The source of funding shall be defined after the proposed projects are officially approved by the MRH and GoG. For the GHA's projects in general, the GoG is responsible for the costs of

involuntary resettlement. The MRH will be responsible for securing budget, and the MoFEP will be responsible for releasing the budget from the national account.

Considering JICA's assistance for the proposed projects, official development assistance loans would be the most suitable option from among the other programmes (technical cooperation project, grant aid, citizen participation, public private partnership, and emergency disaster relief). Based on Japanese ODA policy, items such as land acquisition and compensation, taxes and duties, and administration costs of the executing agency are not eligible for ODA loan financing (Chapter V, Operational Guidance on the Preparation for Japan's ODA Loan Projects). Thus, the GoG will be required to secure budget for the resettlement. The general conditions of Japanese ODA loans are available on JICA's web sites: .

• Official Development Assistance Loans	http://www.jica.go.jp/english/our_work/types_of_assistance/oda_loans/index.html
• Operational Guidance on the Preparation for Japan's ODA Loan Projects	http://www.jica.go.jp/english/our_work/types_of_assistance/oda_loans/oda_op_info/guidance/index.html

CHAPTER 12
OVERALL EVALUATION

Chapter 12 Overall Evaluation

12.1 Overall Evaluation of Projects

12.1.1 Results of Economic Evaluation

(1) Construction of the New Road between Asutsuare Jct. and Asikuma Jct.

In light of the sensitivity analysis in Chapter 10, the construction of the new road between Asutsuare Jct. and Asikuma Jct. is feasible, with an overall EIRR of 26.1% in the "Base Case" scenario and 21.2% in the worst-case scenario. Furthermore, the EIRR in worst case without agricultural development benefit still remained at 15.1%.

In all cases including the improbable worse case condition, the project remains economically viable with EIRRs well above cut-off mark of 12%.

The new construction project can therefore be recommended for implementation.

(2) Upgrading of Asutsuare–Aveyime Road

In case the proposed new eastern corridor is opened, the upgrading of Asutsuare–Aveyime section is feasible returning an overall EIRR of 51.5% under the "Base Case" scenario and 36.8% in worst case scenario.

In all cases including the improbable worse case condition, the project remains economically viable with EIRRs well above cut-off mark of 12%.

The upgrading project is therefore recommended for implementation on condition that the proposed new road between Asutsuare Jct. and Asikuma Jct. is opened.

12.1.2 Qualitative Benefits

(1) Construction of the Road between Asutsuare Jct. and Asikuma Jct.

As described in Section 2.7.1, construction of the bridge across the Volta River as well as the new road between Asutsuare Jct. and Asikuma Jct. will not only generate indirect economic benefits from daily cultivation by local farmers, but also attract large-scale agricultural investment, particularly in the northern part of the Volta River, where about 25,000 ha. of arable land with rich Vertisols soil for farming are mostly unused at present due to the lack of a road to major markets. Construction of the new road between Asutsuare Jct. and Asikuma Jct. will thus generate both qualitative and quantitative benefits for the national economy from new agricultural development.

(2) Upgrading of Asutsuare–Aveyime Road

The Asutsurare–Aveyime road is a feeder road with a gravel surface at present: there is no paved road connecting Asutsuare and Aveyime, where cultivation of agricultural products, particularly rice production, is predominant. In addition, the APGIP scheme is planned to be implemented in the near future and agricultural production is expected to increase along the Asutsurare–Aveyime road. Upgrading of this road will thus facilitate the transportation of agricultural products along the Volta River, which is another qualitative benefit of the Project.

12.1.3 Environmental and Social Considerations

(1) Construction of the Road between Asutsuare Jct. and Asikuma Jct.

The new road to be constructed between Asutsuare Jct. and Asikuma Jct. will not pass through populated areas and will thus require very limited resettlement and cause few impacts on noise, air quality and vibration for local residents. Also, construction of the new Volta Bridge will not affect aqua-cultural activities in the Volta River. In addition, at the public consultation meeting, none of the stake-holders raised any objections to the construction of this road.

Thus, construction of the new road between Asutsuare Jct. and Asikuma Jct. will not cause major negative impacts on the environment or lives along the road.

(2) Upgrading of Asutsuare – Aveyime Road

Upgrading of the Asutsuare – Aveyime road will cause some negative impacts for those living in Aveyime, where some resettlement (less than 10 houses) will be necessary due to the upgrading. On the other hand, upgrading of this road will generate positive impacts for people along the road by providing better access to farm lands and easy transportation of agricultural products.

Thus, upgrading of the Asutsuare – Aveyime road will not cause major negative impacts provided those affected are appropriately compensated.

12.1.4 Indicators for Post Project Evaluation

According to the Terms of Reference for this study, the indicators at 3 years later after the route openings are estimated based on the results of computation with HDM-4 model. Since the traffic opening year on both study roads are assumed to be in 2016, indicators were aimed at the conditions in 2019. The indicators for post project evaluation in 2019 are shown in Table 12-1

Table 12-1 Expected Indicators in 2019

Indicator	Unit	Construction of New Road between Asutsuare Jct. and Asikuma Jct.	Upgrading of Asutsuare – Aveyime Road
Average Daily Traffic	Vehicles/day	8,510	4,339
Savings in Road User Cost	US$ million	6.02	14.63

Source: Study Team based on the calculation with HDM-4 model

12.2 Overall Evaluation

The Study Team has analysed the feasibility of two projects: 1) construction of the road between Asutsuare Jct. and Asikuma Jct. and 2) upgrading of the Asutsuare – Aveyime road, in terms of technical, economic, regional development, environmental and social considerations.

As a result, both projects are considered feasible for implementation at an early stage.

CHAPTER 13

CONCLUSIONS AND RECOMMENDATIONS

Chapter 13 Conclusions and Recommendations

13.1 Conclusions

13.1.1 Major Findings in the Study Area

During the course of the Study, the Study Team carried out data collection, site investigations, surveys of traffic, natural conditions, and environmental and social conditions, and discussions with MRH and GHA officials, as well as stakeholders at the first Workshop on the alternative road alignments prepared by the Study Team.

The major findings in the Study Area as well as the Eastern Corridor related to the development of a part of the Eastern Corridor between Asutsuare Jct. and Asikuma Jct., and upgrading of the Asutsuare – Aveyime Road are as follows:

(1) Road Network in the Study Area

- The road network in the Study Area consists of four national roads, five regional roads and several feeder roads. However, the weak network in the area of N1, N2, and R28 is still hindering agricultural development, particularly to the north of the Volta River.
- The existing N2 has several problems, such as passing through various townships with speed limits, commercial activities encroaching on the carriageway, and expanding urban area, and the Adomi Bridge with its restriction on the gross weight of freight vehicles.
- While the GHA is going to rehabilitate the Adomi Bridge starting early next year, R28 between Sogakope and Ho will be the only trunk road (regional road) available for heavy vehicles, even though the GHA will provide a ferry service across the Volta River.
- There are two feeder roads connecting east to west along both sides of the Volta River, but both of them are gravel roads and not suitable for transporting agricultural products by large freight vehicles.
- The Asutsuare – Aveyime road is expected to play an important role as an inter-regional road, after the existing road has been improved and the APGIP has been implemented to develop more paddy fields.
- There is only one track connecting N2 and R28 on the northern side of the Study Area and it is almost impossible to drive on this track during the rainy season.

(2) Present Situation of Eastern Corridor

- The Eastern Corridor between Brewaniase and Bawku is a gravel road in poor or fair condition and it is difficult even for 4 x 4 vehicles to pass during the rainy season.
- The worst sections of the Eastern Corridor are between Bimbla and Yendi, followed by Nkwanta – Bimbla, Brewaniase – Nkwanta, and Nakpanduri – Garu Natinga sections.
- The GoG has already started upgrading 45 km of section from Asikuma Jct. with GoG funds. The MRH is the executing agency as well as supervisor (Project Management Unit) for this project, while the GHA is not involved in this project. Earth-works for widening the carriageway have been carried out.

- The EU approved the contract for upgrading th Brewaniase–Nkwanta section in July 2012 and the contractor (Burkina) has already started the topographical survey.
- The MRH and GHA carried out the engineering study for construction of the Nkwanta–Yendi road and completed it in December 2011. Based on this study, the MRH has already started upgrading the Nkwanta–Domanko section (50 km) with assistance from the GoC. The same as the previous section, the MRH is the executing agency as well as the supervisor.
- When upgrading of the section up to Yendi is completed, many vehicles using the Central Corridor may divert to the Eastern Corridor, as the regional road between Tamale and Yendi is a paved road in good condition.

(3) Regional Development

- The southern side of the Volta River is a part the Southern Green Belt, where the soil is suitable for cultivation and KIS (an irrigation scheme) exists, and this area has become one of the best lands for producing good-quality rice and some cash crops.
- The GoG plans to implement the APGIP to irrigate more land to accelerate paddy field development also on the south side of the Volta River.
- Two large-scale agricultural development schemes are under way by foreign companies to cultivate crops for export and food crops and vegetables for the domestic market.
- On the northeastern side of the Volta River, there are more than 25,000 ha of arable land with Vertisols soil (black cotton), which is highly suitable for medium- and large-scale agricultural development. This arable land, however, has not been developed due to the lack of access roads to transport products for export or to a market.
- Besides the Akosombo Dam, there is potential for tourism in the Study Area, including for eco-tourism, however, the poor access roads prevent the development of these potential tourism resources.

(3) Environmental and Social Considerations

- According to the results of the baseline survey for environmental and social considerations, the development of new roads will not cause significant negative environmental and social impacts, unless a new road passes through the centre of a community.
- Improvement of the Asutsuare – Aveyime road will require resettlement in Aveyime and Volivo townships, but the number of affected houses and shops is limited.
- Disturbance of the present agricultural land and agricultural development schemes will generate negative social impacts.

13.1.2 Workshops

(1) The First Workshop

The first Workshop was held on 18th May 2012, inviting various stakeholders to discuss the priorities of alternative routes for selecting the highest priority route. However, the Workshop was unable to select a particular alternative for the feasibility study. Therefore, the Study Team

and the GHA held further discussions for selecting the highest priority route for the feasibility study. At the meeting held on 1st June, 2012, the GHA finally agreed to select Alternative 4 for the F/S.

(2) Second Workshop

The second Workshop was held on 26th October 2012, inviting various stakeholders to discuss the contents of the Draft Final Report and some comments were made by the participants. These comments were reflected in preparing the Final Report.

13.1.3 Conclusions

- Based on the results of the Study, the Study Team prepared several alternative road alignments for the development of a part of the Eastern Corridor between Asutsuare Jct. and Asikuma Jct., together with four possible locations for alternative bridge sites.
- The Study Team presented these alternatives with the results of a first screening evaluation to the working group meeting in the GHA, and four alternative routes to the south of the Volta River and one alternative route to the north of the Volta River were selected for further study in the first phase of the Study. After discussion with the Study Team as well as in the internal meetings, the GHA selected Alternative 4 as the highest priority route for the preliminary design in the second phase of the Study.
- Based on the selected route for the F/S, the Study Team carried out more detailed natural condition surveys, and carried out the preliminary design and cost estimation for construction of the road between Asutsuare Jct. and Asikuma Jct., including a new bridge across the Volta River.
- The Study Team also carried out the preliminary design and cost estimation for upgrading the Asutsuare–Aveyime road, which will be converted from a feeder road to an inter-regional road.
- The Study Team then carried out an economic analysis of the above two projects, using the HDM-4 model. The results of this analysis indicated that construction and upgrading of both projects are technically and economically feasible.
- These two projects will also contribute to regional development, particularly for the agricultural sector.
- The Study Team also supported the GHA in holding two public consultation meetings at Asutsuare and Juapong and no objections to the project plan were raised.
- The GHA carried out the Road Safety Audit and minor modifications to the road design were recommended (see Appendix 16). Thus, the Study Team modified the road design according to these recommendations.

13.2 Necessary Items for Project Financed by Japanese Yen Loan

13.2.1 Present Procurement System in the GHA

All processes of procuring consultants and contractors are in accordance with the Public

Procurement Act, 2003 (Act 663).

(1) Procurement of Consultant

The Planning Division of the GHA is responsible for selecting a consultant for the study.

(2) Procurement of Contractor

- The Contract Division of the GHA is responsible for selecting a contractor. In many cases, several contractors are invited to participating in the bidding process.
- Contractors are classified by category and class (Class 1 to 4 and Category A, B, C and S) and eligible contractors are called to participate in the bidding process according to the type of work and contract amount.
- Pre-qualification (PQ) is used mainly for international competitive biddings (ICB).
- The GHA has experience of both local competitive biddings (LCB) and ICB.

13.2.2 System of Japanese Yen Loan

Generally speaking, there are two types of Yen Loan System.

(1) Ordinary Yen Loan

- Condition: Untied
- Interest rate: 1.4% (for Ghana) (FY 2012)
- Repayment period: 25 years
- Grace period: 7 years

(2) Special Term for Economic Partnership (STEP)

- Condition: Tied with Japanese company
- Interest rate: 0.2% (for Ghana) (FY 2012)
- Repayment period: 40 years
- Grace period: 10 years

13.3 Execution, Operation and Maintenance of the Project

13.3.1 Project Executing Agency

Generally speaking, national roads, inter-regional roads and regional roads are under the responsibility of the GHA and the GHA becomes the project executing agency for road construction and improvement projects. However, there is an exception that the MRH is the executing agency as well as the supervisor for the ongoing project on the Eastern Corridor between Asikuma Jct. and Hohoe, and Nkwanta and Damanko for an unknown reason.

The GoG will make the final decision on the executing agency of the Project. However, it is desirable for the GHA to be the executing agency of the Project, because of the construction of a long bridge across the Volta River, as well as new construction of 67 km of road.

13.3.2 Operation and Maintenance of the Project

In order to carry out effective and adequate maintenance on the Project roads, the Study

Team recommends that the GHA outsource maintenance works to private enterprises with resources from the Road Fund. The priorities for routine and periodic maintenance should be identified by using the road database system of the GHA.

13.4 Recommendations

Recommendations for the Eastern Corridor Development Project, including construction of the new road between Asutsuare Jct. and Asikuma Jct, and upgrading of the Asutsuare–Aveyime road, are as follows:

- It is recommended for the MRH and the GHA to share the outcome of the Study with development partners for possible financial assistance for the Project.
- When the financial source is determined, the GHA should carry out the EIA to obtain the environmental permit and to start land acquisition to secure ROW.
- For the construction of the new bridge across the Volta River, the GHA should establish a special bridge unit to supervise the long span cable-stayed bridge, which will be the first experience in Ghana and to transfer the technology of long span bridge construction to Ghanaian engineers.
- The GHA should improve the Asutsuare – Akuse Jct. and Aveyime – Tefle (N1) prior to upgrading the Asutsuare – Aveyime road to ensure maximum utilization of the Project road.
- It is recommended for the GoG to carry out traffic safety education in schools and communities in order to teach local residents, particularly pupils and elderly people, about the dangers associated with high-speed vehicles which will pass through their communities.

13.5 Consideration for Reducing the Project Cost

Project Name: Preparatory Survey on Eastern Corridor Development Project in the Republic of Ghana

Duration of study: March 2012 – January 2013

Project construction cost assumed in the preliminary study: JPY 15,582 million

Project construction cost after reduction: JPY 13,460 million

Table 13-1 List of Cost Reductions for Reconstruction at Planning and Design

No	Item of Cost Reduction	Cost reduction (JPY million)	Attached sheet No.
(A) Reconsideration at planning stage 1) Reconsideration of alignment			
(A) -1) -1	Based on further examinations after the Workshop, the alignment of the Eastern Corridor including the location of the bridge across the Volta River was changed.	1,280	(1)
(B) Reconsideration at design stage 1) Reconsideration of pavement structures			
(B) -1) -1	Cement stabilized sub-base course shall be adopted.	122	(2)
(B) Reconsideration at design stage 2) Reconsideration of bridge structures			
(B) -2) -1	High Fatigue Durability Steel Plate Deck for the bridge across the Volta River shall be adopted.	250	(3)
(B) -2) -2	Panel style fabrication for the main girders of the bridge across the Volta River shall be adopted.	100	(4)
(B) -2) -3	Reinforced concrete main towers shall be adopted.	200	(5)
(B) Reconsideration at design stage 3) Reconsideration of specifications and facilities			
(B) -3) -1	Multi-point automatic welding shall be adopted.	100	(6)
(B) Reconsideration at design stage 3) Reconsideration of bridge temporary structures			
(B) -4) -1	Single steel pipe sheet pile cofferdam shall be adopted.	70	(7)
Total		2,122	
Percentage cost reduction		13.62 %	

Source: Study Team

Attached Sheet (1)

Items for Cost Reduction

(A) Reconsideration at planning stage, 1) Reconsideration of alignment

Outline:

Content of revision

(1) Preliminary study:

A priority route for the Eastern Corridor was selected from several alternative routes through discussion with the GHA.

(2) After revision:

The Study Team carried out further examinations of the alignment design after the Workshop and proposed realignment of the route for the Eastern Corridor. The proposed realignment route was adopted.

Amount of cost reduction

The construction cost was reduced by approximately JPY 1,280 million.

Effect

The adopted alignment not only reduced the cost mainly thanks to shortening the bridge length by 125 m as a result of relocating the bridge across the Volta River 1 km downstream, but also minimised the affected area of paddy fields.

Figure or table for comparison

Table 13-2 Comparison of Alignments

Item	**Preliminary study**	**After revision**
Alignment (Station)	Gentle alignment (25 km+350 to 33 km+075)	Gentle alignment (25 km+350 to 34 km+075)
Route length (Ratio) 1) Earth section	7,725 m (0.89) 1) 7,080 m	8,725 m (1.00) 1) 8,205 m
2) Volta River Bridge	2) 645 m	2) 520 m
Area of affected KIP paddy fields (Ratio)	112,000 m^2 (3.20)	35,000 m^2 (1.00)
Construction cost of 1) and 2) (Ratio)	JPY 8,000 million (1.19)	JPY 6,720 million (1.00)
Cost reduction	JPY 1,280 million	

Source: Study Team

Attached Sheet (2)

Items for Cost Reduction

(B) Reconsideration at design stage, 1) Reconsideration of pavement structures

Outline:

Content of revision

(1) Preliminary study:

The following pavement structures were planned: asphalt concrete course 15 cm, base course 30 cm and sub-base course 40 cm for the section between 00 km+000 and 10 km+800, and asphalt concrete course 15 cm, base course 25 cm and sub-base course 35 cm for the section between 10 km+800 and 67 km+027.

(2) After revision:

The following pavement structures were adopted: asphalt concrete course 10 cm, base course 30 cm and cement stabilised sub-base course 23 cm for the section between 00 km+000 and 10 km+800, and asphalt concrete course 10 cm, base course 20 cm and cement stabilised sub-base course 24 cm for the section between 10 km+800 and 67 km+027.

Amount of cost reduction

The construction cost was reduced by approximately JPY 122 million.

Effect

The adopted pavement structure, in which the sub-base strength is increased by applying the cement stabilisation method which can easily use local materials, reduced the cost by reducing the use of imported asphalt material.

Figure or table for comparison

Table 13-3 Comparison of Pavement Structures

Section		Preliminary study		After revision	
	Area	Unit cost	Cost	Unit cost	Cost
	m^2	Yen/m^2	JPY Yen	JPY/m^2	JPY million
00 km+000 to 10 km+800	84,240	4,893	412	4,601	388
10 km+800 to 67 km+027	433,580	4,786	2,075	4,559	1,977
Total			2,487		2,365
Cost reduction	JPY 122 million				

Source: Study Team

Attached Sheet (3)

Items for Cost Reduction

(B) Reconsideration at design stage, 2) Reconsideration of bridge structures

Outline:

Content of revision

(1) Preliminary study:

A long-span cable-stayed bridge over the Volta River was planned as a conventional steel plate deck bridge.

(2) After revision:

High-fatigue-durability steel plate deck, which has recently been developed, was adopted instead of conventional plate deck.

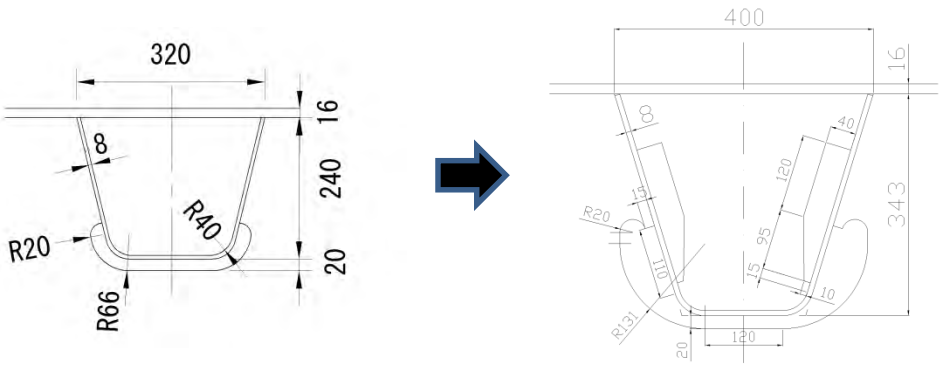
Amount of cost reduction

The construction cost was reduced by approximately JPY 250 million.

Effect

The cost was reduced by not only enhancing the fatigue durability, which is a major issue for steel plate deck, but also enlarging the interval between transverse ribs from the normal 2.5 m to 4.0 m, which decreases the weight of steel and reduces the number of material pieces.

Figure or table for comparison



Conventional Steel Plate Deck High Fatigue Durability Steel Plate Deck

Source: Study Team

Figure 13-1 High-Fatigue-Durability Steel Plate Deck

Attached Sheet (4)

Items for Cost Reduction

(B) Reconsideration at design stage, 2) Reconsideration of bridge structures

Outline:

Content of revision

(1) Preliminary study:

The main girders of the bridge across the Volta River were planned based on block style fabrication, in which the upper and lower flanges are integrated with webs in a factory.

(2) After revision:

Panel style fabrication in which the upper and lower flanges are bolted to the webs on site, was adopted actively.

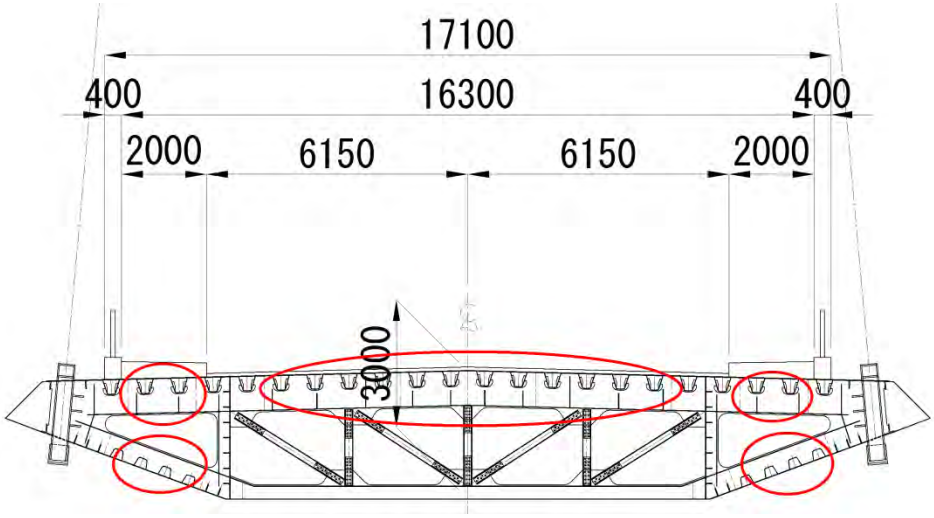
Amount of cost reduction

The construction cost was reduced by approximately JPY 100 million.

Effect

Block style fabrication required many man-days for works such as reversal processing and temporary fixing. In addition, block style fabrication involves higher transportation cost due to increasing transportation volume as well as higher erection cost due to a larger erection crane needed to handle the heavier materials. The active use utilisation of panel style fabrication such as transverse ribs reduced the cost.

Figure or table for comparison



Note: Panel style fabrication shown by decorative mark in red circles
Source: Study Team

Figure 13-2 Cross-section of Main Girder with Panel Style Fabrication

Attached Sheet (5)

Items for Cost Reduction

(B) Reconsideration at design stage, 2) Reconsideration of bridge structures

Outline:

Content of revision

(1) Preliminary study:

Steel main towers as a general structure for long-span cable-stayed bridges was adopted for the bridge across the Volta River.

(2) After revision:

Reinforced concrete main towers were adopted instead of steel main towers.

Amount of cost reduction

The construction cost was reduced by approximately JPY 200 million.

Effect

The adoption of reinforced concrete main towers reduced the cost by reducing the cost of materials, equipment, transport and erection compared with steel main towers.

Attached Sheet (6)

Items for Cost Reduction

(B) Reconsideration at design stage, 3) Rationalisation of specifications and facilities

Outline:

Content of revision

(1) Preliminary study:

Conventional semiautomatic welding was adopted to produce the steel plate deck for the bridge over the Volta River.

(2) After revision:

Multi-point automatic welding, which is used by major Japanese production makers, was adopted.

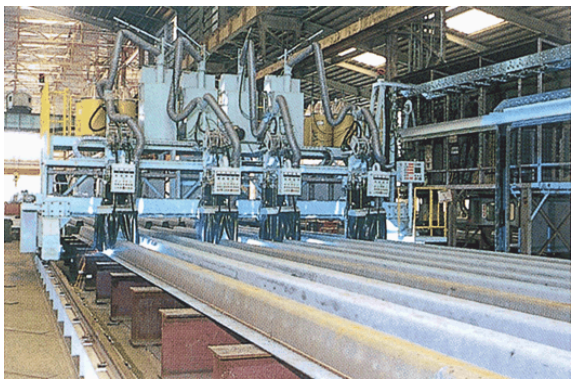
Amount of cost reduction

The construction cost was reduced by approximately JPY 100 million.

Effect

The active use of multi-point automatic welding, which is used by major Japanese production makers, resulted in cost reduction.

Figure or table for comparison



Source: Study Team

Figure 13-3 Multi-point Automatic Welding

Attached Sheet (7)

Items for Cost Reduction

(B) Reconsideration at design stage, 4) Reconsideration of bridge temporary structures

Outline:

Content of revision

(1) Preliminary study:

A double sheet pile cofferdam was adopted as a conventional cofferdam method for at the large depth.

(2) After revision:

A single steel pipe sheet pile cofferdam was adopted instead of a double sheet pile cofferdam.

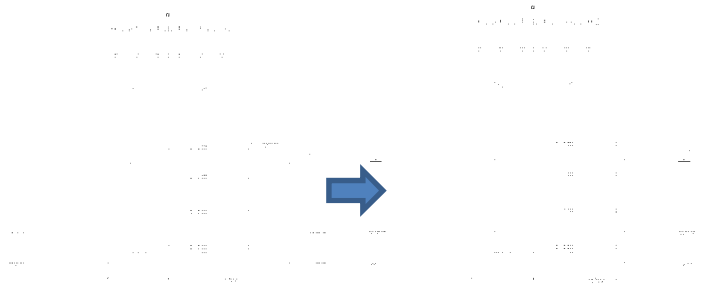
Amount of cost reduction

The construction cost was reduced by approximately JPY 70 million.

Effect

The active use of a single steel pipe sheet pile cofferdam reduced the cost and improved the reduction as well as improvement the construction speed.

Figure or table for comparison



Double Sheet Pile Cofferdam Single Steel Pipe Sheet Pile Cofferdam

Source: Study Team

Figure 13-4 Single Steel Pipe Sheet Pile Cofferdam

APPENDICES

- Appendix 1 POCC Analysis of MTDP and Development Goal of POCC

Table A1-1 POCC Analysis of MTDP of Ho Municipality

Key Development Issues	Potentials	Opportunities	Constraints	Challenges
▪ Inadequate development of, and investment in processing and added value of traditional food crops and cash crops such as cassava and oil palm	▪ Existence of viable market ▪ Availability of vast arable land ▪ Availability of water for irrigation ▪ Large labour force ▪ Existence of NBSSI	▪ Existence of MoFA ▪ Availability of agricultural extension services ▪ Existence of MASLOC ▪ Support from MA	▪ Low income levels of farmers ▪ Lack of collateral security ▪ Land disputes in some areas ▪ Unwillingness of youth to go into agriculture.	▪ Culture of low loan repayment ▪ Low promotion of added value ▪ Low investment in food processing
Conclusion: There are sufficient resources such as a viable market, vast arable land, and agricultural extension services to address the constraints and challenges. In addition the NBSSI would be extensively involved in dialogue to deal with the constraints and challenges				
▪ Difficulty in accessing large tracts of land	▪ Availability of vast land for development ▪ Existence of traditional leaders and opinion leaders	▪ Creation of land bank ▪ Land administration project	▪ Most lands is small scale owned by families ▪ Land disputes and litigation	▪ Difficult to engage in mechanised and large-scale farming
Conclusion: The existence of traditional leaders and opinion leaders, vast land, creation of a land bank as well as land administration project means there is sufficient potential and opportunities to support the programme to address the constraints and challenges.				
▪ Low agricultural productivity and output due to dependence on rainfall	▪ Availability of arable land ▪ Volume of water available for irrigation ▪ Presence of workforce ▪ Availability of organic manure	▪ Availability of market for crops especially horticultural crops	▪ Land litigation ▪ Low rate of adoption of improved technologies ▪ Inadequate and untimely release of credit ▪ Insufficient number of extension staff	▪ Erratic rainfall pattern ▪ High cost of irrigation and agricultural inputs
Conclusion: A project to increase crop production is feasible project. There are rivers as natural resources to support the project. The constraints and challenges would be managed through improved technology and dialogue.				
▪ Low access to irrigated land	▪ Existence of the MA ▪ Availability of traditional authorities ▪ Existence of farmer groups	▪ Existence of NGOs to support	▪ Low income levels of farmers	▪ Socio-cultural beliefs ▪ Outmoded customs
Conclusion: Access to irrigation land by farmers for farming is feasible in the municipality. The constraints and challenges would be managed by involving all stakeholders				
▪ Inadequate credit support facilities for agricultural production	▪ Existence of organised agricultural groups ▪ Presence of banks	▪ Existence of MASLOC, MCA and NGOs	▪ Unwillingness of banks to support agricultural sector	▪ Delay and untimely release of credit by donors
Conclusion: Credit facilities to support the agricultural sector are a viable project in the municipality. The constraints and challenges would be addressed by bringing all stakeholders on board.				
▪ High post-harvest losses	▪ Availability of land to establish processing factories ▪ Agricultural extension agents and NGOs to give education on food storage ▪ Availability of ready market	▪ Government policy to buy and store farm produce ▪ Existence of MA and development partners to build storage facilities	▪ Unattractive prices during certain seasons of the year ▪ High cost of storing chemicals	▪ Insufficient subsidies for agricultural inputs ▪ Delay in government policy implementation
Conclusion: The project would be successful because the numerous economic and social resources listed offer significant potential and opportunities to address the problems. Negotiations and dialogue would also be actively used to engage all stakeholders as part of addressing the constraints and challenges.				

Source: Volta Region Coordinating Council

Table A1-2 Development Goals of POCC of Ho Municipality (1)

Thematic Area	Agriculture Modernisation and Natural Resource Management
Key Focus Area	▪ Accelerated Modernisation of Agriculture ▪ Climate Variability and Change ▪ Land degradation and Land use ▪ Waste Pollution and noise
Objectives	▪ To enhance agricultural extension service delivery. ▪ To increase access of farmers to modern agricultural technology. ▪ To build the operational capacity of farmers along the value chain. ▪ To identify and develop commodities of competitive and comparative advantage. ▪ To adapt to the impacts and reduce vulnerability to climate variability and change ▪ To maintain and enhance the Protected Area system.
Policies	▪ Improve agricultural productivity ▪ Increase agricultural competitiveness and enhance integration into domestic and international markets ▪ Adapt to the impacts and reduce vulnerability to climate variability and change. ▪ Mitigate the impacts of climate variability and change ▪ Curb the loss of bio-diversity by strengthening safe and sound environmental practices ▪ Reverse land and natural resources degradation through investment ▪ Achieve sustainable use of wetlands and water resources
Strategies	▪ Provide agricultural land banks for youths in agriculture in the municipality ▪ Introduce high-yielding crop varieties and improved breeds of animals to farmers ▪ Provide irrigation schemes in the municipality ▪ Re-introduce aqua-culture in the municipality ▪ Introduce appropriate technologies such as dryers to farmers in the municipality ▪ Increase the ratio of agricultural extension agents to farmers. ▪ Increase access to credit to farmer-based organisations in the municipality ▪ Provide markets and storage facilities in the municipality ▪ Establish cassava processing and drying centres in all zonal councils ▪ Promote agro-based industries in the municipality ▪ Train unemployed youths annually in snail and mushroom production. ▪ Facilitate the establishment of mechanisation services provision centres, and machinery hire purchase and lease schemes with backup spare parts for all machinery and equipment. ▪ Develop human capacity in agricultural machinery management, operation and maintenance within the public and private sectors. ▪ Promote the accelerated development of feeder roads and rural infrastructure ▪ Develop trade in local and regional markets ▪ Improve market infrastructure and sanitary conditions ▪ Increase resilience to climate change impacts: through early warning systems ▪ Minimise climate change impacts on human health through improved access to healthcare ▪ Improve waste management mechanisms ▪ Promote energy efficiency in all aspects of social and economic life ▪ Encourage reforestation of degraded forest and off- reserve areas through the plantations development and afforestation programmes ▪ Encourage the use of lesser used species (LUS), particularly for the construction industry in the domestic market ▪ Carry out comprehensive wetlands inventory, supported by research and monitoring ▪ Educate the public on the outcome of improper disposal of waste ▪ Provide waste collection bins at suitable places in the communities, and empty these bins ▪ Regularly enforce all sanitation laws

Table A1-2 Development Goals of POCC of Ho Municipality (2)

Thematic Area	Infrastructure, Energy and Human Settlement
Key Focus Areas	▪ Transport Infrastructure ▪ Information Communication technology for Growth ▪ Recreation Infrastructure ▪ Energy supply to support industries and households ▪ Renewal energy ▪ Human Settlements Development ▪ Housing and Shelter ▪ Water and Environmental sanitation and hygiene
Objectives	▪ To expand the transport infrastructure into farming communities with emphasis on feeder roads and farm tracks. ▪ To promote the rapid development and deployment of the national ICT infrastructure ▪ To develop recreational facilities and promote cultural heritage and natural conservation in both urban and rural areas ▪ To ensure increased access of households and industries to efficient, reliable and adequate energy supply ▪ To promote the sustainable, spatially integrated and orderly development of human settlements for socio-economic development ▪ To promote well structured and integrated urban development ▪ To increase access to safe, adequate and affordable shelter ▪ To accelerate the provision of affordable and safe water ▪ To improve environmental Sanitation.
Policies	▪ Create and sustain an efficient transport system that meets user needs ▪ Promote the application of science, technology and innovation in all sectors of the economy ▪ Integrate land use, transport planning, development planning and service provision (science, technology and innovation to support productivity and development) ▪ Promote information communication technology development for growth ▪ Promote well structured and integrated urban development ▪ Increase access to safe, adequate and affordable shelter
Strategies	▪ Prioritise the maintenance of existing road infrastructure to reduce vehicle operating costs (VOC) and future and rehabilitation costs ▪ Implement Integrated Land use and spatial planning ▪ Promote science, technology and innovation development at all levels of production ▪ Decongest and reverse the decline in productivity of primary cities and selected fast growing settlements ▪ Promote urbanisation as a catalyst for economic growth, social improvement, and environmental sustainability ▪ Provide versatile spaces in urban areas for commercialisation ▪ Create land banks to ensure the availability of serviced lands for housing development at affordable prices ▪ Acquire and develop land/sites for the treatment and disposal of solid waste in major towns and cities

Source: Volta Region Coordinating Council

Table A1-3 POCC Analysis of MTDP of of Adaku-Anygbe District

Key Development Issues	Potentials	Opportunities	Constraints	Challenges
▪ Low access of women to land including irrigated land	▪ Existence of streams and rivers for irrigation	▪ Favourable government policy on agriculture and employment of women	▪ Inadequate dams ▪ Low rainfall pattern in the district ▪ Inadequate funds to construct dams/dug-outs	▪ Limited financial/credit institutions ▪ Harsh collateral requirements ▪ Poor rainfall pattern
▪ Credit support facilities for agricultural production	▪ Existence of financial institutions ▪ Existence of FBOs	▪ Favourable government policy ▪ Favourable interest rate	▪ Inadequate credit institutions ▪ Low loan recovery rate ▪ Misappropriation ▪ of loan facilities	▪ Hash collateral requirements ▪ Untimely release
▪ Low level of mechanisation due to limited availability and access to appropriate agricultural machinery, equipment and mechanised services ▪ High cost of agricultural machinery and equipment ▪ Inadequate technical know-how in agricultural mechanisation ▪ Inadequate post-production infrastructure	▪ Existence of district directorate of agriculture	▪ Govt. policy to establish tractor pool ▪ Availability of hire purchase facility at MoFA	▪ Absence of agriculture technology school ▪ Inadequate agricultural officers ▪ Non-availability of agriculture machinery service centres.	▪ Inadequate budgetary support from government
▪ Poor nature of roads to production centres ▪ Inadequate market information ▪ Limited marketing extension for producers, traders and exporters	▪ Existence of road network ▪ Existence of feeder roads ▪ Existence of internet services	▪ Access to Road Fund ▪ Donors (DANIDA, MCC) ▪ Existence of telecommunication networks	▪ Inadequate IT centres in the district ▪ Inadequate local resources	▪ Delay in release of funds for road construction and maintenance
▪ High incidence of poverty among farmers, especially food crop farmers	▪ Large tracts of farm-land ▪ Availability of market ▪ Cross- border trade	▪ Favourable government. ▪ policy on agriculture	▪ Small scale farming ▪ Difficulty in accessing credit for farming ▪ Labour intensive farming ▪ Rain-fed agriculture	▪ Inadequate funds for poverty reduction projects/programmes ▪ Delay in release of funds
▪ Poor management practices (feeding and health care) and low productivity ▪ Inadequate availability of quality feed ▪ Inability of local livestock farmers to match the stiff competition from cheap imports ▪ Low awareness of food safety lending to practices such as use of inappropriate handling, transportation of livestock/livestock products ▪ Poor quality of data and monitoring system	▪ Availability of agriculture extension services ▪ Organised livestock associations ▪ Large tract of grazing land	▪ Existence of animal research institutes ▪ Availability of livestock development projects	▪ Poor grazing land and supplementary feeding ▪ Culture of free range management system	▪ Inadequate agricultural extension staff ▪ Inadequate logistics for monitoring
Conclusion: Agriculture is the major economic activity in the district. To accelerate the modernisation of agriculture and agro-based industrial development, the district needs to make maximum use of the prevailing government policy on agriculture modernisation. In addition, the lakes and rivers can be used for effective irrigation farming.				
▪ Poor nature of roads	▪ Availability of skilled labour ▪ Availability of road network ▪ Existence of DFR	▪ Access to LSDGP and CBRDP	▪ Low internally generated funds	▪ Delay in release of govt. and donor funds ▪ Delay in the implementation of donor projects
▪ Increase in road traffic accidents ▪ Inadequate enforcement of road transport regulations	▪ DFR ▪ Existence of DVLA ▪ Existence of security agencies	▪ National campaign on road transport regulations	▪ Absence of road signs ▪ Heavy traffic on roads ▪ Narrow width of major roads	▪ Inadequate resources to enforce road regulation
Conclusion: The main issue under the thematic area is inadequate production infrastructure especially road and sanitation infrastructure, and the constraints and challenges of making adequate resources available for providing infrastructure in the district. Fortunately, the LSGDP is accessible at the district level and the existence of relevant institutions such as the DFR, town planning and environmental health in the district can facilitate improvement of production infrastructure in the district. The DA needs to provide resource town planning and the security agencies must strictly enforce the building regulations in the district.				

Source: Volta Region Coordinating Council

Table A1-4 Development Goals of POCC of Adaku-Anygbe District

Thematic Area	Agriculture Modernisation and Natural Resource Management
Objectives	▪ To reduce the risk associated with agriculture
Strategies	▪ Develop appropriate irrigation schemes, dams, boreholes and other water harvesting technologies for different categories of farmers ▪ Promote access to land by women ▪ Provide selective subsidies for the agricultural sector for the procurement of improved seeds, grade breeders and stock, pesticides and fertilisers ▪ Create awareness about environmental issues among all stakeholders and develop an effective and efficient framework for collaboration with appropriate agencies to ensure environmental compliance ▪ Improve incentives and compulsion measure to encourage users of the environment to adopt less exploitative and non-degrading practices in agriculture ▪ Promote joint planning and implementation of programmes with relevant institutions to address environmental issues in food and agriculture
Objectives	▪ To improve agriculture productivity
Strategies	▪ Develop human capacity in agricultural machinery management, operation and maintenance within the public and private sectors ▪ Promote the production and use of small-scale multi-purpose machinery along the value chain, including farm level storage facilities, appropriate agro-processing machinery/equipment and intermediate means of transport
Objectives	▪ To increase competitiveness and enhanced integration into domestic and international markets
Strategies	▪ Improve market infrastructure and sanitary conditions ▪ Promote the formation of viable farmer groups and FBOs to enhance their knowledge, skills and access to resources along the value chain, and to strengthen bargaining power in marketing ▪ Promote selected crops for food security, export and support to industry ▪ Promote the development of selected horticulture and exotic vegetables for export ▪ Promote small-holder productivity in the transition to large-scale production ▪ Extend the concept of nucleus out-grower and block farming schemes and contact farming to cover staple and horticulture crops to bridge the gap between large- and small-scale producers ▪ Promote the linkage of smallholder production to industry
Objectives	▪ To promote livestock and poultry development for food security and income
Strategies	▪ Improve access to quality feed ▪ Develop commercial poultry as the priority for improving meat supply ▪ Introduce measures to transform smallholder production into profitable enterprises ▪ Increase the awareness of food safety and public health ▪ Facilitate the development of livestock statistics and monitoring system ▪ Promote linkage relationships between animal and crop farmers to enhance bi-product utilisation
Thematic Area	**Infrastructure, Energy and Human Settlement**
Goal	▪ To improve rural access to productive infrastructure
Objectives	▪ To link 10 rural communities to major towns and market centres in the District
Strategies	▪ Construct 50 km of feeder roads ▪ Upgrade 25 km feeder roads ▪ Rehabilitate major roads in the district

Source: Volta Region Coordinating Council

Table A1-5 POCC Analysis of MTDP of North Tongu District

Key Development Issues	Potentials	Opportunities	Constraints	Challenges
Poor Road Network	▪ Existence of sector departments at the District Assembly; Department of Feeder Roads; Town and Country Planning Department. ▪ Availability of road construction materials e.g. stone and gravel. ▪ Willingness of communities to co-operate.	▪ Government of Ghana ▪ Road Fund. ▪ Donor grants.	▪ Inadequate monitoring and supervision. ▪ Inadequate maintenance ▪ Inadequate logistics for staff.	▪ Irregular flow of funds. ▪ No support from survey ▪ Department of Town and Country Planning Department.
Conclusion: Currently, there is many ways of improving the situation				
Key Development Issues	**Potentials**	**Opportunities**	**Constraints**	**Challenges**
Absence of Sustainable Industrial Sector to generate employment	▪ Vast land for large scale agro-business. ▪ Existing water bodies of the Volta River and its numerous tributaries, Alabo, Kolor, Aklakpa, Gblor and Nyivu for irrigation. ▪ DA support for access to two big market centres: Accra – Tema and Lome in Togo	▪ Government-supported Rural Enterprise Project ▪ NGOs, DANIDA, GTZ ▪ PSI for cassava and oil palm.	▪ Low level of entrepreneurial skills ▪ Inadequate access to credit facilities. ▪ Land litigation ▪ No plan defined for the district	▪ Poor road network ▪ Low level of energy supply (electricity and gas)
Conclusion: Currently, there are many ways of improving the situation				
Key Development Issues	**Potentials**	**Opportunities**	**Constraints**	**Challenges**
Deteriorating soil fertility	▪ Availability of cow dung ▪ Availability of chemical fertiliser retail shops ▪ Availability of agricultural information	▪ Existence of land and water management project ▪ Availability of the Soil Research Institute ▪ Existence of fertiliser importers	▪ Annual bushfires ▪ Continuous cropping ▪ Inappropriate cropping patterns ▪ Inappropriate land preparation operations	▪ Non-sustainability of land and water management project ▪ Inadequate release of funds ▪ High cost of fertilizer
Conclusion: Not available				
Key Development Issues	**Potentials**	**Opportunities**	**Constraints**	**Challenges**
Low prices for agricultural produce	▪ Emerging farmer group organisations ▪ Existence of Department of Cooperatives ▪ Availability of small-scale processors	▪ Existence of the President's initiative for cassava ▪ Existence of national consumers association ▪ Existence of Food Research Institute (FRI)	▪ No organised producers cooperatives ▪ Lack of farm-gate technology for storage of perishables ▪ Large numbers of farmers producing same commodity	▪ Ban on importation of some food commodities.
Conclusion: Not available				

Source: Volta Region Coordinating Council

Table A1-6 Objectives of POCC of North Tongu District

Thematic Area	Overall
Objectives	▪ To increase revenue mobilisation and management by 20% by 2013 ▪ To improve and increase the basic socio-economic infrastructure development by 10% by 2013 ▪ To increase and promote extension services and the use of improved seeds from 40% to 60% by 2013 ▪ To promote effective private sector participation in the development of the district ▪ To improve the logistics and human resource based in the district ▪ To enhance good governance by strengthening the administrative set-up of the Assembly and the sub-structures. ▪ To promote economic activities in the District especially for the vulnerable and the excluded.

Source: Volta Region Coordinating Council

Table A1-7 POCC Analysis of MTDP of Dangme West District

Key Development Issues	Potentials	Opportunities	Constraints	Challenges
Increase access to irrigation schemes and promote mechanised farming in the District	▪ Availability of land and water bodies for both small-scale and large-scale farming ▪ Availability of agriculture mechanisation centre to provide appropriate technology to farmers ▪ Availability of high yielding seedlings	▪ Closeness to Accra for marketing & export of produce ▪ Government support for non-traditional exports ▪ Availability of high-yielding seedlings ▪ MCA priority on agriculture transformation in the district and linkage to wider markets ▪ MCA support on the establishment of agro-processing industries in the district (including the construction of a pack house at Agomeda) ▪ Government intervention on the irrigation of 2,000 hectares of land for large-scale agriculture ▪ Available government support under the youth in agriculture programme	▪ Destruction of crops by cattle ▪ Unfavourable land tenure system	▪ Frequent bushfires ▪ The credit crunch and fear of limited funding in establishing agro-processing industries from partners ▪ Changing the mindset of farmers to see agriculture as a business ▪ High cost of agro-chemicals and irrigation infrastructure ▪ Drying up of rivers/ water bodies that feed the dams
Conclusion: Utilizing the potential of the district for large-scale agriculture by the constructing irrigation facilities and establishing agriculture mechanisation centre would change the mindset of farmers, increase their productive capacity and reduce the high cost of agro-chemicals.				

