

## **Chapter 16 Solid Waste Management Sector Plan and Programme**

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### **16.1 Background of Solid Waste Management Sector for Greater Kumasi Sub-Region**

#### **16.1.1 Background**

The Greater Kumasi Sub-Region is composed of KMA and seven adjoining districts, and is a socially, economically and physically integrated area. A contiguously urbanizing area centring on Kumasi (Greater Kumasi Conurbation) is expanding beyond the boundary of KMA.

The Spatial Development Framework (SDF) integrates socio-economic development policies and spatial development strategies. The SDF is an official document for an integrated spatial plan of land use and infrastructures in response to future socio-economic frameworks and development policies. The Structure Plan (SP) is for the Greater Kumasi Conurbation.

Validity of the development strategies and spatial plans to be formulated is verified from the solid waste management perspectives not only by considering the existing conditions and on-going/planned projects, but also by forecasting future capacity required for managing future solid waste volumes to be generated towards the future population increase.

From the viewpoints of the proper solid waste management implementation in the Greater Kumasi Sub-Region by 2033, the present waste treatment system of collection, transportation, intermediate treatment (composting and recycling) and final disposal being conducting by MMDAs through the private service providers, should be emphasized systematically. In particular, it is found that the MDAs of the Sub-Region should be required to take more realistic actions in terms of SWM disposal landfilling at the final sanitary landfill sites towards the year of 2033.

As a consequence, the development strategies and spatial plans formulated under the SDF and SP for the Greater Kumasi Sub-Region will be verified for the solid waste management sector sub-programme under the programme formulation and implementation/ construction of the small-scaled final sanitary landfills at each district of the Sub-Region towards 2033, so that the MMDAs of the Sub-Region will be able to be kept clean and healthy through proper management of solid waste. The following are the needs of the SWM sector sub-programme in the future:

- The smooth operation of the Phase 2 area of the existing Oti sanitary landfill for

KMA

- The proper preparation and implementation (construction and operation) of the proposed final small-scaled sanitary landfills scheme for MDAs
- “Primary responsibility for solid waste management rests with the Assembly” and “the polluter-pays-principle”. Based on “the Environmental Sanitation Policy (Revised 2009), Ghana”

### **16.1.2 Goal of Sanitation Policy**

In this context, a government sanitation policy and urban environmental sanitation Bye-Laws in relation to solid waste management should be transformed and are introduced to support the validity of the SDF and SP for the Greater Kumasi Sub-Region for SWM perspectives below:

The policy documents which are the basis for the basic national government policy of sanitation and the MMDAs (Sanitation) Bye-Laws for Solid Waste Management include; the “Environmental Sanitation Policy” of Ghana (Revised 2009) by the Ministry of Local Government and Rural Development (MLGRD), the Government of Ghana (April 2010), and Kumasi Metropolitan Assembly (Sanitation) Bye-Laws, 2011. These policies are general conceptual frameworks for solid waste management. Annex 3: Definitions of Components of Environmental Sanitation, defines “Solid Waste Management” mainly as follows:

- Solid wastes comprised all solid waste material generated by households, institutions (including health-care waste from hospitals and clinics), commercial establishments and industries, and discharged from their premises for collection.
- Hazardous wastes comprise those wastes that are toxic, flammable, corrosive, radioactive, explosive or otherwise dangerous as defines by the EPA.
- Primary responsibility for solid waste management rests with the Assembly.

#### **(1) Goal**

The overall goal of the Environmental Sanitary Policy of Ghana is to develop a clear and nationally accepted vision of environmental sanitation as an essential social service and major determinant for improving the health and quality of life in Ghana.” The policy is based on the polluter-pays-principle.

#### **(2) Mission Statement and Vision for KMA**

The KMA-WMD has a Mission Statement and Vision as follows:

“To keep Kumasi clean and healthy through the provision and delivery of cost effective and environmentally acceptable waste management services in collaboration with all stakeholders to promote development and healthy living.”

“Vision: To make Kumasi one of the top five cleanest cities in Africa by 2025.”

## **16.2 Objectives for Solid Waste Management of Greater Kumasi Sub-Region**

Considering the current situation and issues and National Sanitation Policy, the

following objectives are set for solid waste management sector development for Greater Kumasi Sub-Region:

- To provide the healthy public hygiene area, strengthening the solid waste management (collection, transportation, disposal) in the Greater Kumasi Sub-Region
- To be responsible for (or to secure the ability to do) the solid waste management within not only the areas of the KMA, the Municipal and District Assemblies but also the entire area of Greater Kumasi Sub-Region
- At the same time, to arrange the order of so as to carry out the solid waste management by the cooperation among the KMA, the Municipal and District Assemblies in the Greater Kumasi Sub-Region
- To consider effects carefully on the environment and deepen the understanding of residents regarding the importance of construction of a new final landfill
- In the long-term future, to reduce the solid waste generation amount

### 16.3 Forecast Solid Waste Volume to be generated for the Target Year 2033

For the purpose of designing solid waste management systems (consisting of a series of elements, namely collection, transport, recycling, intermediate treatment and final disposal), the total amounts of solid waste to be generated in the target year 2033 are estimated by using parameters of solid waste disposal per capita per day (an average daily waste generation per capita) and by considering the following future socio-economic aspects.

#### 16.3.1 Future Population and Distribution

The latest population census was carried out by the Ghana National Census of Statistics in 2010. It is projected that the Greater Kumasi Sub-Region has an extended future population of 3,607,766 in 2018, 4,265,645 in 2023, and 5,761,463 in 2033 as shown in Table 16.3.1, and the future population distribution framework in the MMDAs is estimated in Table 16.3.2 based on the proportion of the local type of urban and rural areas in each MDA from the 2010 population census as follows.