Source: Greater Accra Region Coordinating Council

Table A1-8 Development Goals of POCC of Dangme West District

Thematic Area	Agriculture Modernisation and Natural Resource Management
Objectives	▪ To increase access to irrigation schemes and promote mechanised farming in the District
Strategies	▪ Ensure equity and transparency in the distribution of irrigated land to avoid conflicts in the communities ▪ Protect dam walls from erosion by using appropriate measures e.g. Planting of vetiver grass, etc. ▪ Introduce appropriate fishing methods ▪ Encourage the formation of Water Users Associations to enhance the management of dam facilities and improve access to credit and other fund ▪ Encourage fencing of the dam to prevent livestock from getting into the dam ▪ Promote proper landscaping and slope protection measure to avoid siltation of dams that may lead to volume reduction ▪ Support the establishment of 2,000 hectares of irrigated land under the APGIP ▪ Facilitate the establishment of cold storage facilities in fishing communities ▪ Promote the use of both scientific and organic farming methods ▪ Collaborate with decentralised departments and agencies to train the youth in agriculture and other related services ▪ Organise farmers' workshops in four traditional areas ▪ Construct/rehabilitate 4 dams/dugouts in 4 communities ▪ Support the cultivation of traditional and non-traditional crops under the Youth in Agriculture Programme
Objectives	▪ To improve the knowledge of farmers on the use of high yielding seedlings and application of agro-chemicals
Strategies	▪ Promote improved management practices to maximise yield from introduced high-yielding crop varieties ▪ Develop marketing systems to motivate farmers to continue using high-yielding crops ▪ Ensure consumer preferences in the introduction of new varieties to ensure sustainability ▪ Promote appropriate strategies for bio-diversity conservation ▪ Train farmers and farmer-based groups in new technologies ▪ Provide logistics to and other incentives to Agriculture Extension Agents (AEAs) ▪ Support the eradication of pests and diseases ▪ Encourage the production of small ruminants ▪ Educate farmers on modern technologies and the importance and use of improved seedlings ▪ Provide demonstration farms in the District

Source: Greater Accra Region Coordinating Council

Table A1-9 POCC Analysis of MTDP of Dangme East District

Key Development Issues	Potentials	Opportunities	Constraints	Challenges
Poor irrigation facilities	▪ Availability of water from the Volta River. ▪ Availability of large tract of arable land ▪ Co-operation and support from Production Societies and the District Agricultural Directorate	▪ Presence of NGOs and Development Partners ▪ The willingness of Government to support agricultural development ▪ The availability of Agricultural Development Banks	▪ Poor farmer knowledge on the use of irrigation facilities ▪ Inadequate Co-operative Societies to access funds for irrigation ▪ Protracted conflicts between farmer-based organisations	▪ Inadequate funds ▪ Unwillingness of Banks to give loans to undertake agricultural projects due to the high risks involved
Conclusion: Agriculture in the district is mostly rain-fed with only a hand full of farmers having access to irrigational facilities. The District however has high potential for the provision of irrigation facilities due to the availability of water from the Volta River. Great effort is therefore needed to ensure that these potentials are adequately harnessed to enhance agricultural productivity in the District. There is also the need to foster synergy between farmer-based organisations and the Agricultural Directorate in order to ameliorate all agriculture related problems in the District.				
Key Development Issues	**Potentials**	**Opportunities**	**Constraints**	**Challenges**
Poor road network	▪ Presence of the Department of Feeder roads and High ways. ▪ Availability of the DACF and DDF ▪ Availability of road construction and maintenance materials at Tehey and other areas in the District ▪ Co-operation and support from rural communities notwithstanding the low level of income in rural communities ▪ Availability of skilled and unskilled labour for road construction ▪ The presence of reputable and experienced road contractors in the District	▪ Existence of Ghana Road Fund and the presence of Development Partners with interest in roads infrastructure	▪ Inadequate personnel and lack of road maintenance equipment ▪ Poor road designs and execution techniques by contractors ▪ Unfavourable weather conditions and delay in project execution due to inadequate participation and change of priorities ▪ Inadequate involvement of women in road projects ▪ Inadequate maintenance practices due to inadequate funds	▪ Inadequate funds ▪ Delay in the release of funds
Conclusion: Many of the roads in the District are feeder roads. It is extremely important to improve these roads in order to improve living conditions in the District. It is also expected that the existing potentials as well as an increase in the Road Fund by GoG will have a trickledown effect for improving roads in the District, because roads play a major role in the production, distribution and marketing of agricultural produce which form the bedrock of the economic activities of the people in the District.				

Source: Greater Accra Region Coordinating Council

Table A1-10 Development Goals of POCC of Dangme East District

Thematic Area	Agriculture Modernisation and Natural Resource Management
Objectives	▪ To improve agriculture productivity by 20% within the plan period
Strategies	▪ Construct irrigation facilities ▪ Encourage and support the formation of farmer-based organisations ▪ Accelerate agricultural mechanisation ▪ Facilitate the supply of agriculture inputs ▪ Recruit agricultural extension services ▪ Introduce modern practices into agricultural production ▪ Support the fishing industry ▪ Facilitate the introduction of block farming ▪ Introduce improved varieties in agriculture ▪ Develop appropriate methodologies for post-harvest handling ▪ Organise training and sensitisation workshops for farmers regularly ▪ Facilitate micro finance and small-scale loans to farmers ▪ Intensify disease surveillance and control for livestock

Source: Greater Accra Region Coordinating Council

Table A1-11 POCC Analysis of MTDP of Asuogyaman District

Key Development Issues	Potentials	Opportunities	Constraints	Challenges
Inadequate arable lands	▪ Availability of improved farming technologies, e.g., the application of fertiliser ▪ Presence of vast savannah lands for livestock farming	▪ GoG programme to promote selected crop development for food security, export and to support industry ▪ GoG's bid to promote Livestock and poultry development for food security and income	▪ Low income and poverty ▪ Weak revenue base ▪ Inadequate technical know-how in modern methods of farming	▪ High cost of inputs for modern methods of farming ▪ Uncoordinated training programmes for rural farmers
Conclusion: More farmers should be encouraged to undertake livestock farming on a large and productive scale. This would help reduce the pressure on the available arable land, and could be undertaken with the help of effective veterinary service provision. Moreover, with the application of fertiliser and other improved cultural practices, farmers can improve the output per acre of the limited arable lands available.				
Key Development Issues	**Potentials**	**Opportunities**	**Constraints**	**Challenges**
Low agricultural productivity	▪ The presence of Lake Volta for irrigation ▪ The presence of FBO in the district	▪ GoG support to develop appropriate irrigation schemes, dams, boreholes, and other water harvesting techniques for different categories of farmers and ecological zones	▪ Inadequate technical know-how in irrigation farming. ▪ Low income levels of rural farmers.	▪ Weak irrigation infrastructure
Conclusion: The presence of Lake Volta lake in the district and government support for subsistence food crop farmers through irrigation programmes will reduce the overreliance on rainfall for crop production.				
Key Development Issues	**Potentials**	**Opportunities**	**Constraints**	**Challenges**
Poor road surface condition and network	▪ Interest of DA and VRA in road and utility services development ▪ Support from DANIDA and NGOs	▪ Presence of ministry of roads and highways ▪ Presence of GHA	▪ Poor maintenance ▪ High cost of road construction and repairs	▪ Delays in the release of funding by the GoG and other donor agencies
Conclusion: The poor condition of the road surface and network can be addressed by harnessing the opportunities and potentials in the district. The constraints can be addressed by ensuring a proper maintenance culture. The challenges can be managed by ensuring the timely release of funds.				

Source: Eastern Region Coordinating Council

Table A1-12 Objectives of POCC of Asuogyaman District

Thematic Area	Agriculture Modernisation and Natural Resource Management
Issues	▪ Low agricultural productivity
Objectives	▪ To increase agriculture output on available arable land by 60% by the end of the planned period
Strategies	▪ Introduce farmers to modern methods of farming ▪ Encourage farmers to go into productive livestock farming ▪ Provide farmers with micro finance support
Activities	▪ Organize bi-annual training workshops for farmers on mechanised and productive methods of farming (e.g. application of fertilisers) ▪ Provide subsidised viable seeds, seedlings and other inputs to farmers ▪ Organise annual training workshops for livestock farmers ▪ Provide subsidised feeds and other inputs for large scale livestock farmers ▪ Construct cattle ponds ▪ Form FBOs to access credit facilities ▪ Conduct 162 field days for farmer beneficiaries in improved maize, cassava, plantain ▪ Carry out 51 demonstrations of crop production

Source: Eastern Region Coordinating Council

Table A1-13 POCC Analysis of MTDP of Lower Manya Krobo District

Key Development Issues	Potentials	Opportunities	Constraints	Challenges
Increased agricultural productivity	▪ Adequate number of extension services ▪ Availability of agro-chemical shops ▪ The nearness to Accra making the district a good place for poultry and vegetable farming ▪ A double rainfall season ▪ Support by District Assembly ▪ Availability of Lake Volta for fishing and irrigation	▪ Readiness of financial institutions to give credit to farmer groups ▪ Various GoG credit schemes for farmers ▪ Support from NGOs and other international partners ▪ Availability of high yielding planting materials and disease resistant breeds of livestock.	▪ Inability & refusal of many farmers to repay loans ▪ Misappropriation of agro-chemicals ▪ Resistance to modern techniques by some farmers ▪ Low adaptability of farmers to innovation ▪ Over-reliance on rain-fed agriculture ▪ Inadequate storage facilities resulting in post-harvest losses ▪ Continuous use of local planting materials ▪ Low farmer-extension-officer ratio ▪ Use of unauthorised nets and chemicals for fishing	▪ Pest attacks ▪ Low prices for agricultural produce ▪ Flooding of the market with cheaper goods from abroad ▪ Politicisation of GoG interventions
Conclusion: Not available				
Improved layout of the towns in the district	▪ Existence of Town and Country Planning Department ▪ Existence of Statutory Planning Committee ▪ Existence of by-laws	▪ Existence of national laws to ensure compliance by developers ▪ Integration of environmental department in local government ▪ Continuous capacity building of technical staff by MLG&RD	▪ Unfavourable land tenure system ▪ Undue pressure put on the Town and Country Planning Department ▪ Uncooperative attitude of land owners ▪ Financial constraints on the part of the District Assembly	▪ Shifting of the department of Town and Country Planning from one ministry to another ▪ Non-existence of environmental protection office at the district level
Conclusion: Not available				

Source: Eastern Region Coordinating Council

Table A1-14 Development Goals of PCCC of Lower Manya Krobo District

Thematic Area	Agriculture Modernisation and Natural Resource Management
Objectives	▪ To enhance access to improved technologies and credit facilities to ensure food security and annual income
Strategies	▪ Improve farmers' access to modern technology and financial resources for inputs. ▪ Reduce post-harvest crop losses ▪ Apply appropriate agricultural research and technology to introduce economies of scale in agricultural production ▪ Improve the effectiveness of Research-Extension farmer-Linkages ▪ Intensify the use of ICT and media to disseminate agricultural information to farmer ▪ Raise awareness about environmental issues ▪ Facilitate the training of out-grower farmers ▪ Improve and diversify livelihood opportunities for men and women in the post-harvest fishing sector
Objectives	▪ To increase farmer competitiveness and enhance integration into domestic and international markets.
Strategies	▪ Develop institutional capacity and sustainable programmes for non-export farmers
Objectives	▪ To improve institutional Co-ordination and stakeholder engagement in agricultural activities in the district
Strategies	▪ Develop and implement a communication strategy to improve supervision and inter–sectorial coordination. ▪ Raise farmer motivation
Objectives	▪ To process and add value to agricultural produce
Strategies	▪ Promote the establishment of agro-based industries to process agricultural produce
Thematic Area	**Infrastructure, Energy, and Human Settlement Development**
Objectives	▪ To improve the general condition of 40% of the existing road network by December 2013
Strategies	▪ Perform routine maintenance ▪ Construct and upgrade the road network
Objectives	▪ To reduce vehicular congestion and traffic offences on the main Atua–Kpong road
Strategies	▪ Enforce road traffic regulations ▪ Hold education campaign ▪ Improve the professionalism of the drivers

Source: Eastern Region Coordinating Council

Table A1-15 POCC Analysis of MTDP of Yilo Krobo District

Key Development Issues	Potentials	Opportunities	Constraints	Challenges
Poor development of tourism sector	▪ Electricity ▪ Natural land marks ▪ Land ▪ Common Fund	▪ Tourists ▪ Private sector investment	▪ Land litigations ▪ Lack of access roads	▪ Similar potentials nearby
Conclusion: Poor development of the tourism sector can be addressed since significant potentials and opportunities exist. The constraints can be addressed through developing synergies in programme design. The challenge can be managed through effective marketing of the sites.				
Low production	▪ Availability of land. ▪ Availability of labour and raw materials. ▪ MOFA ▪ Rains/rivers/streams/boreholes	▪ NGOs ▪ MCA ▪ MoFA	▪ Difficulty in acquiring land acquisition. ▪ High rent on land. ▪ High cost of labour. ▪ Land litigation.	▪ High interest rates ▪ Collateral ▪ High cost of inputs ▪ Irregular rainfall
Conclusion: Significant potentials and opportunities exist to address the issue of low production. The constraints can be dealt with through developing synergies in programme design. The challenges can be managed through dialogue with banks.				
Inadequate/poor market infrastructure.	▪ DACF ▪ Land for extension. ▪ Market Associations ▪ Goods ▪ Technical support	▪ NGOs	▪ Difficulty in acquiring land. ▪ Inadequate documentation on land. ▪ Land litigation	▪ High cost of building markets.
Conclusion: Significant potentials and opportunities exist to help address the issue of inadequate/poor market infrastructure. The constraints can be addressed through developing synergies in programme design. The challenge can be managed through securing more funds.				
Inadequate/poor nature of roads	▪ Gravels and chippings ▪ Availability of Common Fund ▪ Labour	▪ Road Fund ▪ NGOs ▪ DANIDA	▪ Rocky and hilly terrain ▪ Numerous streams	▪ High cost of construction/maintenance ▪ Delay in the release of funds
Conclusion: Significant potentials and opportunities exist to address the issue of inadequate/poor nature of roads. The constraints can be surmounted through developing synergies in programme design. The challenges can be managed through dialogue with Development Partners				

Source: Eastern Region Coordinating Council

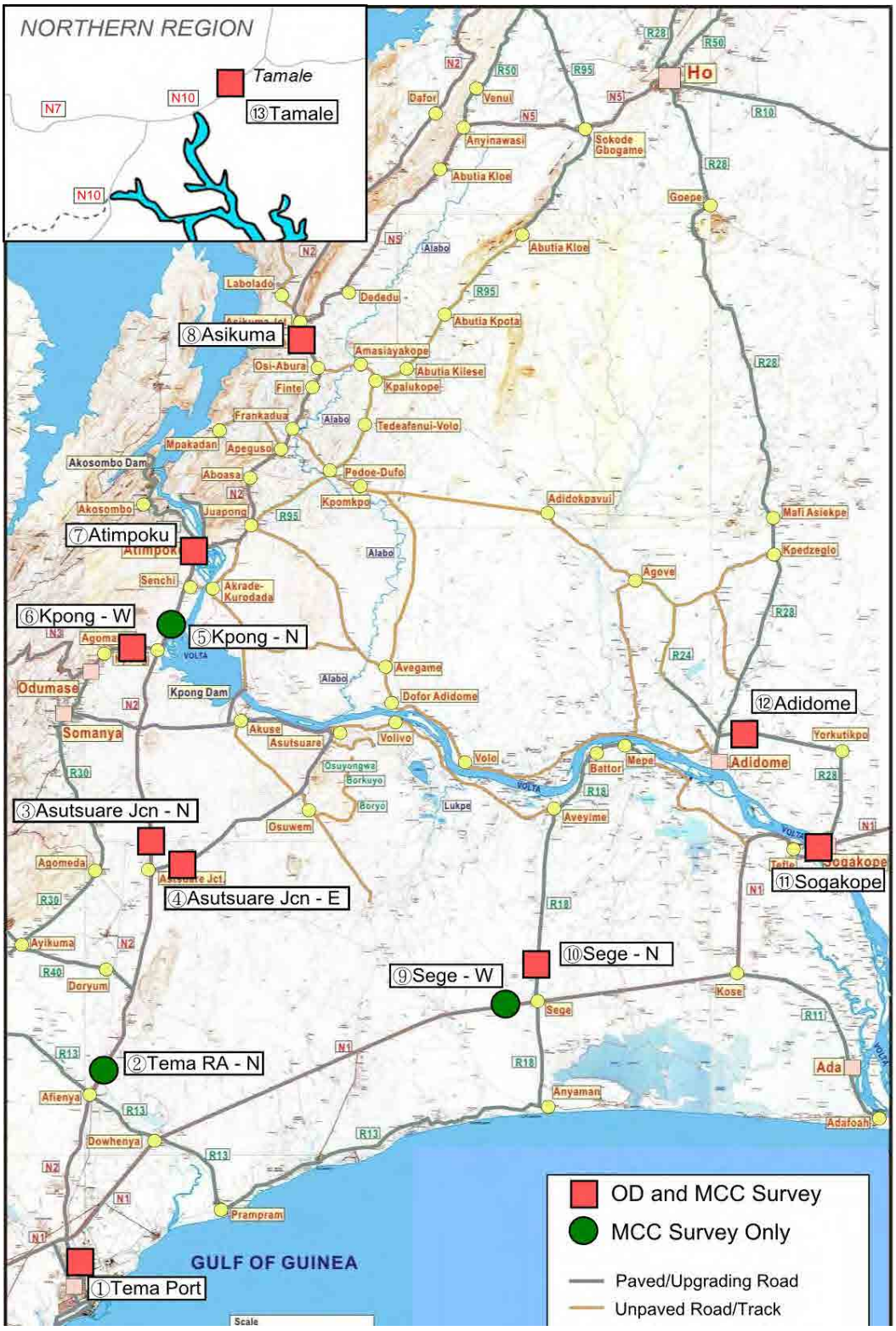
Table A1-16 Development Goals of POCC of Lower Yilo Krobo District

Thematic Area	Agriculture Modernisation and Natural Resource Management
Goals	▪ To increase production and reduce post-harvest losses.
Objectives	▪ To increase agricultural production in the district by 5% by 2013 ▪ To increase access to market for agricultural and industrial products ▪ To protect and conserve forest resources
Strategies	▪ Construct 20 wells for irrigation ▪ Train farmers in the use of appropriate storage facilities, post-harvest handling and proper harvesting methods. ▪ Provide storage and small agro- processing facilities ▪ Provide incentives to extension service workers ▪ Facilitate the recruitment of extension workers ▪ Promote environmentally sustainable cropping practices ▪ Promote irrigated vegetable cultivation, cultivation of sugar cane and cassava, the rearing of grass-cutters and rabbits, beekeeping and fish farming. ▪ Control local animal diseases ▪ Conduct training in fish farming ▪ Provide credit facilities to farmers ▪ Encourage farmers to form co-operatives ▪ Disseminate market information to farmers ▪ Organise agricultural fairs ▪ Embark on reafforestation exercises along Ponpon River upstream/forest reserves ▪ Improve market infrastructure in 5 communities
Thematic Area	**Infrastructure, Energy and Human Settlements Development**
Goals	▪ To improve road infrastructure
Objectives	▪ To enhance accessibility (road) in the District
Strategies	▪ Provide electricity to 30 communities ▪ Construct and maintain 200km of feeder roads ▪ Extend telecommunication/internet services to 20 communities ▪ Enforce building regulations ▪ Create land banks. ▪ Conduct educational campaigns on safe sanitation practices ▪ Promote and support the construction of 100 household toilets ▪ Construct 3 public toilets and 20 institutional latrines ▪ Convert 4 public pan latrines into cesspit tank latrines in collaboration with the private sector ▪ Provide and place 70 refuse containers at designated points ▪ Embark on house-to-house refuse collection at selected areas in Somanya ▪ Enact sanitation by-laws to ensure proper management of household-level liquid waste ▪ Enforce laws on the provision of sanitation facilities and other infrastructure by developers ▪ Construct 50 boreholes ▪ Rehabilitate 30 hand-dug wells ▪ Rehabilitate the Somanya pipe system ▪ Coordinate the activities of all water providers in the district ▪ Encourage communities to participate in the provision and maintenance of potable water facilities

Source: Eastern Region Coordinating Council

Appendix 2 Results of Cross Sectional Traffic Volume Counting Survey

Appendix 2-1 Location of MCC Stations



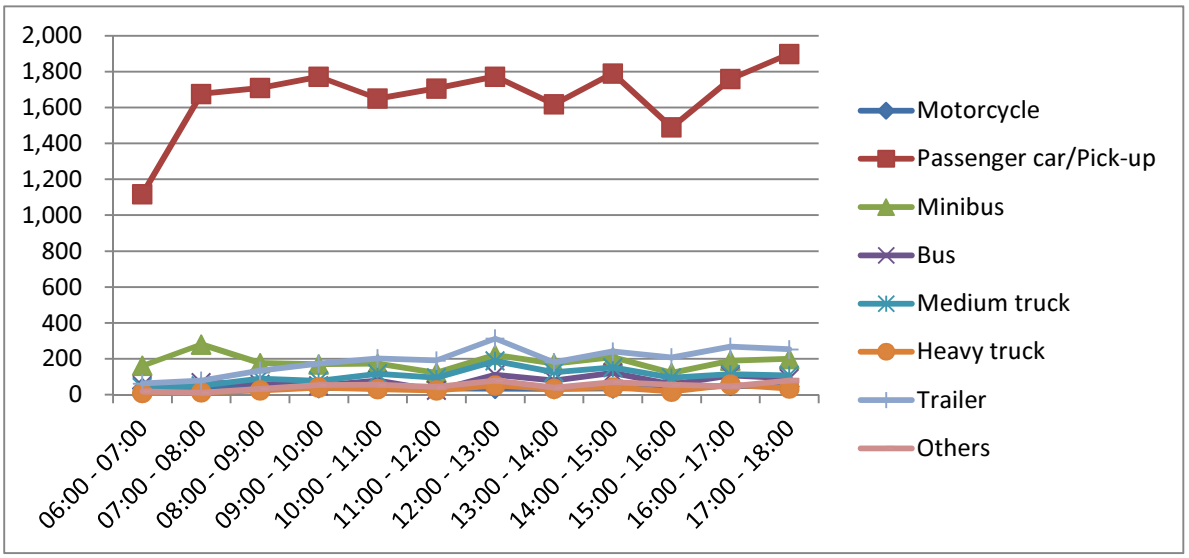
Appendix 2-2 Results of MCC at Station No. 1

Station Number : 1
Station Name : Tema Port
Road : Harbour Road
Day-Night Ratio : 1.528
Weekly Fluctuation : 0.8
Monthly Fluctuation : 1.2
Commercial Vehicle Ratio : 15.1%

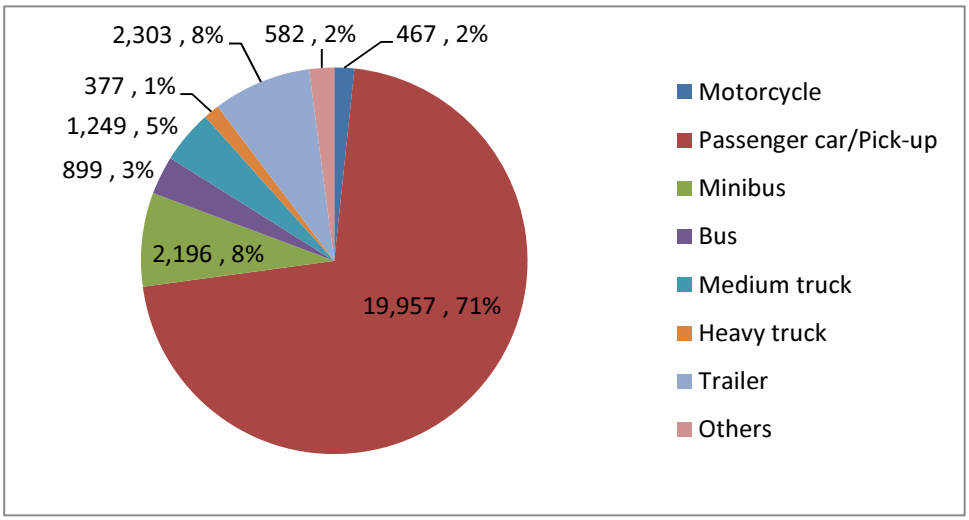
Observed Traffic and ADT

No.	VEHICLE TYPE	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TOTAL	24-hour Volume	ADT
1	Passenger car	1,118	1,676	1,709	1,771	1,650	1,706	1,772	1,618	1,790	1,490	1,759	1,898	19,957	30,494	31,765
2	Minibus	161	280	176	169	173	122	222	173	209	121	190	200	2,196	3,355	3,495
3	Bus	51	68	59	50	79	24	111	79	122	58	107	91	899	1,374	1,431
4	Medium truck	41	50	90	77	117	94	188	125	151	94	114	108	1,249	1,908	1,988
5	Heavy truck	10	13	24	40	31	24	52	33	41	18	56	35	377	576	600
6	Trailer	62	78	134	173	202	191	313	181	241	208	267	253	2,303	3,519	3,666
7	Others	19	11	33	54	55	43	78	39	70	55	46	79	582	889	926
TOTAL		1,462	2,176	2,225	2,334	2,307	2,204	2,736	2,248	2,624	2,044	2,539	2,664	27,563	42,115	43,870

Hourly Fluctuation



Vehicle Composition



Station Number	:	2
Station	:	Tema Roundabout North
Road	:	N2
Day-Night Ratio	:	1.446
Weekly Fluctuation	:	0.8
Monthly Fluctuation	:	1.2
Commercial Vehicle Ratio	:	5.4%

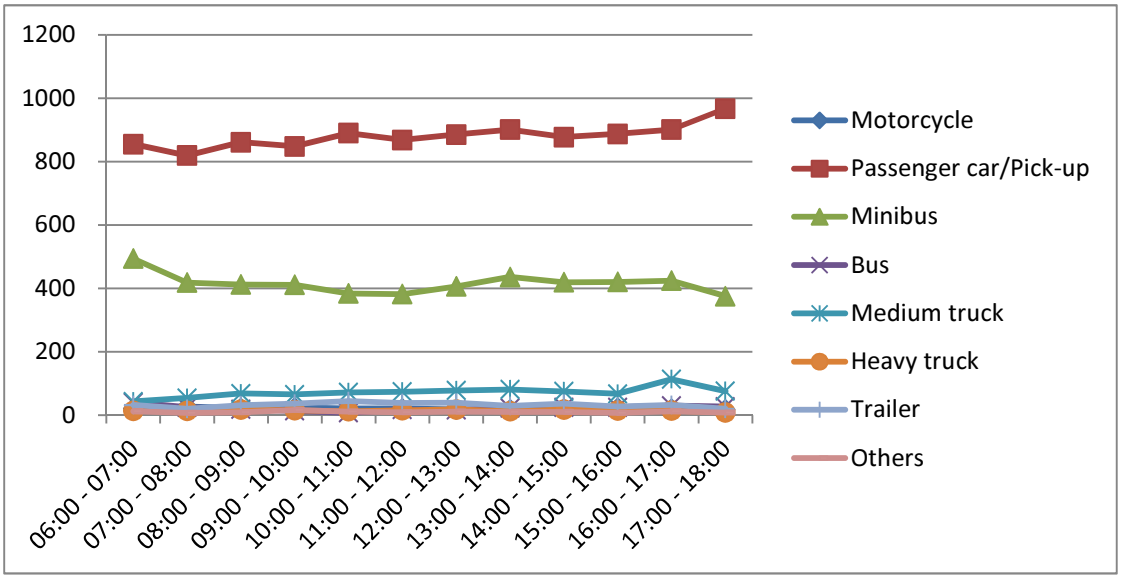
Appendix 2-3 Results of MCC at Station No. 2

Station Number : 2
Station : Tema Roundabout North
Road : N2
Day-Night Ratio : 1.446
Weekly Fluctuation : 0.8
Monthly Fluctuation : 1.2
Commercial Vehicle Ratio : 5.4%

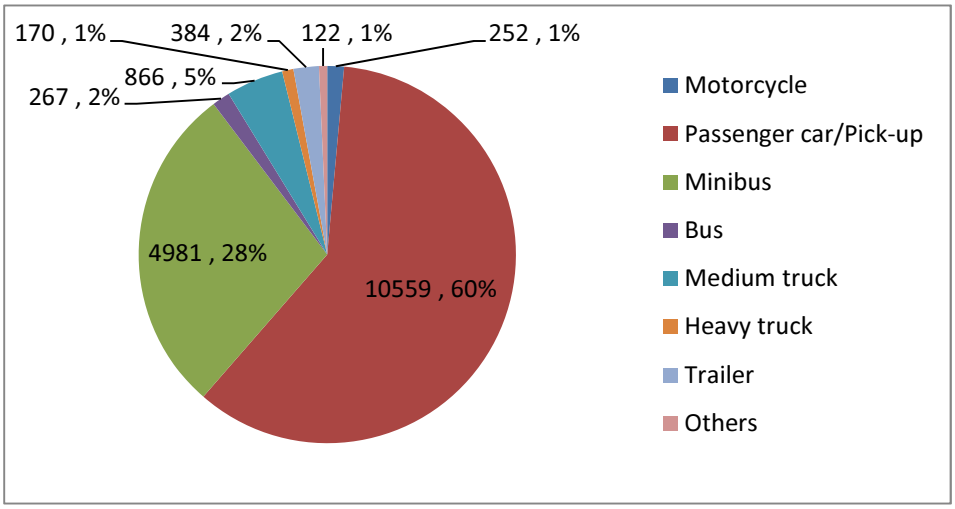
Observed Traffic and ADT

No.	VEHICLE TYPE	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TOTAL	24-hour Volume	ADT
1	Passenger car	855	819	861	848	890	868	885	901	877	887	901	967	10,559	15,268	15,904
2	Minibus	494	418	412	411	384	382	406	436	419	420	424	375	4,981	7,203	7,503
3	Bus	40	25	19	13	7	17	16	23	25	25	30	27	267	386	402
4	Medium truck	43	54	68	65	72	74	78	81	75	67	113	76	866	1,252	1,304
5	Heavy truck	13	13	18	15	12	15	18	12	18	14	14	8	170	246	256
6	Trailer	32	20	31	36	44	38	39	29	36	27	32	20	384	555	578
7	Others	12	7	9	16	11	9	11	10	10	7	12	8	122	176	183
TOTAL		1,489	1,356	1,418	1,404	1,420	1,403	1,453	1,492	1,460	1,447	1,526	1,481	17,349	25,086	26,131

Hourly Fluctuation



Vehicle Composition



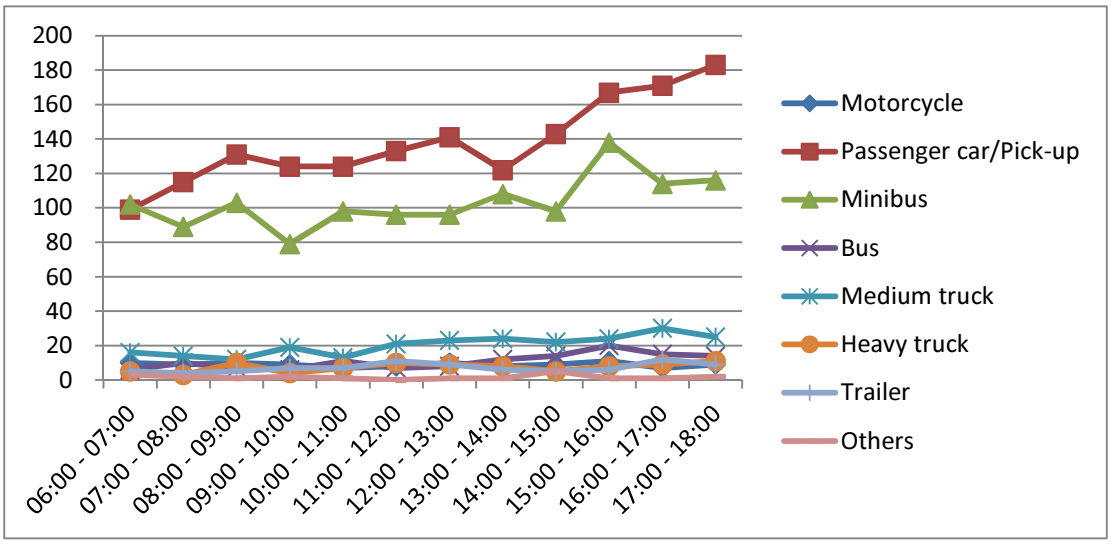
Appendix 2-4 Results of MCC at Station No. 3

Station Number : 3
Station : Asutsuare Jct. North
Road : N2
Day-Night Ratio : 1.446
Weekly Fluctuation : 1.05
Monthly Fluctuation : 1.2
Commercial Vehicle Ratio : 9.4%

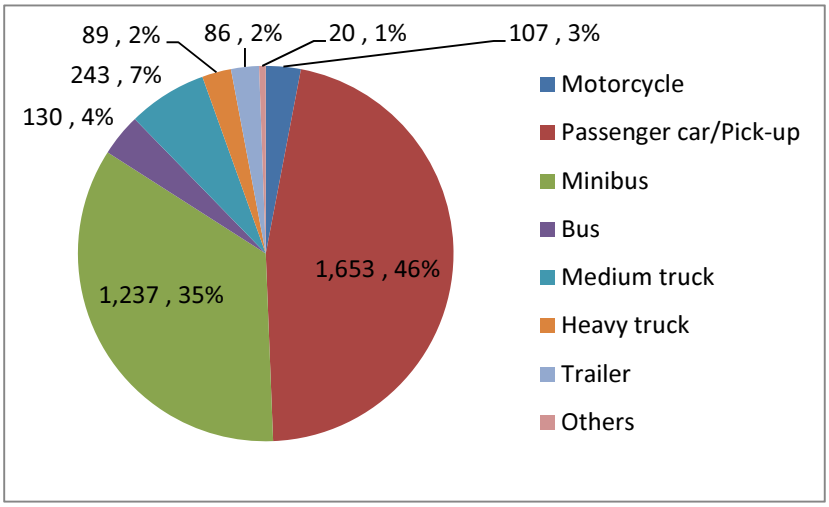
Observed Traffic and ADT

No.	VEHICLE TYPE	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TOTAL	24-hour Volume	ADT
1	Passenger car	99	115	131	124	124	133	141	122	143	167	171	183	1,653	2,390	1,897
2	Minibus	102	89	103	79	98	96	96	108	98	138	114	116	1,237	1,789	1,420
3	Bus	6	10	7	6	11	7	8	12	14	20	15	14	130	188	149
4	Medium truck	16	14	12	19	13	21	23	24	22	24	30	25	243	351	279
5	Heavy truck	5	3	10	4	7	10	9	8	5	8	9	11	89	129	102
6	Trailer	5	4	5	7	7	11	9	6	5	6	12	9	86	124	98
7	Others	3	2	1	2	1	0	1	1	5	1	1	2	20	29	23
TOTAL		236	237	269	241	261	278	287	281	292	364	352	360	3,458	5,000	3,968

Hourly Fluctuation



Vehicle Composition



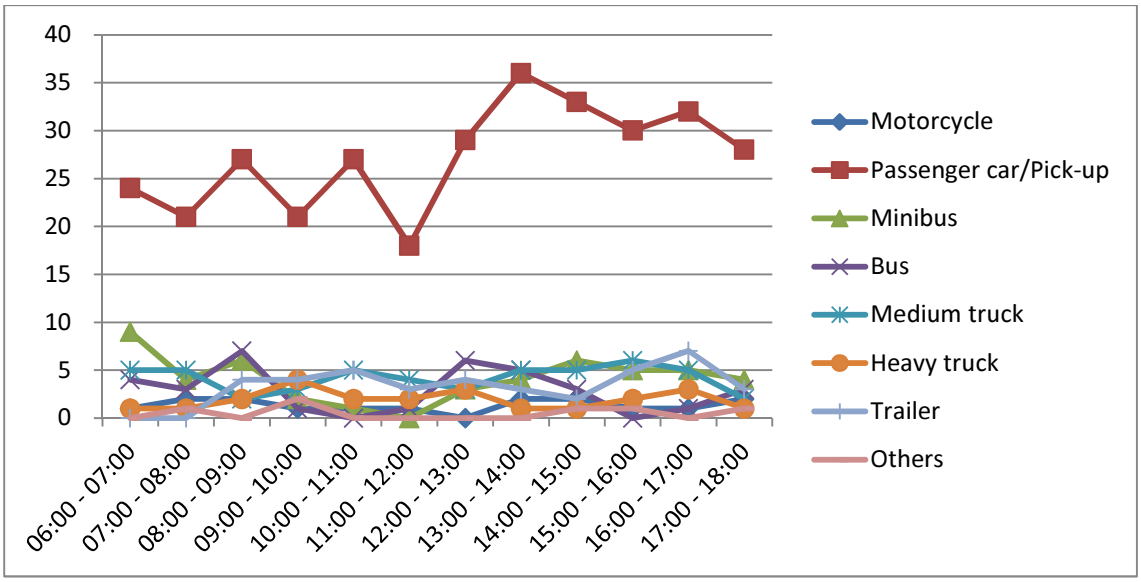
Appendix 2-5 Results of MCC at Station No. 4

Station Number : 4
Station : Asutsuare Jct. East
Road : Asutsuare Jct. – Asutsuare
Day-Night Ratio : 1.446
Weekly Fluctuation : 1.05
Monthly Fluctuation : 1.2
Commercial Vehicle Ratio : 19.5%

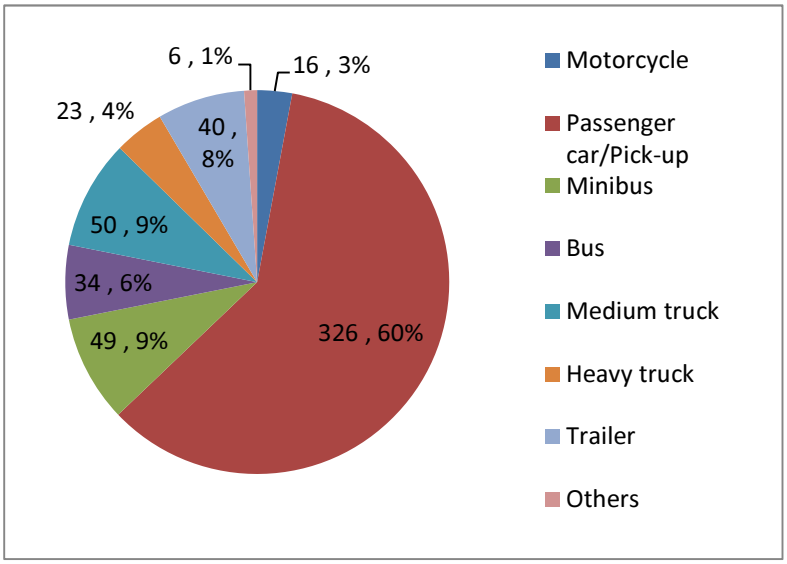
Observed Traffic and ADT

No.	VEHICLE TYPE	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TOTAL	24-hour Volume	ADT
1	Passenger car	24	21	27	21	27	18	29	36	33	30	32	28	326	471	374
2	Minibus	9	4	6	2	1	0	3	4	6	5	5	4	49	71	56
3	Bus	4	3	7	1	0	1	6	5	3	0	1	3	34	49	39
4	Medium truck	5	5	2	3	5	4	3	5	5	6	5	2	50	72	57
5	Heavy truck	1	1	2	4	2	2	3	1	1	2	3	1	23	33	26
6	Trailer	0	0	4	4	5	3	4	3	2	5	7	3	40	58	46
7	Others	0	1	0	2	0	0	0	0	1	1	0	1	6	9	7
TOTAL		43	35	48	37	40	28	48	54	51	49	53	42	528	763	606

Hourly Fluctuation



Vehicle Composition



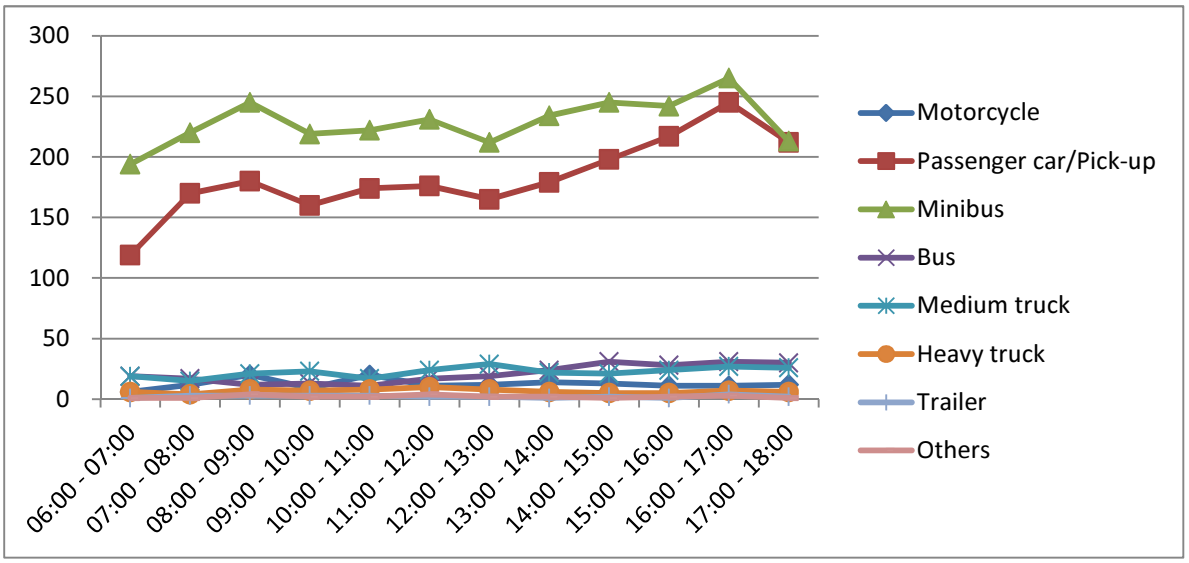
Appendix 2-6 Results of MCC at Station No. 5

Station Number : 5
Station : Kpong North
Road : N2
Day-Night Ratio : 1.446
Weekly Fluctuation : 1.05
Monthly Fluctuation : 1.2
Commercial Vehicle Ratio : 6.9%

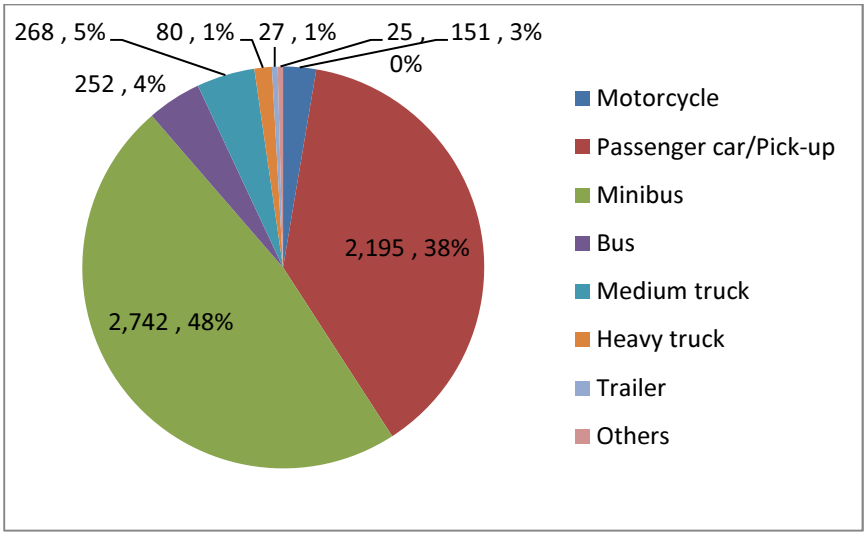
Observed Traffic and ADT

No.	VEHICLE TYPE	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TOTAL	24-hour Volume	ADT
1	Passenger car	119	170	180	160	174	176	165	179	198	217	245	212	2,195	3,174	2,519
2	Minibus	194	220	245	219	222	231	212	234	245	242	265	213	2,742	3,965	3,147
3	Bus	19	17	12	13	11	17	19	24	31	28	31	30	252	364	289
4	Medium truck	19	15	21	23	17	24	29	22	21	24	27	26	268	388	308
5	Heavy truck	6	4	8	7	8	10	8	6	5	5	7	6	80	116	92
6	Trailer	1	3	3	3	3	2	2	1	2	1	4	2	27	39	31
7	Others	1	1	4	2	2	4	2	2	1	2	3	1	25	36	29
TOTAL		359	430	473	427	437	464	437	468	503	519	582	490	5,589	8,082	6,414

Hourly Fluctuation



Vehicle Composition



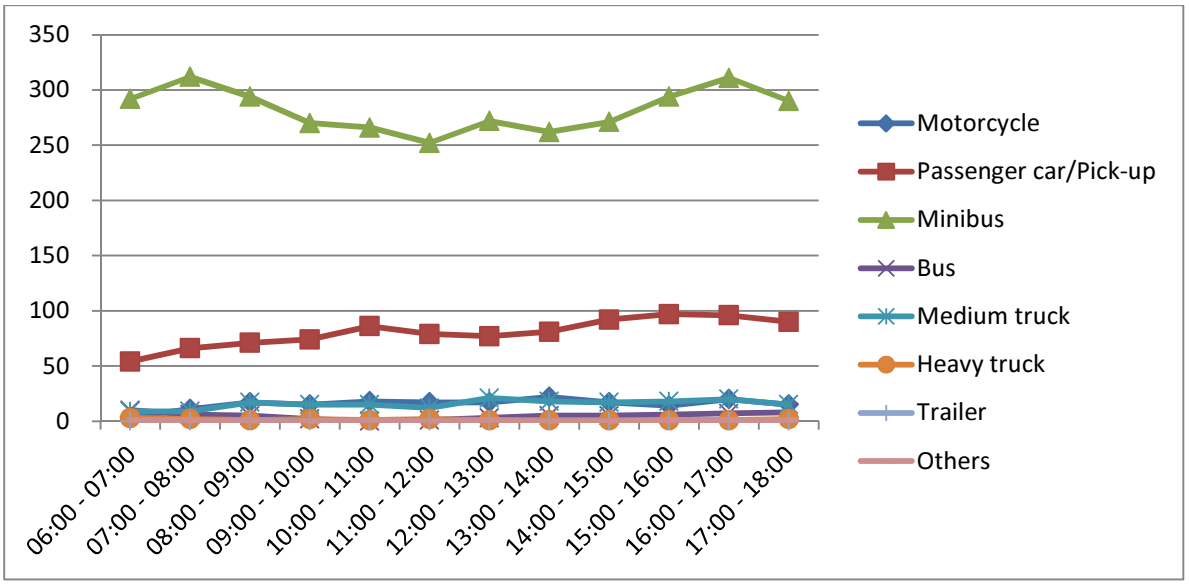
Appendix 2-7 Results of MCC at Station No. 6