**Table 16.3.1 Forecast of Future Population of MMDAs of Greater Kumasi Sub-Region (2013-2033)**

(Unit: persons)

MMDAs		Year				
		2013	2018	2023	2028	2033
1.	KMA (incl. Asokore Mampong)	2,259,869	2,691,071	3,204,551	3,816,007	4,226,860
2.	Afigya Kwabre	148,447	171,482	198,090	228,828	259,891
3.	Kwabre East	124,515	141,017	159,706	180,871	220,322
4.	Ejisu-Juaben	164,552	206,096	258,128	323,297	438,940
5.	Bosomtwe	101,273	114,851	130,249	147,711	165,273
6.	Atwima Kwanwoma	99,010	114,727	132,937	154,039	198,629
7.	Atwima Nwabiagya	156,057	168,522	181,984	196,520	251,548
	Greater Kumasi Sub-Region	3,053,725	3,607,766	4,265,645	5,047,272	5,761,463

Source: JICA Study Team, 2012

**Table 16.3.2 Local Type of Urban and Rural Population Census in MMDAs of Greater Kumasi Sub-Region (2010)**

Locality	KMA	Six Adjoining Districts						Average
		Afigya Kwabre	Kwabre East	Ejisu-Juaben	Bosomtwe	Atwima Kwanwoma	Atwima Nwabiagya	
Urban	100%	26%	58%	28%	30%	20%	32 %	32 %
Rural	0%	74%	42%	72%	70%	80%	68%	68 %

Source: GSS, 2010 Population and Housing Census

### 16.3.2 Future Waste Amount

The most direct influence on waste generation is the change in population. Future solid waste generation amount by the year 2033 is projected based on the results obtained from the following considerations in the updating of future waste amounts:

- Projected population (see Table 16.3.1)
- Gross Domestic Product (GDP) per capita
- Average daily generation amount per capita

To estimate the future waste amounts a correlation between the annual growth rate of GDP per capita (%) and an average daily generation amount per capita (kg/capita/day) is expected to have a larger impact on the waste amount per capita of a developing country. Based on the data from the MMDAs and the considerations above, the following are employed for calculation of the future waste amount:

- 4% is assumed as the annual increase growth rate per capita of waste generation for the SWM sector
- the current 0.60kg/capita/day for KMA and 0.45kg/capita/day for MDAs in 2013, which are assumed the same as those of 2012, are estimated to increase to about 1.31kg/capita/day for KMA and 0.99kg/capita/day for MDAs in 2033

Future waste amounts generated estimated for the year 2033 for the Greater Kumasi Sub-Region are shown in Table 16.3.3. As shown in Figure 6.4.1, the waste discharge amount is made up of the collected amount, uncollected amount and self-disposal, and calculated by subtracting the self-disposal amount from the generation amount. The self-disposal amount is estimated based on the interview survey with the service provider by the JICA Study Team. It is assumed that the waste amount of commercial businesses is included in the domestic waste, according to KMA-WMD.

**Table 16.3.3 Forecast of Future Waste Amounts generated in the Greater Kumasi Sub-Region**

Unit: t/day

MMDAs	Year				
	2013	2018	2023	2028	2033
KMA (incl. Asokore Mampong)	1,662	2,302	3,219	4,535	6,012
Afigya Kwabre	73	102	143	202	278
Kwabre East	67	92	127	175	259
Ejisu-Juaben	81	123	188	286	473
Bosomtwe	50	69	95	132	179
Atwima Kwanwoma	48	67	94	133	209
Atwima Nwabiagya	78	102	134	176	274
Greater Kumasi Sub-Region	<b>2,058</b>	<b>2,858</b>	<b>4,001</b>	<b>5,639</b>	<b>7,685</b>

Notes: Waste amounts for KMA includes waste markets.

Source: KMA, JICA Study Team, 2012

**Table 16.3.4 Forecast of Unit Waste Amount in the Greater Kumasi Sub-Region**

Unit: kg/person/day

MMDAs	Year				
	2013	2018	2023	2028	2033
KMA (incl. Asokore Mampong)	0.60	0.73	0.89	1.08	1.31
Surrounding Districts of KMA	0.45	0.55	0.67	0.81	0.99

Source: JICA Study Team, 2012 based on data from KMA

**Table 16.3.5 Market Waster Amount Collected in KMA in Greater Kumasi Sub-Region (2013-2033)**

Target Year	2013	2018	2023	2028	2033
Projected market waste amount (t/day)	306	338	373	412	455