Station Number : 6
Station : Kpong West
Road : N3
Day-Night Ratio : 1.446
Weekly Fluctuation : 1.05
Monthly Fluctuation : 1.2
Commercial Vehicle Ratio : 1.8%

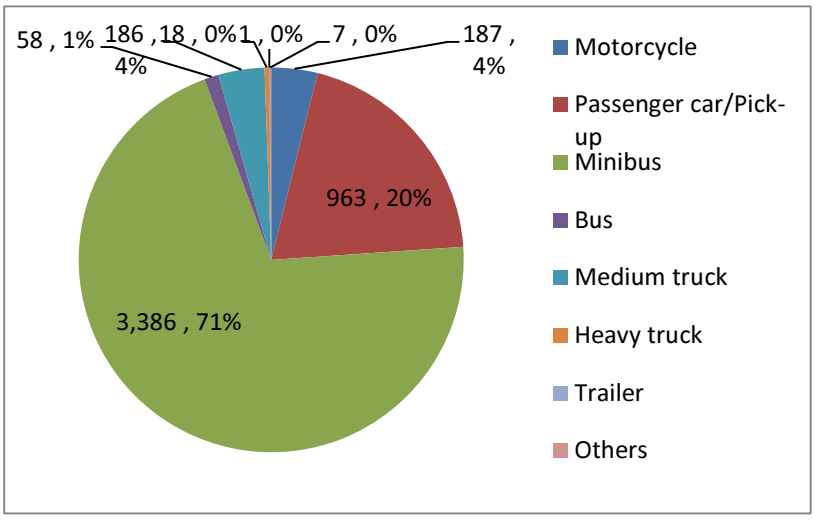
Observed Traffic and ADT

No.	VEHICLE TYPE	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TOTAL	24-hour Volume	ADT
1	Passenger car	54	66	71	74	86	79	77	81	92	97	96	90	963	1,392	1,105
2	Minibus	292	312	294	270	266	252	272	262	271	294	311	290	3,386	4,896	3,886
3	Bus	10	6	5	2	0	1	3	5	5	6	7	8	58	84	67
4	Medium truck	9	9	17	15	15	12	21	18	17	18	20	15	186	269	213
5	Heavy truck	3	2	1	2	1	2	1	1	1	1	1	2	18	26	21
6	Trailer	0	0	1	0	0	0	0	0	0	0	0	0	1	1	1
7	Others	1	1	0	0	1	0	1	0	0	1	1	1	7	10	8
TOTAL		369	396	389	363	369	346	375	367	386	417	436	406	4,619	6,678	5,300

Hourly Fluctuation



Vehicle Composition



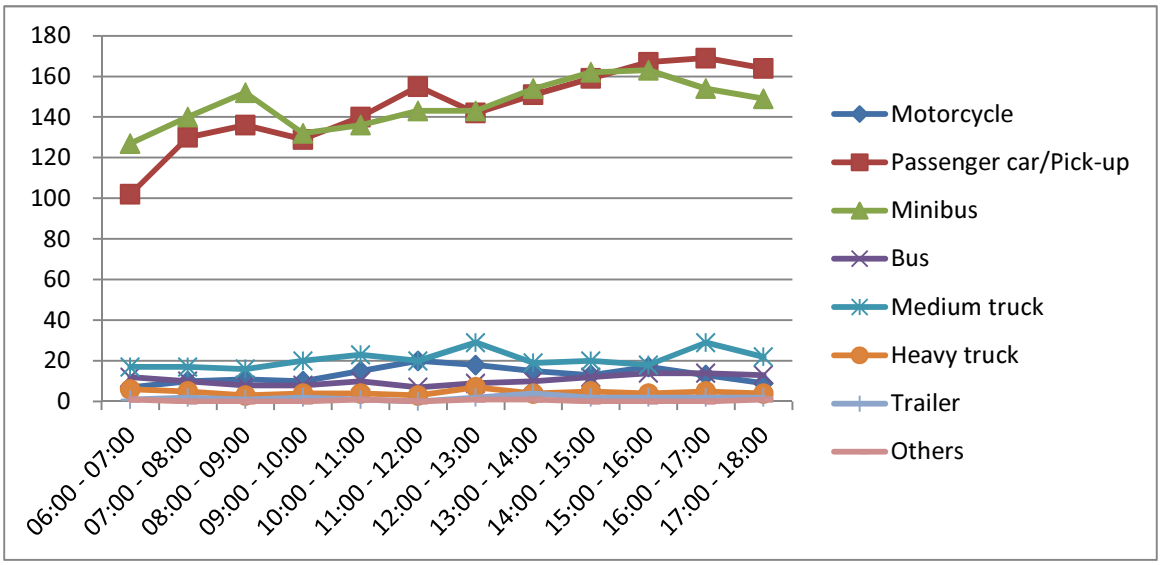
Appendix 2-8 Results of MCC at Station No. 7

Station Number : 7
Station : Atimpoku
Road : N2
Day-Night Ratio : 1.446
Weekly Fluctuation : 1.05
Monthly Fluctuation : 1.2
Commercial Vehicle Ratio : 5.2%

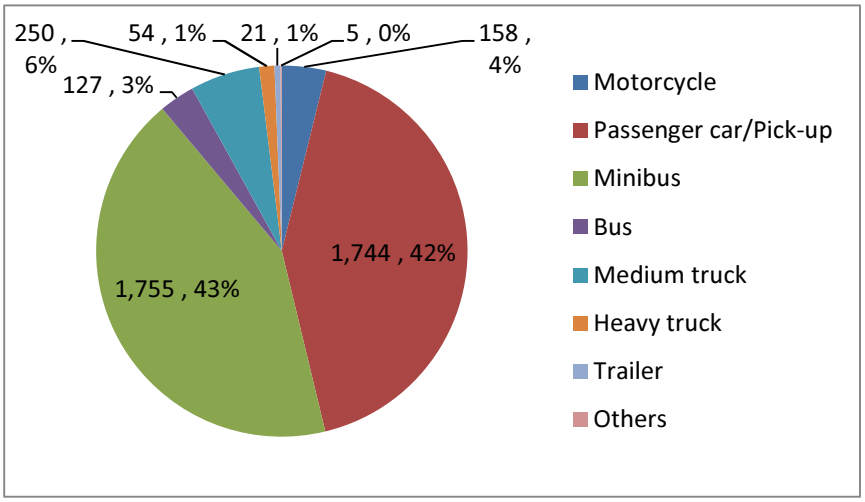
Observed Traffic and ADT

No.	VEHICLE TYPE	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TOTAL	24-hour Volume	ADT
1	Passenger car	102	130	136	129	140	155	142	151	159	167	169	164	1,744	2,522	2,002
2	Minibus	127	140	152	132	136	143	143	154	162	163	154	149	1,755	2,538	2,014
3	Bus	12	10	8	8	10	7	9	10	12	14	14	13	127	184	146
4	Medium truck	17	17	16	20	23	20	29	19	20	18	29	22	250	362	287
5	Heavy truck	6	5	3	4	4	3	7	4	5	4	5	4	54	78	62
6	Trailer	1	2	1	2	1	0	2	4	2	2	2	2	21	30	24
7	Others	1	0	0	0	1	0	1	1	0	0	0	1	5	7	6
TOTAL		266	304	316	295	315	328	333	343	360	368	373	355	3,956	5,721	4,540

Hourly Fluctuation



Vehicle Composition



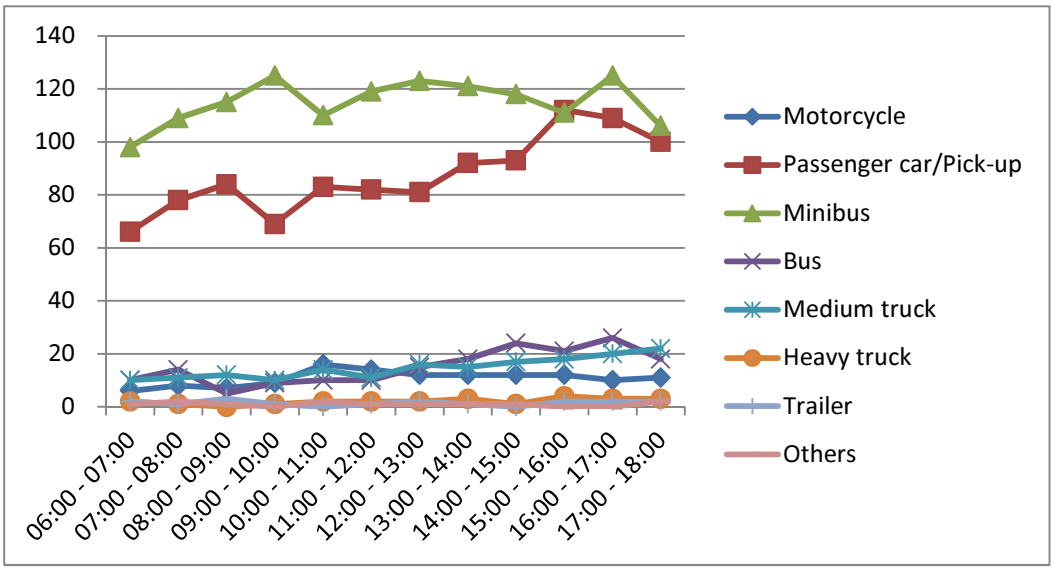
Appendix 2-9 Results of MCC at Station No. 8

Station Number : 8
Station : Asikuma
Road : N2
Day-Night Ratio : 1.446
Weekly Fluctuation : 1.05
Monthly Fluctuation : 1.2
Commercial Vehicle Ratio : 8.2%

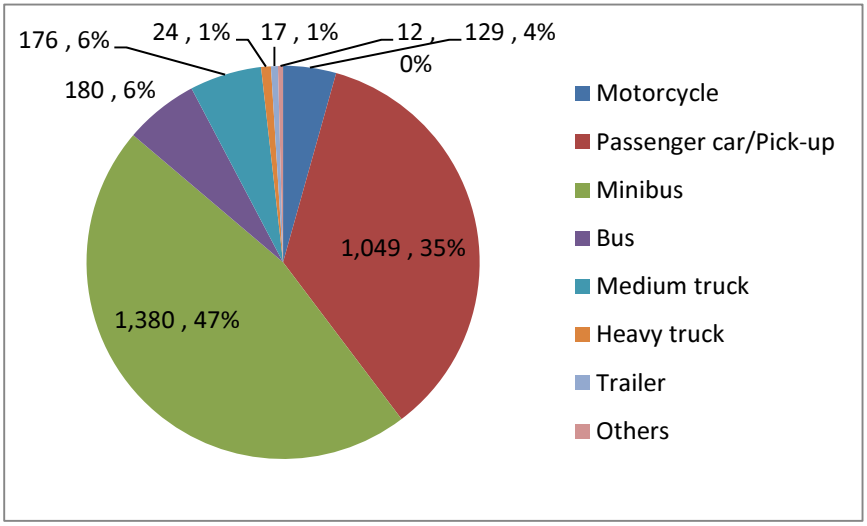
Observed Traffic and ADT

No.	VEHICLE TYPE	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TOTAL	24-hour Volume	ADT
1	Passenger car	66	78	84	69	83	82	81	92	93	112	109	100	1,049	1,517	1,204
2	Minibus	98	109	115	125	110	119	123	121	118	111	125	106	1,380	1,995	1,583
3	Bus	10	14	5	9	10	10	15	18	24	21	26	18	180	260	206
4	Medium truck	10	11	12	10	14	11	16	15	17	18	20	22	176	254	202
5	Heavy truck	2	1	0	1	2	2	2	3	1	4	3	3	24	35	28
6	Trailer	2	1	3	1	0	1	2	1	0	2	2	2	17	25	20
7	Others	1	2	1	0	2	1	1	1	1	0	0	2	12	17	13
TOTAL		189	216	220	215	221	226	240	251	254	268	285	253	2,838	4,103	3,256

Hourly Fluctuation



Vehicle Composition



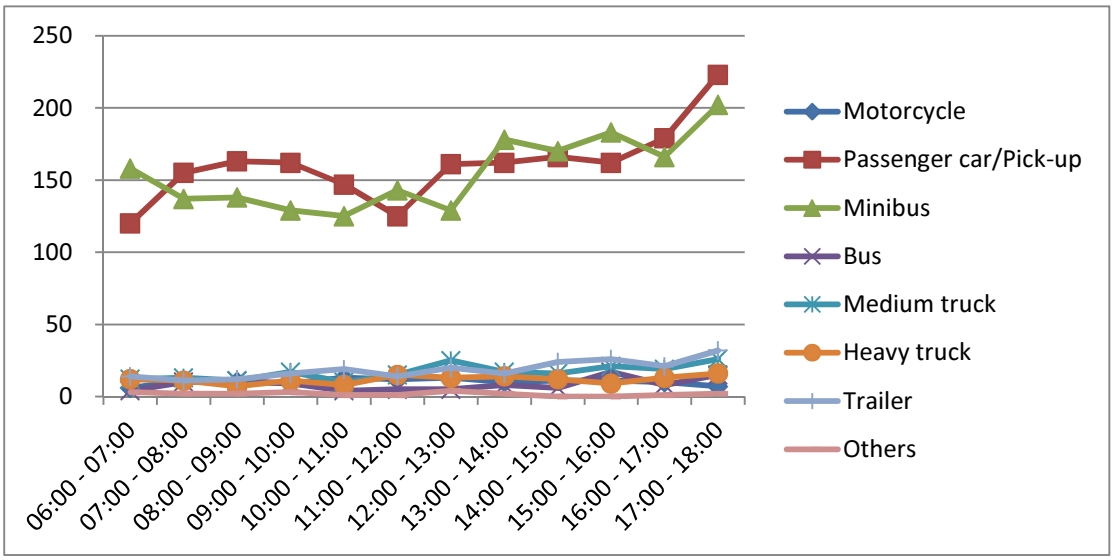
Appendix 2-10 Results of MCC at Station No. 9

Station Number : 9
Station : Sege West
Road : N1
Day-Night Ratio : 1.446
Weekly Fluctuation : 0.8
Monthly Fluctuation : 1.2
Commercial Vehicle Ratio : 10.9%

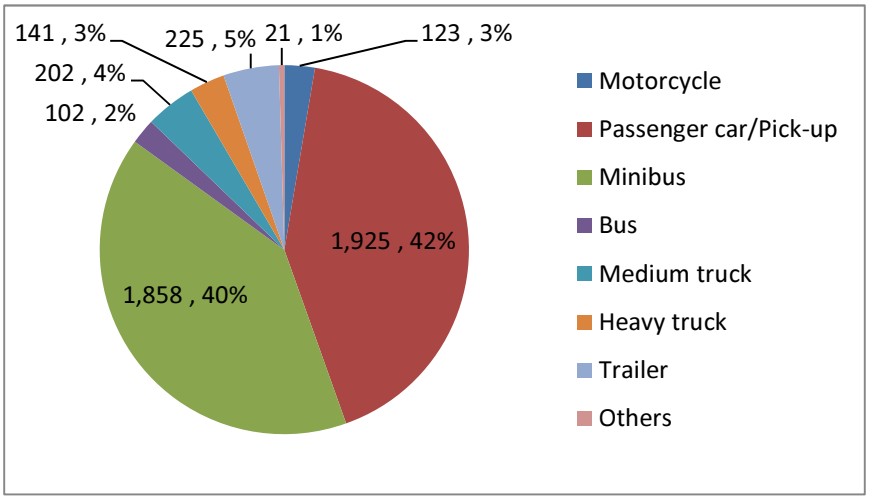
Observed Traffic and ADT

No.	VEHICLE TYPE	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TOTAL	24-hour Volume	ADT
1	Passenger car	120	155	163	162	147	125	161	162	166	162	179	223	1,925	2,784	2,900
2	Minibus	158	137	138	129	125	143	129	178	170	183	166	202	1,858	2,687	2,799
3	Bus	4	10	11	9	4	5	5	8	6	17	8	15	102	147	153
4	Medium truck	12	13	11	17	10	15	25	17	16	21	19	26	202	292	304
5	Heavy truck	12	11	7	11	8	15	13	14	12	9	13	16	141	204	213
6	Trailer	14	11	12	16	19	14	20	16	24	26	21	32	225	325	339
7	Others	3	2	2	3	1	1	4	2	0	0	1	2	21	30	31
TOTAL		323	339	344	347	314	318	357	397	394	418	407	516	4,474	6,469	6,739

Hourly Fluctuation



Vehicle Composition



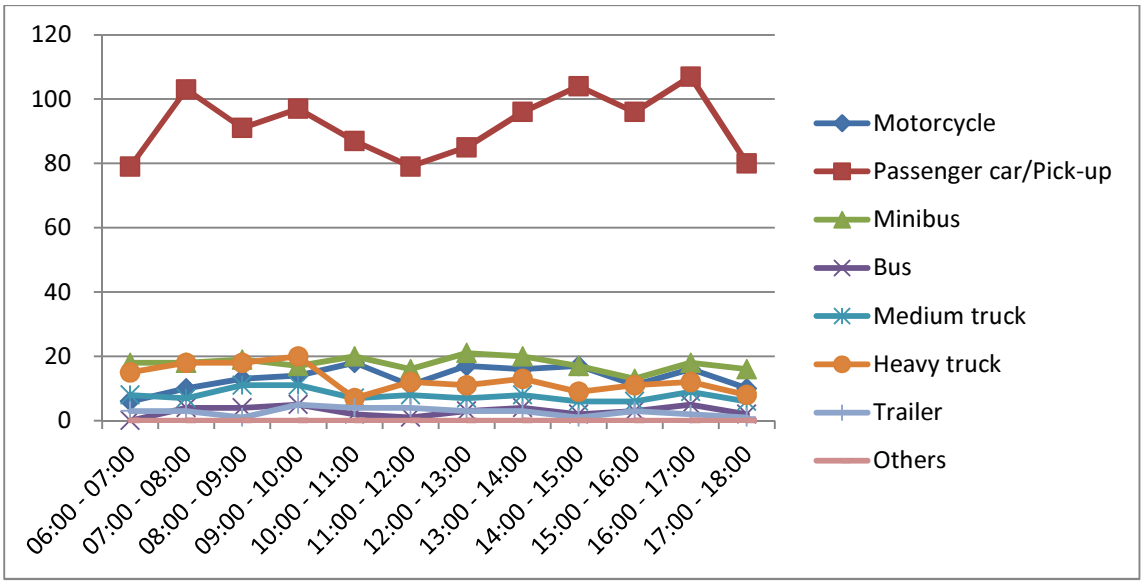
Appendix 2-11 Results of MCC at Station No. 10

Station Number : 10
Station : Sege North
Road : R18
Day-Night Ratio : 1.446
Weekly Fluctuation : 0.8
Monthly Fluctuation : 1.2
Commercial Vehicle Ratio : 13.6%

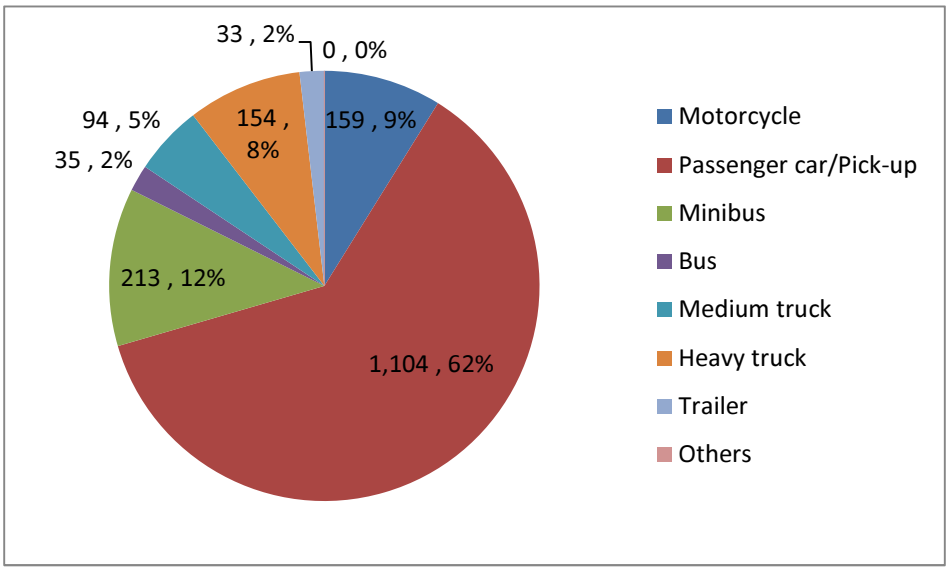
Observed Traffic and ADT

No.	VEHICLE TYPE	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TOTAL	24-hour Volume	ADT
1	Passenger car	79	103	91	97	87	79	85	96	104	96	107	80	1,104	1,596	1,663
2	Minibus	18	18	19	17	20	16	21	20	17	13	18	16	213	308	321
3	Bus	0	4	4	5	2	1	3	4	2	3	5	2	35	51	53
4	Medium truck	8	7	11	11	7	8	7	8	6	6	9	6	94	136	142
5	Heavy truck	15	18	18	20	7	12	11	13	9	11	12	8	154	223	232
6	Trailer	3	3	1	5	4	4	3	3	1	3	2	1	33	48	50
7	Others	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL		123	153	144	155	127	120	130	144	139	132	153	113	1,633	2,362	2,460

Hourly Fluctuation



Vehicle Composition



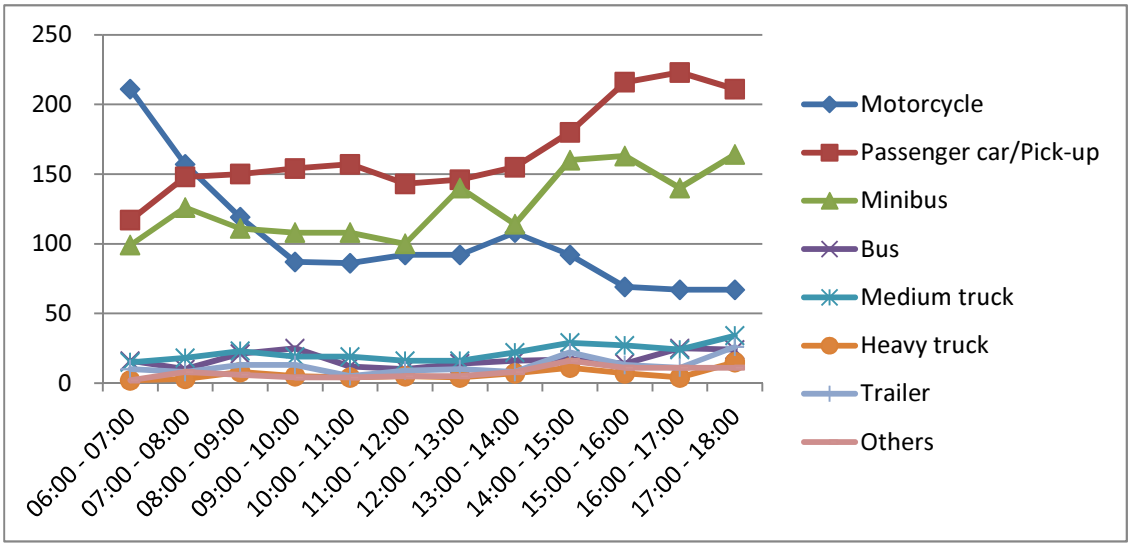
Appendix 2-12 Results of MCC at Station No. 11

Station Number : 11
Station : Sogakope
Road : N1
Day-Night Ratio : 1.446
Weekly Fluctuation : 0.8
Monthly Fluctuation : 1.2
Commercial Vehicle Ratio : 12.0%

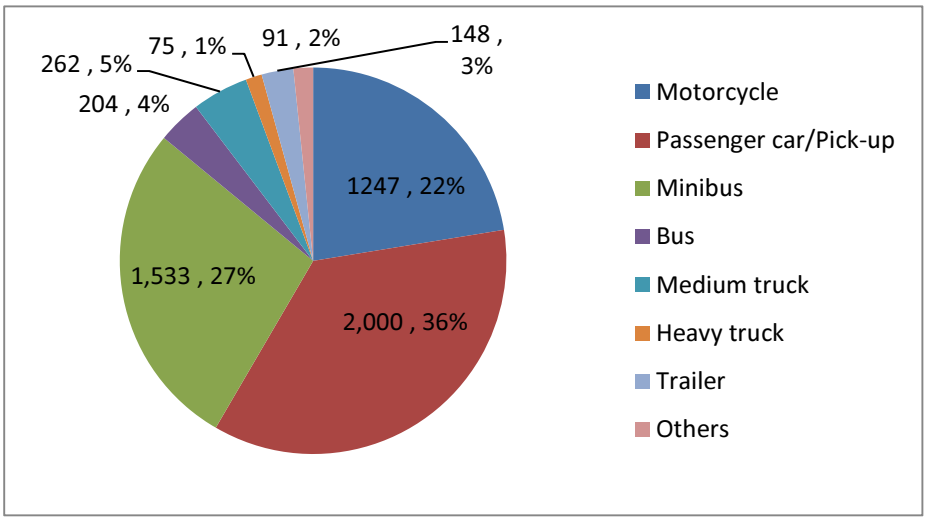
Observed Traffic and ADT

No.	VEHICLE TYPE	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TOTAL	24-hour Volume	ADT
1	Passenger car	117	148	150	154	157	143	146	155	180	216	223	211	2,000	2,892	3,013
2	Minibus	99	126	111	108	108	100	140	114	160	163	140	164	1,533	2,217	2,309
3	Bus	16	10	21	25	12	10	14	16	17	14	25	24	204	295	307
4	Medium truck	15	18	23	19	19	16	16	22	29	27	24	34	262	379	395
5	Heavy truck	2	3	8	5	4	5	4	7	11	7	4	15	75	108	113
6	Trailer	10	8	13	13	5	9	10	8	22	13	11	26	148	214	223
7	Others	2	8	6	4	4	5	5	8	16	11	11	11	91	132	138
TOTAL		261	321	332	328	309	288	335	330	435	451	438	485	4,313	6,237	6,497

Hourly Fluctuation



Vehicle Composition



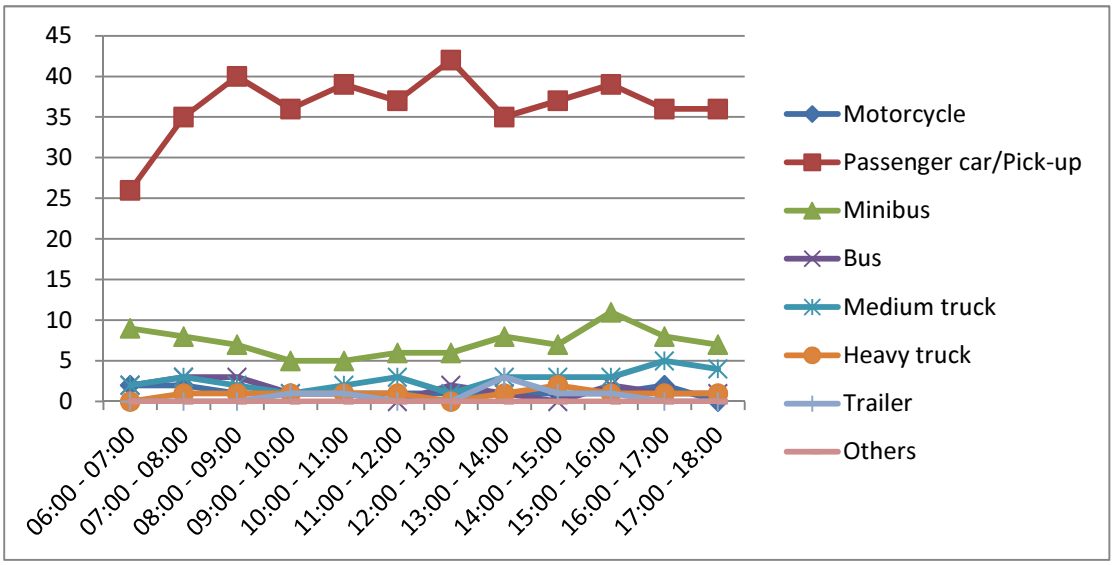
Appendix 2-13 Results of MCC at Station No. 12

Station Number : 12
Station : Adidome
Road : R28
Day-Night Ratio : 1.446
Weekly Fluctuation : 0.8
Monthly Fluctuation : 1.2
Commercial Vehicle Ratio : 5.9%

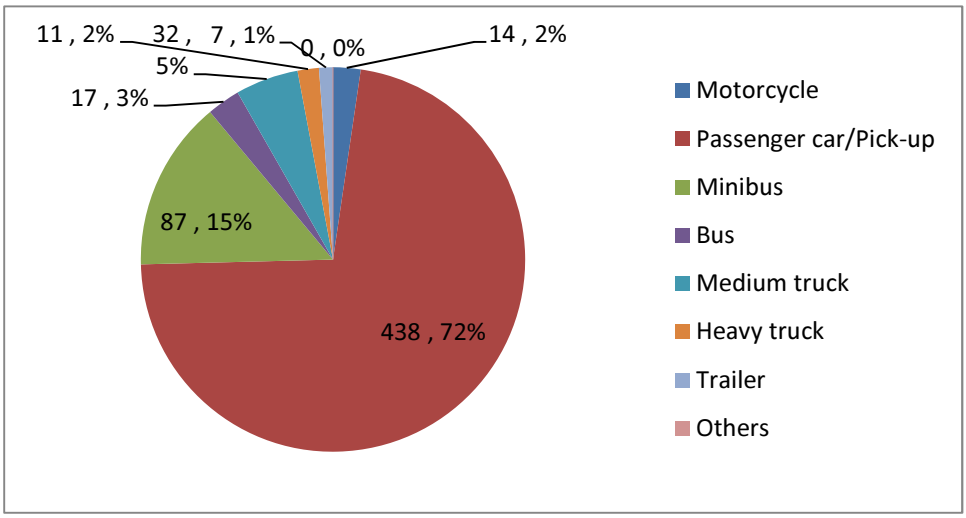
Observed Traffic and ADT

No.	VEHICLE TYPE	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TOTAL	24-hour Volume	ADT
1	Passenger car	26	35	40	36	39	37	42	35	37	39	36	36	438	633	659
2	Minibus	9	8	7	5	5	6	6	8	7	11	8	7	87	126	131
3	Bus	2	3	3	1	1	0	2	1	0	2	1	1	17	25	26
4	Medium truck	2	3	2	1	2	3	1	3	3	3	5	4	32	46	48
5	Heavy truck	0	1	1	1	1	1	0	1	2	1	1	1	11	16	17
6	Trailer	0	0	0	1	1	0	0	3	1	1	0	0	7	10	10
7	Others	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL		39	50	53	45	49	47	51	51	50	57	51	49	592	856	892

Hourly Fluctuation



Vehicle Composition



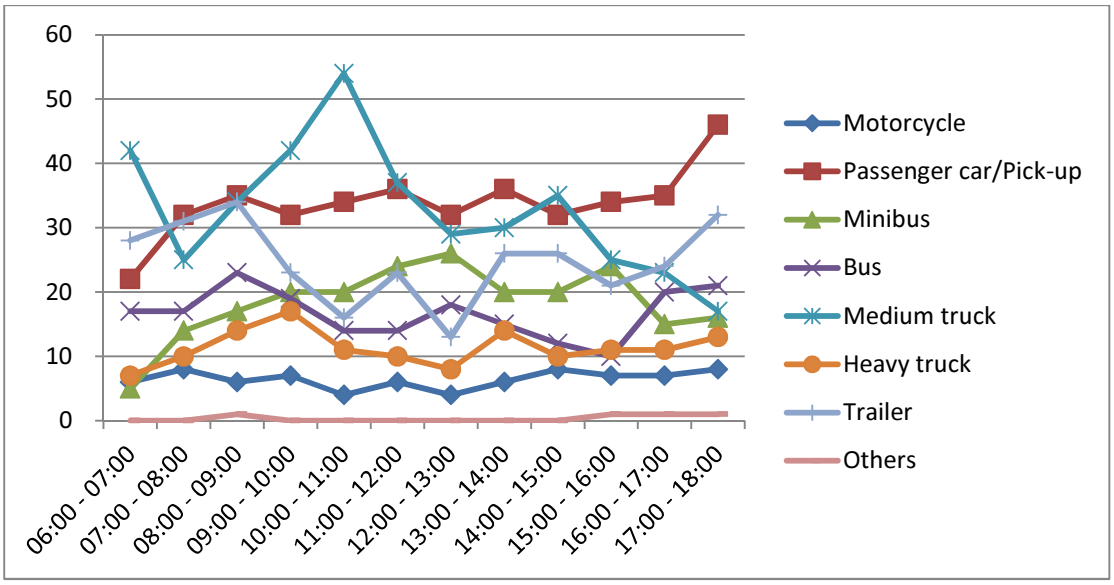
Appendix 2-14 Results of MCC at Station No. 13

Station Number : 13
Station : Tamale
Road : N10 (Central Corridor)
Day-Night Ratio : 1.446
Weekly Fluctuation : 1.05
Monthly Fluctuation : 1.2
Commercial Vehicle Ratio : 38.4%

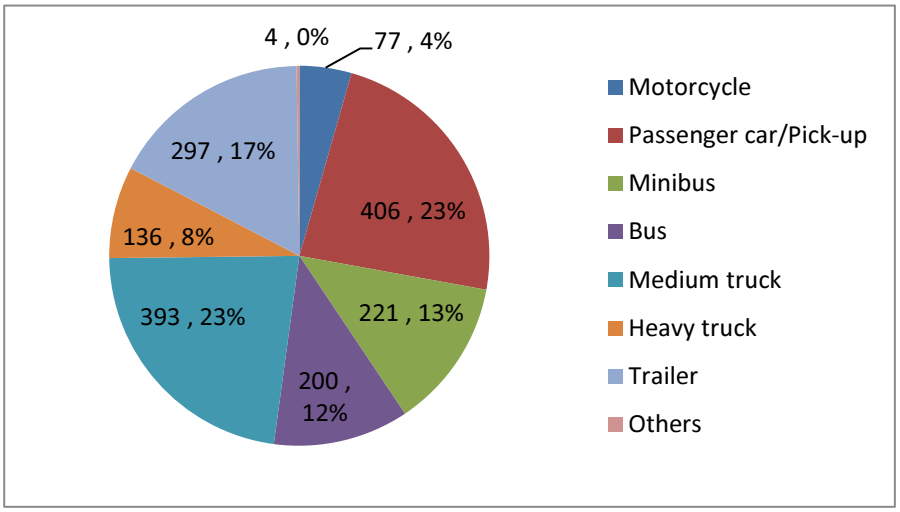
Observed Traffic and ADT

No.	VEHICLE TYPE	06:00 - 07:00	07:00 - 08:00	08:00 - 09:00	09:00 - 10:00	10:00 - 11:00	11:00 - 12:00	12:00 - 13:00	13:00 - 14:00	14:00 - 15:00	15:00 - 16:00	16:00 - 17:00	17:00 - 18:00	TOTAL	24-hour Volume	ADT
1	Passenger car	22	32	35	32	34	36	32	36	32	34	35	46	406	587	466
2	Minibus	5	14	17	20	20	24	26	20	20	24	15	16	221	320	254
3	Bus	17	17	23	19	14	14	18	15	12	10	20	21	200	289	229
4	Medium truck	42	25	34	42	54	37	29	30	35	25	23	17	393	568	451
5	Heavy truck	7	10	14	17	11	10	8	14	10	11	11	13	136	197	156
6	Trailer	28	31	34	23	16	23	13	26	26	21	24	32	297	429	340
7	Others	0	0	1	0	0	0	0	0	0	1	1	1	4	6	5
TOTAL		121	129	158	153	149	144	126	141	135	126	129	146	1,657	2,396	1,902

Hourly Fluctuation



Vehicle Composition



Appendix 3 Forecast of Distributed Traffic Demand (O/D Matrix)

Table A3-1 Forecast of Distributed Traffic Demand (O/D Matrix) for All Vehjicle Types (2012)

(Unit: Vehicles)

Origin	Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	Total
1	North Tongu (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	North Tongu (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
3	North Tongu (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	North Tongu (4)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
5	North Tongu (5)	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	65	0	32	0	0	0	0	0	0	0	4	10	24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	142
6	North Tongu (6)	0	0	0	0	8	0	0	0	0	0	0	0	0	0	4	248	0	0	0	0	0	0	0	0	0	9	15	31	5	0	3	0	0	0	5	0	0	0	0	4	0	0	0	0	332
7	Asugyaman (1)	0	0	0	0	0	0	0	269	0	0	76	0	0	0	3	0	8	0	0	4	5	32	9	0	0	0	13	41	3	0	0	0	0	0	0	0	0	0	0	13	0	0	0	0	476
8	Asugyaman (2)	0	0	0	0	0	0	177	0	0	0	18	0	0	0	4	0	0	7	0	4	114	287	27	0	0	0	32	71	15	2	0	0	0	9	0	0	0	0	0	20	0	0	0	0	787
9	Ho Municipality (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Ho Municipality (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	4
11	Ho City	0	0	0	0	0	5	19	25	0	0	0	0	6	0	4	40	0	16	0	3	15	128	13	0	0	0	174	794	21	80	19	0	0	25	8	7	0	0	0	0	0	0	0	0	1,402
12	Adaklu Anyigme	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
13	Dangme West (1)	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	5	33	0	0	0	0	44	12	0	55	0	59	24	29	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	275
14	Dangme West (2)	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	52	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	64
15	North Tongu (7)	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	42	0	695	0	0	0	4	0	0	0	25	134	253	39	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	1,212
16	South Tongu	0	0	0	14	36	207	0	0	0	0	22	7	0	0	0	0	0	160	0	0	0	0	0	0	0	36	17	195	0	0	0	0	0	0	0	0	0	0	0	5	0	2	0	0	701
17	Dangme West (3)	0	0	0	0	0	0	0	3	0	0	13	0	34	0	24	12	0	0	0	10	8	65	19	0	0	12	60	0	15	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	278
18	Dangme East	0	0	0	0	0	41	8	0	0	0	28	0	0	18	534	303	8	0	0	6	5	8	4	0	0	314	28	0	0	0	0	0	0	0	5	7	0	0	36	12	0	0	0	0	1,365
19	Ho Municipality (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	South Dayi	0	0	0	0	0	0	0	4	0	0	0	0	0	0	5	0	0	0	0	0	0	79	12	7	0	0	30	81	0	8	0	0	0	2	0	0	0	0	0	0	0	0	0	0	228
21	Asugyaman (3)	0	0	0	0	0	0	22	252	0	0	55	0	0	0	0	0	9	8	0	24	0	102	689	8	0	7	33	140	16	23	0	0	0	6	0	0	0	0	0	37	0	0	0	0	1,431
22	Lower Manya Klobo	0	0	0	0	0	0	15	335	0	0	321	0	20	0	0	0	35	0	0	28	149	0	942	16	8	25	234	205	315	131	0	0	0	6	0	0	0	0	0	331	0	0	0	0	3,116
23	Yiro Krobo	0	8	0	0	0	0	8	56	0	0	12	0	0	0	0	0	11	0	0	0	384	782	0	0	0	12	106	38	132	0	0	0	0	0	7	0	0	0	0	25	0	0	0	0	1,581
24	Akwapim North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	30	0	0	0	0	56	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	98
25	Dangme West (4)	0	0	0	0	0	0	0	0	0	0	0	0	17	0	0	0	0	0	0	0	0	16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	37
26	South East of Volta Region	0	0	0	0	2	3	0	0	0	0	0	0	0	0	23	5	0	198	0	0	11	13	0	26	0	0	150	2,046	49	61	5	0	0	16	0	0	0	0	0	2	0	0	0	0	2,610
27	Tema Port	0	3	0	0	9	9	31	69	0	0	167	0	67	0	118	59	60	0	0	37	154	381	60	0	0	180	0	5,206	4,214	133	0	0	0	278	37	158	0	0	64	104	205	0	114	4	11,921
28	Accra Metropolitan Area	0	0	0	0	66	64	91	176	0	0	872	5	112	0	338	269	0	18	0	189	225	211	20	8	0	1,159	1,022	0	0	47	0	0	0	4	5	197	18	3	103	794	291	0	96	0	6,403
29	West of Greater Accra Region	0	0	0	0	0	0	11	25	0	0	212	0	42	0	57	0	0	0	0	4	33	294	135	0	0	11	2,161	56	0	8	0	0	0	0	0	0	0	0	0	288	0	0	0	0	3,337
30	West of Eastern Region	0	0	0	0	0	0	0	0	0	0	180	0	6	0	0	0	0	0	0	0	6	241	16	0	0	52	0	16	20	0	0	0	0	0	0	4	0	0	0	60	0	0	0	0	601
31	Central Region	0	0	0	0	0	0	0	0	0	0	13	0	6	0	0	0	0	0	0	6	0	0	0	0	0	9	15	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	64
32	Western Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	88	0	0	0	0	0	0	0	0	37	0	0	31	0	0	0	35	0	191
33	Sekondi Takoradi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	Ashanti Region	0	0	0	0	0	0	0	7	0	0	13	0	0	0	0	0	0	0	0	0	0	16	0	0	0	13	239	0	0	0	0	0	0	0	0	173	0	0	120	12	0	0	39	0	632
35	Brong Ahafo Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	255	0	0	81	0	0	0	7	0	351
36	West of Northern Region	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	7	99	170	0	4	0	11	0	266	124	0	0	4	20	0	0	0	0	0	705
37	East of Northern Region	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	31	0	4	0	0	0	26	12	5	0	0	0	0	0	0	0	0	81
38	Upper West Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	113	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	121
39	Upper East Region	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	139	161	0	9	0	4	0	55	112	8	0	4	0	0	0	0	0	0	496
40	North of Volta Region	0	0	0	0	3	3	22	11	0	0	3	0	0	0	11	21	9	17	0	0	19	233	12	9	0	6	280	913	82	94	11	3	0	15	0	0	0	0	0	0	0	0	0	0	1,777
41	South of Togo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	58	249	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	307
42	North of Togo	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	14
43	Burkina Faso, Niger & Mali	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	9	82	105	0	0	3	10	0	62	8	0	0	0	0	0	0	0	0	0	279
44	Cote d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Total		0	11	0	14	124	347	404	1,239	0	0	2,009	12	316	18	1,125	1,084	173	1,203	0	315	1,128	2,966	1,970	74	63	1,890	5,458	10,859	4,955	616	41	28	0	778	318	857	25	11	419	1,777	508	2	291	4	43,432

Source: Study Team

Table A3-2 Forecast of Distributed Traffic Demand (O/D Matrix) for All Vehjicle Types (2016)

(Unit: Vehicles)

Origin	Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	Total
1	North Tongu (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	North Tongu (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
3	North Tongu (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	North Tongu (4)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
5	North Tongu (5)	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	83	0	39	0	0	0	0	0	0	0	5	13	29	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	177
6	North Tongu (6)	0	0	0	0	10	0	0	0	0	0	0	0	0	0	5	313	0	0	0	0	0	0	0	0	0	11	18	38	6	0	4	0	0	0	6	0	0	0	0	5	0	0	0	0	416
7	Asugyaman (1)	0	0	0	0	0	0	0	330	0	0	96	0	0	0	3	0	10	0	0	5	6	38	11	0	0	0	16	48	3	0	0	0	0	0	0	0	0	0	0	16	0	0	0	0	583
8	Asugyaman (2)	0	0	0	0	0	0	217	0	0	0	23	0	0	0	5	0	0	8	0	5	138	348	33	0	0	0	42	86	18	2	0	0	0	10	0	0	0	0	0	25	0	0	0	0	960
9	Ho Municipality (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Ho Municipality (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	5
11	Ho City	0	0	0	0	0	6	24	32	0	0	0	0	8	0	5	52	0	19	0	4	19	162	17	0	0	0	226	974	27	100	23	0	0	31	10	9	0	0	0	0	0	0	0	0	1,747
12	Adaklu Anyigme	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
13	Dangme West (1)	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	6	42	0	0	0	0	56	15	0	64	0	91	29	37	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	357
14	Dangme West (2)	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	64	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	79
15	North Tongu (7)	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	55	0	866	0	0	0	5	0	0	0	0	33	173	306	44	0	0	0	0	0	0	0	0	0	21	0	0	0	0	1,509
16	South Tongu	0	0	0	17	46	264	0	0	0	0	29	7	0	0	0	0	0	196	0	0	0	0	0	0	0	0	45	22	243	0	0	0	0	0	0	0	0	0	0	7	0	2	0	0	878
17	Dangme West (3)	0	0	0	0	0	0	0	4	0	0	20	0	42	0	32	15	0	0	0	14	10	81	23	0	0	15	76	0	21	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	360
18	Dangme East	0	0	0	0	0	50	10	0	0	0	35	0	0	22	657	371	10	0	0	7	6	10	5	0	0	378	34	0	0	0	0	0	0	0	0	6	7	0	0	44	15	0	0	0	1,666
19	Ho Municipality (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	South Dayi	0	0	0	0	0	0	0	5	0	0	0	0	0	0	7	0	0	0	0	0	0	99	15	9	0	0	38	100	0	10	0	0	0	3	0	0	0	0	0	0	0	0	0	0	286
21	Asugyaman (3)	0	0	0	0	0	0	27	309	0	0	70	0	0	0	0	0	10	10	0	30	0	124	849	10	0	9	43	169	20	28	0	0	0	6	0	0	0	0	0	47	0	0	0	0	1,756
22	Lower Manya Klobo	0	0	0	0	0	0	18	406	0	0	404	0	24	0	0	0	39	0	0	34	182	0	1,154	19	10	30	293	244	383	157	0	0	0	5	0	0	0	0	0	417	0	0	0	0	3,819
23	Yiro Krobo	0	10	0	0	0	0	10	69	0	0	15	0	0	0	0	0	13	0	0	0	470	957	0	0	0	15	135	45	162	0	0	0	0	0	6	0	0	0	0	31	0	0	0	0	1,938
24	Akwapim North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	15	0	0	0	0	0	36	0	0	0	0	69	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	120
25	Dangme West (4)	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	47
26	South East of Volta Region	0	0	0	0	3	4	0	0	0	0	0	0	0	0	30	7	0	246	0	0	14	17	0	32	0	0	193	2,564	62	77	6	0	0	21	0	0	0	0	0	3	0	0	0	0	3,277
27	Tema Port	0	3	0	0	10	10	37	82	0	0	212	0	84	0	144	69	75	0	0	48	186	464	74	0	0	222	0	6,100	5,203	145	0	0	0	271	32	218	0	0	77	130	283	0	139	5	14,324
28	Accra Metropolitan Area	0	0	0	0	80	77	109	212	0	0	1,081	6	131	0	419	330	0	21	0	233	270	252	24	10	0	1,417	1,255	0	0	55	0	0	0	5	6	249	22	3	132	977	361	0	110	0	7,848
29	West of Greater Accra Region	0	0	0	0	0	0	13	28	0	0	267	0	49	0	69	0	0	0	0	5	41	357	165	0	0	14	2,663	68	0	10	0	0	0	0	0	0	0	0	0	363	0	0	0	0	4,111
30	West of Eastern Region	0	0	0	0	0	0	0	0	0	0	225	0	7	0	0	0	0	0	0	0	6	291	20	0	0	64	0	19	24	0	0	0	0	0	0	5	0	0	0	75	0	0	0	0	736
31	Central Region	0	0	0	0	0	0	0	0	0	0	15	0	7	0	0	0	0	0	0	6	0	0	0	0	0	9	18	0	0	0	0	0	0	0	0	0	0	0	0	19	0	0	0	0	74
32	Western Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	85	0	0	0	0	0	0	0	0	49	0	0	41	0	0	0	40	0	215
33	Sekondi Takoradi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	Ashanti Region	0	0	0	0	0	0	0	9	0	0	16	0	0	0	0	0	0	0	0	0	0	20	0	0	0	14	315	0	0	0	0	0	0	0	0	211	0	0	149	15	0	0	48	0	796
35	Brong Ahafo Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	317	0	0	95	0	0	0	18	0	440
36	West of Northern Region	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	9	157	231	0	5	0	75	0	350	159	0	0	5	29	0	0	0	0	0	1,020
37	East of Northern Region	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	47	0	5	0	0	0	37	16	9	0	0	0	0	0	0	0	0	117
38	Upper West Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	137	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	147
39	Upper East Region	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	195	222	0	11	0	35	0	90	150	12	0	5	0	0	0	0	0	0	725
40	North of Volta Region	0	0	0	0	4	4	25	13	0	0	3	0	0	0	14	27	9	20	0	0	23	292	15	10	0	7	361	1,132	102	116	14	2	0	18	0	0	0	0	0	0	0	0	0	0	2,210
41	South of Togo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	310	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	385
42	North of Togo	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	5	0	0	0	5	0	0	0	0	0	0	0	0	0	0	18
43	Burkina Faso, Niger & Mali	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	100	128	0	0	4	12	0	72	28	0	0	0	0	0	0	0	0	0	356
44	Cote d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Total		0	14	0	17	154	433	489	1,509	0	0	2,515	13	383	22	1,392	1,347	208	1,489	0	390	1,370	3,627	2,418	90	74	2,311	6,858	13,143	6,112	736	51	124	0	927	413	1,094	29	13	523	2,213	658	2	354	5	53,519

Source: Study Team

Table A3-3 Forecast of Distributed Traffic Demand (O/D Matrix) for All Vehjicle Types (2026)

(Unit: Vehicles)

Origin	Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	Total
1	North Tongu (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	North Tongu (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
3	North Tongu (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	North Tongu (4)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
5	North Tongu (5)	0	0	0	0	0	11	0	0	0	0	0	0	0	0	0	113	0	49	0	0	0	0	0	0	0	6	19	39	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	237
6	North Tongu (6)	0	0	0	0	13	0	0	0	0	0	0	0	0	0	6	413	0	0	0	0	0	0	0	0	0	14	31	47	8	0	5	0	0	0	8	0	0	0	0	7	0	0	0	0	551
7	Asugyaman (1)	0	0	0	0	0	0	0	423	0	0	127	0	0	0	3	0	12	0	0	7	8	47	14	0	0	0	24	61	3	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	751
8	Asugyaman (2)	0	0	0	0	0	0	278	0	0	0	30	0	0	0	7	0	0	10	0	7	176	439	42	0	0	0	66	108	23	3	0	0	0	12	0	0	0	0	0	32	0	0	0	0	1,234
9	Ho Municipality (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Ho Municipality (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	6
11	Ho City	0	0	0	0	0	9	32	43	0	0	0	0	10	0	7	71	0	18	0	5	25	214	22	0	0	0	319	1,250	35	130	29	0	0	40	13	12	0	0	0	0	0	0	0	0	2,285
12	Adaklu Anyigme	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
13	Dangme West (1)	0	0	0	0	0	0	0	11	0	0	0	0	0	0	0	9	53	0	0	0	0	71	19	0	75	0	147	37	48	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	481
14	Dangme West (2)	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	82	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	102
15	North Tongu (7)	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	77	0	1,121	0	0	0	7	0	0	0	47	274	405	58	0	0	0	0	0	0	0	0	0	0	28	0	0	0	0	2,021
16	South Tongu	0	0	0	22	63	353	0	0	0	0	39	7	0	0	0	0	0	250	0	0	0	0	0	0	0	62	29	312	0	0	0	0	0	0	0	0	0	0	0	9	0	3	0	0	1,150
17	Dangme West (3)	0	0	0	0	0	0	0	7	0	0	27	0	54	0	44	20	0	0	0	17	13	104	30	0	0	20	105	0	36	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	483
18	Dangme East	0	0	0	0	0	62	12	0	1	0	45	0	0	29	850	479	12	0	0	8	7	12	6	0	0	484	54	0	0	0	0	0	0	0	0	8	7	0	0	57	20	0	0	0	2,151
19	Ho Municipality (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	South Dayi	0	0	0	0	0	0	0	7	0	0	0	0	0	0	9	0	0	0	0	0	0	130	20	11	0	0	51	129	0	13	0	0	0	3	0	0	0	0	0	0	0	0	0	0	374
21	Asugyaman (3)	0	0	0	0	0	0	35	397	0	0	93	0	0	0	0	0	10	12	0	38	0	156	1,092	12	0	12	64	211	25	35	0	0	0	6	0	0	0	0	0	61	0	0	0	0	2,257
22	Lower Manya Klobo	0	0	0	0	0	0	23	514	0	0	531	0	28	0	0	0	44	0	0	42	232	0	1,475	24	13	36	409	302	480	197	0	0	0	5	0	0	0	0	0	552	0	0	0	0	4,909
23	Yiro Krobo	0	13	0	0	0	0	12	90	0	0	20	0	0	0	0	0	16	0	0	0	603	1,222	0	0	0	21	189	57	205	0	0	0	0	0	6	0	0	0	0	38	0	0	0	0	2,491
24	Akwapim North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	20	0	0	0	0	0	46	0	0	0	0	89	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	154
25	Dangme West (4)	0	0	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	62
26	South East of Volta Region	0	0	0	0	3	5	0	0	0	0	0	0	0	0	38	9	0	319	0	0	18	22	0	39	0	0	262	3,356	82	101	8	0	0	27	0	0	0	0	0	4	0	0	0	0	4,293
27	Tema Port	0	4	0	0	7	7	44	92	0	0	267	0	111	0	135	55	98	0	0	65	226	569	93	0	0	250	0	7,217	6,638	135	0	0	0	217	18	369	0	0	184	158	410	0	188	9	17,566
28	Accra Metropolitan Area	0	0	0	0	101	93	135	267	0	0	1,383	8	153	0	540	425	0	26	0	299	338	311	30	12	0	1,802	1,653	0	0	69	0	0	0	6	8	414	27	3	181	1,243	535	0	167	0	10,229
29	West of Greater Accra Region	0	0	0	0	0	0	15	34	0	0	348	0	58	0	86	0	0	0	0	7	52	449	208	0	0	19	3,458	84	0	12	0	0	0	0	0	0	0	0	0	477	0	0	0	0	5,307
30	West of Eastern Region	0	0	0	0	0	0	0	0	0	0	294	0	9	0	0	0	0	0	0	0	9	366	25	0	0	84	0	24	30	0	0	0	0	0	0	6	0	0	0	98	0	0	0	0	946
31	Central Region	0	0	0	0	0	0	0	0	0	0	17	0	9	0	0	0	0	0	0	4	0	0	0	0	0	8	26	0	0	0	0	0	0	0	0	0	0	0	0	24	0	0	0	0	88
32	Western Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	68	0	0	0	0	0	0	0	0	52	0	0	93	0	0	0	48	0	260
33	Sekondi Takoradi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	Ashanti Region	0	0	0	0	0	0	0	12	0	0	18	0	0	0	0	0	0	0	0	0	0	26	0	0	0	9	441	0	0	0	0	0	0	0	0	351	0	0	197	18	0	0	66	0	1,137
35	Brong Ahafo Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	405	0	0	169	0	0	0	43	0	629
36	West of Northern Region	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	12	298	468	0	6	0	65	0	508	305	0	0	6	40	0	0	0	0	0	1,709
37	East of Northern Region	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	74	110	0	6	0	0	0	55	21	15	0	0	0	0	0	0	0	0	286
38	Upper West Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	171	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	183
39	Upper East Region	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	195	232	0	16	0	46	0	141	204	15	0	6	0	0	0	0	0	0	863
40	North of Volta Region	0	0	0	0	5	5	27	17	0	0	3	0	0	0	19	37	9	20	0	0	29	381	19	11	0	9	516	1,461	132	150	18	2	0	23	0	0	0	0	0	0	0	0	0	0	2,891
41	South of Togo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	106	422	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	527
42	North of Togo	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	7	0	0	0	7	0	0	0	0	0	0	0	0	0	0	25
43	Burkina Faso, Niger & Mali	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	13	116	164	0	0	4	40	0	82	29	0	0	0	0	0	0	0	0	0	448
44	Cote d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Total		0	17	0	22	192	558	612	1,912	1	0	3,248	16	474	29	1,746	1,732	254	1,906	0	499	1,736	4,597	3,096	110	87	2,907	9,270	16,510	7,803	895	64	153	0	1,138	612	1,658	35	16	863	2,851	965	3	512	9	69,107

Source: Study Team

Table A3-4 Forecast of Distributed Traffic Demand (O/D Matrix) for All Vehjicle Types (2036)

(Unit: Vehicles)

Origin	Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	Total
1	North Tongu (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	North Tongu (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
3	North Tongu (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	North Tongu (4)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
5	North Tongu (5)	0	0	0	0	0	14	0	0	0	0	0	0	0	0	134	0	55	0	0	0	0	0	0	0	0	8	29	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	284
6	North Tongu (6)	0	0	0	0	15	0	0	0	0	0	0	0	0	0	7	477	0	0	0	0	0	0	0	0	0	16	50	52	9	0	5	0	0	0	9	0	0	0	0	8	0	0	0	0	647
7	Asugyaman (1)	0	0	0	0	0	0	0	477	0	0	145	0	0	0	3	0	14	0	0	8	9	52	16	0	0	0	38	66	2	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	853
8	Asugyaman (2)	0	0	0	0	0	0	317	0	0	0	35	0	0	0	8	0	0	11	0	8	199	489	49	0	0	0	111	119	25	3	0	0	0	13	0	0	0	0	0	37	0	0	0	0	1,426
9	Ho Municipality (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Ho Municipality (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	8
11	Ho City	0	0	0	0	0	10	38	50	0	0	0	0	12	0	9	84	0	19	0	7	30	250	26	0	0	0	457	1,393	40	149	33	0	0	48	16	14	0	0	0	0	0	0	0	0	2,685
12	Adaklu Anyigme	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
13	Dangme West (1)	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	10	60	0	0	0	0	77	22	0	83	0	195	41	50	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	565
14	Dangme West (2)	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	93	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117
15	North Tongu (7)	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	93	0	1,279	0	0	0	8	0	0	0	57	438	448	61	0	0	0	0	0	0	0	0	0	0	33	0	0	0	0	2,423
16	South Tongu	0	0	0	26	75	412	0	0	0	0	47	9	0	0	0	0	0	286	0	0	0	0	0	0	0	79	34	355	0	0	0	0	0	0	0	0	0	0	0	11	0	4	0	0	1,338
17	Dangme West (3)	0	0	0	0	0	0	0	9	0	0	33	0	61	0	51	23	0	0	0	23	14	116	34	0	0	24	134	0	36	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	565
18	Dangme East	0	0	0	0	0	69	13	0	1	0	51	0	0	33	963	538	13	0	0	9	8	13	7	0	0	538	84	0	0	0	0	0	0	0	0	8	8	0	0	64	24	0	0	0	2,444
19	Ho Municipality (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	South Dayi	0	0	0	0	0	0	0	8	0	0	0	0	0	0	11	0	0	0	0	0	0	151	24	13	0	0	60	150	0	15	0	0	0	4	0	0	0	0	0	0	0	0	0	0	435
21	Asugyaman (3)	0	0	0	0	0	0	39	449	0	0	107	0	0	0	0	0	13	13	0	44	0	173	1,235	14	0	14	94	229	27	39	0	0	0	6	0	0	0	0	0	70	0	0	0	0	2,563
22	Lower Manya Klobo	0	0	0	0	0	0	26	577	0	0	610	0	32	0	0	0	49	0	0	49	261	0	1,663	27	14	39	543	324	529	214	0	0	0	4	0	0	0	0	0	635	0	0	0	0	5,596
23	Yiro Krobo	0	15	0	0	0	0	13	102	0	0	24	0	0	0	0	0	19	0	0	0	680	1,370	0	0	0	24	255	60	227	0	0	0	0	0	6	0	0	0	0	44	0	0	0	0	2,838
24	Akwapim North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0	0	0	0	53	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	176
25	Dangme West (4)	0	0	0	0	0	0	0	0	0	0	0	0	36	0	0	0	0	0	0	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	72
26	South East of Volta Region	0	0	0	0	4	6	0	0	0	0	0	0	0	0	51	11	0	364	0	0	22	26	0	46	0	0	311	3,875	96	118	9	0	0	32	0	0	0	0	0	4	0	0	0	0	4,976
27	Tema Port	0	4	0	0	9	9	53	115	0	0	322	0	129	0	172	72	113	0	0	77	265	658	110	0	0	303	0	8,143	7,573	152	0	0	0	275	26	585	0	0	280	192	526	0	274	10	20,444
28	Accra Metropolitan Area	0	0	0	0	111	101	150	299	0	0	1,574	10	174	0	611	474	0	28	0	342	374	341	33	13	0	2,009	2,012	0	0	74	0	0	0	7	8	803	31	3	365	1,405	629	0	187	0	12,167
29	West of Greater Accra Region	0	0	0	0	0	0	16	35	0	0	400	0	63	0	94	0	0	0	0	8	58	501	234	0	0	22	3,951	92	0	13	0	0	0	0	0	0	0	0	0	549	0	0	0	0	6,037
30	West of Eastern Region	0	0	0	0	0	0	0	0	0	0	344	0	10	0	0	0	0	0	0	0	12	408	28	0	0	101	0	26	33	0	0	0	0	0	0	7	0	0	0	114	0	0	0	0	1,082
31	Central Region	0	0	0	0	0	0	0	0	0	0	17	0	10	0	0	0	0	0	0	2	0	0	0	0	0	4	30	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0	0	0	92
32	Western Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114	0	0	0	0	0	0	0	0	112	0	0	90	0	0	0	51	0	367
33	Sekondi Takoradi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	Ashanti Region	0	0	0	0	0	0	0	13	0	0	20	0	0	0	0	0	0	0	0	0	0	30	0	0	0	4	414	0	0	0	0	0	0	0	0	693	0	0	412	20	0	0	88	0	1,693
35	Brong Ahafo Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	662	0	0	173	0	0	0	700	0	1,549
36	West of Northern Region	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	15	355	683	0	7	0	15	0	891	463	0	0	7	36	0	0	0	0	0	2,471
37	East of Northern Region	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	82	0	7	0	0	0	59	23	16	0	0	0	0	0	0	0	0	193
38	Upper West Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	185	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	198
39	Upper East Region	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	343	428	0	13	0	16	0	193	353	12	0	6	0	0	0	0	0	0	1,372
40	North of Volta Region	0	0	0	0	6	6	29	19	0	0	3	0	0	0	22	43	10	21	0	0	32	440	21	11	0	11	723	1,646	150	168	20	1	0	26	0	0	0	0	0	0	0	0	0	0	3,407
41	South of Togo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	170	518	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	688
42	North of Togo	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	9	0	0	0	10	0	0	0	0	0	0	0	0	0	0	32
43	Burkina Faso, Niger & Mali	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	8	136	208	0	0	3	13	0	110	14	0	0	0	0	0	0	0	0	0	493
44	Cote d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Total		0	19	0	26	221	643	694	2,166	1	0	3,739	19	540	33	2,002	1,987	289	2,168	0	577	1,964	5,182	3,503	123	97	3,274	11,387	18,998	8,858	995	71	45	0	1,684	919	2,925	39	17	1,356	3,268	1,179	4	1,300	10	82,320

Source: Study Team

Table A3-5 Forecast of Distributed Traffic Demand for Passenger Vehicles (2036)

(Unit: Vehicles)

Origin	Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	Total
1	North Tongu (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	North Tongu (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3	North Tongu (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	North Tongu (4)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
5	North Tongu (5)	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	125	0	55	0	0	0	0	0	0	0	0	15	35	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	236
6	North Tongu (6)	0	0	0	0	15	0	0	0	0	0	0	0	0	0	6	471	0	0	0	0	0	0	0	0	0	0	14	5	52	9	0	5	0	0	0	9	0	0	0	0	8	0	0	0	0	594
7	Asugyaman (1)	0	0	0	0	0	0	0	477	0	0	145	0	0	0	0	0	14	0	0	8	9	50	16	0	0	0	4	65	0	0	0	0	0	0	0	0	0	0	0	25	0	0	0	0	811
8	Asugyaman (2)	0	0	0	0	0	0	299	0	0	0	32	0	0	0	8	0	0	11	0	8	171	435	40	0	0	0	33	119	21	3	0	0	0	7	0	0	0	0	0	30	0	0	0	0	1,216
9	Ho Municipality (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Ho Municipality (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	Ho City	0	0	0	0	0	10	38	50	0	0	0	0	12	0	9	82	0	9	0	7	30	250	26	0	0	0	227	1,307	40	146	30	0	0	47	16	14	0	0	0	0	0	0	0	0	2,348
12	Adaklu Anyigme	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10
13	Dangme West (1)	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	10	55	0	0	0	0	70	22	0	55	0	58	41	42	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	381
14	Dangme West (2)	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	93	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	117
15	North Tongu (7)	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	93	0	1,273	0	0	0	8	0	0	0	0	57	127	386	35	0	0	0	0	0	0	0	0	0	27	0	0	0	0	2,011
16	South Tongu	0	0	0	23	66	408	0	0	0	0	47	0	0	0	0	0	0	267	0	0	0	0	0	0	0	0	37	34	355	0	0	0	0	0	0	0	0	0	0	11	0	4	0	0	1,252
17	Dangme West (3)	0	0	0	0	0	0	0	0	0	0	0	0	61	0	36	23	0	0	0	0	14	101	34	0	0	24	102	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	396
18	Dangme East	0	0	0	0	0	67	13	0	0	0	51	0	0	33	849	495	13	0	0	5	8	13	7	0	0	426	30	0	0	0	0	0	0	0	0	0	0	0	0	60	24	0	0	0	2,095
19	Ho Municipality (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	South Dayi	0	0	0	0	0	0	0	8	0	0	0	0	0	0	11	0	0	0	0	0	0	146	24	13	0	0	60	127	0	15	0	0	0	4	0	0	0	0	0	0	0	0	0	0	407
21	Asugyaman (3)	0	0	0	0	0	0	39	435	0	0	107	0	0	0	0	0	0	13	0	41	0	167	1,235	14	0	14	34	225	27	39	0	0	0	0	0	0	0	0	0	66	0	0	0	0	2,455
22	Lower Manya Klobo	0	0	0	0	0	0	26	547	0	0	605	0	27	0	0	0	28	0	0	44	261	0	1,654	27	14	31	283	311	527	208	0	0	0	0	0	0	0	0	0	635	0	0	0	0	5,228
23	Yiro Krobo	0	15	0	0	0	0	9	102	0	0	24	0	0	0	0	0	14	0	0	0	659	1,353	0	0	0	24	154	49	223	0	0	0	0	0	0	0	0	0	0	34	0	0	0	0	2,660
24	Akwapim North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	23	0	0	0	0	0	41	0	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	164
25	Dangme West (4)	0	0	0	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	0	0	0	28	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	58
26	South East of Volta Region	0	0	0	0	0	6	0	0	0	0	0	0	0	0	30	11	0	364	0	0	18	26	0	33	0	0	311	3,731	96	118	9	0	0	32	0	0	0	0	0	4	0	0	0	0	4,790
27	Tema Port	0	0	0	0	0	0	44	83	0	0	294	0	129	0	87	10	113	0	0	77	236	611	102	0	0	234	0	6,667	7,403	14	0	0	0	84	0	8	0	0	7	167	0	0	15	0	16,387
28	Accra Metropolitan Area	0	0	0	0	99	86	138	283	0	0	1,481	10	126	0	553	424	0	28	0	328	359	325	29	13	0	1,757	1,621	0	0	66	0	0	0	7	8	109	29	0	40	1,285	520	0	14	0	9,737
29	West of Greater Accra Region	0	0	0	0	0	0	14	31	0	0	396	0	58	0	87	0	0	0	0	8	58	498	230	0	0	22	3,628	92	0	13	0	0	0	0	0	0	0	0	0	546	0	0	0	0	5,681
30	West of Eastern Region	0	0	0	0	0	0	0	0	0	0	314	0	10	0	0	0	0	0	0	0	0	398	28	0	0	69	0	26	33	0	0	0	0	0	0	7	0	0	0	100	0	0	0	0	984
31	Central Region	0	0	0	0	0	0	0	0	0	0	15	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28	0	0	0	0	53
32	Western Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	6	0	0	0	0	0	18
33	Sekondi Takoradi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	Ashanti Region	0	0	0	0	0	0	0	13	0	0	19	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	204	0	0	83	19	0	0	26	0	393
35	Brong Ahafo Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	265	0	0	50	0	0	0	0	0	328
36	West of Northern Region	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	15	8	127	0	7	0	0	0	268	152	0	0	7	0	0	0	0	0	0	583
37	East of Northern Region	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	7	0	0	0	0	7	0	0	0	0	0	0	0	0	0	29
38	Upper West Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	185	0	0	0	0	0	0	0	0	13	0	0	0	0	0	0	0	0	198
39	Upper East Region	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	23	0	6	0	7	0	29	47	0	0	6	0	0	0	0	0	0	131
40	North of Volta Region	0	0	0	0	6	6	14	16	0	0	0	0	0	0	20	41	0	13	0	0	28	430	18	8	0	9	339	1,604	144	157	20	0	0	23	0	0	0	0	0	0	0	0	0	0	2,896
41	South of Togo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	485	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	485
42	North of Togo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	9	0	0	0	10	0	0	0	0	0	0	0	0	0	0	28
43	Burkina Faso, Niger & Mali	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	19
44	Cote d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total		0	15	0	23	187	602	634	2,058	0	0	3,535	10	468	33	1,696	1,814	237	2,124	0	525	1,851	4,979	3,465	107	69	2,731	7,379	15,862	8,600	823	64	7	0	521	239	631	29	13	186	3,065	544	4	55	0	65,185

Source: Study Team

Table A3-6 Forecast of Distributed Traffic Demand for Freight Vehicles (2036)

(Unit: Vehicles)

Origin	Destination	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	Total
1	North Tongu (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	North Tongu (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
3	North Tongu (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	North Tongu (4)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5	North Tongu (5)	0	0	0	0	0	8	0	0	0	0	0	0	0	0	9	0	0	0	0	0	0	0	0	0	0	8	14	9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	48
6	North Tongu (6)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6	0	0	0	0	0	0	0	0	0	2	44	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	53
7	Asugyaman (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	0	0	0	0	34	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	42
8	Asugyaman (2)	0	0	0	0	0	0	19	0	0	0	3	0	0	0	0	0	0	0	0	0	28	54	9	0	0	0	78	0	5	0	0	0	0	6	0	0	0	0	0	8	0	0	0	0	210
9	Ho Municipality (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	Ho Municipality (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8	0	0	0	0	0	0	0	0	0	0	8
11	Ho City	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	10	0	0	0	0	0	0	0	0	0	230	86	0	3	4	0	0	1	0	0	0	0	0	0	0	0	0	0	336
12	Adaklu Anyigme	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13	Dangme West (1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	6	0	0	28	0	137	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	184
14	Dangme West (2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
15	North Tongu (7)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	311	62	25	0	0	0	0	0	0	0	0	0	0	6	0	0	0	0	411
16	South Tongu	0	0	0	3	9	4	0	0	0	0	0	9	0	0	0	0	0	19	0	0	0	0	0	0	0	42	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	86
17	Dangme West (3)	0	0	0	0	0	0	0	9	0	0	33	0	0	0	15	0	0	0	0	23	0	15	0	0	0	0	32	0	36	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	170
18	Dangme East	0	0	0	0	0	1	0	0	0	0	0	0	0	0	114	43	0	0	0	4	0	0	0	0	0	112	53	0	0	0	0	0	0	0	0	8	8	0	0	4	0	0	0	0	348
19	Ho Municipality (3)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
20	South Dayi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0	0	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	28
21	Asugyaman (3)	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	13	0	0	3	0	6	0	0	0	0	60	4	0	0	0	0	0	6	0	0	0	0	0	4	0	0	0	0	108
22	Lower Manya Klobo	0	0	0	0	0	0	0	29	0	0	6	0	5	0	0	0	21	0	0	4	0	0	9	0	0	8	261	13	2	6	0	0	0	4	0	0	0	0	0	0	0	0	0	0	368
23	Yiro Krobo	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	4	0	0	0	21	17	0	0	0	0	100	11	4	0	0	0	0	0	6	0	0	0	0	10	0	0	0	0	178
24	Akwapim North	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	12
25	Dangme West (4)	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14
26	South East of Volta Region	0	0	0	0	4	0	0	0	0	0	0	0	0	0	22	0	0	0	0	0	4	0	0	12	0	0	0	144	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	186
27	Tema Port	0	4	0	0	9	9	9	32	0	0	28	0	0	0	84	61	0	0	0	0	29	46	8	0	0	69	0	1,477	171	137	0	0	0	190	26	577	0	0	273	25	526	0	258	10	4,057
28	Accra Metropolitan Area	0	0	0	0	12	15	12	16	0	0	93	0	48	0	58	49	0	0	0	14	15	15	4	0	0	252	390	0	0	7	0	0	0	0	0	694	2	3	325	120	109	0	174	0	2,430
29	West of Greater Accra Region	0	0	0	0	0	0	2	5	0	0	4	0	5	0	7	0	0	0	0	0	0	3	4	0	0	0	323	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	356
30	West of Eastern Region	0	0	0	0	0	0	0	0	0	0	30	0	0	0	0	0	0	0	0	0	12	10	0	0	0	32	0	0	0	0	0	0	0	0	0	0	0	0	0	14	0	0	0	0	98
31	Central Region	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	2	0	0	0	0	0	4	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	38
32	Western Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	114	0	0	0	0	0	0	0	0	100	0	0	84	0	0	0	51	0	349
33	Sekondi Takoradi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
34	Ashanti Region	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	414	0	0	0	0	0	0	0	0	489	0	0	329	1	0	0	62	0	1,300
35	Brong Ahafo Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	397	0	0	123	0	0	0	700	0	1,221
36	West of Northern Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	347	556	0	0	0	15	0	623	311	0	0	0	36	0	0	0	0	0	1,888
37	East of Northern Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	73	0	0	0	0	0	59	16	16	0	0	0	0	0	0	0	0	164
38	Upper West Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
39	Upper East Region	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	336	405	0	7	0	9	0	164	307	12	0	0	0	0	0	0	0	0	1,241
40	North of Volta Region	0	0	0	0	0	0	15	3	0	0	3	0	0	0	2	2	10	8	0	0	4	10	3	3	0	2	383	42	6	11	0	1	0	2	0	0	0	0	0	0	0	0	0	0	511
41	South of Togo	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	170	33	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	203
42	North of Togo	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
43	Burkina Faso, Niger & Mali	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	8	136	199	0	0	3	13	0	100	14	0	0	0	0	0	0	0	0	0	474
44	Cote d'Ivoire	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
Total		0	4	0	3	34	41	60	108	0	0	204	9	73	0	306	173	53	44	0	52	114	202	37	15	28	543	4,007	3,136	258	172	7	38	0	1,163	680	2,294	10	3	1,170	203	635	0	1,245	10	17,134

Source: Study Team

Appendix 4 Link Data of Road Network for Traffic Demand Forecast

Table A4-1 Link Data of Road Network for Traffic Demand Forecast (1)

No.	Corridor	Code	Node Name		Node No.		Distance (km)	Surface	Class	No. of Lane	Condition	Width (m)
			From	To	From	To						
1	Eastern	N2P-1	Tema Port	Tema Roundabout	27	73	6.2	Paved	National	2	Good	7.3
2	Eastern	N2P-2	Tema Roundabout	Afienya	73	72	13	Paved	National	2	Good	7.3
3	Eastern	N2P-3	Afienya	Doryum	72	71	10.2	Paved	National	2	Fair	7.3
4	Eastern	N2P-4	Doryum	Asutsuare Jct.	71	59	10.6	Paved	National	2	Fair	7.3
5	Eastern	N2P-5	Asutsuare Jct.	Akuse Jct.	59	67	12.9	Paved	National	2	Fair	7.5
6	Eastern	N2P-6	Akuse Jct.	Kpong	67	66	7.3	Paved	National	2	Fair	7.5
7	Eastern	N2P-7	Kpong	Atimpoku	66	7	10.0	Paved	National	2	Fair	7.5
8	Eastern	N2P-8	Atimpoku	Adome	7	52	4.2	Paved	National	2	Fair	7.5
9	Eastern	N2P-9	Adome	Juapong	52	53	1.5	Paved	National	2	Fair	7.5
10	Eastern	N2P-10	Juapong	Frankadua	53	54	10.3	Paved	National	2	Fair	7.4
11	Eastern	N2P-11	Frankadua	Osi-Abura	54	55	5.6	Paved	National	2	Fair	7.2
12	Eastern	N2P-12	Osi-Abura	Asikuma Jct.	55	8	4.9	Paved	National	2	Fair	7.2
13	Eastern	N2P-13	Asikuma Jct.	Dafor	8	20	23.0	Paved	National	2	Good	7.3
14	Eastern	N2P-14	Dafor	Fume	20	19	32.2	Paved	National	2	Good	7.3
15	Coastral	N1P-1	Aflao	Akatsi	41	26	51.6	Paved	National	2	Fair	7.8
16	Coastral	N1P-2	Akatsi	Sogakope	26	16	29.3	Paved	National	2	Fair	7.8
17	Coastral	N1P-3	Sogakope	Peterkope	16	65	8.4	Paved	National	2	Good	7.9
18	Coastral	N1P-4	Peterkope	Kase	65	18	11.2	Paved	National	2	Good	7.6
19	Coastral	N1P-5	Kase	Sege	18	62	17.9	Paved	National	2	Good	7.6
20	Coastral	N1P-6	Sege	Nyigbenya	62	17	19.0	Paved	National	2	Good	7.6
21	Coastral	N1P-7	Ode-Opeo	Dawhenya	17	61	28.9	Paved	National	2	Good	7.6
22	Coastral	N1P-8	Dawhenya	Tema Roundabout	61	73	12.4	Paved	National	2	Good	7.6
23	-	R28P-1	Sogakope	Adidome	16	6	20.3	Paved	Regional	2	Good	7.3
24	-	R28P-2	Adidome	Dadaboe	6	51	5.1	Paved	Regional	2	Good	7.3
25	-	R28P-3	Dadaboe	Kpedzeglo	51	49	12.1	Paved	Regional	2	Good	7.3
26	-	R28P-4	Kpedzeglo	Mafi Asiekpe	49	5	3.2	Paved	Regional	2	Good	7.3
27	-	R28G-5	Mafi Asiekpe	Tsrefe	5	12	29.4	Gravel	Regional	2	Good	7.3
28	-	R28G-6	Tsrefe	Ho	12	11	13.3	Gravel	Regional	2	Good	7.3
29	-	R28G-7	Ho	Fume	11	19	24.8	Gravel	Regional	2	Good	7.3
30	-	N5P-1	Asikuma	Dededu	8	9	5.7	Paved	National	2	Good	7.2
31	-	N5P-2	Dededu	Anyinawasi	9	10	17.9	Paved	National	2	Good	7.2
32	-	N5P-3	Anyinawasi	Sokode Gbogame	10	58	10.9	Paved	National	2	Fair	7.2
33	-	N5P-4	Sokode Gbogame	Ho	58	11	9.4	Paved	National	2	Fair	7.2
34	-	N3P-1	Kpong	Odumase	66	22	7.0	Paved	National	2	Fair	6.6
35	-	R21P-1	Atimpoku	Akosombo	7	21	14.2	Paved	Regional	2	Fair	7.1
36	-	R95G-1	Juapong	Padoe Dufo	53	45	8.3	Gravel	Regional	2	Fair	5.7
37	-	R95G-2	Padoe Dufo	Kpolukope	45	56	8.5	Gravel	Regional	2	Fair	5.7
38	-	R95G-3	Kpolukope	Abutia Kloe	56	57	19.8	Gravel	Regional	2	Fair	5.7
39	-	R95P-4	Abutia Kloe	Sokode Gbogame	57	58	11.8	Paved	Regional	2	Good	6.2
40	-	R13P-1	Prampram	Dawhenya	63	61	40.6	Paved	Regional	2	Poor	7.0
41	-	R13P-2	Dawhenya	Afienya	61	72	7.1	Paved	Regional	2	Poor	7.0
42	-	R13P-3	Afienya	Dodowa	72	25	15.6	Paved	Regional	2	Poor	7.0
43	-	R18P-1	Anyaman	Sege	63	62	9.3	Gravel	Regional	2	Good	7.0
44	-	R18P-2	Sege	Aveyime	62	15	17.2	Paved	Regional	2	Fair	7.0
45	-	R18P-3	Aveyime	Mepe	15	64	10.6	Paved	Regional	2	Fair	7.0
46	-	F1G-1	Mepe	Peterkope	64	65	15.6	Gravel	Feeder	2	n.a	n.a
47	-	R22P-1	Doryum	Ayikuma	71	24	18.7	Paved	Regional	2	Poor	7.0
48	-	R40P-1	Dodowa	Adenta	25	29	20.9	Paved	Regional	2	Fair	7.5
49	-	R30P-1	Odumase	Somanya	22	23	4.5	Paved	Regional	2	Fair	7.8
50	-	R10G-1	Aflao	Dzodze	41	70	43.6	Gravel	Regional	2	Fair	7.5
51	-	R10P-2	Dzodze	Kpetoe	70	69	24.1	Paved	Regional	2	Poor	7.0
52	-	R10P-3	Kpetoe	Ho	69	11	43.9	Paved	Regional	2	Poor	7.0
53	-	R12G-1	Akatsi	Dzodze	26	70	25.1	Gravel	Regional	2	Good	10.0
54	-	R14G-1	Akatsi	Kpetoe	26	69	38.5	Gravel	Regional	2	Poor	10.0
55	-	R11P-1	Kase	Adafoa	18	84	20.0	Paved	Regional	2	Poor	7.3
56	-	F2P-1	Somanya	Akuse Jct.	23	67	6.7	Paved	Feeder	2	Fair	n.a
57	-	F2P-2	Akuse Jct.	Kpong Dam Jct.	67	68	8.8	Paved	Feeder	2	Fair	n.a
58	-	F2P-3	Kpong Dam Jct.	Kagyanya	68	48	6.4	Paved	Feeder	2	Fair	n.a
59		F2P-4	Kagyanya	Asutsuare	48	13	2.3	Paved	Feeder	n.a	Fair	n.a
60	-	F3P-1	Kpong Dam Jct.	Ageteklekyi	68	46	8.9	Paved	Feeder	2	n.a	n.a
61	-	F3G-2	Ageteklekyi	Dokotsi	46	47	13.1	Gravel	Feeder	2	n.a	n.a
62	-	F4G-1	Ageteklekyi	Adome	46	52	12.7	Gravel	Feeder	2	n.a	n.a
63	-	F5G-1	Dadaboe	Agove	49	50	7.0	Gravel	Feeder	2	n.a	n.a
64	-	F5G-2	Agove	Kpedzeglo	50	51	8.8	Gravel	Feeder	2	n.a	n.a
65	-	F6G-1	Adidome	Volo	6	4	27.0	Gravel	Feeder	2	n.a	n.a
66	-	F6G-2	Volo	Dufor-Adidome	4	2	9.5	Gravel	Feeder	2	n.a	n.a
67	-	F7G-1	Osi-Abura	Kpolukope	55	56	5.1	Gravel	Feeder	1	n.a	n.a

Table A4-1 Link Data of Road Network for Traffic Demand Forecast (2)

No.	Corridor	Code	Node Name		Node No.		Distance (km)	Surface	Class	No. of Lane	Condition	Width (m)
			From	To	From	To						
68	-	T1E-1	Agove	Adidokpavui	50	3	20.0	Earth	Track	1	n.a	n.a
69	-	T1E-2	Adidokpavui	Kpomkpo	3	1	14.7	Earth	Track	1	n.a	n.a
70	Project	ALT_F8P-1	Asutsuare Jct.	Jerusalem	59	60	10.4	Paved	Feeder	2	n.a	n.a
71	Project	F8P-2	Jerusalem	Asutsuare	60	13	11.4	Paved	Feeder	2	n.a	n.a
72	Project	F8P-3	Asutsuare	Volivo	13	14	6.3	Paved	Feeder	2	n.a	n.a
73	Project	F10G-1	Dufor-Adidome	Dokotsi	47	2	6.1	Gravel	Feeder	2	n.a	n.a
74	Project	F10G-2	Dokotsi	Juapong	47	53	15.8	Gravel	Feeder	2	n.a	n.a
75	Project	F11G-1	Kpomkpo	Podoe-Dufo	1	45	4.2	Gravel	Feeder	2	n.a	n.a
76	Project	F11G-2	Podoe-Dufo	Frankadua	45	54	5.2	Gravel	Feeder	2	n.a	n.a
77	Project	ALT1_NC1-1	Jerusalem	Kagyanya	60	48	20.0	Paved	National	2	Fair	n.a
78	Project	ALT1_NC1-2	Kagyanya	Dokotsi	48	47	8.3	Paved	National	2	Fair	n.a
79	Project	ALT4_NC2-1	Jerusalem	Volivo	60	14	30.0	Paved	National	2	Fair	n.a
80	Project	ALT4_NC2-2	Volivo	Dufor-Adidome	14	2	1.9	Paved	National	2	Fair	n.a
81	Project	ALT4_NC2-3	Dufor-Adidome	Dokotsi	2	47	6.4	Paved	National	2	Fair	n.a
82	Project	ALT_NC3-1	Dokotsi	Kpomkpo	47	1	14.3	Paved	National	2	Fair	n.a
83	Project	ALT_NC3-2	Kpomkpo	Kpolukope	1	56	9.7	Paved	National	2	Fair	n.a
84	Project	ALT_NC3-3	Kpolukope	Asikuma Jct.	56	8	9.7	Paved	National	2	Fair	n.a
85	Project	ALT5_F11G-1	Volivo	Aveyime	14	15	18.7	Paved	National	2	Fair	n.a
86	Coastral	N1P-9	Tema Roundabout	Tetteh Quashie	73	74	19.2	Paved	National	2	Good	7.3
87	Coastral	N1P-10	Tetteh Quashie	Accra	74	28	5.9	Paved	National	2	Good	10.5
88	Coastral	N1P-11	Accra	Cape Coast	28	31	129.7	Paved	National	2	Good	8.9
89	Coastral	N1P-12	Cape Coast	Daboasi Jct.	31	32	58.8	Paved	National	2	Good	7.9
90	Coastral	N1P-13	Daboasi Jnc.	Takoradi Port	32	33	28.7	Paved	National	2	Fair	8.0
91	Coastral	N1P-14	Takoradi Port	Elubo	33	44	138.6	Paved	National	2	Good	7.6
92	Eastern	N2P-15	Fume	Nkwanta	19	40	231.1	Paved	National	2	Good	8.8
93	Eastern	N2G-16	Nkwanta	Yendi	40	37	95.1	Gravel	National	2	Fair	8.2
94	Eastern	N2P-17	Yendi	Sakpiegu	37	82	12.2	Paved	National	2	Good	7.3
95	Eastern	N2G-18	Sakpiegu	Misiga	82	81	193.9	Gravel	National	2	Fair	8.1
96	Eastern	N2G-19	Misiga	Kulungugu	81	80	10.7	Gravel	National	2	Poor	9.6
97	-	N14G-1	Sakpiegu	Yawgu	82	42	100.2	Gravel	National	2	Good	8.1
98	-	N3P-2	Odumase	Koforidua	22	30	46.4	Paved	National	2	Fair	7.0
99	-	N4P-1	Tetteh Quashie	Adenta	74	29	9.8	Paved	National	2	Poor	7.3
100	-	N4P-2	Adenta	Koforidua	29	30	73.3	Paved	National	2	Good	7.3
101	-	N4P-3	Koforidua	Bunso	30	75	27.5	Paved	National	2	Good	7.2
102	Central	N6G-1	Accra	Bunso	28	75	87.6	Gravel	National	2	Fair	7.5
103	Central	N6P-2	Bunso	Kumasi	75	34	150.6	Paved	National	2	Good	7.4
104	-	N6P-3	Kumasi	Sunyani	34	35	122.8	Paved	National	2	Fair	7.8
105	-	N8P-1	Cape Coast	Anwiankwantsa	31	76	174.1	Paved	National	2	Fair	7.3
106	-	N10G-1	Daboasi Jct.	Anwiankwantsa	32	76	189.1	Gravel	National	2	Fair	8.1
107	-	N10P-2	Anwiankwantsa	Kumasi	76	34	45.0	Paved	National	2	Good	7.5
108	Central	N10P-3	Kumasi	Fufulsu Jct.	34	77	307.9	Paved	National	2	Good	8.3
109	Central	N10P-4	Fufulsu Jct.	Tamale	77	36	59.1	Paved	National	2	Poor	7.3
110	Central	N10P-5	Tamale	Bolgatanga	36	39	160.6	Paved	National	2	Fair	7.5
111	Central	N10P-6	Bolgatanga	Navrongo	39	79	30.3	Paved	National	2	Fair	7.3
112	Central	N10P-7	Navrongo	Paga	79	43	12.7	Paved	National	2	Fair	6.9
113	-	N11P-1	Bolgatanga	Misiga	39	81	83.5	Paved	National	2	Poor	7.7
114	Western	N12G-1	Elubo	Sunyani	44	35	322.9	Gravel	National	2	Poor	8.4
115	Western	N12P-2	Sunyani	Sawla	35	78	253.3	Paved	National	2	Good	7.9
116	Western	N12P-3	Sawla	Wa	78	38	95.2	Paved	National	2	Good	7.6
117	Western	N12P-4	Wa	Dowene	38	83	74.4	Paved	National	2	Good	8.3
118	-	N7G-1	Fufulsu Jct.	Sawla	77	78	147.7	Gravel	National	2	Poor	8.0
119	-	N13G-1	Navrongo	Dowene	79	83	157.4	Gravel	National	2	Poor	8.5
120	-	R201P-1	Yendi	Tamale	37	36	92.7	Paved	Regional	2	Fair	7.7
121	-	N4P-5	Mamfe	Koforidua	24	30	34.8	Paved	National	2	Fair	7.6
122	-	N4P-6	Mamfe	Adenta	24	29	31.32	Paved	National	2	Fair	7.6

Source: GHA Road Condition Survey, GHA
Lands Commision Topographical Map

Appendix 5 Results of Route Assignment

Table A5-1 Results of Route Assignment in 2016 (1)

(Unit: Vehicles)