Source: JICA Study Team, 2012

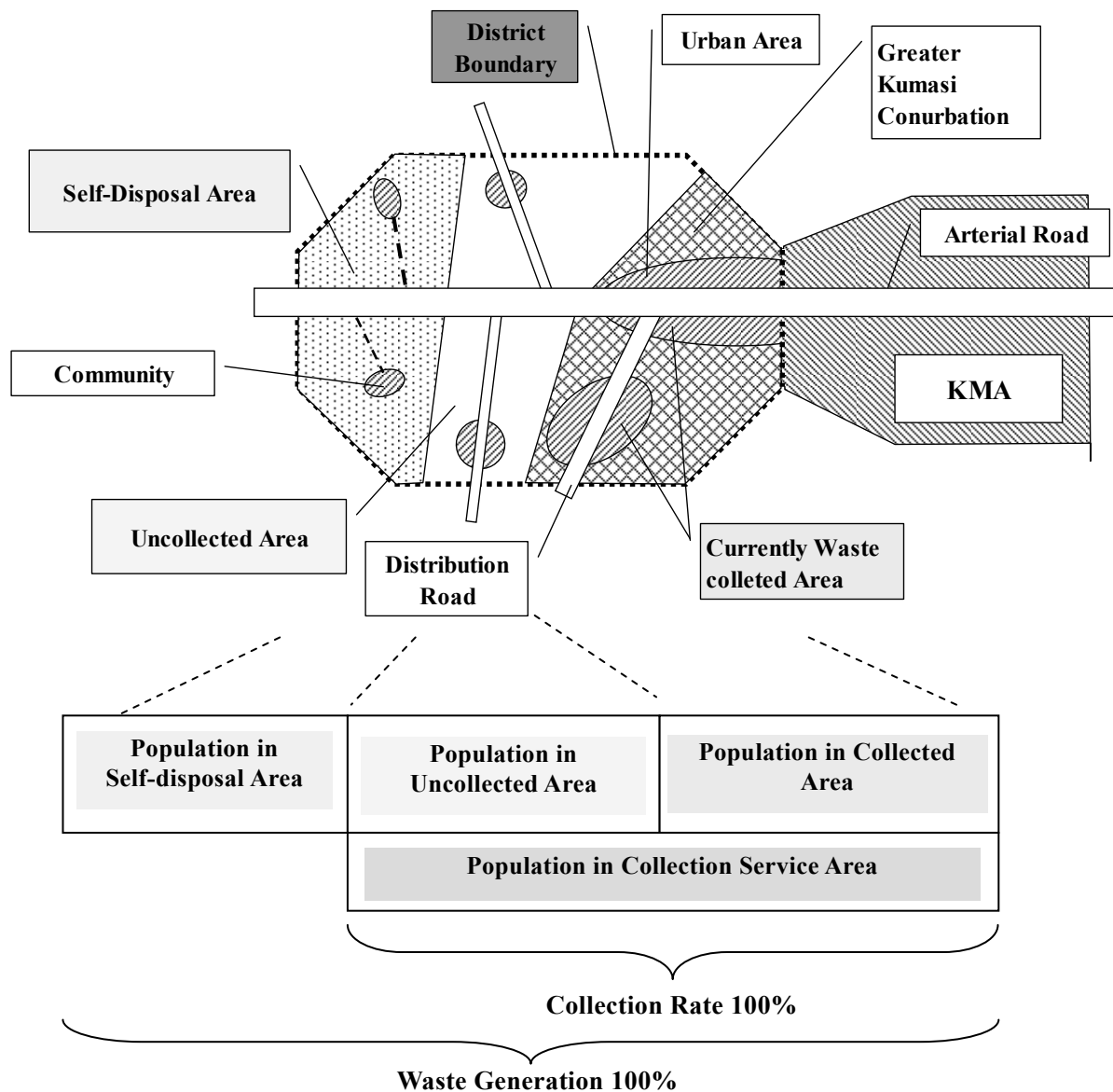
## 16.4 Future Solid Waste Management System for Greater Kumasi Sub-Region

### 16.4.1 Solid Waste Management Systems

The general features of the Solid Waste Management System for KMA have already been developed and will be enhanced to improve their performance. On the other hand, the Solid Waste Management System for adjoining districts (See Figure 16.4.1), which is still underdevelopment, is composed of different service areas as follows:

- Self-disposal areas
- Collection service areas
  - Uncollected areas
  - Collected areas

The Greater Kumasi Conurbation Area should be within the Collection Service Area.



**Figure 16.4.1 Systematic Diagram of Self-Disposal, Uncollected and Collected Areas in MDAs of Greater Kumasi Sub-Region (2013-2033)**

### 16.4.2 3R and Intermediate Treatment System

The term 3R as defined herein stands for reduce, reuse and recycling, while the intermediate treatment system consists of composting and incineration. The current state of 3R and intermediate treatment systems in the Greater Kumasi Sub-Region are not very activate. In the collection, transportation and disposal system, it is recommended that sorting of wastes is to be carried out at the source, collection points, transfer stations, and final landfill site. The 3R and intermediate treatment systems are as discussed below.

#### (1) Waste Reduction

Waste generation amount per capita is currently not very high in the Greater Kumasi

Sub-Region and it may be to conduct the waste reduction plan. However, there are still some spaces to reduce waste generation amount through avoiding excessive use or saving consumable goods, and repairing and reuse of commodities.

**(2) Waste Recovery**

The major items of resource recovery are paper, plastic, glass and metals. The waste composition survey by KMA shows that about 30% of the total waste was recyclable materials such as paper, plastics, glass and metals. It is essential that if the waste composition by weight in 2033 is assumed to be to the same as that in 2010 there will be high potential for recovery of the materials in the Greater Kumasi Sub-Region.

**(3) Reuse**

People in the Sub-Region, especially the lower income group families, are practicing reuse as a natural daily activity. Domestic or imported second hand clothes and shoes are usually sold at the markets such as Central Market, and other markets. Hard plastics and metals are being reused as major recyclable materials in KMA. However, there still exist groups to promote reuse or use of items over and over again, even the repaired ones, for the reduction of waste discharge amount.

**(4) Recycling**

The recycling of paper, glass and metals is not being practiced in KMA or the 6 MDAs much. It is noted that the distribution channel system for recycling does not yet expand well in the market. Accordingly, the resource recovery and recycling plan will be formulated in line with the policy of waste utilization in industry as a potential material resource in the future.