Link No.	Corridor	Node Name		Passenger Car/ Pick-up	Minibus	Bus	Medium Truck	Heavy Truck	Trailer	Others	Total	CVR*
1	Eastern	Tema Port	Tema Roundabout	11,785	3,365	1,025	1,425	890	3,015	860	22,365	25.9%
2	Eastern	Tema Roundabout	Afienya	4,196	1,748	496	638	343	1,124	346	8,891	26.0%
3	Eastern	Afienya	Doryum	4,796	2,197	405	741	447	1,288	484	10,358	25.3%
4	Eastern	Doryum	Asutsuare Jct.	2,843	2,241	470	740	502	1,363	491	8,650	32.7%
5	Eastern	Asutsuare Jct.	Akuse Jct.	1,489	916	113	217	92	122	4	2,953	11.2%
6	Eastern	Akuse Jct.	Kpong	1,469	1,898	205	312	44	99	5	4,032	8.8%
7	Eastern	Kpong	Atimpoku	2,142	3,081	165	283	38	64	12	5,785	4.8%
8	Eastern	Atimpoku	Adome	2,070	1,945	130	236	46	42	13	4,482	5.2%
9	Eastern	Adome	Juapong	2,070	1,945	130	236	46	42	13	4,482	5.2%
10	Eastern	Juapong	Frankadua	2,029	1,936	130	234	46	35	12	4,422	5.0%
11	Eastern	Frankadua	Osi-Abura	2,029	1,936	130	234	46	35	12	4,422	5.0%
12	Eastern	Osi-Abura	Asikuma Jct.	2,029	1,936	130	234	46	35	12	4,422	5.0%
13	Eastern	Asikuma Jct.	Dafor	1,818	2,200	368	488	279	1,115	491	6,759	33.3%
14	Eastern	Dafor	Fume	1,440	2,010	346	453	259	1,110	491	6,109	36.1%
15	Coastral	Aflao	Akatsi	440	20	130	10	45	320	75	1,040	54.8%
16	Coastral	Akatsi	Sogakope	2,665	2,520	380	285	130	570	75	6,625	17.4%
17	Coastral	Sogakope	Peterkope	4,050	3,367	552	527	297	1,330	341	10,464	24.1%
18	Coastral	Peterkope	Kase	4,107	2,736	369	483	282	1,254	340	9,571	23.5%
19	Coastral	Kase	Sege	3,925	2,423	264	434	252	1,231	340	8,869	23.5%
20	Coastral	Sege	Nyigbenya	2,247	1,448	374	391	356	867	182	5,865	30.3%
21	Coastral	Ode-Opeo	Dawhenya	2,334	1,454	376	395	358	876	182	5,975	30.0%
22	Coastral	Dawhenya	Tema Roundabout	5,782	2,114	288	517	436	1,576	487	11,200	24.9%
23	-	Sogakope	Adidome	1,767	618	173	296	162	740	265	4,021	33.3%
24	-	Adidome	Dadaboe	1,009	537	172	251	150	738	265	3,122	42.4%
25	-	Dadaboe	Kpedzeglo	1,009	537	172	251	150	738	265	3,122	42.4%
26	-	Kpedzeglo	Mafi Asiekpe	1,009	537	172	251	150	738	265	3,122	42.4%
27	-	Mafi Asiekpe	Tsrefe	816	511	172	213	150	738	265	2,865	46.2%
28	-	Tsrefe	Ho	816	519	172	213	142	738	265	2,865	46.0%
29	-	Ho	Fume	350	301	139	144	136	710	265	2,045	61.1%
30	-	Asikuma Jct.	Dededu	1,363	1,629	110	182	33	47	0	3,364	5.6%
31	-	Dededu	Anyinawasi	1,363	1,629	110	182	33	47	0	3,364	5.6%
32	-	Anyinawasi	Sokode Gbogame	1,363	1,629	110	182	38	47	0	3,369	5.8%
33	-	Sokode Gbogame	Ho	1,363	1,629	110	182	38	47	0	3,369	5.8%
34	-	Kpong	Odumase	2,983	4,814	331	486	83	103	8	8,808	6.0%
35	-	Atimpoku	Akosombo	1,085	1,825	55	115	15	25	10	3,130	3.4%
36	-	Juapong	Padoe Dufo	43	8	0	2	0	7	1	61	13.1%
37	-	Padoe Dufo	Kpolukope	0	0	0	0	0	0	0	0	-
38	-	Kpolukope	Abutia Kloe	0	0	0	0	0	0	0	0	-
39	-	Abutia Kloe	Sokode Gbogame	0	0	0	0	0	0	0	0	-
40	-	Prampram	Dawhenya	1,793	1,497	0	125	0	471	160	4,046	15.6%
41	-	Dawhenya	Afienya	3,788	1,053	134	193	126	520	146	5,960	15.5%
42	-	Afienya	Dodowa	4,692	1,045	623	340	232	544	38	7,514	19.1%
43	-	Anyaman	Sege	1,793	1,497	0	125	0	471	160	4,046	15.6%
44	-	Sege	Aveyime	1,992	825	119	219	126	106	2	3,389	10.4%
45	-	Aveyime	Mepe	924	704	184	78	23	77	0	1,990	14.3%
46	-	Mepe	Peterkope	924	704	184	78	23	77	0	1,990	14.3%
47	-	Doryum	Ayikuma	3,271	2,201	305	524	61	123	8	6,493	7.7%
48	-	Dodowa	Adenta	4,704	1,050	623	345	232	547	38	7,539	19.1%
49	-	Odumase	Somanya	1,553	4,074	142	230	96	101	5	6,201	5.5%
50	-	Aflao	Dzodze	0	0	0	0	0	0	0	0	-
51	-	Dzodze	Kpetoe	0	0	0	0	0	0	0	0	-
52	-	Kpetoe	Ho	0	0	0	0	0	0	0	0	-
53	-	Akatsi	Dzodze	0	0	0	0	0	0	0	0	-
54	-	Akatsi	Kpetoe	0	0	0	0	0	0	0	0	-
55	-	Kase	Adafoa	0	0	0	0	0	0	0	0	-
56	-	Somanya	Akuse Jct.	1,190	875	101	178	92	101	4	2,541	11.7%
57	-	Akuse Jct.	Kpong Dam Jct.	1,155	1,368	147	213	68	88	3	3,042	10.1%
58	-	Kpong Dam Jct.	Kagyanya	1,120	1,861	193	247	44	75	2	3,542	8.9%
59	-	Kagyanya	Asutsuare	1,120	1,861	193	247	44	75	2	3,542	8.9%
60	-	Kpong Dam Jct.	Ageteklekyi	110	1	0	26	0	0	0	137	0.0%
61	-	Ageteklekyi	Dokotsi	110	1	0	26	0	0	0	137	0.0%
62	-	Ageteklekyi	Adome	0	0	0	0	0	0	0	0	-
63	-	Dadaboe	Agove	0	0	0	0	0	0	0	0	-

Table A5-1 Results of Route Assignment in 2016 (2)

(Unit: Vehicles)

Link No.	Corridor	Node Name		Passenger Car/ Pick-up	Minibus	Bus	Medium Truck	Heavy Truck	Trailer	Others	Total	CVR*
64	-	Agove	Kpedzeglo	0	0	0	0	0	0	0	0	-
65	-	Adidome	Volo	253	36	0	38	0	0	0	327	0.0%
66	-	Volo	Dufor-Adidome	249	21	0	36	0	0	0	306	0.0%
67	-	Osi-Abura	Kpolukope	0	0	0	0	0	0	0	0	-
68	-	Agove	Adidokpavui	0	0	0	0	0	0	0	0	-
69	-	Adidokpavui	Kpomkpo	0	0	0	0	0	0	0	0	-
70	Project	Asutsuare Jct.	Jerusalem	2,531	2,379	524	565	472	1,264	486	8,221	33.4%
71	Project	Jerusalem	Asutsuare	152	23	30	25	15	39	0	284	29.6%
72	Project	Asutsuare	Volivo	1,078	1,848	183	218	45	86	2	3,460	9.1%
73	Project	Dufor-Adidome	Dokotsi	0	0	0	0	0	0	0	0	-
74	Project	Dokotsi	Juapong	0	0	0	0	0	0	0	0	-
75	Project	Kpomkpo	Podoe-Dufo	43	8	0	2	0	7	1	61	13.1%
76	Project	Podoe-Dufo	Frankadua	0	0	0	0	0	0	0	0	-
77	Project	Jerusalem	Kagyanya	0	0	0	0	0	0	0	0	-
78	Project	Kagyanya	Dokotsi	0	0	0	0	0	0	0	0	-
79	Project	Jerusalem	Volivo	2,380	2,358	496	542	457	1,223	486	7,942	33.5%
80	Project	Volivo	Dufor-Adidome	2,315	2,957	386	582	311	1,139	487	8,177	28.4%
81	Project	Dufor-Adidome	Dokotsi	2,280	2,938	386	598	311	1,134	487	8,134	28.5%
82	Project	Dokotsi	Kpomkpo	2,170	2,937	386	572	311	1,134	487	7,997	29.0%
83	Project	Kpomkpo	Kpolukope	2,129	2,928	386	570	311	1,127	486	7,937	29.1%
84	Project	Kpolukope	Asikuma Jct.	2,129	2,928	386	570	311	1,127	486	7,937	29.1%
85	Project	Volivo	Aveyime	1,716	1,478	371	234	225	189	3	4,216	18.7%
86	Coastral	Tema Roundabout	Tetteh Quashie	5,673	2,156	555	572	219	616	42	9,833	14.6%
87	Coastral	Tetteh Quashie	Accra	10,543	4,650	1,330	1,383	536	1,215	95	19,752	16.1%
88	Coastral	Accra	Cape Coast	58	15	0	20	16	45	55	209	55.5%
89	Coastral	Cape Coast	Daboasi Jct.	6	0	0	0	10	30	55	101	94.1%
90	Coastral	Daboasi Jnc.	Takoradi Port	26	0	0	0	10	15	5	56	53.6%
91	Coastral	Takoradi Port	Elubo	26	0	0	0	10	15	5	56	53.6%
92	Eastern	Fume	Nkwanta	1,769	2,311	485	597	395	1,820	755	8,132	42.5%
93	Eastern	Nkwanta	Yendi	447	66	180	333	329	1,765	675	3,795	77.7%
94	Eastern	Yendi	Sakpiegu	15	0	0	0	0	0	0	15	0.0%
95	Eastern	Sakpiegu	Misiga	0	0	0	0	0	0	0	0	-
96	Eastern	Misiga	Kulungugu	0	0	0	0	0	0	0	0	-
97	-	Sakpiegu	Yawgu	15	0	0	0	0	0	0	15	0.0%
98	-	Odumase	Koforidua	3,047	3,484	388	457	111	111	17	7,615	8.2%
99	-	Tetteh Quashie	Adenta	6,942	3,277	921	909	324	638	53	13,064	14.8%
100	-	Adenta	Koforidua	1,317	1,030	0	0	0	0	0	2,347	0.0%
101	-	Koforidua	Bunso	0	4	10	13	11	0	0	38	55.3%
102	Central	Accra	Bunso	0	0	0	0	0	0	0	0	-
103	Central	Bunso	Kumasi	0	4	10	13	11	0	0	38	55.3%
104	-	Kumasi	Sunyani	245	146	205	233	109	245	235	1,418	56.0%
105	-	Cape Coast	Anwiankwantsa	0	0	0	0	0	0	0	0	-
106	-	Daboasi Jct.	Anwiankwantsa	0	0	0	0	0	0	0	0	-
107	-	Anwiankwantsa	Kumasi	0	0	0	0	0	0	0	0	-
108	Central	Kumasi	Fufulsu Jct.	0	0	0	0	0	0	0	0	-
109	Central	Fufulsu Jct.	Tamale	571	264	217	305	122	281	226	1,986	42.6%
110	Central	Tamale	Bolgatanga	90	18	57	148	239	1,391	456	2,399	89.3%
111	Central	Bolgatanga	Navrongo	70	27	34	115	221	1,363	444	2,274	90.7%
112	Central	Navrongo	Paga	20	0	20	110	240	1,370	455	2,215	94.1%
113	-	Bolgatanga	Misiga	0	0	0	0	0	0	0	0	-
114	Western	Elubo	Sunyani	26	0	0	0	4	15	5	50	48.0%
115	Western	Sunyani	Sawla	467	291	255	334	156	300	245	2,048	46.7%
116	Western	Sawla	Wa	190	27	51	38	31	19	19	375	32.0%
117	Western	Wa	Dowene	50	27	46	34	31	19	19	226	50.9%
118	-	Fufulsu Jct.	Sawla	571	264	217	305	122	281	226	1,986	42.6%
119	-	Navrongo	Dowene	50	27	46	34	31	19	19	226	50.9%
120	-	Yendi	Tamale	432	66	160	334	324	1,770	675	3,761	77.9%
121	-	Mamfe	Koforidua	1,482	1,740	282	295	64	85	17	3,965	11.3%
122	-	Mamfe	Adenta	4,629	3,895	587	798	125	208	24	10,266	9.2%

Note: CVR – Commercial Vehicle Ratio

Source: Study Team

Table A5-2 Results of Route Assignment in 2026 (1)

(Unit: Vehicles)

Link No.	Corridor	Node Name		Passenger Car/ Pick-up	Minibus	Bus	Medium Truck	Heavy Truck	Trailer	Others	Total	CVR*
1	Eastern	Tema Port	Tema Roundabout	15,205	4,355	1,315	1,545	1,080	4,190	1,230	28,920	27.0%
2	Eastern	Tema Roundabout	Afienya	4,159	1,777	340	442	207	2,044	623	9,592	33.5%
3	Eastern	Afienya	Doryum	3,250	1,751	591	661	429	2,565	842	10,089	43.9%
4	Eastern	Doryum	Asutsuare Jct.	4,475	2,692	351	575	433	1,844	802	11,172	30.7%
5	Eastern	Asutsuare Jct.	Akuse Jct.	2,434	623	23	155	53	648	393	4,329	25.8%
6	Eastern	Akuse Jct.	Kpong	1,479	2,786	321	344	155	185	23	5,293	12.9%
7	Eastern	Kpong	Atimpoku	2,157	4,112	337	383	38	126	30	7,183	7.4%
8	Eastern	Atimpoku	Adome	2,223	2,653	297	351	44	118	34	5,720	8.6%
9	Eastern	Adome	Juapong	2,866	2,653	297	351	44	118	34	6,363	7.7%
10	Eastern	Juapong	Frankadua	2,737	2,635	292	331	44	102	30	6,171	7.6%
11	Eastern	Frankadua	Osi-Abura	2,737	2,635	292	331	44	102	30	6,171	7.6%
12	Eastern	Osi-Abura	Asikuma Jct.	2,737	2,635	292	331	44	102	30	6,171	7.6%
13	Eastern	Asikuma Jct.	Dafor	1,469	1,826	435	463	299	1,660	678	6,830	45.0%
14	Eastern	Dafor	Fume	1,035	1,581	406	429	281	1,655	678	6,065	49.8%
15	Coastral	Aflao	Akatsi	558	27	185	10	65	495	105	1,445	58.8%
16	Coastral	Akatsi	Sogakope	3,285	3,073	510	315	155	770	110	8,218	18.8%
17	Coastral	Sogakope	Peterkope	4,636	3,527	577	655	449	1,468	334	11,646	24.3%
18	Coastral	Peterkope	Kase	5,214	2,962	518	684	504	1,445	332	11,659	24.0%
19	Coastral	Kase	Sege	4,560	2,502	380	587	462	1,427	332	10,250	25.4%
20	Coastral	Sege	Nyigbenya	2,149	2,947	272	572	409	713	128	7,190	21.2%
21	Coastral	Ode-Opeo	Dawhenya	2,300	2,953	271	565	408	730	128	7,355	20.9%
22	Coastral	Dawhenya	Tema Roundabout	4,906	2,537	528	804	755	1,810	592	11,932	30.9%
23	-	Sogakope	Adidome	2,632	1,712	298	452	313	821	227	6,455	25.7%
24	-	Adidome	Dadaboe	1,245	786	155	325	208	742	226	3,687	36.1%
25	-	Dadaboe	Kpedzeglo	1,245	785	155	325	208	742	226	3,686	36.1%
26	-	Kpedzeglo	Mafi Asiekpe	1,245	785	155	325	208	742	226	3,686	36.1%
27	-	Mafi Asiekpe	Tsrefe	995	726	155	265	208	742	226	3,317	40.1%
28	-	Tsrefe	Ho	995	736	155	265	199	742	226	3,318	39.8%
29	-	Ho	Fume	893	850	110	182	176	699	225	3,135	38.6%
30	-	Asikuma Jct.	Dededu	2,588	2,754	154	183	35	52	0	5,766	4.2%
31	-	Dededu	Anyinawasi	2,588	2,754	154	183	35	52	0	5,766	4.2%
32	-	Anyinawasi	Sokode Gbogame	2,588	2,754	154	183	38	52	0	5,769	4.2%
33	-	Sokode Gbogame	Ho	2,588	2,754	154	183	38	52	0	5,769	4.2%
34	-	Kpong	Odumase	2,813	6,174	631	637	293	201	12	10,761	10.6%
35	-	Atimpoku	Akosombo	1,395	2,345	75	135	15	20	10	3,995	3.0%
36	-	Juapong	Padoe Dufo	129	18	6	21	0	16	4	194	13.4%
37	-	Padoe Dufo	Kpolukope	0	0	0	0	0	0	0	0	-
38	-	Kpolukope	Abutia Kloe	0	0	0	0	0	0	0	0	-
39	-	Abutia Kloe	Sokode Gbogame	0	0	0	0	0	0	0	0	-
40	-	Prampram	Dawhenya	3,013	217	142	132	179	774	248	4,705	28.5%
41	-	Dawhenya	Afienya	2,744	1,338	411	407	218	699	216	6,033	25.6%
42	-	Afienya	Dodowa	5,206	2,576	450	387	124	305	21	9,069	9.9%
43	-	Anyaman	Sege	3,013	217	142	132	179	774	248	4,705	28.5%
44	-	Sege	Aveyime	2,608	999	39	236	145	59	45	4,131	7.0%
45	-	Aveyime	Mepe	1,907	856	61	65	69	135	4	3,097	8.7%
46	-	Mepe	Peterkope	1,907	856	61	65	69	135	4	3,097	8.7%
47	-	Doryum	Ayikuma	3,502	1,752	520	400	124	848	64	7,210	21.6%
48	-	Dodowa	Adenta	5,231	2,597	450	399	124	314	21	9,136	9.9%
49	-	Odumase	Somanya	2,667	5,443	60	185	52	181	176	8,764	5.4%
50	-	Aflao	Dzodze	47	2	0	0	0	0	0	49	0.0%
51	-	Dzodze	Kpetoe	245	227	0	0	0	0	0	472	0.0%
52	-	Kpetoe	Ho	245	227	0	0	0	0	0	472	0.0%
53	-	Akatsi	Dzodze	198	225	0	0	0	0	0	423	0.0%
54	-	Akatsi	Kpetoe	0	0	0	0	0	0	0	0	-
55	-	Kase	Adafoa	0	0	0	0	0	0	0	0	-
56	-	Somanya	Akuse Jct.	2,261	1,713	13	136	56	181	176	4,536	9.4%
57	-	Akuse Jct.	Kpong Dam Jct.	1,292	1,183	12	35	3	467	217	3,209	21.8%
58	-	Kpong Dam Jct.	Kagyanya	1,392	1,787	151	238	72	102	132	3,874	11.8%
59	-	Kagyanya	Asutsuare	1,392	1,787	151	238	72	102	132	3,874	11.8%
60	-	Kpong Dam Jct.	Ageteklekyi	643	1,559	161	89	136	43	0	2,631	12.9%
61	-	Ageteklekyi	Dokotsi	0	1,559	161	89	136	43	0	1,988	17.1%
62	-	Ageteklekyi	Adome	643	0	0	0	0	0	0	643	0.0%
63	-	Dadaboe	Agove	0	0	0	0	0	0	0	0	-

Table A5-2 Results of Route Assignment in 2026 (2)

(Unit: Vehicles)

Link No.	Corridor	Node Name		Passenger Car/ Pick-up	Minibus	Bus	Medium Truck	Heavy Truck	Trailer	Others	Total	CVR*
64	-	Agove	Kpedzeglo	0	1	0	0	0	0	0	1	0.0%
65	-	Adidome	Volo	701	878	141	120	89	75	1	2,005	15.3%
66	-	Volo	Dufor-Adidome	696	858	141	118	89	75	1	1,978	15.5%
67	-	Osi-Abura	Kpolukope	0	0	0	0	0	0	0	0	-
68	-	Agove	Adidokpavui	0	1	0	0	0	0	0	1	0.0%
69	-	Adidokpavui	Kpomkpo	0	1	0	0	0	0	0	1	0.0%
70	Project	Asutsuare Jct.	Jerusalem	3,998	2,404	336	431	448	1,760	565	9,942	31.3%
71	Project	Jerusalem	Asutsuare	184	33	24	26	10	45	0	322	24.5%
72	Project	Asutsuare	Volivo	1,409	1,777	110	211	57	112	132	3,808	10.8%
73	Project	Dufor-Adidome	Dokotsi	0	0	0	0	0	0	0	0	-
74	Project	Dokotsi	Juapong	0	0	0	0	0	0	0	0	-
75	Project	Kpomkpo	Podoe-Dufo	129	18	6	21	0	16	4	194	13.4%
76	Project	Podoe-Dufo	Frankadua	0	0	0	0	0	0	0	0	-
77	Project	Jerusalem	Kagyanya	0	0	0	0	0	0	0	0	-
78	Project	Kagyanya	Dokotsi	0	0	0	0	0	0	0	0	-
79	Project	Jerusalem	Volivo	3,814	2,371	312	405	436	1,717	565	9,620	31.5%
80	Project	Volivo	Dufor-Adidome	3,403	2,822	368	496	380	1,691	656	9,816	31.5%
81	Project	Dufor-Adidome	Dokotsi	2,702	3,379	508	590	470	1,668	657	9,974	33.1%
82	Project	Dokotsi	Kpomkpo	2,702	3,295	348	502	333	1,626	657	9,463	31.3%
83	Project	Kpomkpo	Kpolukope	2,573	3,278	343	481	333	1,610	653	9,271	31.7%
84	Project	Kpolukope	Asikuma Jct.	2,573	3,278	343	481	333	1,610	653	9,271	31.7%
85	Project	Volivo	Aveyime	2,989	1,779	192	206	242	201	49	5,658	12.1%
86	Coastral	Tema Roundabout	Tetteh Quashie	9,155	3,086	819	768	197	600	39	14,664	11.3%
87	Coastral	Tetteh Quashie	Accra	13,564	7,305	1,720	1,600	583	1,315	105	26,192	14.2%
88	Coastral	Accra	Cape Coast	64	20	0	15	23	50	45	217	54.4%
89	Coastral	Cape Coast	Daboasi Jct.	16	0	0	0	17	25	45	103	84.5%
90	Coastral	Daboasi Jnc.	Takoradi Port	38	0	0	0	17	20	5	80	52.5%
91	Coastral	Takoradi Port	Elubo	38	0	0	0	17	20	5	80	52.5%
92	Eastern	Fume	Nkwanta	1,845	2,427	511	610	455	2,352	904	9,104	46.4%
93	Eastern	Nkwanta	Yendi	819	660	276	438	407	2,310	829	5,739	66.6%
94	Eastern	Yendi	Sakpiegu	20	356	5	5	0	0	0	386	1.3%
95	Eastern	Sakpiegu	Misiga	0	356	0	0	0	0	0	356	0.0%
96	Eastern	Misiga	Kulungugu	0	0	0	0	0	0	0	0	-
97	-	Sakpiegu	Yawgu	20	0	5	5	0	0	0	30	16.7%
98	-	Odumase	Koforidua	3,517	5,169	595	551	272	273	193	10,570	12.6%
99	-	Tetteh Quashie	Adenta	10,509	5,865	1,339	1,063	401	856	66	20,099	13.2%
100	-	Adenta	Koforidua	1,779	2,008	236	254	70	137	14	4,498	10.2%
101	-	Koforidua	Bunso	458	613	129	155	113	588	226	2,282	46.3%
102	Central	Accra	Bunso	0	0	0	0	0	0	0	0	-
103	Central	Bunso	Kumasi	458	613	129	155	113	588	226	2,282	46.3%
104	-	Kumasi	Sunyani	341	773	369	405	209	751	394	3,242	53.1%
105	-	Cape Coast	Anwiankwantsa	0	0	0	0	0	0	0	0	-
106	-	Daboasi Jct.	Anwiankwantsa	0	0	0	0	0	0	0	0	-
107	-	Anwiankwantsa	Kumasi	0	0	0	0	0	0	0	0	-
108	Central	Kumasi	Fufulsu Jct.	502	6	0	0	0	0	0	508	0.0%
109	Central	Fufulsu Jct.	Tamale	1,094	548	388	458	143	288	249	3,168	33.7%
110	Central	Tamale	Bolgatanga	124	53	81	199	332	1,992	611	3,392	88.9%
111	Central	Bolgatanga	Navrongo	85	416	30	133	301	1,946	587	3,498	81.9%
112	Central	Navrongo	Paga	30	0	30	170	405	2,440	745	3,820	94.8%
113	-	Bolgatanga	Misiga	0	356	0	0	0	0	0	356	0.0%
114	Western	Elubo	Sunyani	38	0	0	0	2	20	5	65	41.5%
115	Western	Sunyani	Sawla	526	955	431	517	251	791	413	3,884	48.6%
116	Western	Sawla	Wa	228	416	53	66	109	503	164	1,539	53.9%
117	Western	Wa	Dowene	55	416	48	61	109	503	164	1,356	60.8%
118	-	Fufulsu Jct.	Sawla	592	542	388	458	143	288	249	2,660	40.2%
119	-	Navrongo	Dowene	55	416	48	61	109	503	164	1,356	60.8%
120	-	Yendi	Tamale	813	304	258	456	406	2,324	829	5,390	70.8%
121	-	Mamfe	Koforidua	1,933	2,455	279	277	103	699	63	5,809	19.7%
122	-	Mamfe	Adenta	5,105	4,149	800	653	227	459	41	11,434	13.4%

Note: CVR – Commercial Vehicle Ratio

Source: Study Team

Table A5-3 Results of Route Assignment in 2036 (1)

(Unit: Vehicles)

Link No.	Corridor	Node Name		Passenger Car/ Pick-up	Minibus	Bus	Medium Truck	Heavy Truck	Trailer	Others	Total	CVR*
1	Eastern	Tema Port	Tema Roundabout	17,300	4,975	1,490	2,145	1,465	4,930	1,615	33,920	28.0%
2	Eastern	Tema Roundabout	Afienya	4,570	1,869	438	607	511	2,008	835	10,838	35.0%
3	Eastern	Afienya	Doryum	3,808	2,410	374	683	514	2,700	1,103	11,592	40.5%
4	Eastern	Doryum	Asutsuare Jct.	4,532	3,111	399	644	545	2,071	847	12,149	31.8%
5	Eastern	Asutsuare Jct.	Akuse Jct.	1,747	1,251	24	195	16	129	1	3,363	5.1%
6	Eastern	Akuse Jct.	Kpong	3,912	2,635	378	308	111	118	0	7,462	8.1%
7	Eastern	Kpong	Atimpoku	3,403	4,418	308	374	39	50	9	8,601	4.7%
8	Eastern	Atimpoku	Adome	3,447	2,761	256	304	47	37	15	6,867	5.2%
9	Eastern	Adome	Juapong	4,112	3,525	256	304	47	37	15	8,296	4.3%
10	Eastern	Juapong	Frankadua	3,837	3,511	256	303	47	26	11	7,991	4.3%
11	Eastern	Frankadua	Osi-Abura	3,837	3,511	256	303	47	26	11	7,991	4.3%
12	Eastern	Osi-Abura	Asikuma Jct.	3,902	3,560	294	346	154	889	65	9,210	15.2%
13	Eastern	Asikuma Jct.	Dafor	1,575	1,633	423	415	384	1,920	837	7,187	49.6%
14	Eastern	Dafor	Fume	1,104	1,381	399	378	366	1,915	837	6,380	55.1%
15	Coastral	Aflao	Akatsi	730	31	188	4	74	559	170	1,756	56.4%
16	Coastral	Akatsi	Sogakope	3,988	3,405	507	296	172	805	174	9,347	17.7%
17	Coastral	Sogakope	Peterkope	4,989	4,381	590	562	261	1,274	446	12,503	20.6%
18	Coastral	Peterkope	Kase	5,476	4,095	508	606	336	1,227	446	12,694	19.8%
19	Coastral	Kase	Sege	4,730	3,534	374	508	296	1,238	446	11,126	21.2%
20	Coastral	Sege	Nyigbenya	2,201	2,086	312	465	524	1,062	138	6,788	30.0%
21	Coastral	Ode-Opeo	Dawhenya	2,420	2,099	314	471	555	1,085	138	7,082	29.5%
22	Coastral	Dawhenya	Tema Roundabout	4,286	2,749	263	645	630	2,379	720	11,672	34.2%
23	-	Sogakope	Adidome	2,898	1,288	150	282	89	434	273	5,414	17.5%
24	-	Adidome	Dadaboe	1,761	1,144	123	252	63	432	273	4,048	22.0%
25	-	Dadaboe	Kpedzeglo	1,761	1,144	123	252	63	432	273	4,048	22.0%
26	-	Kpedzeglo	Mafi Asiekpe	1,761	1,144	123	252	63	432	273	4,048	22.0%
27	-	Mafi Asiekpe	Tsrefe	1,484	1,120	123	195	63	432	273	3,690	24.1%
28	-	Tsrefe	Ho	1,484	1,130	123	195	54	432	273	3,691	23.9%
29	-	Ho	Fume	657	753	58	78	103	647	279	2,575	42.2%
30	-	Asikuma Jct.	Dededu	3,435	3,553	343	388	166	448	12	8,345	11.6%
31	-	Dededu	Anyinawasi	3,435	3,553	343	388	166	448	12	8,345	11.6%
32	-	Anyinawasi	Sokode Gbogame	3,435	3,553	343	388	169	448	12	8,348	11.6%
33	-	Sokode Gbogame	Ho	3,653	3,553	343	388	169	448	12	8,566	11.3%
34	-	Kpong	Odumase	3,950	5,889	552	498	203	231	13	11,336	8.8%
35	-	Atimpoku	Akosombo	1,575	2,650	80	165	20	25	10	4,525	3.0%
36	-	Juapong	Padoe Dufo	271	12	0	3	0	11	4	301	5.0%
37	-	Padoe Dufo	Kpolukope	218	0	0	0	0	0	0	218	0.0%
38	-	Kpolukope	Abutia Kloe	218	0	0	0	0	0	0	218	0.0%
39	-	Abutia Kloe	Sokode Gbogame	218	0	0	0	0	0	0	218	0.0%
40	-	Prampram	Dawhenya	2,580	1,575	11	90	117	644	308	5,325	20.3%
41	-	Dawhenya	Afienya	1,579	1,262	133	233	432	1,550	274	5,463	43.7%
42	-	Afienya	Dodowa	4,035	3,005	515	429	125	318	24	8,451	11.6%
43	-	Anyaman	Sege	2,580	1,575	11	90	117	644	308	5,325	20.3%
44	-	Sege	Aveyime	2,581	689	119	211	385	508	6	4,499	22.6%
45	-	Aveyime	Mepe	1,487	611	109	140	96	116	1	2,560	12.6%
46	-	Mepe	Peterkope	1,487	611	109	140	96	116	1	2,560	12.6%
47	-	Doryum	Ayikuma	3,879	2,369	291	305	82	738	288	7,952	17.6%
48	-	Dodowa	Adenta	4,063	3,025	515	444	125	328	24	8,524	11.6%
49	-	Odumase	Somanya	2,709	5,757	298	357	120	205	8	9,454	6.7%
50	-	Aflao	Dzodze	29	4	47	1	1	26	0	108	68.5%
51	-	Dzodze	Kpetoe	150	396	103	43	8	70	1	771	23.6%
52	-	Kpetoe	Ho	150	396	103	43	8	70	1	771	23.6%
53	-	Akatsi	Dzodze	121	391	56	42	7	44	1	662	16.3%
54	-	Akatsi	Kpetoe	0	0	0	0	0	0	0	0	-
55	-	Kase	Adafoa	0	0	0	0	0	0	0	0	-
56	-	Somanya	Akuse Jct.	2,131	1,956	250	316	121	205	6	4,985	11.7%
57	-	Akuse Jct.	Kpong Dam Jct.	2,586	1,688	250	199	54	266	6	5,049	11.4%
58	-	Kpong Dam Jct.	Kagyanya	1,885	2,050	308	261	83	172	1	4,760	11.8%
59	-	Kagyanya	Asutsuare	1,885	2,050	308	261	83	172	1	4,760	11.8%
60	-	Kpong Dam Jct.	Ageteklekyi	1,114	1,080	196	128	85	129	2	2,734	15.1%
61	-	Ageteklekyi	Dokotsi	449	317	196	128	85	129	2	1,306	31.5%
62	-	Ageteklekyi	Adome	666	763	0	0	0	0	0	1,429	0.0%
63	-	Dadaboe	Agove	0	0	0	0	0	0	0	0	-

Table A5-3 Results of Route Assignment in 2036 (2)

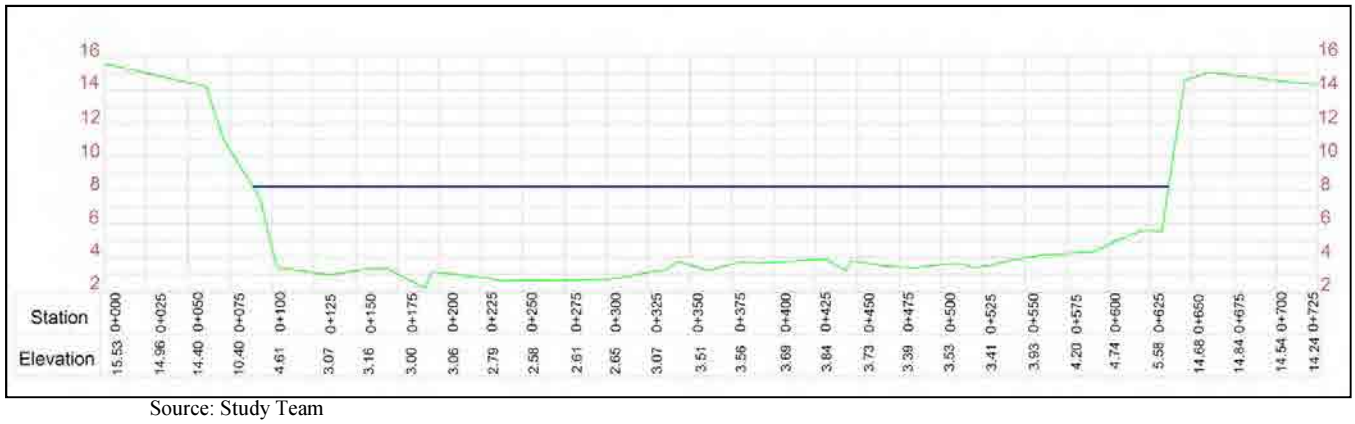
(Unit: Vehicles)

Link No.	Corridor	Node Name		Passenger Car/ Pick-up	Minibus	Bus	Medium Truck	Heavy Truck	Trailer	Others	Total	CVR*
64	-	Agove	Kpedzeglo	0	0	0	0	0	0	0	0	-
65	-	Adidome	Volo	410	33	23	8	0	0	0	474	4.9%
66	-	Volo	Dufor-Adidome	404	9	23	3	0	0	0	439	5.2%
67	-	Osi-Abura	Kpolukope	65	49	37	43	108	862	54	1,218	87.1%
68	-	Agove	Adidokpavui	0	0	0	0	0	0	0	0	-
69	-	Adidokpavui	Kpomkpo	0	0	0	0	0	0	0	0	-
70	Project	Asutsuare Jct.	Jerusalem	2,845	1,881	381	457	482	1,794	836	8,676	40.3%
71	Project	Jerusalem	Asutsuare	246	33	28	36	12	79	0	434	27.4%
72	Project	Asutsuare	Volivo	1,765	2,027	261	235	65	166	1	4,520	10.9%
73	Project	Dufor-Adidome	Dokotsi	0	0	0	0	0	0	0	0	-
74	Project	Dokotsi	Juapong	4	2	0	0	0	0	0	6	0.0%
75	Project	Kpomkpo	Podoe-Dufo	53	12	0	3	0	11	4	83	18.1%
76	Project	Podoe-Dufo	Frankadua	0	0	0	0	0	0	0	0	-
77	Project	Jerusalem	Kagyanya	0	0	0	0	0	0	0	0	-
78	Project	Kagyanya	Dokotsi	0	0	0	0	0	0	0	0	-
79	Project	Jerusalem	Volivo	2,795	1,864	353	434	470	1,761	836	8,513	40.2%
80	Project	Volivo	Dufor-Adidome	3,414	2,934	435	533	598	2,338	842	11,094	38.0%
81	Project	Dufor-Adidome	Dokotsi	3,045	2,925	459	530	598	2,332	842	10,731	39.4%
82	Project	Dokotsi	Kpomkpo	2,593	3,196	552	656	512	2,203	840	10,552	38.9%
83	Project	Kpomkpo	Kpolukope	2,540	3,184	552	653	512	2,192	836	10,469	39.1%
84	Project	Kpolukope	Asikuma Jct.	2,475	3,135	515	610	404	1,330	782	9,251	32.8%
85	Project	Volivo	Aveyime	2,397	1,183	370	246	515	621	7	5,339	28.3%
86	Coastral	Tema Roundabout	Tetteh Quashie	11,815	4,352	1,142	1,066	353	841	60	19,629	12.2%
87	Coastral	Tetteh Quashie	Accra	15,408	8,310	1,970	1,760	592	1,355	120	29,515	13.7%
88	Coastral	Accra	Cape Coast	65	25	0	10	17	70	75	262	61.8%
89	Coastral	Cape Coast	Daboasi Jct.	30	0	0	0	14	40	75	159	81.1%
90	Coastral	Daboasi Jnc.	Takoradi Port	55	0	0	0	14	15	5	89	38.2%
91	Coastral	Takoradi Port	Elubo	55	0	0	0	14	15	5	89	38.2%
92	Eastern	Fume	Nkwanta	1,632	2,100	438	447	458	2,560	1,116	8,751	52.2%
93	Eastern	Nkwanta	Yendi	1,175	1,426	351	391	401	2,506	997	7,247	58.7%
94	Eastern	Yendi	Sakpiegu	446	273	103	89	58	20	41	1,030	21.6%
95	Eastern	Sakpiegu	Misiga	428	273	100	86	58	20	41	1,006	21.8%
96	Eastern	Misiga	Kulungugu	0	0	0	0	0	0	0	0	-
97	-	Sakpiegu	Yawgu	30	0	5	5	0	0	0	40	12.5%
98	-	Odumase	Koforidua	4,773	4,534	762	612	224	332	18	11,255	11.9%
99	-	Tetteh Quashie	Adenta	12,981	7,041	1,514	1,230	451	682	60	23,959	11.3%
100	-	Adenta	Koforidua	2,364	1,807	282	251	161	124	10	4,999	11.5%
101	-	Koforidua	Bunso	994	1,400	292	298	154	640	279	4,057	33.6%
102	Central	Accra	Bunso	0	0	0	0	0	0	0	0	-
103	Central	Bunso	Kumasi	994	1,400	292	298	154	640	279	4,057	33.6%
104	-	Kumasi	Sunyani	1,126	1,581	529	500	215	810	463	5,224	38.6%
105	-	Cape Coast	Anwiankwantsa	0	0	0	0	0	0	0	0	-
106	-	Daboasi Jct.	Anwiankwantsa	0	0	0	0	0	0	0	0	-
107	-	Anwiankwantsa	Kumasi	0	0	0	0	0	0	0	0	-
108	Central	Kumasi	Fufulsu Jct.	173	0	0	0	0	0	0	173	0.0%
109	Central	Fufulsu Jct.	Tamale	1,029	1,451	352	359	117	231	236	3,775	24.8%
110	Central	Tamale	Bolgatanga	225	53	96	187	300	2,163	731	3,755	87.6%
111	Central	Bolgatanga	Navrongo	651	334	211	248	344	2,147	758	4,693	73.7%
112	Central	Navrongo	Paga	40	0	35	125	385	2,565	890	4,040	95.9%
113	-	Bolgatanga	Misiga	428	273	100	86	58	20	41	1,006	21.8%
114	Western	Elubo	Sunyani	55	0	0	0	5	15	5	80	31.3%
115	Western	Sunyani	Sawla	1,443	1,785	593	608	257	852	477	6,015	36.2%
116	Western	Sawla	Wa	829	334	249	249	140	621	238	2,660	46.9%
117	Western	Wa	Dowene	643	334	246	247	140	621	238	2,469	50.4%
118	-	Fufulsu Jct.	Sawla	855	1,451	352	359	117	231	236	3,601	26.0%
119	-	Navrongo	Dowene	643	334	246	247	140	621	238	2,469	50.4%
120	-	Yendi	Tamale	755	1,153	244	356	346	2,500	956	6,310	64.1%
121	-	Mamfe	Koforidua	2,906	2,635	475	472	142	825	287	7,742	22.3%
122	-	Mamfe	Adenta	5,925	4,311	715	552	178	280	31	11,992	10.0%

Note: CVR – Commercial Vehicle Ratio

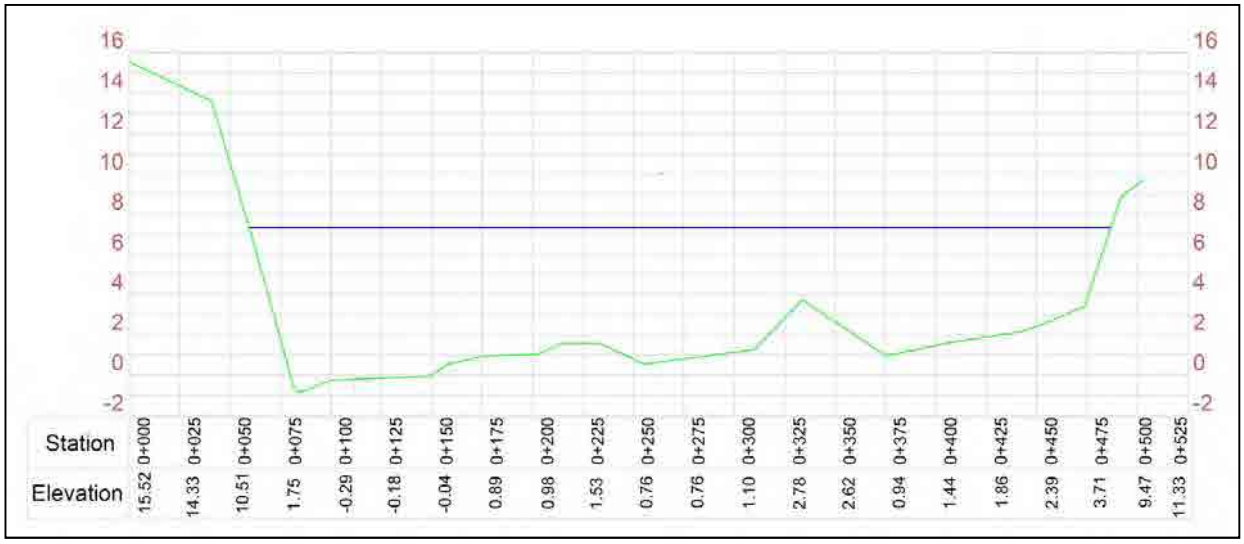
Source: Study Team

Appendix 6 Results of Bathymetric Survey



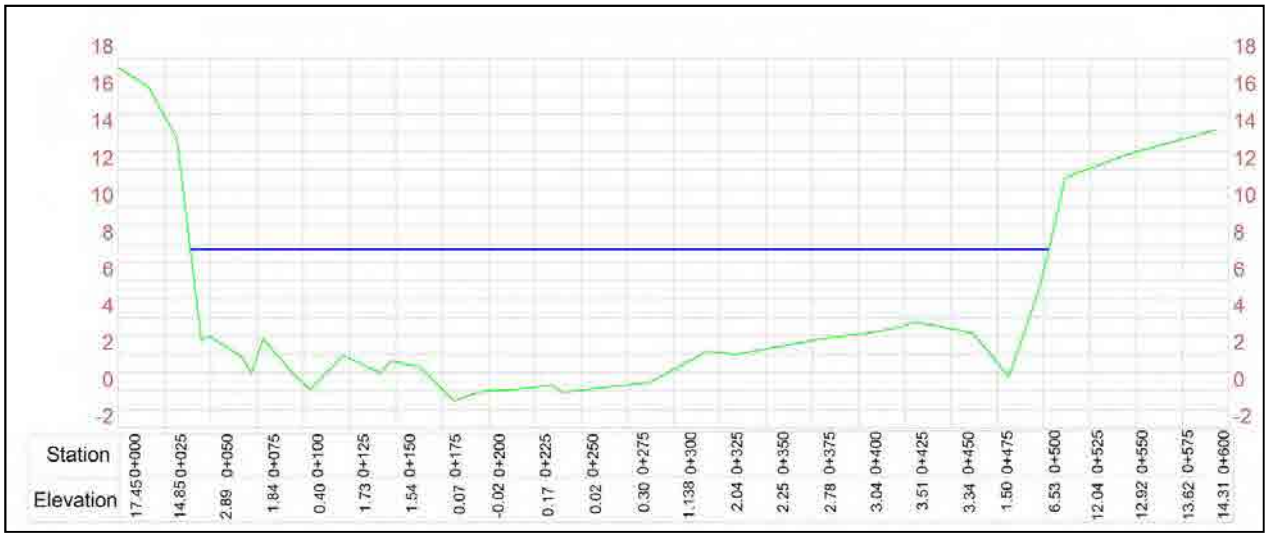
Source: Study Team

Figure A6-1 River Cross Section of the Alternative Bridge Locations B-1



Source: Study Team

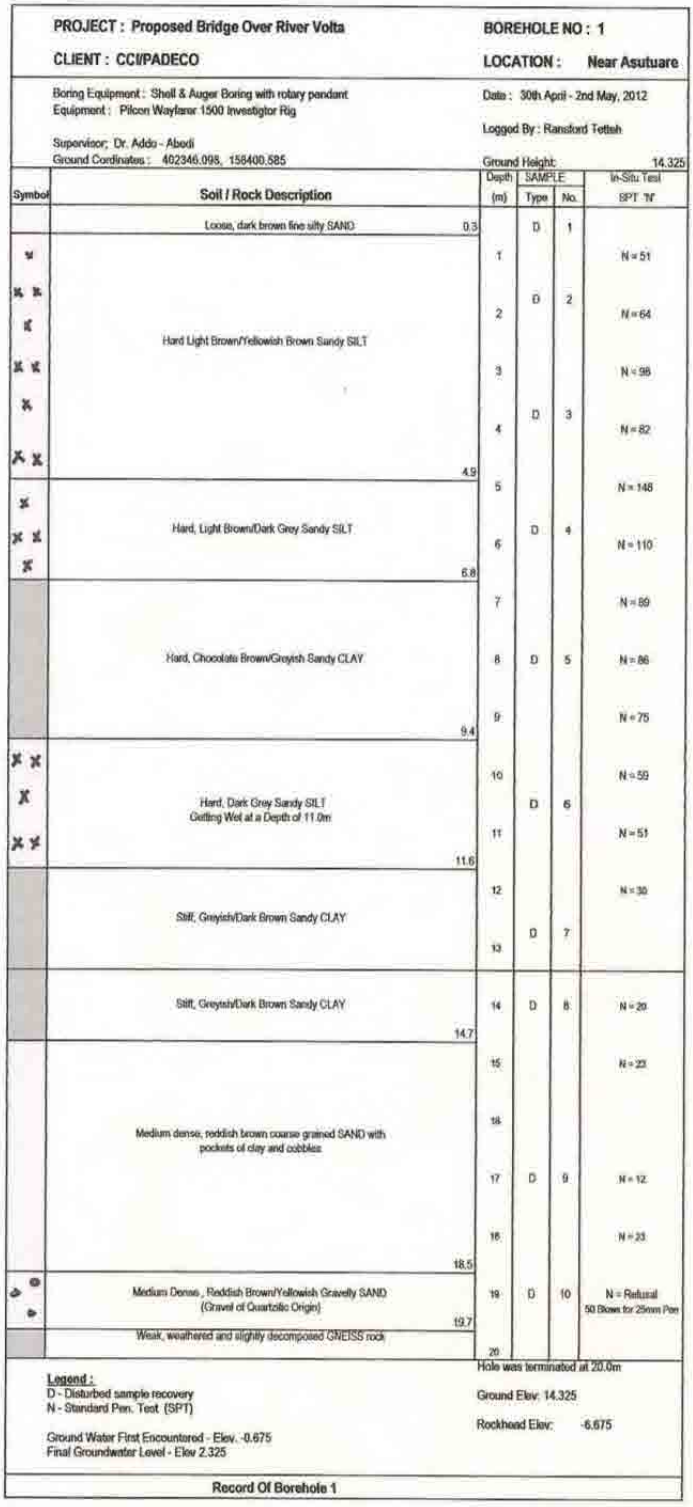
Figure A6-2 River Cross Section of the Alternative Bridge Locations B-2