**(5) Composting**

With the high ratio of organic waste composition of more than 40% in KMA, composting of biodegradable waste is considered as the most practical way for intermediate treatment. It is proposed to promote composting by utilizing the private sector as well as local governments, because of the following advantages:

- 1) The residents of KMA and the surrounding regional areas of the Greater Kumasi Sub-Region do not have much experience with composting activities; it is thus better that the private sector such as the Kumasi Compost Recycling Plant (KCRP) and NGOs undertakes to compost organic solid waste collected from general households because according to the KMA.
- 2) Treatment of a large amount of organic waste by utilizing the plant for intermediate treatment contributes to deducing total amount of solid waste produced in the Greater Kumasi Sub-Region. The existing Accra Composting & Recycling Plant in Greater Accra is presently under operation and the on-going Kumasi Composting & Recycling Plant (KCRP) will be under land preparation in Bosomtwe District. It is therefore highly expected that the private sector

experienced in composting for the KCRP will be helpful for agricultural and gardening uses in the Sub-Region and reduction of disposal amounts to not only the existing Oti sanitary landfill in KMA but also small-scale landfills in adjoining districts. And it will be expected in future that composting will become popular among farmers and agriculture-related companies in not only the Greater Kumasi Sub-Region but also outside Greater Kumasi.

- 3) Separating solid waste at households is important; and organic waste composted jointly with relevant NGOs could be used for agriculture and gardening.

As for dissemination of such compost by the private sector, a market for the compost project is expected to be expanded to rural area as well as KMA in future,

## 16.5 SWM Sector Plan for the Target Year 2033

Based on the study results above, a solid waste management system will be designed for the target year of 2033 by clarifying the following aspects.

### (1) Gross Amount of Solid Waste

Gross amount of solid waste to be generated, gross amount of solid waste to be recycled, gross amount of solid waste to be collected and gross amount of solid waste for final disposal are estimated as below. The projected waste stream in 2013 and 2033 for KMA is shown in Figure 16.5.1.

By the year of 2033, it is estimated that in the Sub-Regional level the gross amount of solid waste generated will be 7,085 t/day including market waste of 455 t/day, the gross amount of solid waste for composting and recycling will be 600 t/day, and the gross amount of solid waste for final landfilling will be 7,400 m<sup>3</sup>/day.

The collection rate of 100% was set in the Project as a goal to realize the respective current SWM situation of the collection rates in the Greater Kumasi Sub-Region, and for the visible improvement of the environmental and sanitary condition at the target year of 2033.

The total waste amounts projected in the Greater Kumasi Sub-Region for the years 2013, 2018, 2023, 2028 and 2033 are summarized in Table 16.5.1, and the breakdown amounts of the total waste amounts for KMA and for MDAs are shown in Table 16.5.2 and Table 16.5.3, respectively.

**Table 16.5.1 Waste Amount Generated in Greater Kumasi Sub-Region (2013 -2033)**

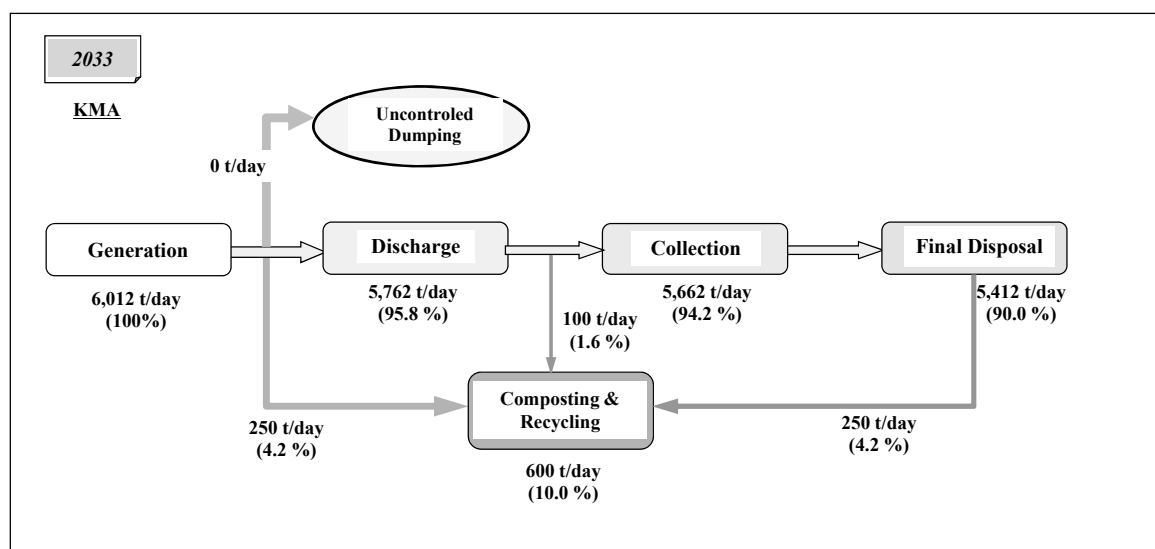
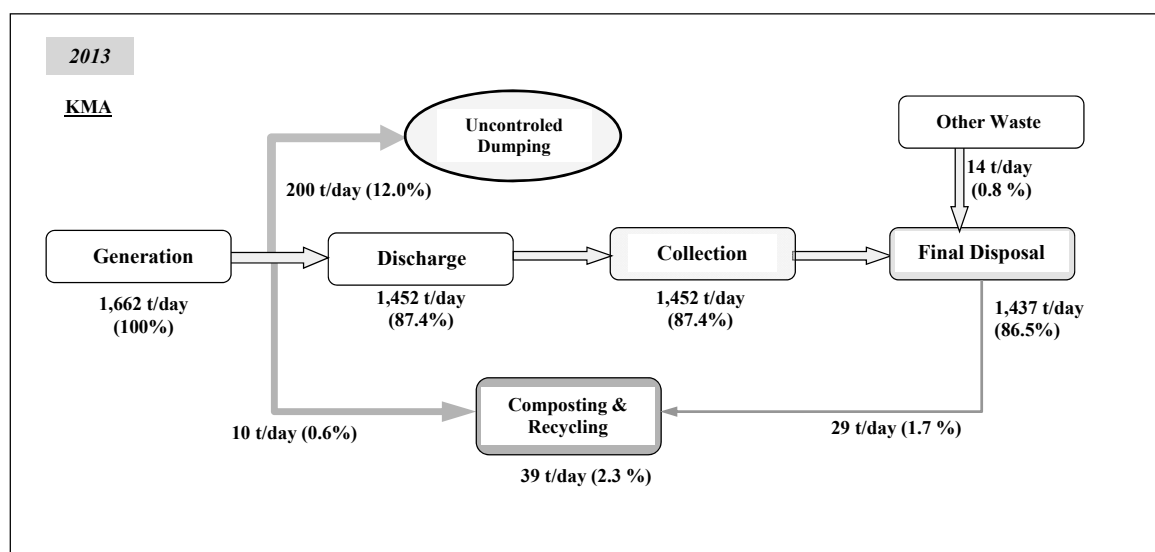
Target Year	2013	2018	2023	2028	2033
Projected waste amount in KMA including market waste (t/day) (1)	1,662	2,302	3,219	4,535	6,012
Projected waste amount in MDAs urbanized (t/day) (2)	396	556	782	1,104	1,674
Total waste amount in Greater Kumasi Sub-Region (t/day) (3) = (1) + (2)	2,058	2,858	4,001	5,639	7,685

Source: KMA-WMD, JICA Study Team, 2012

**Table 16.5.2 Target Collection Rate and Waste Amount Collected in KMA in Greater Kumasi Sub-Region (2013-2033)**

Target Year	2013	2018	2023	2028	2033
KMA- Target Collection Rate (%)	87	90	93	97	100
Projected waste amount in KMA (t/day) (1)	1,356	1,964	2,846	4,123	5,557
Projected market waste amount (t/day) (2)	306	338	373	412	455
Total in KMA (t/day) (3) = (1) + (2)	1,662	2,302	3,219	4,412	6,012

Source: JICA Study Team, 2012



Source: KMA-WMD, JICA Study Team, 2012

**Figure 16.5.1 Waste Stream in KMA in 2013 and 2033**

**Table 16.5.3 Target Collection Rate and Waste Stream of MDAs in Greater Kumasi Sub-Region (2013-2033)**

Target Year	2013	2018	2023	2028	2033
<b>Afigya Kwabre District/</b>					
Collection rate (%)	45	59	73	86	100
Total waste generated (t/day)	73	102	143	202	278
Self-disposal waste (t/day)	13	21	33	49	69
Uncollected waste (t/day)	33	17	11	6	0
Collected waste (t/day)	27	61	100	148	209
<b>Kwabre East District /</b>					
Collection rate (%)	62	72	82	92	100
Total waste generated (t/day)	67	92	127	175	259
Self-disposal waste (t/day)	2	6	12	22	35
Uncollected waste (t/day)	25	12	8	4	0
Collected waste (t/day)	40	74	110	153	224
<b>Ejisu-Juaben Municipality/</b>					
Collection rate (%)	59	70	80	90	100
Total waste generated (t/day)	81	123	188	286	473
Self-disposal waste (t/day)	8	34	64	107	182
Uncollected waste (t/day)	30	11	7	5	0
Collected waste (t/day)	43	83	125	178	291
<b>Bosomtwe District/</b>					
Collection rate (%)	78	83	89	95	100
Total waste generated (t/day)	50	69	95	132	179
Self-disposal waste (t/day)	13	14	25	36	48
Uncollected waste (t/day)	8	5	3	1	0
Collected waste (t/day)	29	50	68	96	131
<b>Atwima Kwanwoma District/</b>					
Collection rate (%)	60	71	81	91	100
Total waste generated (t/day)	48	67	94	133	209
Self-disposal waste (t/day)	4	10	32	49	85
Uncollected waste (t/day)	17	10	5	3	0
Collected waste (t/day)	26	45	61	80	123
<b>Atwima Nwabiagya District/</b>					
Collection rate (%)	26	45	64	82	100
Total waste generated (t/day)	78	102	134	176	274
Self-disposal waste (t/day)	7	10	27	46	86
Uncollected waste (t/day)	63	37	23	11	0
Collected waste (t/day)	22	55	85	120	189
<b>Greater Kumasi Sub-Region Waste amount generation in MDAs (t/day)</b>	<b>396</b>	<b>556</b>	<b>782</b>	<b>1,104</b>	<b>1,674</b>

Source: JICA Study Team, 2012

## (2) Required Capacity Necessary for Final Disposal Sites for Target Year of 2033

It is expected that the Phase 2 area of the existing Oti sanitary landfill will be open and in operation in the beginning of 2013 and will start waste land filling. The required waste amounts to be disposed of at the Oti sanitation landfill between 2013 and 2033 are calculated as shown in Table 16.5.4. About 43.3 million m<sup>3</sup> of landfill capacity will be required by the year of 2033. Considering the available waste

capacity at the existing Oti landfill, it is very important to find another new sanitary landfill site for KMA. In the case of the MDAs in the Greater Kumasi Sub-Region, the projected solid waste to be collected and disposed of is estimated at about 2,100 t/day as shown in Table 16.5.5.