Source: Study Team

Figure A6-3 River Cross Section of the Alternative Bridge Locations B-3

Appendix 7 Results of Geotechnical Investigation



PROJECT : Proposed Bridge Over River Volta — BOREHOLE NO : 1

CLIENT : CCI/PADECO — LOCATION : Near Asutuare

Boring Equipment : Shell & Auger Boring with rotary pendant
Equipment : Pilcon Wayfarer 1500 Investigtor Rig
Supervisor; Dr. Addo - Abedi
Ground Cordinates : 402346.098, 158400.585

Date : 30th April - 2nd May, 2012
Logged By : Ransford Tettah
Ground Height: 14.325

Symbol	Soil / Rock Description	Depth (m)	SAMPLE Type	SAMPLE No.	In-Situ Test SPT 'N'
	Loose, dark brown fine silty SAND 0.3		D	1	
	Hard Light Brown/Yellowish Brown Sandy SILT	1			N = 51
		2	D	2	N = 64
		3			N = 98
		4	D	3	N = 82
	4.9	5			N = 148
	Hard, Light Brown/Dark Grey Sandy SILT	6	D	4	N = 110
	6.8	7			N = 89
	Hard, Chocolate Brown/Greyish Sandy CLAY	8	D	5	N = 86
	9.4	9			N = 75
	Hard, Dark Grey Sandy SILT Getting Wet at a Depth of 11.0m	10			N = 59
		11	D	6	N = 51
	11.6	12			N = 30
	Stiff, Greyish/Dark Brown Sandy CLAY	13	D	7	
	Stiff, Greyish/Dark Brown Sandy CLAY 14.7	14	D	8	N = 26
	Medium dense, reddish brown coarse grained SAND with pockets of clay and cobbles	15			N = 23
		16			
		17	D	9	N = 12
	18.5	18			N = 23
	Medium Dense , Reddish Brown/Yellowish Gravelly SAND (Gravel of Quartzitic Origin) 19.7	19	D	10	N = Refusal 50 Blows for 25mm Pen
	Weak, weathered and slightly decomposed GNEISS rock	20			Hole was terminated at 20.0m

Legend :
D - Disturbed sample recovery
N - Standard Pen. Test (SPT)

Ground Water First Encountered - Elev. -0.675
Final Groundwater Level - Elev 2.325

Ground Elev: 14.325
Rockhead Elev: -6.675

Record Of Borehole 1

Source: Study Team

Figure A7-1 Borehole Log at BH-A

PROJECT : Proposed Bridge Over river Volta | **BOREHOLE NO : 2**

CLIENT : CCI/PADECO | **LOCATION : Near Volivo**

Boring Equipment : Shell & Auger Boring with rotary pendant
Equipment : Pilcon Wayfarer 1500 Investigtor Rig

Date : 3th May - 5th May, 2012

Logged By : Ransford Tetteh

Supervisor; Dr. Addo - Abedi
Ground Cordinates : 411301.316, 158787.219

Ground Level: 62.015

Symbol	Soil / Rock Description	Depth (m)	SAMPLE Type	SAMPLE No.	In-Situ Test SPT 'N'
	Medium Dense Dark Brown Silty SAND with Organic Matter	1	D	1	N = 22
			D	2	
		2			N = 30
	Stiff to Hard Light Brown Sandy CLAY	3	D	3	N = 34
		4			N = 44
			D	4	
		5			N = 73
	Hard, dark brown coarse Sandy SILT	6			N = 67
			D	5	
		7			N = 94
	Hard to Stiff Dark Grey Sandy SILT getting wet at 11.0m depth	8			N = 92
			D	6	
		9			N = 70
		10	D	7	N = 11
		11			N = 16
	Medium Dense Reddish Brown Gravelly SAND	12			
		13	D	8	N = 11
	Medium Dense Reddish Brown Gravelly SAND	14			
			D	9	
		15			N = 10
	Medium Dense to Very Dense, Reddish Brown Coarse Grained SAND with Rounded Quartzitic Gravel	16			N = 12
		17	D	10	N = 70
		18			N = Refusal 25Blows/25mmPen
	Weak, weathered and slightly decomposed GNEISS rock	19			N = Refusal 25Blows/25mmPen
		20			

Hole was terminated at 20.0m

Legend :
D - Disturbed sample recovery
N - Standard Pen. Test (SPT)

Ground Elev: Elev 13.985

Rockhead Elev: -6.015

Ground Water First Encountered: Elev 1.985
Final Ground Water Level: Elev 3.385

Record Of Borehole 2

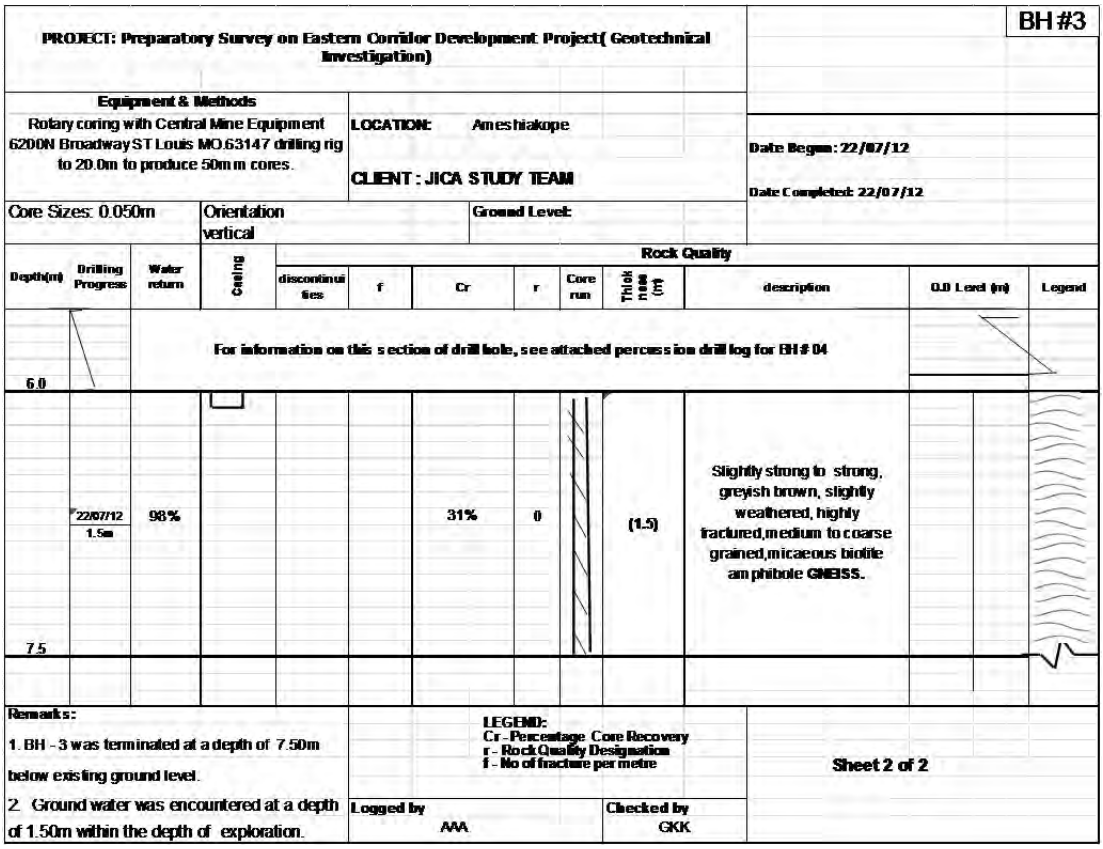
Source: Study Team

Figure A7-2 Borehole Log at BH-B

PROJECT: Preparatory Survey on Eastern Corridor Development Project(Geotechnical Investigation)			BOREHOLE No. BH# 3				
Equipment & Methods Rotary coring with Central Mine Equipment 6200N Broadway ST Louis MO.63147 drilling rig to 20.0m to produce 50mm cores.			Elevation:	Coordinates:			Date Begun: 22/07/12
CLIENT : JICA STUDY TEAM			LOCATION: Ameshiakope				Date Completed: 22/07/1
Description	**Reduced Level (m)**	**Legend**	**Depth (Thick) (m)**	**Samples/ Tests** Depth (m)	Sample Type	Sample No.	Test / Field Records
Moist.Loose. dark brown/black. Sandy **CLAY**			0.20				
Moist, firm to stiff, dark brown /black Silty sandy **CLAY**			0.50	0.20 - 0.50	DS	1	
Moist, dense to firm,dark brown silty **CLAY**			1.00	0.60 - 1.00	DS	2	1.0
Moist, firm to stiff, dark brown,silty **CLAY**				1.00 - 1.50	DS	3	
			1.50	1.50 - 1.95	SPT	1	**N=5** 2,2,3 1.5
Moist, stiff, yellowish-brown, silty **CLAY** with occasional gravels				2.00 - 3.00	DS	4	2.0
			3.00	3.00 - 3.45	SPT	2	**N=43** 18,21,22 3.0
Moist, hard to compact, yellowish brown silty **CLAY** with quartzitic gravel.				3.50 - 4.50	DS	5	4.0
			4.50	4.50 - 4.95	SPT	3	**N=51** 24,25,26
Moist, stiff. Yellowish brown, silty **CLAY** with whitish quartz veins.				5.00 - 6.00	DS	6	5.0
			6.00	6.00 6.45	SPT	4	**N= 54** 6.0
Remarks:			**LEGEND:** SB - Small Bulk Sample; U - Undisturbed sample; S - Standard Penetration Test; LB - Large Bulk Sample; W - Water Sample; R - Rock Sample; V - Shear strength results from vane test				**Sheet 1 of 2**
			Logged by AAA	**Checked by** GKK			

Source: Study Team

Figure A7-3 Borehole Log at BH-3 (1)



PROJECT: Preparatory Survey on Eastern Corridor Development Project(Geotechnical Investigation)											BH #3
Equipment & Methods Rotary coring with Central Mine Equipment 6200N Broadway ST Louis MO.63147 drilling rig to 20.0m to produce 50mm cores.			LOCATION: Ameshiakope CLIENT : JICA STUDY TEAM							Date Begun: 22/07/12 Date Completed: 22/07/12	
Core Sizes: 0.050m		Orientation vertical			Ground Level:						
			Rock Quality								
Depth(m)	Drilling Progress	Water return	Casing	discontinuities	f	Cr	r	Core run	Thickness (m)	description	O.D Level (m)	Legend
6.0			For information on this section of drill hole, see attached percussion drill log for BH # 04									
7.5	22/07/12 1.5m	98%				31%	0		(1.5)	Slightly strong to strong, greyish brown, slightly weathered, highly fractured,medium to coarse grained,micaceous biotite amphibole GNEISS.		
Remarks: 1. BH - 3 was terminated at a depth of 7.50m below existing ground level. 2. Ground water was encountered at a depth of 1.50m within the depth of exploration.			LEGEND: Cr - Percentage Core Recovery r - Rock Quality Designation f - No of fracture per metre							Sheet 2 of 2		
			Logged by AAA						Checked by GKK			

Source: Study Team

Figure A7-3 Borehole Log at BH-3 (2)

PROJECT: Preparatory Survey on Eastern Corridor Development Project in Ghana (Geotechnical Investigation)

BOREHOLE No. BH# 4

Equipment & Methods
Rotary coring with Central Mine Equipment 6200N Broadway ST Louis MO.63147 drilling rig to 20.0m to produce 50mm cores.

Elevation: **Coordinates:**

Date Begun: 20/07/12

CLIENT : JICA STUDY TEAM

LOCATION: Dorfor Adidome

Date Completed: 20/07/1

Description	Reduced Level (m)	Legend	Depth (Thick) (m)	Samples/ Tests: Depth (m)	Sample Type	Sample No.	Test	Field Records	
Moist.Loose to dense. dark black, silty **CLAY** with rootlets. (**ORGANIC TOPSOIL**)			0.20						
Moist,dense to stiff, dark black/brownish ,Silty **CLAY**			0.50	0.20 - 0.50	DS	1			
Moist,dense to stiff, brownish black,silty **CLAY**			1.00	0.60 - 1.00	DS	2			1.0
Moist, firm to stiff, dark brown,silty **CLAY**				1.00 - 1.50	DS	3			
			1.50	1.50 - 1.95	SPT	1	**N=13**	4,6,7	1.5
Moist, firm to stiff, dark brown, silty **CLAY**				2.00 - 3.00	DS	4			2.0
			3.00	3.00 - 3.45	SPT	2	**N =17**	5,7,10	3.0
Moist, stiff to hard, greyish brown silty **CLAY** with occasional gravels				3.50 - 4.50	DS	5			4.0
			4.50	4.50 - 4.95	SPT	3	**N=40**	10,13,27	
Moist, stiff to hard. greyish brown, clayey **SILT**. (Highly weathered biotite amphibole **GNEISS**)				5.00 - 5.50	DS	6			5.0
				5.50 - 5.95	SPT	4	**N= 58**	8 15,18,40	
			6.00						6.0

END OF PERCUSSION DRILLING

Remarks: BH - 4 was terminated at a depth of 5.95m below existing ground level.

LEGEND:
SB - Small Bulk Sample
U - Undisturbed sample
S - Standard Penetration Test
LB - Large Bulk Sample
W - Water Sample
R - Rock Sample
V - Shear strength results from vane test

Sheet 1 of 1

Logged by **Andrew**

Checked by GKK

Source: Study Team

Figure A7-4 Borehole Log at BH-4

PROJECT: Preparatory Survey on Eastern Corridor Development Project in Ghana (Geotechnical Investigation)

BOREHOLE No. BH# 4a

Equipment & Methods
Rotary coring with Central Mine Equipment 6200N Broadway ST Louis MO.63147 drilling rig to 20.0m to produce 50mm cores.

Elevation: **Coordinates:**

Date Begun: 17/07/12

CLIENT : JICA STUDY TEAM

LOCATION: Dorfor Adidome

Date Completed: 19/07/1

Description	Reduced Level (m)	Legend	Depth (Thick) (m)	Samples/ Tests: Depth (m)	Sample Type	Sample No.	Test	Field Records	
oist.Loose to dense. dark brown,yellowish, silty **CLA** with gravels.			0.20						
Moist,dense to stiff, dark brown ,Silty **CLAY**			0.50	0.20 - 0.50	DS	1			
Moist,dense to stiff, reddish brown,silty **CLAY**			1.00	0.60 - 1.00	DS	2			1.0
Moist, stiff, dark brown,silty **CLAY** with shells				1.00 - 1.50	DS	3			
			1.50	1.50 - 1.95	SPT	1	**N=15**	3,6,9	1.5
Moist,stiff, reddish brown, silty **CLAY**				2.00 - 3.00	DS	4			2.0
			3.00	3.00 - 3.45	SPT	2	**N =17**	4,7,10	3.0
Moist, stiff, dark brown silty **CLAY**				3.50 - 4.50	DS	5			4.0
			4.50	4.50 - 4.95	SPT	3	**N=25**	6,11,14	
Moist, stiff. greyish brown, clayey **SILT**. (Highly weathered biotite amphibole **GNEISS**)				5.00 - 5.50	DS	6			5.0
			6.00	5.50 - 5.95	SPT	4	**N= 46**	8,15,31	6.0

END OF PERCUSSION DRILLING

Remarks: BH - 4a was terminated at a depth of 5.95m below existing ground level.

LEGEND:
SB - Small Bulk Sample
U - Undisturbed sample
S - Standard Penetration Test
LB - Large Bulk Sample
W - Water Sample
R - Rock Sample
V - Shear strength results from vane test

Sheet 1 of 1

Logged by **AAA**

Checked by GKK

Source: Study Team

Figure A7-5 Borehole Log at BH-4a

PROJECT: Proposed

BOREHOLE No. BH 5

Equipment & Methods
Picon Wayfarer 1500 light cable percussion rig with standard accessories for sinking 150mm diameter holes.

Elevation:

Coordinates: N E

Date Begun: 30/06/12

CLIENT :

Date Completed: 30/06/12

LOCATION: Near Kpompo

Description	Reduced Level (m)	Legend	Depth (Thick) (m)	Samples/ Tests: Depth (m)	Sample Type	Sample No.	Test	Field Records
Soft ,moist, dark brown sandy CLAY			0.20					
Very stiff, moist, dark brown CLAY with traces of sand and gravel				0.50	SB	1		
			1.00	1.00 - 1.45	SPT	1	N= 21	5,6,5,5,6,5 1.0
Highly decomposed, yellowish/ greyish brown GNIESS			1.30					
Moderately decomposed, yellowish brown, light grey GNIESS				1.50	SB	2		
				2.00 - 2.45	SPT	2	N=40	9,17,12,9,10,9 2.0
				3.00 - 3.45	SPT	3	N= 40	6,6,8,12,10,10 3.0
			3.50					
Highly weathered, light grey greenish brown GNIESS				4.00 - 4.45	SPT	4	N= 53	11,19,15,13,14 4.0
				5.00 -5.30	SPT	5	N>50	12,25,28,30 5.0
			5.30					
END OF PERCUSSION DRILLING								

Remarks:
1. Drill- hole was terminated at a depth of 5.30m below existing ground Level.
2. Groundwater was not encountered within the depth of exploration
3. Hole chiselled from 3.50-5.30m in 2hrs

LEGEND:
SB - Small Bulk Sample
U - Undisturbed sample
S - Standard Penetration Test
LB - Large Bulk Sample
W - Water Sample
R - Rock Sample
V - Shear strength results from vane test

Sheet 1 of 1

Logged by Ebenezer **Checked by** Ansah

Source: Study Team

Figure A7-6 Borehole Log at BH-5

PROJECT: Proposed

BOREHOLE No. BH 6

Equipment & Methods: Pilcon Wayfarer 1500 light cable percussion rig with standard accessories for sinking 150mm diameter holes.

Elevation:

Coordinates: N E

Date Begun: 28/06/2012

CLIENT :

LOCATION: Osuwem - Asutuare

Date Completed: 28/06/2012

Description	Reduced Level (m)	Legend	Depth (Thick) (m)	Samples/ Tests: Depth (m)	Sample Type	Sample No.	Test	Field Records
Soft ,moist, dark brown sandy CLAY			0.30					
Very stiff, moist, dark brown CLAY with traces of sand and gravel				0.50	SB	1		
				1.00 - 1.45	SPT	1	N = 22	5,7,6,6,5,5 1.0
			1.80	1.50	SB	2		
Highly weathered yellowish/ greyish brown GNIESS				2.00 2.35	SPT	2	N >50	14,14,7,18,32 2.0
			3.35	3.00 - 3.45	SPT	3	N = 35	9,8,10,6,8,11 3.0
END OF PERCUSSION DRILLING								

Remarks:
1. Drill- hole was terminated at a depth of 3.35m below existing ground Level. Encountered rock at 3.35m below the surface.
2. Groundwater was not encountered within the depth of exploration

LEGEND:
SB - Small Bulk Sample
U - Undisturbed sample
S - Standard Penetration Test
LB - Large Bulk Sample
W - Water Sample
R - Rock Sample
V - Shear strength results from vane test

Sheet 1 of 1

Logged by: Ebenezer **Checked by:** Ansah

Source: Study Team

Figure A7-7 Borehole Log at BH-6

Appendix 8 HDM-4 Input Data

Table A8-1 Road Sections - Basic

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Road Sections - Basic

Study Name: 4. Construction of new bypass_ECDP
Run Date: 09-01-2013

ID	Name	Speed Flow Type	Traffic Flow Pattern	Road Class	Climate Zone	Surface Class	Pavement Type	Length (Km)	Width (m)	Shoulder width (m)	Lanes	MT AADT	NMT AADT	AADT Year
CC_A	CC_A Tema - Accra	Two Lane Standard	Free-Flow	Primary or Trunk	Ghana ECDP	Concrete	JRCP	25.15	7.30	1.00	2	2,485	0	2013
CC_B	CC_B Accra - Kumasi	Two Lane Standard	Free-Flow	Primary or Trunk	Ghana ECDP	Bituminous	AMGB	243.37	7.40	1.00	2	2,485	0	2013
CC_C	CC_C Kumasi - Tamale	Two Lane Standard	Free-Flow	Primary or Trunk	Ghana ECDP	Bituminous	AMGB	357.20	8.15	1.00	2	2,485	0	2013
EEC_A	EEC_A Tema - Asu Jct.	Two Lane Standard	Free-Flow	Primary or Trunk	Ghana ECDP	Bituminous	AMGB	34.28	7.30	1.00	2	8,856	0	2013
EEC_B	EEC_B Asu Jct. - Asikun	Two Lane Standard	Free-Flow	Primary or Trunk	Ghana ECDP	Bituminous	AMGB	48.20	7.30	1.00	2	8,856	0	2013
EEC_C	EEC_C Asikuma Jct. - Fi	Two Lane Standard	Free-Flow	Primary or Trunk	Ghana ECDP	Bituminous	AMGB	83.36	7.30	1.00	2	3,664	0	2013
EEC_D	EEC_D Fume - Nkwanta	Two Lane Standard	Free-Flow	Primary or Trunk	Ghana ECDP	Bituminous	AMGB	167.08	7.30	1.00	2	5,641	0	2013
EEC_E	EEC_E Nkwanta - Tama	Two Lane Standard	Free-Flow	Primary or Trunk	Ghana ECDP	Bituminous	AMGB	251.86	7.30	1.00	2	1,428	0	2013
PEC	Proposed Eastern Corrid	Wide 2 Lane Road	Free-Flow	Primary or Trunk	Ghana ECDP	Bituminous	AMGB	67.20	7.30	2.50	2	8,163	0	2016
R28	R28 Tema - Fume	Two Lane Standard	Free-Flow	Primary or Trunk	Ghana ECDP	Bituminous	AMGB	210.05	7.30	1.00	2	3,692	0	2013

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Table A8-2 Road Sections - Condition

HDM-4
HIGHWAY DEVELOPMENT & MANAGEMENT

Road Sections - Condition

Study Name: 4. Construction of new bypass_ECDP
Run Date: 10-01-2013

Bituminous Sections:

ID	Name	Condition Year	Roughness IRI (m/km)	Total Cracking Area (%) ACRA	Ravelled Area (%) ARV	Potholes (no./km) NPT	Edge Break (m2/km) AEB	Rut Depth (mm) RDM	Texture Depth (mm) TD	Skid Resistance (SCRIM) SFC50	Drainage Condition
EEC_A	EEC_A Tema - Asu Jct.	2012	2.50	1.00	1.00	0.00	0.00	3	3	1	Excellent
EEC_B	EEC_B Asu Jct. - Asiku	2012	4.00	5.00	5.00	8.00	5.00	5	2	1	Excellent
EEC_C	EEC_C Asikuma Jct. - F	2012	2.50	1.00	1.00	0.00	0.00	3	3	1	Excellent
EEC_D	EEC_D Fume - Nkwanta	2012	4.00	5.00	5.00	8.00	5.00	5	2	1	Excellent
EEC_E	EEC_E Nkwanta - Tam	2012	4.00	5.00	5.00	8.00	5.00	5	2	1	Excellent
R28	R28 Tema - Fume	2012	2.50	1.00	1.00	0.00	0.00	3	3	1	Excellent
CC_B	CC_B Accra - Kumasi	2012	2.50	1.00	1.00	0.00	0.00	3	3	1	Excellent
CC_C	CC_C Kumasi - Tamale	2012	2.50	1.00	1.00	0.00	0.00	3	3	1	Excellent
PEC	Proposed Eastern Corri	2015	2.00	0.00	0.00	0.00	0.00	0	1	1	Excellent

Concrete Sections:

ID	Name	Condition Year	IRI (m/km)	Average Faulting (mm)	Spalled Joints (%)	Cracked Slabs (%)	Deter Cracks (no./km)	Failures (no./km)
CC_A	CC_A Tema - Accra	2008	4.00	2	0.50	1.00	1	0.0

Table A8-3 Vehicle Fleet – Basic

HDM - 4
HIGHWAY DEVELOPMENT & MANAGEMENT

Vehicle Fleet - Basic

Study Name: **4. Construction of new bypass_ECDP**
Run Date: **10-01-2013**

Motorised Vehicle Types:

Name	Base Type	PCSE	No. of Wheels	No. of Axles	Tyre Type	Tyre Base Recaps	Tyre Retread Cost (%)	Annual Km	Annual Work Hours	Avg Life	Private Use (%)	Pass-engers	Work Related Trips (%)	ESALF	Oper. Weight (t)	Life Model
6-3_Truck Trailer	Articulated Truck	1.80	18	5	Bias ply	1.30	15.00	85,000	2,050	15	0	0	100.00	4.63	28.00	Optimal
5_Heavy truck	Heavy Truck	1.60	10	3	Bias ply	1.30	15.00	60,000	2,050	15	0	0	100.00	2.28	13.00	Optimal
4-2_Medium Truck	Medium Truck	1.40	6	2	Bias ply	1.30	15.00	40,000	1,200	12	0	0	100.00	1.25	7.50	Optimal
2_Small Bus	Mini Bus	1.20	4	2	Radial ply	1.30	15.00	60,000	750	8	10	10	90.00	0.01	1.50	Optimal
1-1_Car/Taxi	Four Wheel Drive	1.00	4	2	Bias ply	1.30	15.00	23,000	1,300	10	20	3	80.00	0.01	1.80	Optimal
3-2_Large Bus	Heavy Bus	1.60	10	3	Bias ply	1.30	15.00	70,000	1,750	12	10	40	90.00	0.80	10.00	Optimal
7_Others	Articulated Truck	1.80	18	5	Bias ply	1.30	15.00	85,000	2,050	15	0	0	100.00	4.63	28.00	Optimal
1-2_Pick-up	Four Wheel Drive	1.00	4	2	Bias ply	1.30	15.00	23,000	1,300	10	20	3	80.00	0.01	1.80	Optimal
3-1_Medium Bus/Mummy W	Heavy Bus	1.60	10	3	Bias ply	1.30	15.00	70,000	1,750	12	10	40	90.00	0.80	10.00	Optimal
4-1_Light Truck	Medium Truck	1.40	6	2	Bias ply	1.30	15.00	40,000	1,200	12	0	0	100.00	1.25	7.50	Optimal
6-1_Semi - Trailer (Light)	Articulated Truck	1.80	18	5	Bias ply	1.30	15.00	85,000	2,050	15	0	0	100.00	4.63	28.00	Optimal
6-2_Semi - Trailer (Heavy)	Articulated Truck	1.80	18	5	Bias ply	1.30	15.00	85,000	2,050	15	0	0	100.00	4.63	28.00	Optimal

Table A8-4 Vehicle Fleet – Economic

HDM-4
HIGHWAY DEVELOPMENT & MANAGEMENT

Vehicle Fleet - Economic

Study Name: 4. Construction of new bypass_ECDP
Run Date: 10-01-2013
Currency: To be completed

Motorised Vehicle Types:

Name	Base Type	New Vehicle	Replace Tyre	Fuel (per litre)	Lubr. Oil (per litre)	Maint Labour (per hr)	Crew Wages (per hr)	Annual Overhead	Annual Interest (%)	Passenger Work Time (per hr)	Passenger Non-Work (per hr)	Cargo Holding (per hr)
6-3_Truck Trailer	Articulated Truck	134,344	556	0.55	2.60	1.61	1.09	800	12.00	0.34	0.09	0.50
5_Heavy truck	Heavy Truck	95,487	556	0.55	2.60	1.15	1.09	800	12.00	0.34	0.09	0.30
4-2_Medium Truck	Medium Truck	68,830	215	0.55	2.60	1.15	0.95	700	12.00	0.34	0.09	0.10
2_Small Bus	Mini Bus	30,786	155	0.42	4.15	1.15	0.52	500	12.00	0.34	0.09	0.00
1-1_Car/Taxi	Four Wheel Drive	11,600	120	0.42	4.15	1.84	0.09	400	12.00	0.50	0.13	0.00
3-2_Large Bus	Heavy Bus	61,964	297	0.55	2.60	1.15	0.78	700	12.00	0.34	0.09	0.00
7_Others	Articulated Truck	146,797	608	0.55	2.60	1.61	1.09	800	12.00	0.34	0.09	0.30
1-2_Pick-up	Four Wheel Drive	16,385	312	0.42	4.15	1.84	0.09	400	12.00	0.50	0.13	0.00
3-1_Medium Bus/Mummy W	Heavy Bus	61,964	297	0.55	2.60	1.15	0.78	700	12.00	0.34	0.09	0.00
4-1_Light Truck	Medium Truck	68,830	215	0.55	2.60	1.15	0.95	700	12.00	0.34	0.09	0.10
6-1_Semi - Trailer (Light)	Articulated Truck	134,344	556	0.55	2.60	1.61	1.09	800	12.00	0.34	0.09	0.50
6-2_Semi - Trailer (Heavy)	Articulated Truck	134,344	556	0.55	2.60	1.61	1.09	800	12.00	0.34	0.09	0.50

Appendix 9 Road Sectors Impact Assessment and Recommended Mitigation Measures in ESMF

APPENDIX 5

Analysis of Environmental / Social Issues Common to Road Sector Activities

	Environmental / Social Parameters	Common								Average	Ranking
		GHA	EPA	DUR	DFR	WD	FS D	WRC	FC		
1	Dust	H	H	H	H	H	H	H		H	1
2	Noise	H	H	H	H	M	H	L		H	5
3	Road accidents	M	M	M	M	H	M	-		M	16
4	Public safety	M	M	M	H	M	M	M		M	17
5	Resettlement	M	M	H	L	M	M	H	L	M	21
6	Compensation issues/agreement	M	M	H	M	M	M	H	M	M	11
7	Wildlife concerns	L	L	M	L	M	M	-	M	M	20
8	Forestry concerns (e.g. access)	L	L	H	L	M	M	M	L	M	19
9	Habitat disruption	M	M	H	L	H	M	M	M	M	15
10	Water contamination	H	H	M	M	H	M	H	M	M	14
11	Stream diversion / blocking	M			M	M	M	H	M	M	9
12	Flooding	M	M	M	L	M	M	M	M	M	12
13	Run off	M	M	M	M	M	M	M	M	M	10
14	Induced development	M	M	H	M	M	M	M	H	M	8
15	Cultural concerns	M	M	H	M	M	M	L	L	M	13
16	Archaeological losses	L	L	L	L	M	M	L	L	L	22
17	Pits / trenches near roads	H	H	H	H	H	M	M	M	H	4
18	Inadequate drains along roads	H	H	M	M	H	H	L	M	H	6
19	Road construction waste generation & disposal	H	M	M	H	H	L	H	M	H	7
20	Top soil removal	H	H	H	M	H	H	M	M	H	3
21	Tree & vegetation removal	H	H	H	H	H	M	H	M	H	2
22	Extensive construction (impact) corridor	H	M	H	L	M	-	M	M	M	18

Note: L - Represents Low Occurrence
M - Represents Medium Occurrence
H - Represents High Occurrence

APPENDIX 6

Analysis of Environmental / Social Issues Significant to Road Sector Activities

	Environmental / Social Parameters	Significant								Average	Ranking
		GHA	EPA	DUR	DFR	WD	FS D	WRC	FC		
1	Dust	H	H	H	H	H	H	H	M	H	1
2	Noise	H	H	H	M	M	H	L	M	M	12
3	Road accidents	H	M	M	M	-	M	-	H	M	15
4	Public safety	H	H	H	M	M	M	H	M	H	3
5	Resettlement	H	H	H	M	M	M	H	M	M	8
6	Compensation issues/agreement	H	M	H	M	M	H	H	M	M	9
7	Wildlife concerns	H	M	M	M	M	M	-	M	M	17
8	Forestry concerns (e.g. access)	H	M	M	M	M	M	M	M	M	16
9	Habitat disruption		M	H		H	M	M	M	M	18
10	Water contamination	H	H	H	M	H	H	H	M	H	2
11	Stream diversion / blocking	H	M	M	M	M	H	M	M	M	14
12	Flooding	H	H	M	M	L	H	M	M	M	11
13	Run off	H	L	H	H	M	H	M	H	H	5
14	Induced development	M	M	H	M	M	M	-	M	M	21
15	Cultural concerns	H	H	H	M	M	M	M	M	M	13
16	Archaeological losses	M	M	L	M	H	L	M	M	M	20
17	Pits / trenches near roads	H	H	H	H	H	M	M	L	H	6
18	Inadequate drains along roads	H	H	H	M	H	M	M	M	M	10
19	Road construction waste generation & disposal	M	M	H	H	M	L	M	M	M	19
20	Top soil removal	H	M	H	M	H	M	H	M	M	7
21	Tree & vegetation removal	H	H	H	H	M	M	H	M	H	4
22	Extensive construction (impact) corridor	H	M	H	L	M	-	M	M	M	22

APPENDIX 8

Summary of Potential Environment and Social Impacts Associated with Road Transport Sector and Mitigation Measures (1)

No	Impact	Potential Source	Mitigation Measures
1	**Soil Impacts** Loss of productive soil elimination of the productive capacity of the soil covered by roads particularly where the site for the road development is also suitable for agriculture.	Removal of productive soil Compaction with heavy machinery during construction Burrow pits and gravel winning, Quarries Spoil dumping Site preparation and clearing	• Minimizing the area of ground clearance; • Avoiding sensitive alignments, including steep slopes • Progressive replanting of disturbed areas during construction not after • Terracing of nearby marginal farmland to make it more productive on the long term; • Remediation of affected soils by using a sub soils to break up hardpan produced by compaction with heavy equipment;
	Erosion	Removal of vegetation and Soil disturbance coupled with poor drainage Site preparation and clearing	• Specifications for contractors responsibilities to cover such issues as erosion control, prevention of fuel spills during construction, and planting as well as timely watering of plantings. • Minimizing the area of ground clearance
	Destabilization of slopes which can lead to landslides	Creation of road cuts or embankments. Excessive steepness of cut slopes, deficiency of drainage, modification of water flows,	• Balancing filling and cutting requirements through route choice, so as to avoid/minimize the production of excess spoil material and reduce the need for borrow pits; • Avoiding the creation of cut slopes and embankments of an angle greater than the natural angle of repose for the local soil type; and • Engineering solutions such as intercepting ditches at the tops and bottoms of slopes. Gutters and spillways are used to control the flow of water down a slope; • Terraced or stepped slopes to reduce the steepness of a slope. riprap, or rock material embedded in a slope face, sometimes combined with planting, retaining structures, such as gabions (rectangular wire baskets of rocks), etc should be explored
	Soil contamination during road construction and traffic operations.	Daily traffic operation on very busy roads. Metals from emissions such as chromium, lead, and zinc remain in the soil for hundreds of years. Pollutants settling in roadside soil can impair the growth of vegetation increasing potential for erosion. Spillage of hazardous products in transit. Site preparation and clearing	• Enforcement of emission standards and introduction of control legislation and mechanism • Guidelines for transport of hazardous products defining permissible routes • Emergency response procedures for spillage

APPENDIX 8

Summary of Potential Environment and Social Impacts Associated with Road Transport Sector and Mitigation Measures (2)

No	Impact	Potential Source	Mitigation Measures
2	**Water Resources Impacts** Modification of flow of surface waters Ground water table modifications Water quality degradation (surface and groundwater)	Concentrating flows at certain points and, in some cases, increasing the speed of flow resulting in flooding, soil erosion, channel modification, and siltation of streams. - Earthworks Road drainage and excavation & embankments and structures can reduce or raise the water table (through restricting flow) • Sedimentation, changes in biological activity in streams and on their banks • Uncontrolled construction activities, • Chemicals spillage • Chronic pollution of surface runoff from exhaust emissions, pavement and tyre wear, petroleum product drippage, and corrosion of metals	• Avoiding alignments which are susceptible to erosion, such as those crossing steep slopes; • Minimize the number of water crossings • Use clean fill materials around watercourses such as quarried rock containing no fine soil; and • Provide reservations/buffer zones of undisturbed vegetation between road sites and water bodies • Introduce Water speed reduction measures e.g. grasses, riprap, and other devices in water channels etc • Provide settling basins to remove silt, pollutants, and debris from road runoff water before discharge to adjoining streams or rivers • Construction of runoff channels, contouring or other means of erosion control • Pave sections of roads prone to erosion and sedimentation particularly relevant near water crossings. • Compensatory measures such as provision of bore holes and wells for communities adversely affected • Adopt environmental enhancements measures in design such as water retention structures in dry areas, and raising inlets to drainage culverts in high water table areas, retarding basins in areas prone to flooding to reduce runoff peaks, spillways

APPENDIX 8

Summary of Potential Environment and Social Impacts Associated with Road Transport Sector and Mitigation Measures (3)

No	Impact	Potential Source	Mitigation Measures
3	**Air Quality Impacts** Dust Emissions such as Nitrogen oxides (NO_X), Hydrocarbons (HC), Carbon monoxide (CO). Sulfur dioxide (SO_2), Particulates including suspended airborne particles from diesel fuel combustion, materials produced by tyre, brake and road wear, and dust, lead (Pb) Aldehydes etc.	Construction-related air pollution Batching plants and asphalt plant operations Material dump sites Vehicular emissions Haulage of materials	• Water dousing to minimize dust • Contract specifications include dust control measures • Rerouting traffic away from populated areas and reducing traffic congestion. • Provision of Bypass roads. • Covering of Hauling trucks carrying sand with canvass to avoid dust emission; • Location of material storage areas away from communities and environmentally sensitive receptors • Selecting road alignments which avoids housing, schools, and workplaces; • Avoiding placement of busy intersections, near housing, schools or workplaces; • Taking account of prevailing wind direction when siting roads and road features, including refueling stations, near population centres; • Avoiding steep grades and sharp curves which would promote deceleration, acceleration and shifting wherever possible; • Sealing high-use dirt roads, where they pass through populated areas, to control dust; and • Planting tall, leafy, and dense vegetation between roads and human settlements to filter pollutants • Vehicle emissions standards as well as inspection and maintenance requirements;

APPENDIX 8

Summary of Potential Environment and Social Impacts Associated with Road Transport Sector and Mitigation Measures (4)

No	Impact	Potential Source	Mitigation Measures
4	**Habitat Destruction and disruption (flora and fauna impacts)** Habitat loss Habitat fragmentation	Right of way and land take Road intersecting habitat, Borrow and pits, and quarries When a road cuts through an ecosystem it affects the ecosystem's stability and health. Roads tend to fragment an area into weaker ecological sub-units, thus making the whole more vulnerable to invasions and degradation. Corridor restrictions Accidental death and poaching of animal species. Aquatic habitat damage -Erosion from poorly constructed and rehabilitated sites can lead to downstream siltation, ruining spawning beds for fish. Constriction of flows at water crossings can make the current too fast for some species. Alterations of flood cycles, tidal flows, and water levels can upset trophic dynamics by affecting the life cycle of plankton, and have corresponding effects on the rest of the food chain. Rechanneling of waterways is often undertaken as part of road construction to avoid flooding and make crossing structures simpler. In the process, natural streambeds are dug up and useful obstructions, including large boulders, are removed.	• Avoid environmentally sensitive areas to prevent severe impacts on flora and fauna. • Water crossings should be minimized, and buffer zones of undisturbed vegetation should be left between roads and watercourses. • Planting in road rights-of-way and adjacent areas can help to support local flora and fauna. • Re-engineering road cross-section designs by using narrower widths, lower vertical alignments, smaller cuts and fills, flatter side slopes, and less clearing of existing vegetation. • Provision of animal crossings to facilitate movements • Fencing or plant barriers can reduce the risk of collisions between animals and vehicles. • Provision of aquatic crossings: Culverted crossings should be designed with the needs of migratory aquatic species in mind. • Baffles might be installed to slow the flow enough to allow fish movement etc • Traffic control measures- speed limits, particularly at night and in areas of frequent animal crossing, warning signs • Roadside reflectors to scare animals away from the roadway when vehicles approach at night.

APPENDIX 8

Summary of Potential Environment and Social Impacts Associated with Road Transport Sector and Mitigation Measures (5)

No	Impact	Potential Source	Mitigation Measures
5	**Noise and Vibration** Degradation of human welfare and hearing impairment, communication problems and leading to elevated stress levels as well as associated behavioural and health effects. Causing auditory fatigue, temporary and permanent loss of hearing ability, sleep disorders, and can even contribute to learning problems in children. Damage to roadside structures particularly makeshift or lightly constructed buildings through vibration Disruption of wildlife habitat and movement	Vehicular movement - friction between vehicle and the road surface; Driver behaviour- using vehicles' horns, playing loud music, shouting at each other, and causing their tyres to squeal as a result of sudden braking or acceleration. Construction and maintenance activities Asphalt plant operations Resonance of traffic Piling for interchange construction and bridges	• Surface design and maintenance • Application of a bituminous surface layer over worn concrete roadways is effective in reducing frictional noise. • Use open-graded asphalt • Smooth, well-maintained surfaces such as freshly laid asphalt without grooves and cracks will keep noise to a minimum. • Road design should avoid steep grades and sharp corners to reduce noise resulting from acceleration, braking, gear changes, and the use of engine brakes by heavy trucks at critical locations. • Provision of Noise barriers – concrete, earth, metal, window glazing etc. • Environmental specifications for contractors - In carrying out construction, quarrying, or other such activities in noise-sensitive areas, special attention may have to be paid to equipment noise standards, hours of operation, material haulage routes, and other aspects of work-site management.
6	**Landscape Alteration and aesthetics**	Lack of harmony between the road and Landscape features such as natural relief and morphology, hydrology, vegetation, recreational areas, cultural heritage sites. Quarrying, Borrow pits and gravel winning associated with road construction	• Reforestation • Landscaping of route • Selection of alignment characteristics that best fit the route into the landscape e.g. Vertical and horizontal alignment should follow the natural relief • Reclamation of degraded lands

APPENDIX 8

Summary of Potential Environment and Social Impacts Associated with Road Transport Sector and Mitigation Measures (6)

No	Impact	Potential Source	Mitigation Measures
7.	**Impact on communities and economic activities** Splitting of Communities Loss/disruption of roadside community business and social activity Increased land and property values leading to higher rental values, a turnover in occupancy, and displacement of lower-income tenants	Both new roads and reconstruction requiring widening can split a community. Introduction of faster traffic, access controls, and median barriers generally cuts traditional lines of travel or communication in communities Provision of longer alternative routes for local movements affects businesses and pedestrian movements Disruption of links between villagers and their farmlands by a new road or increased traffic. Roadside business activities including the selling of goods, small businesses such as cafes and vehicle, repair shops; bus or taxi stops can be disrupted by road const. Added to this list of activities are social activities associated with the roadside . In rural areas, in particular, but also in urban areas and at entrances to towns and villages, the roadside provides a social disruption People congregate along the roads to talk, smoke, drink or watch the traffic Increased traffic flows as a result of road improvements can increase conflicts between local activities and the efficiency and safety of traffic functions of the road. Further conflicts and safety concerns arise when road improvement plans call for widening the road and reducing encroachments and accesses. Creation of by pass roads Although by-pass roads can reduce conflict between road use and community welfare, they also can lead to loss of business and death of communities increased by infrastructural improvements, new roads, road improvements Creation of diversion routes	• Resettlement and compensation may need to be considered for those whose housing, land; welfare or livelihood is directly affected by a project. • Take account of local movements in road design stage • Make provision for improved crossings or alternative access routes. • Provision of alternative space for displaced activities and service areas adjacent to the new routes for displaced businesses • Planning of temporary traffic diversions,

APPENDIX 8

Summary of Potential Environment and Social Impacts Associated with Road Transport Sector and Mitigation Measures (7)

No	Impact	Potential Source	Mitigation Measures
8	**Impacts from land acquisition and resettlement** displacement of communities loss of business, properties and incomes social stress economic loss, social and psychological disruption for the affected individuals and their families.	Compulsory land acquisition (expropriation of properties for public projects). Demolishing of structures such as houses, buildings, shops	• Impacts on roadside land users can be avoided by choosing route locations away from built-up areas and by restricting the extent of road • Works to avoid interference with existing activities. • Adoption of a reduced speed design, reduced right-of-way land • Requirements, or design changes (underground drainage, for instance) can avoid impacts on properties and activities. • Compensation of owners of the land and properties on the basis of the current market rates • Resettlement of affected persons where possible
9	**Impact on Cultural Heritage** Damage could affect the historic, scientific, social, and amenity values; aesthetic impacts on cultural monuments and archaeological sites;	Damage caused by road construction, related works such as quarries and borrow sites, and unregulated access to cultural heritage sites.	• Road construction should avoid any alignment that cuts through known cultural sites • Cultural sites uncovered during road works should lead to possible realignment of the road. • In some unusual cases it is preferable to leave a cultural site buried beneath the road. • Excavation, erosion control, restoration of structural elements, rerouting of traffic, and site mapping. • Salvage excavation and relocating artifacts or ruins from a site. • Dialogue between the road department and Monuments and Museums board is required to avoid damage to cultural sites • Marking and fencing important cultural sites during the construction period
10	**Waste Generation**	Excavation spoils Inappropriate Construction camp design and mismanagement leading to sewage and garbage pollution; Spills from construction equipment operation and servicing. Construction waste Waste asphalt	• Disposal of construction related waste materials at designated waste dump site • Waste minimization measures • Waste management plan to be incorporated in road planning
11	**Traffic Disruptions and interruption of local traffic**	Carelessly planned detours and road closures.	• Provision of planned diversion routes during construction • Use of signboards and other public information mechanisms to inform public in advance of construction work and schedule

APPENDIX 8

Summary of Potential Environment and Social Impacts Associated with Road Transport Sector and Mitigation Measures (8)

No	Impact	Potential Source	Mitigation Measures
12	**Utility Disruptions**	Construction activities and the need to realign utility supply lines	• Advance public notices • Collaboration with utility providers • Provision of alternative supplies where applicable e.g. water supply by tankers to affected communities • Restoration of utility lines and other structures damaged during the construction
13	**Public Safety and Health**	Exposure to atmospheric emissions from construction equipment Exposure to excessive and continuous noise and vibration from construction activities Lack of warning sign and safeguards Influx of migrant workers and introduction of diseases such as STDs	• Servicing of construction equipment • Use of equipment with low operating noise levels • Restricting construction works to day time hours • Introduction of traffic/speed control devices • Intensive public awareness campaigns • Provision of signboards • Provision of Diversions where possible during construction period • open ditches and other potential hazards to be properly marked with visible tapes
14	**Occupational Health and Safety**	Accidents from operation of construction equipment	• Training of workers in equipment use • Provision of personal protective equipment and clothing • Enforcement of the use of such equipment • Frequent maintenance of equipment • Safety rules for workers and their enforcement • Emergency procedures and training

Appendix 10 Requirement of JICA Guideline (Appendix 1 of JICA Guideline)

Appendix 1. Environmental and Social Considerations Required for Intended Projects

In principle, appropriate environmental and social considerations are undertaken, according to the nature of the project, based on the following:

1. Underlying Principles

1. Environmental impacts that may be caused by projects must be assessed and examined in the earliest possible planning stage. Alternatives or mitigation measures to avoid or minimize adverse impacts must be examined and incorporated into the project plan.
2. Such examinations must be endeavored to include an analysis of environmental and social costs and benefits in the most quantitative terms possible, as well as a qualitative analysis; these must be conducted in close harmony with the economic, financial, institutional, social, and technical analyses of projects.
3. The findings of the examination of environmental and social considerations must include alternatives and mitigation measures, and must be recorded as separate documents or as a part of other documents. EIA reports must be produced for projects in which there is a reasonable expectation of particularly large adverse environmental impacts.
4. For projects that have a particularly high potential for adverse impacts or that are highly contentious, a committee of experts may be formed so that JICA may seek their opinions, in order to increase accountability.