**Table 16.5.4 Landfill Site Capacity Requirements in KMA in Greater Kumasi Sub-Region**

Year	Waste Amount	Composting & Recycling	Collection Rate	Waste Amount	Waste Amount	Cover soil	Total Waste Amount	Total Accumulated Waste	
	(t/day)	(t/day)	(%)	(m <sup>3</sup> /day) (4)=(1)-(2) x(3)%/(Bulk Density) 0.60	(m <sup>3</sup> /year) (5)=(4) x 365	(m <sup>3</sup> /year) (6)=(5)/3	(m <sup>3</sup> ) (7)=(5)+(6)	(m <sup>3</sup> ) (8)	
	¶ (1)	¶ (2)	¶ (3)					¶ (8)	
2012	0	1,609	39	87	2,277	831,124	277,041	1,108,166	1,108,166
2013	1	1,662	39	87	2,353	858,931	286,310	1,145,241	2,253,407
2014	2	1,790	95	88	2,472	902,180	300,727	1,202,907	3,456,314
2015	3	1,918	151	88	2,591	945,868	315,289	1,261,157	4,717,471
2016	4	2,046	207	89	2,717	991,857	330,619	1,322,476	6,039,948
2017	5	2,174	263	89	2,845	1,038,431	346,144	1,384,574	7,424,522
2018	6	2,302	320	90	2,974	1,085,588	361,863	1,447,450	8,871,972
2019	7	2,486	376	91	3,200	1,168,100	389,367	1,557,467	10,429,439
2020	8	2,669	432	92	3,431	1,252,161	417,387	1,669,549	12,098,988
2021	9	2,852	488	92	3,639	1,328,181	442,727	1,770,908	13,869,896
2022	10	3,036	544	93	3,849	1,404,717	468,239	1,872,956	15,742,852
2023	11	3,219	600	93	4,060	1,481,769	493,923	1,975,692	17,718,544
2024	12	3,482	600	94	4,516	1,648,227	549,409	2,197,636	19,916,179
2025	13	3,746	600	95	4,981	1,817,887	605,962	2,423,850	22,340,029
2026	14	4,009	600	96	5,435	1,983,838	661,279	2,645,117	24,985,146
2027	15	4,272	600	96	5,896	2,151,924	717,308	2,869,232	27,854,378
2028	16	4,535	600	97	6,362	2,322,145	774,048	3,096,193	30,950,571
2029	17	4,831	600	98	6,875	2,509,248	836,416	3,345,664	34,296,235
2030	18	5,126	600	98	7,392	2,698,147	899,382	3,597,530	37,893,765
2031	19	5,421	600	99	7,928	2,893,731	964,577	3,858,308	41,752,073
2032	20	5,716	600	99	8,470	3,091,709	1,030,570	4,122,279	45,874,352
2033	21	6,012	600	100	9,019	3,292,083	1,097,361	4,389,444	50,263,795
Total					37,697,847	12,565,949	50,263,795		

Source: KMA-WMD, JICA Study Team

Notes: C/R= Collection Rate

### (3) Willingness to Pay, Possibility of Privatization and Final Disposal

People's willingness to pay for solid waste collection and possibility of privatization of solid waste collection, transport and final disposal are addressed as follows.

In both the KMA and MDAs in the Greater Kumasi Sub-Region, the solid waste collection, transportation and final disposal services are presently conducted through

private contractors as service providers for each Sub-Metropolitan Area for KMA and each MDAs. There are the seven service provides for the Sub-Metropolitan Area of KMA and one service provider for the 6 adjoining districts.

In line with the Assembly's Fee Fixing Resolution, there are presently two collection service systems with waste charges as follows.

**Table 16.5.5 Waste Charge History (2008-2011)**

Year	2008	2009	2010	2011
Collection System	No charge	Starting to charge for waste collection in 2 systems (house-to-house/ communal collection)	House-to-house collection/ Communal collection	House-to-house collection/ Communal collection
Remarks		55,000 households participated in the house-to-house waste collection scheme (WMD-KMA, 2010). Low-income households generally rely on the pay-as-you-dump system, whereby communal containers / skips are placed at designated sites, and households pay between GHC0.10 - GHC0.20 per load.	GHC3.0- GHC5.0 High income residential class : GHC10.00 Middle-income residential class: GHC8.00 Low-income class: GHC5.00 GHC0.10 - GHC0.30 could be charged per person and the average number of individuals contributing refuse that fill each of the containers (at the communal containers of 10m <sup>3</sup> , 12m <sup>3</sup> , 14m <sup>3</sup> and 23m <sup>3</sup> ) was determined during the survey exercise.	Charge for communal collection per head load of waste of GHC0.30 while for the house-to-house collection system charge was GHC10 per month.

Source: KMA-WMD

**Table 16.5.6 Waste Collection Cost, Cost Recovery and Subsidy (2010)**

Item	Total Cost for Solid Waste Collection (GHC/year)	Cost Recovery (GHC/year)	Subsidy Paid by the Central Government
Cost	3,800,000 (100%)	1,400,000 (37%)	2,400,000 (63%)
Remarks	The total cost of waste collection for the year stands at the above amount.	The service providers were able to recover this amount from the waste charges from house-to-house collection and pay-as-you-dump from the communal sites.	The outstanding cost which constitutes the subsidy to be paid by the KMA.

Source: KMA-WMD

#### (4) Possibility of the Solid Waste Reduction

In the KMA, composting and recycling of waste materials have not yet been conducted as mentioned in Sub-section 15.2.3 3R and Intermediate Treatment System. However, the on-going new MRF, Kumasi Composting and Recycling Plant (KCRP) at Adagya organized by Zoomlion Ghana Ltd., is planned to be opened and be commissioned in 2014. According to the KCRP plan it is expected that about 600 tonnes will be processed at the MRF plant operation daily under two-shifts a day operation and the disposal amount at the final sanitary landfill site will be drastically

reduced.

## **16.6 SWM Sector Programme**

The JICA Study Team will prepare a Solid Waste Management Programme which is composed of four sub-programmes including schedules and costs, and possible financial sources for implementation.

There are four action programmes to be established in the implementation plan for the solid waste management sector sub-programmes for the Greater Kumasi Sub-Region.

- Sub-Programme 1: Expansion of Oti Sanitary Landfill Site
- Sub-Programme 2: Continuation of Kumasi Composting and Recycling Plant (KCRP) Project at Adagya
- Sub-Programme 3: Enhancement of SWM Unit of EHD, MMDAs especially MDAs
- Sub-Programme 4: Construction of Final Sanitary Landfill Sites in MDAs

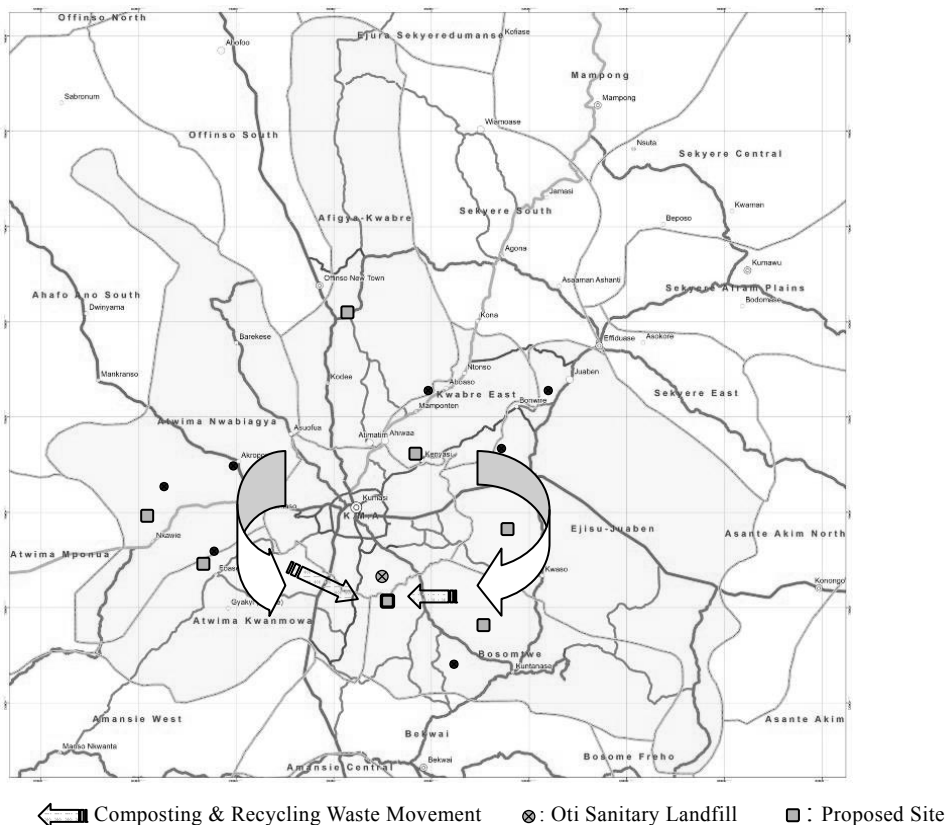
The detailed plans of each Programme for realization of the SWM sector are as follows:

- 1) Sub-Programme 1: Expansion of Oti Sanitary Landfill Site
  - a) Implementation (Operation/ Maintenance) of Phase 2
  - b) Implementation (Preparation/ O-M) of Phase 3
- 2) Sub-Programme 2: Continuation of Kumasi Composting and Recycling Plant (KCRP) Project at Adagya
  - a) Formulation of 3R (reduce, reuse, recycling) Implementation Plan
  - b) Construction of Plant
  - c) Operation of Plant
  - d) Implementation of Waste Reduction Plan
  - e) Preparation of New Landfill Site
  - f) Operation of New Landfill Site
- 3) Sub-Programme 3: Enhancement of SWM Unit of EHD, MMDAs especially the surrounding Districts of KMA
  - a) Formulation of 3R (reduce, reuse, recycling) & Composting Implementation Plan
  - b) Construction of 3R & Composting Plant
  - c) Preparation of MDAs' SWM Plans
  - d) Preparation of Small-Scale Sanitary Landfill Plan
  - e) Preparation of Land Acquisition Process for Landfills
  - f) Implementation of IEC Campaign on SWM
  - g) Capacity Development
- 4) Sub-Programme 4: Construction of Final Sanitary Landfill Sites in MDAs
  - a) Formulation of Final Small-Scale Landfill Construction Plans

b) Implementation of Final Small-Scale Sanitary Landfill

The goals of the action programmes of the solid waste management sector of the Project are outlined in Table 16.6.1 with prospective target levels to be achieved by the year 2018 for the Short-Term Plan, year 2023 for the Mid-Term Plan, year 2028 for the Long-Term Plan, and year 2033 for Extra Long-Term Plan. Sub-Programme 1 is now under operation by KMA and Sub-Programme 2 is an on-going project for implementation (preparation and operation) including a possibility study on a succeeding sanitary landfill site for KMA, and Sub-Programme 3 and Sub-Programme 4 are newly proposed action plans under this Project.

Figure 16.6.1 shows some potential landfill sites for small-scale sanitary landfill sites as of 2012, which are obtained from the EHD of MDAs and KMA-WMD in the Greater Kumasi Sub-Region. It is recommended that this kind of diagram map will be upgraded and marked with more promising sites with the concerned parties such as landowners, local government offices and residents for a study on the succeeding proposed sites for small-scale sanitary landfills for MDAs for not only the periods of Short-Term and Mid-Term Plan Phases, but also the period of the Long-Term Plan Phase.