2. Examination of Measures

1. Multiple alternatives must be examined in order to avoid or minimize adverse impacts and to choose better project options in terms of environmental and social considerations. In the examination of measures, priority is to be given to avoidance of environmental impacts; when this is not possible, minimization and reduction of impacts must be considered next. Compensation measures must be examined only when impacts cannot be avoided by any of the aforementioned measures.
2. Appropriate follow-up plans and systems, such as monitoring plans and environmental management plans, must be prepared; the costs of implementing such plans and systems, and the financial methods to fund such costs, must be determined. Plans for projects with particularly large potential adverse impacts must be accompanied by detailed environmental management plans.

3. Scope of Impacts to Be Assessed

1. The impacts to be assessed with regard to environmental and social considerations include impacts on human health and safety, as well as on the natural environment, that are transmitted through air, water, soil, waste, accidents, water usage, climate change, ecosystems, fauna and flora, including trans-boundary or global scale

impacts. These also include social impacts, including migration of population and involuntary resettlement, local economy such as employment and livelihood, utilization of land and local resources, social institutions such as social capital and local decision-making institutions, existing social infrastructures and services, vulnerable social groups such as poor and indigenous peoples, equality of benefits and losses and equality in the development process, gender, children's rights, cultural heritage, local conflicts of interest, infectious diseases such as HIV/AIDS, and working conditions including occupational safety.

2. In addition to the direct and immediate impacts of projects, their derivative, secondary, and cumulative impacts as well as the impacts of projects that are indivisible from the project are also to be examined and assessed to a reasonable extent. It is also desirable that the impacts that can occur at any time throughout the project cycle should be considered throughout the life cycle of the project.

4. Compliance with Laws, Standards, and Plans

1. Projects must comply with the laws, ordinances, and standards related to environmental and social considerations established by the governments that have jurisdiction over project sites (including both national and local governments). They must also conform to the environmental and social consideration policies and plans of the governments that have such jurisdiction.

2. Projects must, in principle, be undertaken outside of protected areas that are specifically designated by laws or ordinances for the conservation of nature or cultural heritage (excluding projects whose primary objectives are to promote the protection or restoration of such areas). Projects are also not to impose significant adverse impacts on designated conservation areas.

5. Social Acceptability

1. Projects must be adequately coordinated so that they are accepted in a manner that is socially appropriate to the country and locality in which they are planned. For projects with a potentially large environmental impact, sufficient consultations with local stakeholders, such as local residents, must be conducted via disclosure of information at an early stage, at which time alternatives for project plans may be examined. The outcome of such consultations must be incorporated into the contents of project plans.

2. Appropriate consideration must be given to vulnerable social groups, such as women, children, the elderly, the poor, and ethnic minorities, all members of which are susceptible to environmental and social impacts and may have little access to decision-making processes within society.

6. Ecosystem and Biota

1. Projects must not involve significant conversion or significant degradation of critical natural habitats and critical forests.

2. Illegal logging of forests must be avoided. Project proponents etc. are encouraged to obtain certification by forest certification systems as a way to ensure the prevention of illegal logging.

7. Involuntary Resettlement

1. Involuntary resettlement and loss of means of livelihood are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures to minimize impact and to compensate for losses must be agreed upon with the people who will be affected.

2. People who must be resettled involuntarily and people whose means of livelihood will be hindered or lost must be sufficiently compensated and supported by project proponents etc. in a timely manner. Prior compensation, at full replacement cost, must be provided as much as possible. Host countries must make efforts to enable people affected by projects and to improve their standard of living, income opportunities, and production levels, or at least to restore these to pre-project levels.

Measures to achieve this may include: providing land and monetary compensation for losses (to cover land and property losses), supporting means for an alternative sustainable livelihood, and providing the expenses necessary for the relocation and re-establishment of communities at resettlement sites.

3. Appropriate participation by affected people and their communities must be promoted in the planning, implementation, and monitoring of resettlement action plans and measures to prevent the loss of their means of livelihood. In addition, appropriate and accessible grievance mechanisms must be established for the affected people and their communities.

4. For projects that will result in large-scale involuntary resettlement, resettlement action plans must be prepared and made available to the public. In preparing a resettlement action plan, consultations must be held with the affected people and their communities based on sufficient information made available to them in advance. When consultations are held, explanations must be given in a form, manner, and language that are understandable to the affected people. It is desirable that the resettlement action plan include elements laid out in the World Bank Safeguard Policy, OP 4.12, Annex A.

8. Indigenous Peoples

1. Any adverse impacts that a project may have on indigenous peoples are to be avoided when feasible by exploring all viable alternatives. When, after such an examination, avoidance is proved unfeasible, effective measures must be taken to minimize impacts and to compensate indigenous peoples for their losses.

2. When projects may have adverse impacts on indigenous peoples, all of their rights in relation to land and resources must be respected in accordance with the spirit of relevant international declarations and treaties, including the United Nations Declaration on the Rights of Indigenous Peoples. Efforts must be made to obtain the consent of indigenous peoples in a process of free, prior, and informed consultation.

3. Measures for the affected indigenous peoples must be prepared as an indigenous peoples plan (which may constitute a part of other documents for environmental and social consideration) and must be made public in compliance with the relevant laws and ordinances of the host country. In preparing the indigenous peoples plan, consultations must be made with the affected indigenous peoples based on sufficient information made available to them in advance. When consultations are held, it is desirable that explanations be given in a form, manner, and language that are understandable to the people concerned. It is desirable that the indigenous peoples plan include the elements laid out in the World Bank Safeguard Policy, OP4.10, Annex B.

8. Monitoring

1. After projects begin, project proponents etc. monitor whether any unforeseeable situations occur and whether the performance and effectiveness of mitigation measures are consistent with the assessment's prediction. They then take appropriate measures based on the results of such monitoring.

2. In cases where sufficient monitoring is deemed essential for appropriate environmental and social considerations, such as projects for which mitigation measures should be implemented while monitoring their effectiveness, project proponents etc. must ensure that project plans include feasible monitoring plans.

3. Project proponents etc. should make efforts to make the results of the monitoring process available to local project stakeholders.

4. When third parties point out, in concrete terms, that environmental and social considerations are not being fully undertaken, forums for discussion and examination of countermeasures are established based on sufficient information disclosure, including stakeholders' participation in
relevant projects. Project proponents etc. should make efforts to reach an agreement on procedures to be adopted with a view to resolving problems.

Appendix 11 Baseline of Natural and Social Environment in the Study Area

11.1 Project Area of Influence

(1) Construction of New Road between Asutsuare Jct. and Asikuma Jct.

The project road traverses three districts, namely Dangme West in the Greater Accra Region, North Tongu in the Volta Region and Asuogyaman in the Eastern Region. The main townships along the road include Osuwem, Asutsuare, Dufor Adidome, and Asikuma

(2) Upgrading of Asutsuare – Aveyime Road

The project road traverses two districts, namely Dangme West and Asuogyaman in the Eastern Region. There are three main townships at the both end of the target road, Asutsuare and Aveyime, and Volivo at the middle.

Table A11-1 Main Towns in Proposed Project Area

Region	District	District Capital	Main Townships on Road
Greater Accra	Dangme West	Dodowa	Osuwem, Asutsuare, Volivo,
Eastern	Asuogyaman	Atimpoku	Asikuma
Volta	North Tongu	Adidome	Dufor Adidome, Aveyime

Source: Study Team

(3) Overview of Land Use and Livelihoods

In general along the proposed road projects, the land use along the existing roads proposed alignments are:

- Food crop farms, mainly cassava and rice
- Cash crop farms, mainly oil palm, mango, woodlots, and banana plantations
- Cattle grazing fields (mostly north of the Volta River between Dufor Adidome and Asikuma Jct.)
- Natural or original vegetation

Other livelihoods specifically related to the Volta River are:

- Aquaculture in the Volta River (limited but popular)
- Shell mining as a raw materials for white paint or as a construction materials
- Canoe ferries offering transport services

11.2 Profiles of Potentially Affected Districts

(1) Dangme West District

a) Climate

The Dangbe West part of the southeast coastal plain of Ghana, which encompasses the project area, is one of the hottest and driest parts of the country. Temperatures are high for most of the year, being the highest during the main dry season (November – March) and the lowest during the short dry season (July – August). The absolute maximum temperature is 40°C.

Rainfall is generally very low, with most of it being very erratic in nature and falling between September and November. Mean annual rainfall increases from 762.5 mm on the coast to 1,220 mm.

Photo A11-1 Land scape around grazing field

Photo A11-2 Aquaculture pond

Photo A11-3 Shell mining and baking

Photo A11-4 Canoe ferry

Photos by the Study Team, May 2012

b) Topography, Geology and Soil

In the central portion of the Accra plain, the relief is gentle and undulating, with heights not exceeding 70 m. The plains are punctuated by a few prominent inselbergs, isolated hills, outliers and knolls scattered over the area. Prominent relief features include the Yongua inselberg (427 m) which has a conical shape with a number of outliers around Asutsuare and Osuwem areas; the Krabote inselberg also to the North, and the Shai Hills (289 m) towards the western part of the area. There are conspicuous large rock outcrops and boulders in the vicinity of the hills in some places.

The soils in the area are poorly drained pale-coloured sandy silty and clay soils formed recently or contemporary Volta Alluvium. The soils appear to be moderately well supplied with nutrients under natural conditions and are easily workable even with simple implements. In the recent past most of it was under sugarcane cultivation to feed the now collapsed Asutsuare Sugar complex. The same fields are currently under extensive rice cultivation, making the flood plain soils one of the most fertile soils in the area. Recent alluvium occupies the Volta flood plain and the valleys of the major streams on the plain. There are no known mineral deposits of commercial and economic value in the area, except for oyster shell deposits at Volivo and its surroundings and clays of various types.

c) Land Use

Although the soils in the district have relatively low fertility and remain dry for most of the year due to the unreliable and insufficient rainfall, there is still enormous potential for the

development and expansion of agriculture. Extensive irrigation of the low plains with water drawn from the Volta River would enable these soils to support extensive rice, maize and vegetable cultivation. At present, the area is widely used for the cultivation of rice, sugarcane and vegetables.

d) Water Resources and Drainage

Flowing over fairly low terrain, most of the streams have carved wide valleys, which are dry for most of the year. The very seasonal nature of most of the streams caused by high temperatures and equally high insolation levels has encouraged the construction of a number of artificial dams and ponds of varying size, which are used for irrigation and for watering of livestock.

The project area forms part of the lower Volta flood plain. The repeated process of flooding and recession of the Volta waters over the years has created fertile alluvial soil, a vast sedimentary strata of oyster shells and a number of inland lakes. Ground water potential in the area is quite low and saline.

Sources of water for domestic use are pipe borne, boreholes, streams and wells. Except for the towns, most of the villages depend on borehole water, hand-dug well water, streams and rivers.

e) Economic Activities

The area is largely rural. The predominance of the rural population is reflected in the occupational distribution, with agriculture being the main occupation. The relocation of the Golden Exotic Estate (a 3,000-ha banana plantation of which almost 800-ha have been planted) and Tropo Farms, a 5-ha fish farm has, broken new ground in agriculture. Fishing, which could be another big employer given the presence of the Volta River, employs only 6.4% of the people. The area is noted for the production of fruits such as mangoes, pineapple, and banana. In addition, rice production and aquaculture (tilapia) are practised in the Asutsuare area. The area is also noted for animal production with cattle, goats and poultry rearing being the leading activities.

f) Social Infrastructure

The district has about 252 km of roads, of which 40% is paved and the rest are feeder roads. Tracks and footpaths also link villages. The total road network appears to have a good spatial distribution compared to other districts. The 14.8-km railway line from Tema through Afienya to the Shai Hills is not being used. Out of the 231 settlements in the district, about 30% are connected to the national electricity grid. Major towns in the district including Dodowa, Prampram, Asutsuare, Dawhenya, Afienya, Dorymu, Old Ningo, Kordiabe, New Ningo and Agomeda have electricity. An estimated 34% of the inhabitants in the 231 settlements in the district have no access to potable water. A total of 18 towns have access to piped water, with the remaining towns depending on wells, boreholes and other sources.

g) NGOs

There are many NGOs such as World Vision operating in the district. These NGOs are

involved in projects such as community water supply, food security, capacity building and HIV/AIDS intervention activities.

(2) North Tongu

a) Climate

The climate of the North Tongu District is tropical, greatly influenced by the south-west monsoons from the south Atlantic and the dry Harmattan winds from the Sahara. There are two rainy seasons, the major one from mid-April to early July and the minor one from September to November. The average annual rainfall varies from 900 mm to 1,100 mm with more than 50% of it falling in the major season.

Temperature and relative humidity vary little throughout the year. The mean temperature is 27ºC, ranging from a maximum of 33ºC and to a minimum of 22ºC. Average relative humidity is about 80%, making the weather quite conducive to human activities, such as habitation, farming and recreation.

b) Topography, Geology and Soil

North Tongu is dominantly medium to moderately coarse textured alluvial soils along the Volta River. Below these are the heavier clay soils that characterise most parts of the area, leading to poor surface and sub-surface drainage, making road development difficult. These soils are also very difficult to cultivate because they have low water holding capacity. They are also shallow (low effective rooting depth). They are, however, suitable for rice and sugarcane cultivation under irrigation. They also provide the raw material for the pottery, brick and tile industries. The main mineral deposits in the area are clay, oyster shells, feldspar, nepheline gneiss, sand and granite.

c) Land Use

The project road traverses a number of farming villages and towns. The main form of land use in the project area is agriculture. The land is mainly used for the cultivation of food crops and cattle rearing.

d) Water Resources and Drainage

The area is drained by the Alabo, Kolo, Aklakpa, Gblor, and Nyifla rivers and their numerous tributaries into the Volta River. In the rainy season, these streams overflow their banks, causing damage to roads and farms. There are several ponds and dugouts/dams in the area, which serve as main sources of water supply for the inhabitants and livestock.

The same as in Dangme West District, sources of water for domestic use are pipe borne, boreholes, streams and wells. Except for the towns, most of the villages depend on borehole water, hand-dug well water, streams and rivers.

e) Economic Activities

The leading sector of the district's economy is agriculture. The sector is dominated by small-scale unorganised farmers who depend mainly on labour-intensive production techniques. The sector is characterised by low production resulting from the continuous usage of indigenous farm implements, adoption of indigenous farming practices and a higher level of post-harvest

losses particularly in maize and vegetable production. Fishing, which is done mostly in the Volta River, has declined considerably due to the construction of the Kpong Dam. Traditional fishing communities (Bakpa, Mafi, Mepe, Battor and Volo) close to the Volta River have had their economic base eroded. Livestock breeding is an integral part of the farming communities, with about 30% of the farmers in the district keeping some ruminants. The district is one of the largest cattle breeding areas in the country.

f) Social Infrastructure

The road network in the district is in a poor state, although efforts are being made to improve the roads and make them more motorable. A number of roads and bridges are currently undergoing construction or rehabilitation, and when completed they will make the district generally more accessible.

Until 1994, most communities in the North Tongu District had no access to potable water. The inception of the DANIDA brought a tremendous change in the water supply situation in the district. The DANIDA water project provided piped water to Tedeafenui and other communities in the Adidome area. In addition, 26 communities have been provided with a total of 89 shallow wells fitted with hand pumps. The Volta River provides an important source of water supply to the towns and villages, located along it.

The current supply of hydroelectric power is limited to Adidome, Akyemfo, Battor, Mepe, Mafi-Kumase-Asiekpe and Juapong. Electricity supply is being extended to most of the major settlements in the district. Extension of electric power to towns and villages outside the district capital is dependent on community self-help with the support of the rural electrification programme. Wood fuel and charcoal are the main sources of energy for cooking.

The district has 35 kindergartens, 126 primary schools, 71 junior high schools, five senior high schools and a special school for rehabilitation of the mentally retarded. There is also a farm institute at Adidome, which trains youths in self-employable agricultural skills.

g) NGOs

The same as in Dangme West District, there are many NGOs operating in the district. These NGOs are mainly involved in community water supply, food security, capacity building and HIV/AIDS intervention activities.

(3) Asuogyaman District

a) Climate

This part of the project area in the Asuogyaman District lies within the dry equatorial climate zone and experiences substantial precipitation. It has a long rainy season which starts in April, peaks in June/July and ends in November. The dry season starts in November/December and ends in March.

The annual rainfall is between 67 mm and 1,130 mm and the maximum temperature is 37.2^{o}C, The relative humidity is generally high, ranging from 98% in June to 31% in January.

b) Topography, Geology and Soil

The main rock types of the Asuogyaman District are quartzite acidic gneiss and schist. There

are several out–crops of rocks in the area. In the low-lying areas along Lake Volta, the soil types are Savannah Greisol and Aluviosols. These are hydro-morphine soils confined to the large depression and valley bottoms of the Volta River plain.

The soil is a greyish, dark red in colour. It is mainly impervious and moderately supplied with nutrients. Because of its structure, the soil is liable to temporary flooding in times of high water level. Its nutrient status is moderate but fertiliser is required to ensure sustained yields of crops.

c) Land Use

The project road traverses a number of farming villages and towns in this district and the main form of land use is agriculture (crop farming and animal husbandry). The land is mainly used for cultivation of food crops and cattle rearing.

d) Water Resources and Drainage

The water resources are Lake Volta and the downstream side of the Akosombo Hydroelectric Dam. The same as in other districts, sources of water for domestic use are pipe borne, boreholes, streams and wells. Except for the towns, most of the villages depend on borehole water, hand-dug well water, streams and rivers.

e) Economic Activities

Agriculture is the major economic activity in the district in terms of employment and rural income generation. Crop farming is predominant, with maize, cassava, plantain, vegetables and yam being the major crops. Fishing in Lake Volta is an important economic activity along the 141 km shoreline. It is carried out in wooden planked canoes, with tilapia and chryrtrissa (one-mouth thousand) being popular catches. Live box aquaculture of tilapia is also being developed on Lake Volta. The fish are processed mostly by smoking and frying and sent to market centres at Dzeneni, Akosombo, Atimpoku and Agormanya.

There are three main types of farming activities in the district: livestock breeding, food cropping and cash cropping among which food cropping accounts for more than 78% of the farmers in the district (population and housing census in the year 2000). Livestock breeding is carried out on a limited scale, employing only about 8% of farmers, whiles cash cropping also employs just 12% of the farming population.

f) Social Infrastructure

The Ghana Water Company supplies piped water to towns and villages along the major trunk road and the Volta River Authority supplies water to Akosombo. Other towns and villages depend on deep wells, hand-dug wells and streams.

The district has 28 junior high schools and 7 senior high schools. The teacher/pupil ratio for primary school and junior high scool is 1:32 and 1:19 respectively, which are lower than the national average.

The National Health Insurance Scheme (NHIS) began in 2004 and has since registered a total of 31,320 people. Service providers include two hospitals and 13 health centres.

g) NGOs

The same as in Dangme West District, there are many NGOs operating in the district. These

NGOs are mainly involved in community water supply, food security, capacity building and HIV/AIDS intervention activities.

11.3 Water Quality

Water sampling and analysis was conducted. The results of analyzing physical, chemical and bacteriological parameters of surface water (Volta River) are presented in Table A11-2 alongside EPA guideline values. There are no indicators exceeding the EPA guideline values.

Table A11-2 Water Quality of Volta River Surface Water (Mean Concentrations)

Parameter	EPA Method No.	Unit	Sample/Volta River Water	EPA Guideline
Temperature	-	ºC	28.6	
Turbidity	3	NTU	10.0	75.0
Colour (apparent)	2	Hz	10.0	100
pH	4	pH Units	6.88	6.0-9.0
Conductivity	1	µS/cm	66.0	1,500
Tot. Susp. Solids (T-SS)	5	mg/l	4.00	50.0
Tot. Dis. Solids (TDS)	6	Mg/l	43.6	1,000
BOD	30	Mg/l	1.64	50.0
COD	29	Mg/l	19.3	250
Sulphate (SO_4)	19	Mg/l	3.80	250
Phosphate (PO_4-P)	17	Mg/l	0.692	2.00
Nitrate (NO_3-N)	15	Mg/l	0.119	50.0
Ammonia (NH_3-N)	13	Mg/l	0.871	1.00
Salinity	-	ppt	0.041	-
Oil & Grease	-	mg/l	<1.00	10.0

Source: EPA Wastewater Quality Guidelines and Study Team

11.4 Air and Noise Quality

(1) Air Quality

In accordance with sampling methods for the EPA Ambient Air Quality Guidelines, air quality sampling was conducted at representative locations of the two proposed projects. The results shows that at present, all sampling locations are below the EAP guide line for residential areas.

Table A11-3 Results of Ambient Particulate Matter Monitoring

Sample Location	GPS Coordinates	PM_{10} (µg/m^3)	TSP(µg/m^3)
Adebosu	N - 06° 24' 14.1", E- 000° 11' 53.1"	18.5	39.7
Amesinyekope	N - 06° 22' 54.3", E- 000° 12' 53.7"	30.1	63.2
Dafor Akpatanu	N - 06° 06' 20.9", E- 000° 15' 54.9"	22.3	50.2
Adakope	N - 06° 03' 07.7", E- 000° 17' 41.3"	40.8	70.3
Osuwem	N-06° 01' 35.4", E- 000° 10' 58.4	55.7	73.4
Aveyime	N06° 01' 30.7", E000° 22' 02.15"	58.2	83.3
EPA Ambient Air Quality Guidelines for Residential Areas		70 µg/m^3	150µg/m^3

Instrument Used: Minivol samplers
Source: Study Team

Photo A11-5 Sampling location

Photo A11-6 Air sampler

Photos by the Study Team, August 2012

(2) Noise Quality

In general, the noise levels recorded at the various locations along the projects were low. The project roads are all located in mostly rural settings where there is no industrial activity and the traffic volumes is low, and so the noise levels are also low. The ambient noise levels monitored for selected communities are listed in Table A11-4.

Table A11-4 Ambient Noise Levels at Selected Locations

Location	GPS Coordinates	Leq	Lmax	Lmin	L90
Adabosu	N - 06° 24' 14.1", E- 000° 11' 53.1"	48.9	66.4	42.9	45.3
Amesinyekope	N - 06° 22' 54.3", E- 000° 12' 53.7"	66.3	94.4	52.3	55.3
Dafor Akpatanu	N - 06° 06' 20.9", E- 000° 15' 54.9"	45.2	52.6	44.4	48.5
Adakope	N - 06° 03' 07.7", E- 000° 17' 41.3"	56.6	71.9	42.8	50.1
Osuwem	N-06° 01' 35.4", E- 000° 10' 58.4"	64.7	73.7	54.9	57.4
Aveyime	N06° 01' 30.7", E000° 22' 02.15"	**69.3**	108	59.3	62.8
EPA Daytime Recommended Level for Residential Areas dB(A)		55	–	–	–

Note: Instruments used - Quest Suite Professional, Sound Level Metre, type1900
Source: Study Team

Photo A11-7 Noise monitor setup

Photo A11-8 Noise monitor

Photos by the Study Team, August 2012

11.5 Flora and Fauna

(1) Flora

The predominant type of vegetation found in this southern part is short savannah grass interspersed with shrubs and short trees, which are characteristic of the Sub- Sahelin type. A large portion of vegetation remains dry for most of the year particularly towards the south except for the short rainy season. In the Volta flood plain areas, tall swampy grass and tall savannah grass with isolated thickets and trees are the main types of vegetation.

The northern area lies within the tropical savannah grassland zone. The vegetation is dense along the Volta River and along the stream basins, and is maily mangoes, oil palms, baobab, silk cotton, acacia, etc. Farther from the river the vegetation is sparse, predominantly grassland, interspersed with Neem trees and guinea grass, digitaria decumbent and fan palms. The shrub and grassland areas are suitable grounds for cattle breeding, making the area one of the largest cattle-producing areas in the country.

Photo A11-9 Typical vegetation in the proposed project area

Photo A11-10 Typical vegetation in the proposed project area

Photos by the Study Team, August 2012

(2) Fauna

Harvesting of trees for lime and charcoal production in the area and also poaching has caused wildlife, which included elephants, antelopes, monkeys hogs to flee to other reserves close to the Study Area (Figure A11-1). Partridges are, however, still common in the area.

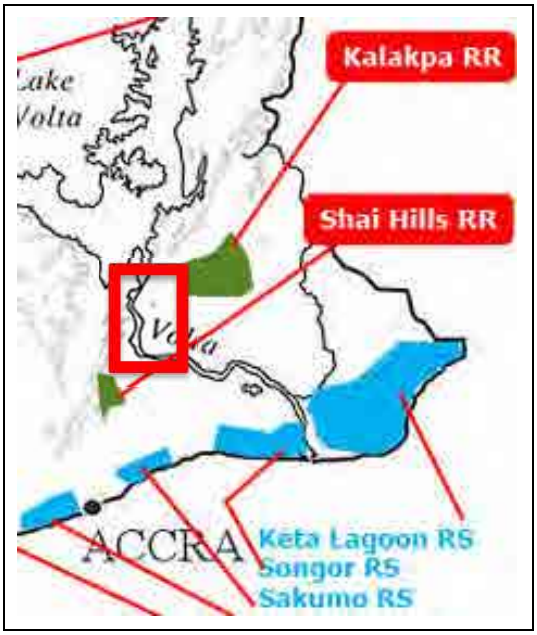
Photo A11-11 Partridges

Photo A11-12 Partridges

Photos by the Study Team, August 2012

11.6 Environmentally Sensitive Area around the Proposed Project Area

Details of environmentally sensitive area around the proposed project area are described in the Main Report Section 11.2.2 (6) Environmentally Sensitive Area around Proposed Project Area).



Source: Ghana Wildlife Division
<http://www.wildlifeghana.com/wildlifeMain/map.html>

Figure A11-1 Protected Wildlife Areas around Proposed Project Area

Appendix 12 Result of Environmental and Social Environmental Survey

The potential impacts of and appropriate mitigation measures for the projects have been confirmed with reference to similar projects throughout Ghana, and the particular concerns of the local communities have been investigated.

From baseline information gathered at the fieldwork phase and issues that transpired during consultations with stakeholders, the impacts of the projects, particularly during the construction phase, will be as follows:

- Water resources
- Soil erosion and sedimentation
- Air quality
- Noise and vibration
- Expropriation of farmland and forest reserves
- Establishment of borrow pits
- Flora and fauna
- Construction waste
- Construction camps
- Employment and income
- Gender issues
- Traffic safety, accidents and convenience
- Vehicle operating costs and transportation costs

12.1 Potential Positive Impacts

(1) Regional Economy

Construction or upgrading of roads is expected to provide socio-economic benefits to the nation as well as sub-region. The new road between Asutsuare Jct. and Asikuma Jct. will form a major link to parts of the Eastern Corridor. Thus, consturciton of new road between Asutsuare Jct. and Asikuma Jct. and upgrading of Asutsuare – Aveyime road will have psitive impacts on the regional economy, by enhancing accessibility and commercial activities, and facilitating regional economic integration. Although construction activities on the Asutsuare – Aveyime road will cause temporary delays to public and private transport, access to services and facilities should be improved in the long-term through greater reliability and, possibly increased availability of public transport.

Public and private transport opportunities should improve because of faster travel speeds, reduced frequency of breakdowns, and lower maintenance costs. This may encourage an increase in taxi and bus services. Increased growth in the size and number of settlements along the road will speed up deliveries and the availability of transport services.

Construction and upgrading of the road will also improve access to health care and other social services and strengthen local economies.

Demand for goods is expected to increase, and many more people will engage in various economic activities. In the long term, the projects will help reduce poverty in the Study Area. Thus, the impact on the regional and national economies is positive and significant.

(2) Traffic Safety, Accidents and Convenience

Reconstruction of culverts and side drains to reduce flooding of the road will be a component of upgrading the Asutsuare – Aveyime road. The project will improve horizontal and vertical alignment together with improvement of intersection that will significantly improve traffic safety and comfort for road users. As a consequence of the traffic safety measures and improvements of the road, the number of accidents is expected not to increse.

The construction of the new road between Asutsuare Jct. and Asikuma Jct. will ease traffic congestion at townships along the existing N2, particularly Kpong and Atimpoku, and hence the conflicts vehicules and pedestrians and its associated accidents in these areas will be reduced.

Construction of the road will confer additional benefits and convenience including improved access to markets, increased government services such as the provision of electricity, potable water, health services, education and stimulation of agro-industries, especially in the Asutsuare and Aveyime areas.

(3) Vehicle Operating Costs and Transportation Costs

The project has the potential to benefit road users through reduced vehicle maintenance costs and delays. It will benefit the people in the area through increased opportunities and reduced costs of transporting agricultural produce to distribution centres or sale points; sending children to school; getting to other facilities or service centres and encouraging migrant workers to return home more frequently. The effect on overall vehicle operating costs is positive and significant for the local and regional users in the operation phase.

(4) Employment and Income

The projects will lead to an overall upgrading of the socioeconomic setting in the area. In the short-term, recruitment of labour from roadside villages will contribute towards raised employment, increased income and upgrading of the skills of local residents and their families. Newly skilled workers will have enhanced prospects for future employment. The presences of a labour force in the vicinity of settlements will also increase economic and employment opportunities for residents. In the long term, an increase in traffic volume may stimulate business opportunities along the road through the sale of goods and other services. Since the economy of the settlements along the road is largely based on agriculture, road construction may increase transport opportunities and potentially decrease the costs of distributing agricultural products and thereby increase earning potential.

The major economic activity of the inhabitants in the project area is agricultural production and marketing. The improved road will open up the possibilities for agro-business. New industries tend to locate where land is available and infrastructure exists; road corridors are logical choices. Incomes earned directly or indirectly will raise the standard of living of the people involved in the projects.

The impact on employment and income is considered to be significant and positive in the construction phase and slightly positive when the road is in operation.

(5) Gender Issues

The road project will bring new job opportunities for women and also improve their situation within the agriculture and trading sectors. The influx of labour will temporarily cause a significant increase in the demand for vegetables and other foodstuff traditionally produced by women. Catering and trading opportunities will also increase.

The indirect benefits include improved access to health facilities and schools for children. The transport of people and products between the fields and the villages will become faster and safer with the improved road. The women will benefit greatly from the savings in time.

It is anticipated that improvement in the transportation sector, which supports the marketing of agricultural produce, would help increase income levels and the general well-being of women in the districts. Improvement of the road is therefore critical to the livelihood of women in the districts.

(6) Air Quality Improvement

Upgrading of the Asutsuare – Aveyime road will result in improved air quality during the operational life of the road. The paved surfaces will generate much less dust than the present gravel roads, reducing the current negative effect on the flora and crops along the road as well as the health of those people living in the area. The consumption of fuel and thus the amount of exhaust fumes produced per tonnage kilometre will be reduced as the road standard is improved. The post-construction impact on air quality is therefore positive.

Construction of road between Asutsuare Jct. and Asikuma Jct. which will be far from most communities, will reduce the exhaust fumes on the existing N2 because traffic diversion will reduce the number of vehicles on it.

12.2 Potential Negative Impacts

(1) Pollution of Water Resources

Road construction alters the hydrology of watersheds through changes in water quantity and quality, stream channel morphology, and ground water levels. Some culverts over streams and a bridge across the Volta River are to be constructed; as a result, pollution and siltation of the watercourses under these culverts and bridge could occur. If construction takes place during the dry season, the silt banks that are close to the place of work may obstruct the flow if proper de-silting is not carried out. If works are done during the rainy season, a high concentration of suspended matter will occur in the water body concerned. For works that will be done during the rainy season, suspended matter will be carried further with the flow and eventually end up in downstream reservoirs. Soil and water contamination by oil, grease, fuel and paint from equipment yards is likely to occur during the construction phase.

Vegetation cover will be removed from not only the road alignment but also from borrow pits and the fine materials of exposed surfaces would be susceptible to erosion by intense tropical

rainstorms and winds. The creation of stagnant water bodies in borrow pits, quarries, etc. during construction of the road will create conditions suitable for mosquito breeding and other vectors. The impact is negative and significant. Mitigation measures are thus required.

In addition, discharge of wastewater from construction camps will contribute to pollution of nearby rivers. Surface run-off from construction sites and camps may include but not necessarily be limited to hydrocarbons such as waste oil and lubricants. Decreased water quality, through sedimentation or pollution, may have downstream impacts on aquatic fauna (which are important for purifying water), agriculture and other socio-economic uses, such as washing and drinking by rural inhabitants.

The largest impact on present water quality is expected where the project road crosses water bodies. The impact on water quality is considered to be negative and significant in the construction phase and slightly negative in the operation phase.

(2) Soil Erosion and Sedimentation

Road construction will intensify the effects of natural soil erosion due to vegetation removal, soil disturbance, and exposure of bare soil surfaces. The most severe problems will be associated with embankment construction in the plain area, road sections with heavy cuts and fills, borrow and spoil sites, as well as bridge and culvert construction sites, particularly on rainy days. Soil erosion decreases the agricultural potential of the affected land with consequences for the economy of the region.

(3) Air Quality

During the construction phase, the use of construction equipment and vehicles will increase the level of dust and emissions not only in the work areas, but also along the permanent and temporary roads to quarries, borrow pits and sand pits as well as disposal sites for spoils and waste. The impact is negative and significant.

During the life of the road, vehicle exhaust fumes will increase due to traffic growth. The impact will be most significant in towns. The impact is negative due to negative health implications.

(4) Noise and Vibration

Certain levels of noise pollution are unavoidable at major construction sites. Excessive noise, however, can be a nuisance to construction workers, farm workers and people who live close to the road, and in extreme cases could be a health hazard.

Construction activities involving heavy duty machinery, vehicular movement, vehicle horns, etc. will increase ambient noise levels and vibration beyond the immediate road corridor. Noise and vibration will also occur as a result of the creation of sandpits and borrow pits, and other construction activities such tipping and turning of heavy-duty trucks and other trucks and compacting of gravel spread on the road. The effects of this impact include welfare and physiological disruptions. Vibrations can damage roadside structures, particularly makeshift or lightly constructed buildings. The impacts are negative and significant. Mitigation measures are required to reduce noise and vibration in the construction phase to the EPA acceptable ambient

noise level of 55 dBA between the hours of 06:00 to 22:00, for residential, educational and other facilities.

(5) Expropriation of Farmland and Forest Reserves

The need to improve the vertical and horizontal alignments of some sections of the existing road will cause farmland to be destroyed. Where new bridges will be constructed across the Volta River and other rivers, farmland is likely to be destroyed. In the project roads area, there are several intersections that need to be properly designed and constructed All these activities at the construction phase will result in the destruction of farmland and natural vegetation. Vegetation cover, once established, is central to maintaining the ecosystem of an area. Destruction of vegetation has a multitude of negative effects on other environmental attributes which include reduced capacity for water infiltration, increased rate of surface runoff, reduced groundwater recharge, reduced water quality through increased sedimentation, accelerated soil erosion, reduced production of atmospheric oxygen, and loss of habitat for wildlife. The impacts on farmland and forests are considered to be negative and significant and mitigation measures are required.

(6) Landscape Modification

It is proposed to use borrow pits during rehabilitation of the road. Disfiguration of the landscape by embankments, deep cuts, fills and quarries as well as roadside littering are also expected to take place during the construction and operation phases of the project. There will be destruction of beautiful landscapes rich in vegetation and wildlife in the ROW created by the project roads. Furthermore, disused borrow pits if not rehabilitated, could serve as breeding grounds for mosquitoes and vectors of other water-borne diseases.

The landscape is considered to be environmentally sensitive along the entire section of the project roads. The impact of sandpits, borrow pits and dumpsites on the aesthetic and visual quality and value of the landscape is thus considered to be negative and highly significant. Mitigation measures are required to reduce these environmental impacts.

(7) Flora and Fauna

a) Flora

Vegetation must be cleared and trees felled where borrow pits have been proposed and on sections where there is horizontal realignment of the road. The clearing of vegetation causes destruction or damage to terrestrial wildlife habitats, biological resources or ecosystems that should be preserved. Emissions and spilled oil that will be washed out from the road are also likely to have negative effects on the growth of plants by the roadside. These impacts are considered to be negative but moderate since the actual areas involved will not be large. Mitigation measures are required to reduce the negative impacts.

b) Fauna

The impact on fauna is expected to be low since the destruction of vegetation and other human activities have already caused paucity of fauna along the existing roads. The noise and vibration from the construction works will frighten the few reptiles and birds and probably drive

them from their habitat.

(8) Traffic Diversion

Travellers and commuters may experience possible inconvenience due to road diversions during the construction period. The traffic diversions could result in traffic congestion, increased waiting times and traffic accidents. This will be for a limited period, but will have direct bearing on economic activity in the predominantly farming area. The impact on road users is significant and negative. Mitigation measures are required during the construction phase.

(9) Construction Wastes

Large quantities of construction wastes will be generated while construction and upgrading of the roads. Poor sanitation and solid waste disposal in construction camps and work sites are likely to have negative impacts on human health. The improper handling and disposal of construction wastes would have a negative impact on the environment.

(10) Construction Camps

Temporary construction camps will be required for housing construction workers, and storing construction vehicles, equipment, fuel and road-building materials. Establishing new construction camps may involve the bulldozing and levelling of pieces of ground, and erection of temporary or permanent housing units. This could destroy an area, leading to obvious consequences on soil erosion and water quality, if the camp is poorly sited and or constructed. Indiscriminate dumping of engine oils, fuel, lubricants or other solvents could contaminate soil and leach into subsoil water.

The impacts of construction camps are negative and significant. Mitigation measures are required.

(11) Traffic Safety

Conflicts will occur between passing vehicles and the activities in the work areas. Such conflicts will be most pronounced on the Asutsuare – Aveyime road. The movement of construction vehicles and workers, pedestrians and non-construction vehicles in these settlements will result in conflicts. The safety of vehicle users and pedestrians may be endangered by an increased risk of collisions with construction equipment or unsafe road conditions.

When the project is completed, accident rates could rise due to speeding on the improved roads. Indirectly, construction and upgrading of roads will induce commercial, industrial and residential developments along these roads.

The impacts are considered to be significant and negative in the construction and operation phases. Mitigation measures are therefore required in the construction and operation phases.

(12) Public Health

The influx of construction workers as well as freight vehicle drivers into the area could increase the risk of spreading sexually transmitted infections (STIs) and HIV/AIDS to rural inhabitants. In addition, the safety of vehicle users and pedestrians may be endangered by an

increased risk of collisions with construciton equipment or unsafe road conditions.

Standing water in borrow pits, quarries and pools near the road is a health hazard to nearby residents since it serves as a breeding site for vectors of disease such as mosquitoes and snails which transmit malaria and bilharzia. During the rainy season, many people may use these pools of water for domestic purposes and watering of livestock, thereby increasing health risks. Reworking and reclamation of existing borrow pits and installation of sufficient culverts will reduce the risk of standing water and associated health hazards.

(13) Community Cohesion and Social Disruption

The social fabric of rural settlements, especially the smaller ones, may be disrupted by an influx of construction workers and the opportunities these pose for providing services and forging new relationships. The construction camps may severely disrupt the social fabric of settlements by exposing residents to different norms and practices.

Appendix 13 Results of Public Consultations

The GHA conducted initial public consultations for both construction of new road between Asutsuare Jct. and Asikuma Jct. and upgrading of the Asutsuare – Aveyime road at Asutsuare on 10th September, 2012 and at Juapong on 11th September, 2012. Each of the public consultations is summarized as follows.

(1) Public Consultation at Asutsuare

a) Overview

- Date: September 10, 2012
- Place: Osudoku Senior High Technical School
- Style: Public meeting
- Number of attendants: 328
- Chiefs and traditional community's key persons: 9
- GoG officials: 9 including Minister of Roads and Highways, and Members of Parliament
- Language: English and 2 local languages

b) Major Comments from the Public and Response from the GHA or Other Government Officials

Table A13-1 Comments and Responses in the Public Consultation at Asutsuare

Comments from the Public	Responses from GHA or GoG officials
- Schedule of the project.	The GHA described the status of the Study and expected detail design, but no specific schedule was announced.
- The reason for excluding the Juapong to Mafi Adidome road from construction of Asutsuare Jct. and Asikkuma Jct.	The road project is now under another agency, but it is at the procurement stage at present.
- Without government officials supervision on site, contractors tend to do poor quality road construction work. The GHA should monitor the contractors and make sure the road quality is good.	The MRH/GHA will assure proper implementation of the road construction work.
- In the past, due to the lack of government funds, PAPs agreed to relocate before full payment. However, some PAPs never received the rest of the compensation without proper explanation. The GHA should take this issue seriously and prevent.	The MRH/GHA will ensure necessary mitigation measures including payment of compensation and recovery assistances.
- Why the road will not pass through Asutsuare township.	Asutsuare was excluded because it would require too much involuntary resettlement.
- During the construction of the Kpong Dam, some PAPs were not compensated. For the proposed road projects, all PAPs should be compensated.	The MRH/GHA will ensure that the necessary mitigation measures are taken in accordance with the resettlement policy. The issue of the Kpong Dam is not clear due to the different jurisdiction.

Source: Study Team

c) General Responses from the Public

No objections to the proposed projects were made. In general, the attendants agreed with the proposed projects and were keen to see them actually implemented. Historically, many projects were promised not only roads but also other public facilities, especially before elections. People in general are sceptical about politicians' promes. As the minister himself explained his strong intention that the proposed projects be carried out, the attendants seemed excited about the high

priority status of the projects.

d) Selected Pictures

Photo A13-1 Project Description by Planning Director of GHA

Photo A13-2 Meeting hall (front left →back right)

Photo A13-3 Meeting hall (front right →back left)

Photo A13-4 Additional attendants next to the meeting hall

Photo A13-5 English presentation followed by two local language translations

Photo A13-6 Some responses by Minister of Roads and Highways

Photos by the Study Team, September 2012

(2) Public Consultation at Juapong

Though the Juapong community is not directly affected by the proposed projects, it was chosen due to its central role between proposed bridge across the Volta River and N2 Asikuma Jct.

a) Overview

- Date: 11th September, 2012
- Place: St.Francis of Assisi Catholic Church
- Style: Public meeting
- Number of attendants: 376
- Chiefs and traditional community's key persons: 70
- GoG Officials: 8 including Members of Parliament
- Language: English and 2 local languages

b) Major Comments from the Public and Response from the GHA or Other Government Officials

Table A13-2 Comments and Responses in the Public Consultation at Juapong

Comments from the Public	Responses from GHA or GoG Officials
- The reason for excluding the Juapong to Dufor Adidome road from construction of Asutsuare Jct. and Asikkuma Jct.	The road project is now under another agency, but it is at the procurement stage at present.
- The reason for little description of Dufor Adidome's resettlement requirements despite the social environmental survey.	The GHA will conduct a detailed survey at a later stage. This time, the consultants conducted a survey for rough estimation purpose only.
- Request to hire young local people for the project implementation.	No specific response was given.

Source: Study Team

c) General Responses from the Public

No objections to the proposed projects were made. The majority of comments concerned the Juapong to Dufor Adidome road, which has been postponed for some reason and people are anxious about implementation of the project. However, in general, the attendants agreed with the proposed projects and are keen to see them actually implemented. Some Juapong based people are concerned about depopulation of Juapong and reduction of business opportunities due to construction of road between Asutsuare Jct. and Asikuma Jct.

d) Selected Pictures

Photo A13-7 Project Description by Planning Director of GHA

Photo A13-8 Meeting hall (back → front)

Photo A13-9 Meeting hall (front right →back left)

Photo A13-10 Attendants' registration

Photo A13-11 English presentation followed by two local language translation

Photo A13-12 Some responses by Member of Parliament (Volta Region)

Photos by the Study Team, September 2012

Appendix 14 Scope of Resettlement Impact

14.1 Summary of the Population and Housing Census

The GoG conducted a population and housing census in 2010 and has been processing the results. As of September 2012, only a summary report of the final results was available for the general public. The summary report covers both population and housing census results at the regional level and the appendix includes the population at the district level. With the support of the GSS, MoFEP, the Study Team could obtainthe population and selected socio-economic data at the district level. The following are the key findings of the 2010 population census and district level data sheets for the purpose of understanding the socioeconomic setup for the project affected area (Dangbe West District in Greater Accra Region, North Tongu District in Volta Region, and Asuogyaman District in Eastern Region): 1) population, 2) ethnicity, 3) religion, 4) educational level, and 5) economic activities.

(1) Population

The population of Ghana in 2010 was 24,658,823, up 30.4% from 2000. The age-sex structure is shown in the following figure. Based on the summary report, the present structure reflects the effects of high fertility and decreasing mortality rate. The populations in the project affected districts and regions are shown in Table A14-1.

Table A14-1 Population in the Project-Affected Districts

Region/ District	Ratio in Region	Total	Male	Female	No. of Households	Household size	Urban	Rural
Greater Accra		4,010,054	1,938,225	2,071,829	1,036,426	3.8	3,630,955	379,099
Dangbe West	3.1%	122,836	58,806	64,030	26,489	4.5	41,629	81,207
Volta		2,118,252	1,019,398	1,098,854	495,603	4.2	713,735	1,404,517
North Tongu	7.0%	149,188	70,282	78,906	31,573	4.7	43,410	105,778
Eastern		2,633,154	1,290,539	1,342,615	632,048	4.1	1,143,918	1,489,236
Asuogyaman	3.7%	98,046	47,030	51,016	23,551	4.1	28,788	69,258

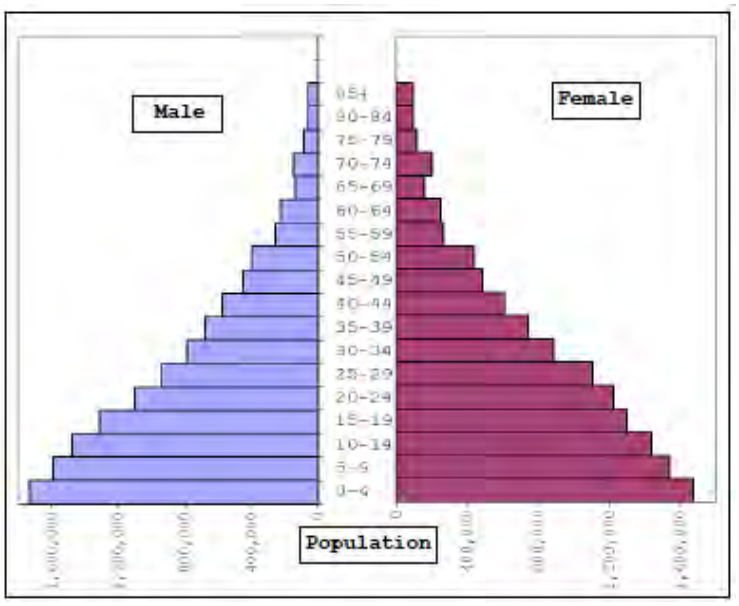
Source: 2010 Population and Housing Census, May 2012, GSS

(2) Ethnicity

Table A14-2 shows the ethnicity of the project affected regions. The ethnicity ratios vary greatly among the three affected regions.

(3) Religion

Table A14-3 shows the religions in the project affected districts. The religion rations vary greatly among the three affected districts. In all districts, Pentecostal/Charismatic accounts for the majority, followed by Protestants. There are slight differences among project affected districts, but the distribution of religions is similar.



Source: 2010 Population and Housing Census, May 2012, GSS

Figure A14-1 Age-Sex Structure of Population

Table A14-2 Ethnicity in the Project-Affected Regions

Ethnicity	National	Greater Accra	Ratio in Region	Volta	Ratio in Region	Eastern	Ratio in Region
Akan	47.5%	1,528,722	39.7%	55,736	2.8%	1,312,977	51.1%
Ga-Dangme	7.4%	1,056,158	27.4%	31,130	1.5%	460,814	17.9%
Ewe	13.9%	775,332	20.1%	1,482,180	73.8%	486,136	18.9%
Guan	3.7%	73,409	1.9%	162,981	8.1%	137,386	5.3%
Gurma	5.7%	62,435	1.6%	227,282	11.3%	42,291	1.6%
Mole-Dagbani	16.6%	200,735	5.2%	9,473	0.5%	83,311	3.2%
Grusi	2.5%	48,822	1.3%	2,214	0.1%	19,412	0.8%
Mande	1.1%	28,656	0.7%	1,591	0.1%	6,771	0.3%
Others	1.4%	75,568	2.0%	36,313	1.8%	20,377	0.8%

Source: 2010 Population and Housing Census, May 2012, GSS

Table A14-3 Religion in the Project-Affected Districts

Ethinicity	National	Greater Accra	Dangbe West	Volta	North Tongu	Eastern	Asuogyaman
No religion	5.3%	3.4%	5.4%	6.6%	7.4%	6.5%	4.1%
Catholic	13.1%	7.5%	4.9%	17.6%	11.5%	7.9%	8.4%
Protestant	18.4%	22.3%	19.0%	21.5%	27.0%	24.8%	28.7%
Pentecostal/Charismatic	28.3%	44.6%	52.0%	26.6%	31.3%	36.3%	36.1%
Other Christian	11.4%	8.9%	9.8%	7.1%	10.7%	15.5%	15.9%
Islam	17.6%	11.4%	5.3%	5.4%	2.8%	6.3%	3.5%
Ahmadi		0.4%	0.3%	0.3%	0.4%	0.4%	0.2%
Traditionalist	5.2%	0.5%	2.1%	14.1%	8.3%	1.4%	2.4%
Other	0.8%	1.0%	1.1%	0.8%	0.7%	0.9%	0.8%

Source: 2010 Population and Housing Census, May 2012, GSS

(4) Education

Table A14-4 shows the educational level in the project affected districts. The education level in Dangbe West District and North Tongu District is similar, while the Asuogyaman District has a slightly higher educational level for both males and females. In all districts, primary school is the most common educational level for males, followed by junior high school and never

attended school. For females, most have either never attended school or attended only primary school. Regarding higher education for both males and females, the Dangbe West District and Asuogyaman District have slightly higher proportions than North Tongu District. Based on the census data, there is no critical gender segregation in the project area.

Table A14-4 Educational Level of Project-Affected Districts

Educational Level	Nation	Greater Accra	Dangbe West		Volta	North Tongu		Eastern	Asuogyaman	
			Male	Female		Male	Female		Male	Female
Never attended	23.4%	10.0%	18.2%	**30.0%**	24.1%	16.2%	30.8%	17.1%	8.9%	19.8%
Nursery	3.2%	0.2%	0.6%	0.5%	0.4%	0.6%	0.5%	0.3%	0.2%	0.3%
Kindergarten	5.4%	1.2%	2.4%	2.2%	2.5%	3.6%	3.0%	2.5%	2.6%	2.4%
Primary school	24.8%	22.3%	**29.0%**	29.1%	**29.3%**	**31.6%**	**31.1%**	**29.7%**	**28.5%**	**29.5%**
Juniot secondary school/Junior high school	18.7%	**23.0%**	21.7%	20.0%	20.0%	22.6%	20.0%	23.2%	23.9%	23.4%
Middle school	8.3%	10.8%	8.7%	5.9%	10.1%	9.8%	6.5%	13.1%	14.5%	11.3%
Senior secondary school/Senior high school	8.1%	13.6%	8.8%	5.8%	7.3%	9.1%	5.6%	7.2%	9.7%	7.1%
Secondary school	1.2%	3.2%	1.6%	0.7%	0.9%	0.9%	0.4%	1.1%	1.3%	0.5%
Vocational/Technical/ Commercial	1.6%	4.1%	2.5%	1.5%	1.5%	1.2%	0.7%	1.6%	2.7%	1.7%
Post middle/ secondary certificate	1.1%	1.5%	1.1%	0.8%	1.4%	1.5%	0.8%	1.2%	1.3%	1.2%
Post secondary diploma	2.1%	4.4%	2.7%	2.0%	1.7%	1.8%	0.5%	1.8%	3.5%	1.9%
Bachelor degree	1.7%	4.5%	2.2%	1.3%	0.7%	0.8%	0.2%	1.0%	2.3%	0.9%
Post graduate (Cert. Diploma, Masters, PHD, etc.)	0.3%	1.0%	0.5%	0.1%	0.1%	0.2%	0.0%	0.2%	0.6%	0.1%

Source: 2010 Population and Housing Census, May 2012, GSS

(5) Economic Activity

Tables A14-5 to A14-9 show the status of economic activity (15 years and older) in the project affected districts. The ratios of the respective activity statuses are similar among all districts. The unemployed ratio is slightly higher in the Asuogyaman District. Regarding economic activity by industry, agriculture, forestry and fishery account for the highest number in all districts, followed by manufacturing. Wholesale and retail is second highest for females in all districts.

Table A14-5 Status of Economic Activity (15 years and older)

Activity Status	Greater Accra	Dangbe West		Volta	North Tongu		Eastern	Asuogyaman	
		Male	Female		Male	Female		Male	Female
Employed	65.3%	65.3%	68.1%	67.0%	65.3%	68.1%	68.6%	65.1%	63.1%
Unemployed	5.9%	2.9%	2.6%	2.9%	2.9%	2.6%	4.1%	5.6%	5.1%
Not active	28.8%	31.8%	29.3%	30.1%	31.8%	29.3%	27.3%	29.3%	31.7%

Source: 2010 Population and Housing Census, May 2012, GSS

Table A14-6 Economically Active Population in Dangbe West District

(Unit: person)

Activity Status	Employed		Unemployed		Not Active	
	Male	Female	Male	Female	Male	Female
Employee	8,079	2,861	139	87	-	-
Self employed without employee(s)	11,636	17,984	112	343	-	-
Self employed with employee(s)	1,127	857	8	13	-	-
Casual worker	864	270	26	9	-	-
Contributing family worker	1,299	1,957	7	13	-	-
Apprentice	472	624	6	13	-	-
Domestic employee (Househelp)	132	148	3	4	-	-
Other	61	20	0	2	-	-
New workers seeking employment	0	0	1,168	1,584	10,119	13,995
Total	23,670	24,721	1,469	2,068	10,119	13,995

Source: 2010 Population and Housing Census, May 2012, GSS

Table A14-7 Economically Active Population in North Tongue District

(Unit: person)

Activity Status	Employed		Unemployed		Not Active	
	Male	Female	Male	Female	Male	Female
Employee	5,485	3,906	1,579	68	36	-
Self employed without employee(s)	44,481	18,306	26,175	48	115	-
Self employed with employee(s)	1,285	703	582	7	5	-
Casual worker	995	668	327	9	4	-
Contributing family worker	8,144	3,267	4,877	2	5	-
Apprentice	630	252	378	2	2	-
Domestic employee (Househelp)	384	148	236	1	0	-
Other	103	43	60	0	0	-
New workers seeking employment	0	0	0	1,063	1,131	13,299
Total	61,507	27,293	34,214	1,200	1,298	13,299

Source: 2010 Population and Housing Census, May 2012, GSS

Table A14-8 Economically Active Population in Asuogyaman District

(Unit: person)

Activity Status	Employed		Unemployed		Not Active	
	Male	Female	Male	Female	Male	Female
Employee	9,517	6,924	2,593	126	88	-
Self employed without employee(s)	24,863	9,438	15,425	44	163	-
Self employed with employee(s)	1,197	584	613	1	3	-
Casual worker	540	375	165	6	8	-
Contributing family worker	2,066	746	1,320	1	2	-
Apprentice	905	354	551	3	13	-
Domestic employee (Househelp)	150	63	87	0	0	-
Other	94	66	28	1	2	-
New workers seeking employment	0	0	0	1,424	1,412	8,342
Total	39,332	18,550	20,782	1,606	1,691	8,342

Source: 2010 Population and Housing Census, May 2012, GSS

Table A14-9 Economic Activity of Employees by Industry (15 years and older)

(Unit: person)

Activity Status	Dangbe West		North Tongu		Asuogyaman	
	Male	Female	Male	Female	Male	Female
1. Agriculture, forestry and fishery	9,169	6,274	17,455	20,523	8,057	6,533
- Mining and quarrying	799	319	318	140	73	35
2. Manufacturing	2,077	4,582	2,281	4,029	1,925	3,035
- Electricity gas stream and air conditioning supply	60	8	30	2	996	176
- Water supply; sewerage waste management and remediation activities	87	81	73	42	90	29
3. Construction	2,714	93	1,256	33	1,216	28
4. Wholesale and retail; repair of motor vehicles and motorcycles	1,823	6,729	1,457	4,967	1,053	5,499
5. Transportation and storage	2,621	130	1,103	59	1,353	72
- Accommodation and food service	320	3,191	177	1,952	240	1,922
- Information and communication	112	41	37	7	83	33
- Finance and insurance	158	99	94	24	148	77
- Real estate	72	9	2	1	3	-
- Professional scientific and technical	279	89	122	78	255	535
- Administrative and support service	254	62	152	36	324	57
- Public administration and defence; compulsory social security	1,046	215	236	67	281	90
- Education	848	835	1,252	686	1,047	984
- Human health and social work	186	278	478	322	565	302
- Arts entertainment and recreation	230	31	128	12	167	18
- Other service activities	678	1,488	526	1,051	506	1,103
- Activities of households as employers; undifferentiated goods and services, producing activities of households for own use	131	165	113	183	167	254
- Activities of extraterritorial organisations and bodies	6	2	3	-	1	-
Total	23,670	24,721	27,293	34,214	18,550	20,782

Source: 2010 Population and Housing Census, May 2012, GSS

14.2 Summary of Socioeconomic Survey

(1) Positive Impacts of Construction Phase

a) Job Creation

During the construction phase, there will be opportunities for skilled as well as unskilled workers to earn income. People skilled in driving heavy equipment, trucks and other artisans are expected to be engaged. Some women will also seize the opportunity to provide various services to the contractors and workers, especially the sale of food. About 96% of respondents believed that the project will boost employment opportunities for men and women during the construction phase.

b) Increasing Trading Activities, especially for Women

Women who sell along the road side will benefit from an increase in business because construction workers will buy their products. Some people will also burn some demolished trees

into charcoal for domestic use.

(2) Negative Impacts of Construction Phase

a) Demolition of Properties

There are various types of structures along the roads and within the ROW: some temporary structures and some permanent structures will be affected. The road alignment will result in some property owners either partially or completely losing their properties. Some properties may be completely removed and others blighted which may indirectly reduce their quality and value in the short term.

b) Destruction of Farmlands and Other Important Areas of Value

The construction of the project roads will very likely affect farmlands with various crops and economic trees along the road. This will create untold hardships for men and women.

c) Increase in Dust and Noise Levels

Levels of dust will rise significantly because of dirt on the road, and vehicular movement and wind will stir up dust. Loading and unloading of dump trucks will also generate dust and reduce air quality. When air quality is poor, upper respiratory tract infections increase, asthmatics have more attacks and dust also causes eye irritation.

Noise levels will increase as a result of activities such as, movement of vehicles and earth-moving equipment, drilling, hammering, emptying and loading of trucks, and noise of workers. Moreover, piercing noise caused by drilling machines for example will cause high noise levels while in operation. High noise levels are known to cause stress, headaches and when persistent, hearing impairment.

d) Impact on Public Health and Safety

The construction of roads will bring an influx of additional persons into the road corridor. Construction workers will be made up mainly of men who are separated from their regular partners. Such persons tend to indulge in risky sexual behaviour which increases the incidence of STDs and HIV/AIDS.

The increase in dust levels could increase the incidence of colds and other upper respiratory infections in the general populace in the corridor. Construction of drains tends to leave uncovered trenches that collect rain water especially during the wet season and become breeding grounds for mosquitoes. This may mean that the incidence of malaria may increase in the corridor.

e) Impact on Traffic Movement

During construction, movement of traffic along the route will be difficult, riding comfort will be poor and speeds will be low, so traffic will tend to crawl and this will increase travel time. It will take longer to cross the corridor than it did before construction commenced.

f) Disruption and Reduction in the Supply of Utility Services

The communities along the arterial roads may experience some disruption and reduction in the supply of utility services such as water, electricity and telecommunications in the short term. These community utility services may be interrupted due to the relocation of service lines and

poles, but this will only be in the short term.

g) Impact on Business Operation and Income

Some roadside sellers will suffer demolition of their structures and if unmitigated, they may lose their businesses all together. Table-top sellers and kiosk operators in the towns may also lose their business sites and would need to relocate. However, where space is available beyond the ROW, roadside sellers may only need to be assisted to move the structures backward and face very short-term disruption to their business activities. If they have to relocate elsewhere, they may face transportation costs that may be overwhelming considering the general poverty in the area.

The dust, noise and difficulty in travelling along the route will all impact on business operations. During the dry season, dust will cling to items on display or cover netting and discolour walls. All this will adversely affect the ambience and have a negative impact on business operations. Past experiences of construction on other road corridors has shown that business in those areas dips during construction due to a fall in the number of customersr. Such a fall will result in loss of income. Increased cleaning costs will also aggravate the loss of income. On some days high levels of noise will make it difficult for businesses premises abutting the road to operate, resulting and that will result in their closing down for the day.

(3) Positeve Impacts of Operational Phase

a) Improved Road Infrastructure and Transport Service

It is expected that during the operational phase, when the roads road infrastructure have been improved, there will be free flow of traffic. This will reduce vehicle operating costs and travel time. The provision of parking lots, drains, bus stops and a better road surface will also reduce vehicle-pedestrian conflicts and travel cost. The overall effect on vehicle operating costs will be positive and significant for road users.

b) Increase in Local Economic Activities

It is expected that with the completion of the Benchema – Adwufia road project, more businesses as well as customers will be attracted than before. Hence, business activities will flourish and have a impact significantly impact on the communities. It is also expected that the population will increase along the road. This will lead to an increase in demand for goods and services. In the longer term, the project will lead to increased business activities and strengthen local economies, thus helping to reduce poverty in the area.

c) Increase in Property Values

The value of properties along the road is expected to increase since most of them will have a new facelift as the landscape becomes more beautiful with the new road, particularly the new bridge across the Volta River.

d) Public Health and Safety

The existing roads do not have proper drainage systems and some of them are very dusty. This is detrimental to the well-being of the people who live alongside such roads. The road projects will include improvement of the alignment and the road surface and construction of

drainage structures. With such improvements, flooding will be prevented and stagnant water will be eliminated, thus reducing the occurrence of certain diseases like malaria, typhoid, diarrhoea and asthma.

e) Traffic Safety

When roads are upgraded, the road surface and travel comfort improves and with moderate speeds and facilities for greater pedestrian safety, some accidents that are now common may reduce significantly. The project will solve some of the vehicle-pedestrian conflicts along the section. The provision of sidewalks, pedestrian crossings and other traffic management schemes will reduce accidents.

f) Beautification of Affected Communities

With the completion of the project, the communities along the project roads will look more beautiful and therefore attract more people and more commercial properties into the area.

g) Impact on Land Use

The land abutting the road is used for farming, residences, artisanship and small trading activities. When the road is upgraded, some of the unused lands may be developed into residential and commercial areas and the value of properties will tend to increase. Some property owners will also scale up their property to attract higher rents.

h) Improved and Easier Access to Social Amenities

The delivery of education services, markets, hospitals, etc. is expected to be made much easier through the provision of better transport services. For instance, more teachers will accept postings to schools on the road corridor.

(4) Negative Impacts of Operational Phase

a) Vehicler-Pedestrian Conflicts and abuse of Traffic Regulations

Quite a number of respondents expressed fears that once the road is paved, drivers are likely to flout traffic regulations and exceed speed limits(even in communities), in a bid to shorten their travel time and maximise profits. This could result in knocking down of pedestrians, cyclists and animals. Another abuse is careless overtaking and consequent fatal accidents.

b) Increase in Criminality and Prostitution

While the influx of people into the road influence area is likely to boost the local economies, the ease of movement may also facilitate an influx of criminals and prostitutes engaging in highway robbery, stealing and prostitution.

c) Impact on Public Health and Safety

The construction of international trunk roads will bring an influx of additional persons into the road corridor. Freight vehicle drivers will be made up mainly of men who are separated from their regular partners. Such persons tend to indulge in risky sexual behaviour which increases the incidence of STDs and HIV/AIDS.

14.3 Results of Consultations with Potentially Affected Persons for Construction of New Road between Asutsuare Jct. and Asikuma Jct.

(1) District and Communities of Project-Affected Persons

The survey was conducted in three districts namely: Asuogyaman, Dangme West and North Tongu. In total, 210 respondents (132 males and 78 females) were interviewed. The distribution of the respondents among the districts was as follows: Asuogyaman 26 (18.1% of respondents); Dangme West 117 (55.7%), and North Tongu 55 (26.2%).

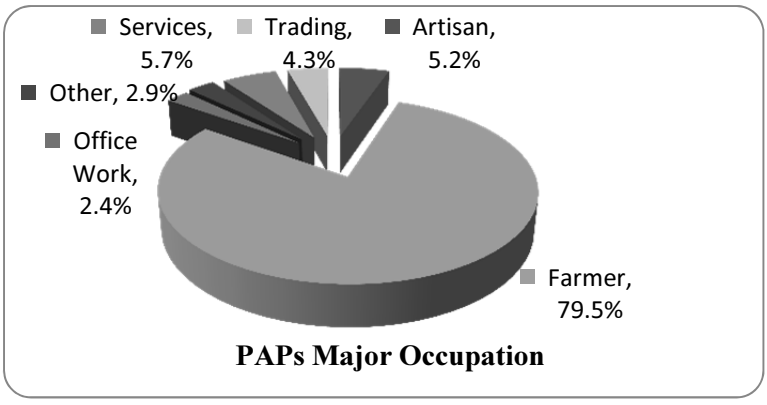
Table A14-10 Districts and Communities of Projected Affected Persons (Construction of New Road between Asutsuare Jct. and Asikuma Jct.)

District	Community	Male		Female		Total	
		Number	%	Number	%	Number	%
Asuogyaman	AbotiaNorvisi	9	4.3	4	1.9	13	6.2
	Amesianyakope	3	1.4	0	0	3	1.4
	Asikuma	8	3.8	6	2.9	14	6.7
	Dangbe	6	2.9	2	1.0	8	3.8
Asuogyaman Total		26	12.4	12	5.7	38	18.1
Dangme West	Asutsuare Junction	7	3.3	1	0.5	8	3.8
	Lubuse	35	16.7	20	9.5	55	26.2
	Osuwem	10	4.8	7	3.3	17	8.1
	Tanya	6	2.9	6	2.9	12	5.7
	Volivo	11	5.2	14	6.7	25	11.9
Dangme West Total		69	32.9	48	22.9	117	55.7
North Tongu	Dufor Adidome	34	16.2	16	7.6	50	23.8
	Osiabura	3	1.4	2	1.0	5	2.4
North Tongu Total		37	17.6	18	8.6	55	26.2
Grand Total		132	62.9	78	37.1	210	100

Source: Study Team

(2) Occupations of Respondents

Six major occupation categories were identified in the communities. Figure A14-2 shows that the vast majority (79.5%) of the respondents were crop farmers, followed by the services sector (5.7%), artisans (5.2%) and trading (4.3%).



Source: Study Team

Figure A14-2 Major Occupation of Respondents (New Road between Asutsuare Jct. and Asikuma Jct.)

(3) Potentially Affected Properties

Table A14-11 shows potentially affected properties by construction of new road between Asutsuare Jct. and Asikuma Jct.

Table A14-11 Potentially Affected Properties
(New Road between Asutsuare Jct. and Asikuma Jct.)

Affected Properties	Male	Female	Total
	Number	Number	Number
House	1	0	1
Storage/hut	10	8	18
Farm	99	55	154
Container	1	1	2
Kiosk	1	1	2
Kitchen	1	0	1
Land	1	3	4
Wooden Shed	0	1	1
Fish Pond	2	1	3
Total	114	69	183**

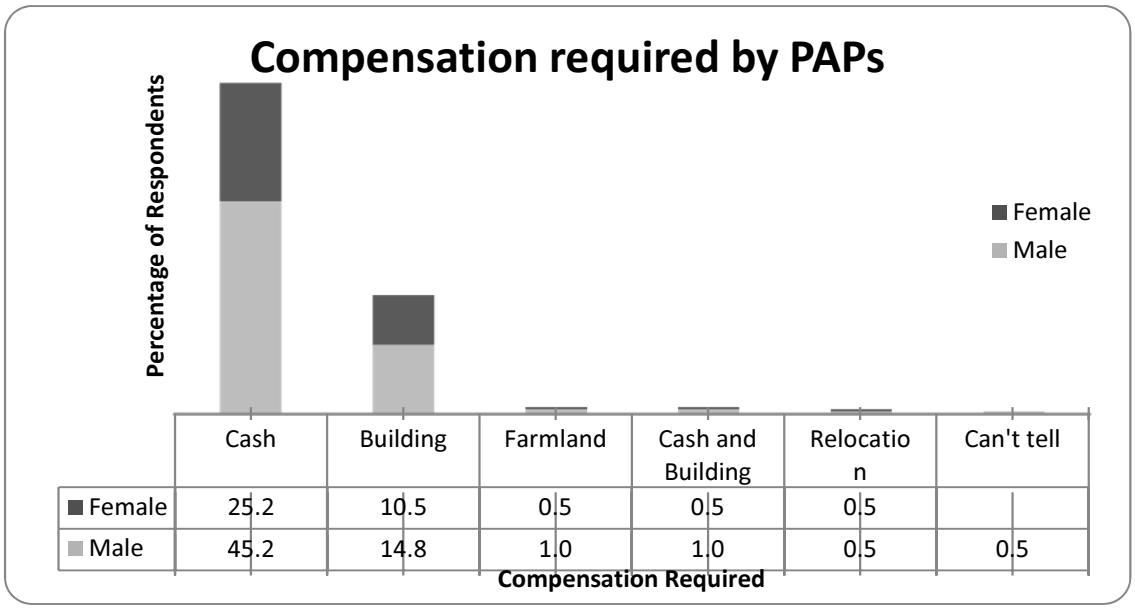
Notes: * multiple ownership included

** Unless the ENTIRE DISPLACED PAP is fewer than 200, the category of the project would be B and would require ARAP (WB OP4.12) (cf. paragraph 25). A draft resettlement plan that conforms to this policy is a condition of appraisal (see Annex A, paragraphs 2-21) for projects referred to in paragraph 17(a) above. However, where impacts on the entire displaced population are minor, or fewer than 200 people are displaced, an abbreviated resettlement plan may be agreed with the borrower(see Annex A, paragraph 22). The information disclosure procedures set forth in paragraph 22 apply.

Source: Study Team

(4) Type of Compensation Required by PAPs

A majority (70.4%) would want cash compensation. This was followed by 25.3% who would want their affected buildings to be replaced. A further 1.5% said they would prefer both cash and buildings. Of the remaining 2.8%, 1.5% would want farmland as composition.



Source: Study Team

Figure A14-3 Compensation Required by PAPs
(New Road between Asutsuare Jct. and Asikuma Jct.)

14.4 Results of Consultations with Potentially Affected Persons for Upgrading of Asutsuare – Aveyime Road

(1) District and Communities of Project Affected Persons

In all, 122 respondents were interviewed in two districts of Dangme West (59.8%) and North Tongu (40.2%). Five communities were selected from Dangme West and one from North Tongu.

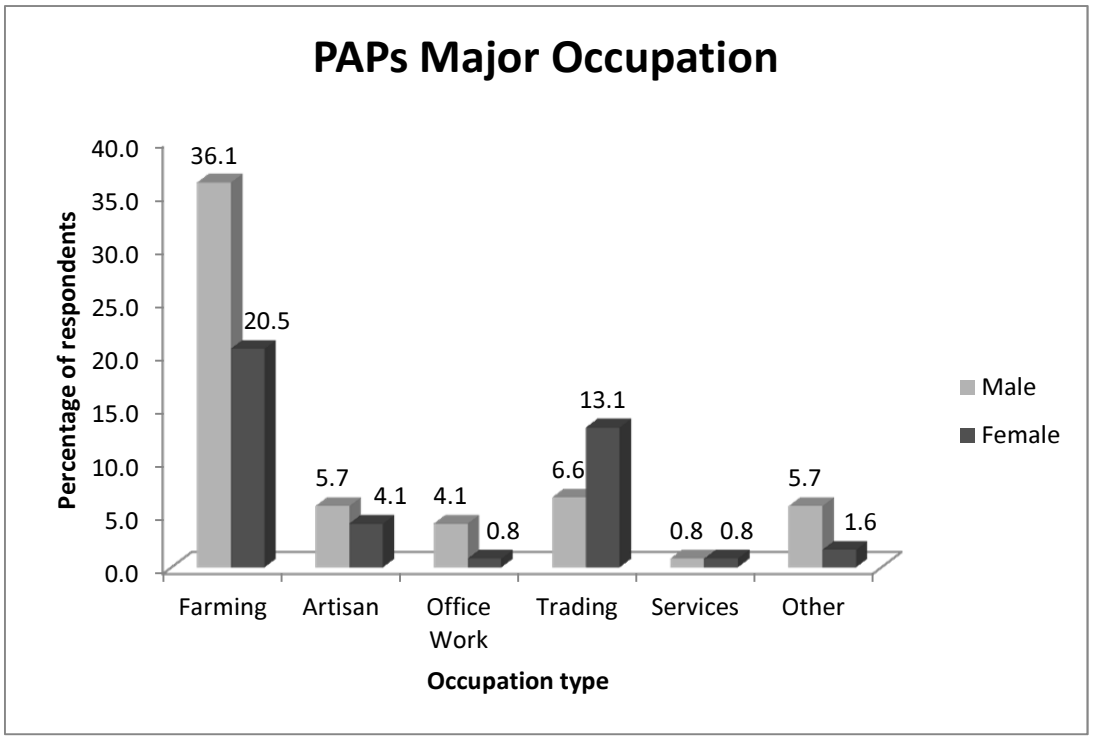
Table A14-12 Districts and Communities of PAPs (Asutsuare – Aveyime Road)

District	Community	Male		Female		Total	
		Number	%	Number	%	Number	%
Dangme West	Asutsuare	15	12.3	7	5.7	22	18.0
	Atrobinya	21	17.2	14	11.5	35	28.7
	Dufor	1	0.8	1	0.8	2	1.6
	Kewum	7	5.7	1	0.8	8	6.6
	Volivo	3	2.5	3	2.5	6	4.9
Dangme West Total		**47**	38.5	**26**	21.3	**73**	59.8
North Tongu	Aveyime	25	20.5	24	19.7	49	40.2
Grand Total		**72**	**59.0**	**50**	**41.0**	**122**	**100**

Source: Study Team

(2) Occupations of Respondents

Six major occupation categories were identified: farming (56.6%), trading (19.7%), artisans (9.8%), office work (4.9%), services (1.6%), and others (7.3%). The farming industry was made up of crop farming (54.9%)



Source: Study Team

Figure A14-4 Major Occupations of Respondents (Asutsuare – Aveyime Road)

(3) Potentially Affected Properties

Table A14-13 shows potentially affected properties by upgrading of Asutsuare – Avyime road.

Table A14-13 Potentially Affected Properties* (Asutsuare – Aveyime Road)

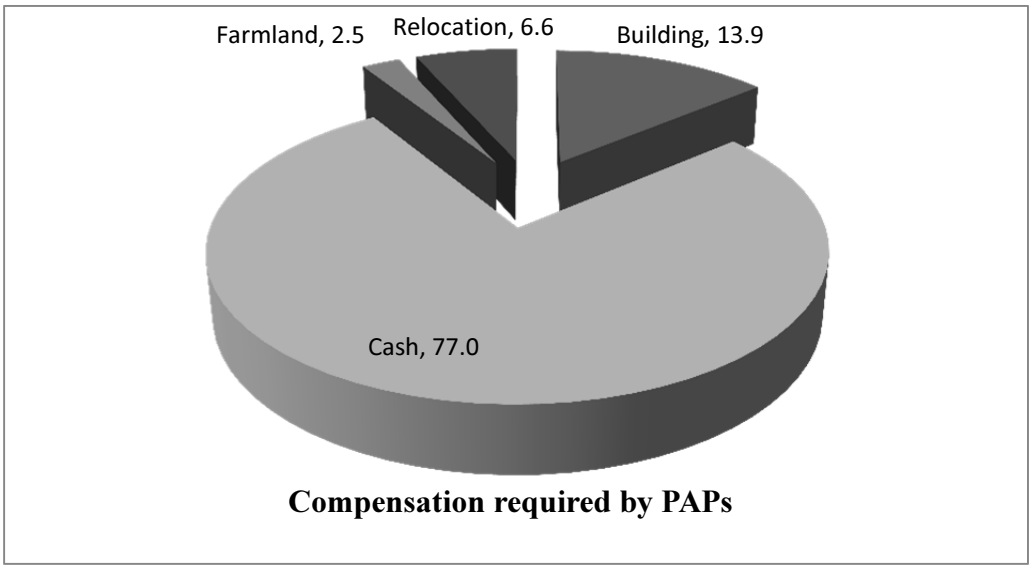
Affected Properties	Male	Female	Total
	Number	Number	Number
House	5	4	9
Farm	45	26	71
Container/Kiosk	1	6	7
Fence wall	0	1	1
Wooden Structure	3	1	4
Total	73	50	113

Note: * multiple ownership included

Source: Study Team

(4) Compensation Required by PAPs

The vast majority (77.0%) of the respondents stated that they would want to have cash compensation, 13.9% would want replacement of their buildings, whilst 6.6% wanted relocation. The rest (2.5%) said they would need farmland.



Source: Study Team

Figure A14-5 Compensation Required by PAP (Asutsuare – Aveyime Road)

Appendix 15 Recommended Monitoring Items and Standards for Environmental Quality Monitoring

All standers shall meet the most updated EPA's guidelines at the time of implementation. As the environmental standards are not available on the EPA's website (www.epa.gov.gh) as of September 2012, GHA and responsible consultants would be required to obtain the updated standers at the EPA office. The following standards were extracted from the EPA's relevant guidelines as of May 2012.

Air Quality (~~Emission Gas /~~ Ambient Air Quality) ***EPA Ambient Air Quality Guidelines**			
Item	**Unit**	**Country's Standards***	**Referred International Standards****
SO_2	µg/m^3	<Industrial/Project Site> 900 µg/ m^3-h average 150 µg/ m^3-24h average 80 µg/ m^3-1year average <Residential> 700 µg/ m^3-h average 100 µg/ m^3-24h average 50 µg/ m^3-1year average	0.04 ppm/h-daily average 0.1 ppm/h-peak
NO_2	µg/ m^3	<Industrial/Project Site> 400 µg/ m^3-h average 150 µg/ m^3-24h average <Residential> 200 µg/ m^3-h average 60 µg/ m^3-24h average	0.04-0.06 ppm/h-daily average
CO	mg/ m^3	100 mg/ m^3-15min average 60 mg/ m^3-30min average 30 mg/ m^3-h average 10 mg/ m^3-8h average	10 ppm/h-daily average 20 ppm/h-peak (consecutive 8h)
Total Suspended Particle Matter	µg/ m^3	<Industrial/Project Site> 230 µg/ m^3-24h average 75 µg/ m^3-1year average <Residential> 150 µg/ m^3-24h average 60 µg/ m^3-1year average	0.10 mg/m^3-h-daily average 0.10 mg/m^3-h--peak
PM_{10}	µg/m3	70 µg/m3-24h average	N/A
**Japanese Ministry of Environment (J-MOE) Environmental Quality Standards –Air Quality as of September 2012 Due to the units of the items as well as analysis methods are different from Ghanaian and Japanese standards, it is advisable to carefully refer the Japanese standards, especially volume to weight conversion with the effect of temperature.			

Water Quality（Effluent/Wastewater~~/Ambient Water Quality~~）			
***EPA Schedule 1 (Regulation 2) of Wastewater Quality Guidelines for Discharges into Water Bodies or Water Courses**			
Item	**Unit**	**Country's Standards***	**Referred International Standards****
pH	-	6-9	5.8 - 8.6
Total Suspended Solid	mg/l	50	150 mg/l-daily average 200 mg/l-peak
Total Dissolved Solid	mg/l	1,000	N/A
BOD/COD	mg/l	BOD: 200 COD: 1,000	BOD (not into sea and lakes) 120 mg/l-daily average 160 mg/l-peak
Total Nitrogen	mg/l	100	60 mg/l-daily average 120 mg/l-peak
Total Phosphorus	mg/l	10.0	8 mg/l-daily average 16 mg/l-peak
Hydrocarbons / Mineral Oils	mg/l	20	5 mg/l (mineral oil) 30 mg/l (animal/vegetable fats)
Oil	-	No visible floating oil	N/A
** J-MOE Uniform National Effluent Standards as of May 25, 2012			

Noise / Vibration (Ambient)			
*** EPA Ambient Noise Level Standards**			
Item	**Unit**	**Country's Standards***	**Referred International Standards****
Noise level	dB	(day:6AM-10PM/night:10PM-6AM) 55/48: (A: residential area) 55/50: (B1: school and hospital) 60/50: (B2: commercial area) 65/60: (C1: light industry /entertainment/public place) 75/65: (C2: predominantly commercial area) 70/60: (D: light industrial area) 70/70: (E: predominantly heavy industrial area)	85dB <Construction site> working time: 6 am – 10 pm max working time: 14 hours max consecutive work: 6 days prohibited work day: Sundays and holidays <Residential> working time: 6 am – 10 pm max working time: 14 hours max consecutive work: 6 days prohibited work day: Sundays and holidays
Vibration level	dB	No standard at this moment Necessity of vibration control shall be decided based on the discussion of GoG and JICA before the loan agreement with EPA and other authorities' consideration, especially considering practicability of monitoring and acceptability/common practices of residents adjacent to the construction site and roads.	***85dB (Construction Works) max consecutive work: 6 days prohibited work day: Sundays and holidays <Construction site> working time: 6 am – 10 pm max working time: 14 hours <Residential> working time: 7 am – 7 pm max working time: 10 hours 70dB (daytime: motor vehicle) 65dB (nighttime: motor vehicle)
** J-MOE Environmental Quality Standards for water pollution /human health *** Appendix II of Vibration Regulation Law #64 of 1976 (amended by Law #75 of 1995)			

Appendix 16 Result of the Road Safety Audit

The report on Road Safety Audit – Stage 2 (Preliminary Design) for the Eastern Corridor Development Project on Construction of Asutsuare Junction – Asukuma Junction and Asutsuare – Aveyime Roads was prepared by the GHA on Octoboer 2012. Results of the report are as follows:

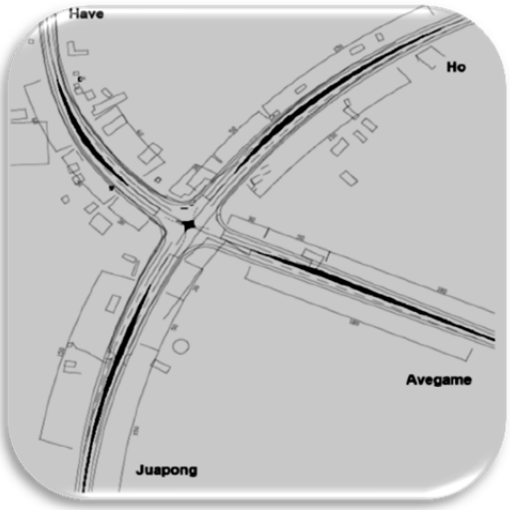
REPUBLIC OF GHANA

MINISTRY OF ROADS AND HIGHWAYS

GHANA HIGHWAY AUTHORITY

REPORT ON

ROAD SAFETY AUDIT – STAGE 2 (PRELIMINARY DESIGN)



EASTERN CORRIDOR DEVELOPMENT PROJECT

CONSTRUCTION OF ASUTSUARE JUNCTION-ASIKUMA JUCTION AND ASUTSUARE-AVEYIME ROADS

THE CHIEF EXECUTIVE
GHANA HIGHWAY AUTHORITY
HALL OF TECHNOLOGY, ACCRA

OCTOBER, 2012

TABLE OF CONTENTS

1.0 Introduction

The basic objective of road safety audit is the reduction of road casualties through the adoption of a more proactiveapproach, contrary to traditional blackspot analysis which is a reactivemethod of identifying high accident locations. The intent is to identify and mitigate problem areas before accidents have a chance to occur.

A stage two (preliminary design) road safety audit was carried out by a multidisciplinary audit team (who are absolutely independent of the design team and had no involvement in the production of the design) between 26th and 29th October, 2012 to ensure that the Asutsuare Junction-Asikuma Juction and Asutsuare-Aveyime roads would not jeopardize the safety of motorist and other road users using the roadway after completion. The field audit was carried out during daylight hours.

This document is a Report of the study carried out at stage 2 (Draft Design). The project consists of Ninety-Seven (97) Highway Drawings. These are:

1. Plan and profile (31 Drawings)
2. Typical Cross Sections (2 Drawings)
3. General plan of bridges (4 Drawings)
4. Cross sections (58 Drawings)
5. Intersections (2 Drawings)

The audit covers an assessment of the above drawings relating to the project road supplied by the designeras well as the examination of physical and visual features of the study area which may affect road users' safety. Traffic conflict studies at major intersections and a review of road traffic crashes data, as well as socio-economic activities and other contextual issuesalong the entire project corridor that might affect the safety performance of the roadway, were also undertaken.

This Stage 2 Road Safety Audit has been carried out in accordance with the relevant sections of Ghana Highway Authority's Road Safety Audit procedures. The Audit Team has examined only those issues within the design relating to the road safety implications of the scheme.

In this report, issues considered to be potentially risky for accident occurrence have been raised. The reason for concern for the issues raised/observations made have been addressed. In addition, opportunities that exist (Recommendations) for improvements in safety for all road users have been provided.

The Road Safety Audit was undertaken by the following:

Victor Owusu, BSc, MPhil, MGhIE, MCIHT, MSoRSA- Team Leader

Harold Atobra-Acheampong, BSc, MGhIE – Member

Anthony K. Spio, HND Civil Engineering – Member

Bernard Owusu, BSc, MGhIE – Member

2.0 General Safety Concerns

2.1 Highway Classification and Design Speed on Mainline

a) Observation

The project road traverses through densely populated communities and large agricultural lands. Socio-economic activities are soaring with the rapid development of commercial, residential and social amenities along the route belt.

According to distribution of urban centers and populations along the roadside, forecast traffic, the project function and its role in the network, the evaluation was carried out to the proposed highway classification from the concern of adaptability to operating safety.

The road traffic crashes potential and safety performance evaluation of the preliminary scheme was carried out to design speed based on proposed highway classification, forecast traffic, traffic component and terrain along roadside. The design speed difference between two adjacent road sections with different design speed was not to exceed 20km/h. For adjacent road sections which speed difference is more than 20km/h, the transition section was to be arranged, which length shall guarantee the smooth and safe transition along the alignments. Also, relevant traffic facilities shall be arranged to instruct driver to adjust operating speed.

The design speed adopted for the proposed mainline between Asutsuare Junction and Asikuma Junction was 100kph. This is following the prescription for the desirable design speeds for national roads as obtains in the Ghana Road Design Guide (1991).

b) Reason for concern

It is generally accepted that the chosen design speed must relate to the potential/actual driving behaviour as represented by the 85th percentile speed of passenger cars under free flow conditions. This is likely to be higher with only passenger cars, and even more so, if these were to be travelling on the proposed carriageway which lies on a relatively flat terrain.

The design speed is probably the most important geometric design parameter because it is supposed to be applied to obtain a consistent coordinated alignment. Adoption of 100 kph design speed throughout the mainline would very likely result in departure from consistency on the approaches of the proposed intersections where vehicular maneuverabilities at the transition zone will be at its threshold and operating speeds of diverging and merging traffic (leaving/entering the intersections) are likely to be lower than speeds of through traffic. This means that the design speed is at variance with actual driving behaviour (a situation which has the propensity of violating drivers' expectation) and may lead directly to an increase in accident potential.

c) Recommendation

- The design speed difference between the transition zones and the mainline should be kept at 20km/h. This means that a design speed of 80kph should be maintained at the transition zones.

- The transition zone should also to be arranged, which length shall guarantee the smooth and safe transition along the alignments. Also, relevant traffic facilities such as variable message signs (VMS), Intelligent Traffic System (ITS) and roadway delineation should be arranged in the detailed design stage to instruct driver to adjust operating speed. This is essential
- Signalization of the major intersection on the N2 Highway is essential.
- At the detailed design stage, consideration should be given to the provision of advance directional signs (on gantries and in combination with lane selection signs/markings) to inform/direct drivers to select the appropriate lanes at the approaches of the intersection. This will reduce side-swipe accidents
- In the long term an Interchange should be considered at the Asikuma Junction to enhance the smooth and safe transition of vehicles from one mainline to the other.

2.2 Auxiliary lanes at Asikuma Junction, Asutsuare Junction and Volivo Intersections

a) Observation

The storage and taper lengths are too short and inappropriate traffic safety

b) Reason for concern

Drivers will compete for the small auxiliary lanes as they leave/enter the intersections.

Erratic merging and diverging of impatience drivers may lead to traffic crashes.

c) Recommendation

- Consideration should be given to the extension of the auxiliary lanes to cater for the storage and turning movements of all vehicles.

3.0 Ssafety Concerns at Specific Locations

3.1 Toll Plaza

a) Observation

The proposed Toll Plaza is located quite close to the Volta River Bridge and it is sandwiched between the Volta River Bridge (Km 28+685) and the crossing of Juapong-Dufor Adidome feeder road (Km 29+060).

b) Reason for concern

The propensity of vehicles tailing back into and congesting the Volta River Bridge is high, considering the rather short approach lane of Toll Plaza and the significant proportion of Heavy Goods Vehicles that may use the road.

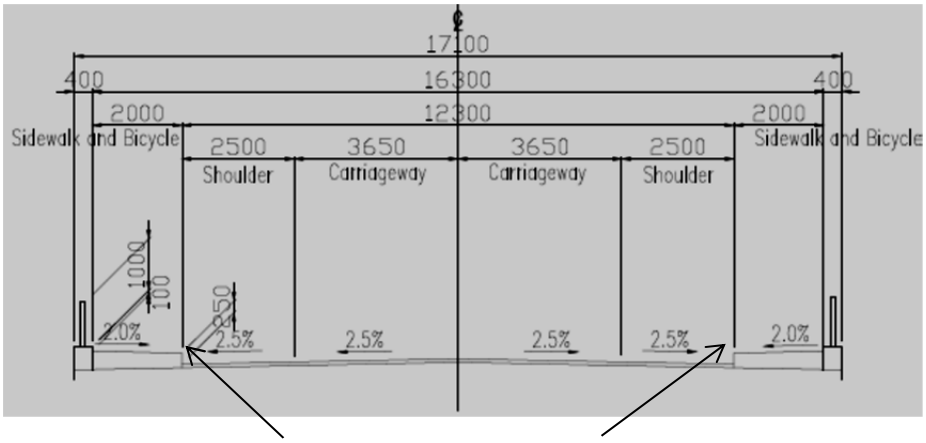
c) Recommendation

- The location of toll booth should be closer to the crossing of Juapong-Dufor Adidome feeder road (Km 29+060) to compensate for adequate space for vehicle approaching the toll both from the Volta River Bridge.
- Consideration should be given to the provision of multiple toll booths and approach lanes to manage the traffic in the vicinity of the Volta River Bridge.

3.2 Cross section of Volta River Bridge

a) Observation

Safety fence has not been provided at the interface of the carriageway and the walkway



No safety fence at the interface of walkway and carriageway

b) Reason for concern

The safety of pedestrian and other vulnerable road users will be impaired as errant motoristcross their path.

c) Recommendation

- Consideration should be given to the provision of appropriate safety fence during the detailed design stage.
- Provision of enhanced road markings and shoulder rumble strips should be considered.