Source: JICA Study Team, 2012

**Figure 16.6.1 Proposed Final Disposal Sites for Sanitary Landfill in Greater Kumasi Sub-Region (2033)**

**Table 16.6.1 Implementation Plan for SWM Sector Programme for Greater Kumasi Sub-Region**

Action Sub-Programmes	Phasing for Spatial Developing Planning																						
	Short-Term Plan Phase					Mid-Term Plan Phase					Long-Term Plan Phase					Extra Long-Term Plan Phase							
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033		
<b>Sub-Programme 1: Expansion of Oti Final Sanitary Landfill</b> 1-1 Implementation (Operation/ Maintenance) of Phase 2 1-2 Implementation (Preparation/O-M) of Phase 3																							
<b>Sub-Programme 2: Continuation of KCRP at Adagya</b> 2-1 Formulation of 3R Implementation Plan 2-2 Construction of Plant 2-3 Operation of Plant 2-4 Implementation of Waste Reduction Plan 2-5 Preparation of New Landfill Site 2-6 Operation of New Landfill Site																							
<b>Sub-Programme 3: Enhancement of SWM Unit of EHD, MMDAs especially MDAs</b> 3-1 Formulation of 3R (reduce, reuse, recycling) & Composting Implementation Plan 3-2 Implementation of 3R & Composting Plan 3-3 Preparation of MDAs SWM Plans 3-4 Preparation of Small-Scale Sanitary Landfill Plan 3-5 Implementation of IEC Campaign on SWM 3-6 Capacity Development																							
<b>Sub-Programme 4: Construction of Final Sanitary Landfill Sites in MDAs</b> 4-1 Formulation of Final Small-Scale Landfill Construction Plan 4-2 Implementation of Final Small-Scale Sanitary Landfills																							
Remarks * Target Year of SDF (2013 - 2033) 20 years * Target Year of SP (2013 - 2028) 15 years																							

Sources: KMA-WMD, Zoomlion Ghana Co. Ltd.

Notes: Kumasi Composting and Recycling Plant (KCRP), Bosomtwe District Assembly (BDA), Municipality and Districts Assemblies (6 MDAs)

Spatial Development Frameworks (SDF), Structure Plan (SP), Environmental Health Department (EHD), Information Education and Communication (IEC)

## 16.7 Preliminary Economic and Financial Analysis

### 16.7.1 Economic Analysis

#### (1) Methodology

With the new and increasing supply of solid waste management services, the benefits of the Sector Programme will be positive regarding health and social impact. The JICA Study Team estimated the significant benefits, both direct and indirect, due to the Sector Programme with the following steps:

Step 1: Identification of “with” and “without” cases,

Step 2: Assumption parameters for direct benefit such as affordability to pay, and saving on waste disposal cost,

Step 3: Estimation of economic costs based on the estimated capital investment cost,

Step 4: Estimating the indirect effects and

Step 5: Economic evaluation using economic benefits and economic costs.

**(2) “With” and “Without” cases**

The project inputs and outputs should be identified, quantified and valued by comparing the “Without case” with that of the “With case” to derive the economic benefit.

**1) “With” Case**

The proposed increase in solid waste management facilities and future waste stream are described in the Sector Programme.

**2) “Without” Case**

The current facilities, the waste stream and current location of landfill shall be unchanged in the future.

**(3) Assumption of Benefit**

**1) Application of Affordability to Pay**

To estimate the value of the impact, the JICA Study Team assumed to quantify the affordability to pay based on the ratio of disposable income. According to project appraisal manual issued by IBRD, the ratio of solid waste management cost in the household budget is 2% so that the monthly affordability to pay for this sector in households is GHC 9/month.

In accordance with Table 16.5.6, there are presently two collection service systems with waste charges. However, current revenue is very poor, because only about 10% households pay waste charges. Thus, the estimated affordability to pay can be considered to represent the value of the positive impact, which is the project benefit, when the landfill project is done and issues in management are solved.

**2) Saving on waste disposal cost**

The average unit rate of current waste disposal cost is assumed to be GHC 14/ton of disposed waste. After the proposed landfill sites are completed in each district by year 2033, the disposal cost is estimated to reduce to GHC 12.5/ton by considering the waste volume to be transported to the intermediate treatment systems in the projected waste stream as presented in the previous section.

**(4) Estimation of Economic Cost**

The capital investment cost of the Sector Programme is estimated as shown in Table 16.7.1. In this study the economic cost was estimated by deducting government taxes and import duty from the capital investment cost and O/M cost so that a conversion factor of 0.85 was assumed. Hence, the total economic cost is estimated at GHC 23.8million as shown in Table 16.7.2. Operation and maintenance (O&M) applied cost is 10% of each investment cost.

Waste disposal cost is also added to the cost estimation. The cost is based on waste generated in KMA and 7 adjoining districts in accordance with Table 16.7.2 and

Table 16.7.3.

**Table 16.7.1 Capital Investment Cost and O&M Cost**

MMDAs	Capital Investment Cost			O & M Cost (Thousand GHC/year)
	Cost of Each Landfill Site (Thousand GHC /year)	Number of Landfills	Total Cost (Thousand GHC /year)	
Afigya Kwabre	800	7	5,600	560
Kwabre East	600	7	4,200	420
Ejisu-Juaben	800	7	5,600	560
Bosomtwe	500	7	3,500	350
Atwima Kwanwoma	500	7	3,500	350
Atwima Nwabiagya	800	7	5,600	560
Total	4,000		28,000	2,800

Source: JICA Study Team

**Table 16.7.2 Economic Cost of Small-Scale Landfills in 7 Adjoining Districts**

	Financial Cost (GHC Thousand)	Conversion Factor	Economic Cost
Capital Investment Cost	28,000	0.85	23,800
O&M Cost (per/year)	2,800	0.85	2,380

Source: JICA Study Team

**Table 16.7.3 Disposal Cost**

Year	Disposal Cost	
	Financial Cost (Thousand GHC/year)	Economic Cost (Thousand GHC/year)
2013	9,390	7,982
2018	13,040	11,084
2023	18,255	15,517
2028	25,167	21,392
2033	35,067	29,807

Source: JICA Study Team

## (5) Result of Economic Analysis

The cash flow projection based on the above assumptions is presented in Table 16.7.4. Project life is 30 years after the start of project implementation. The Economic Internal Rate of Return (EIRR) of the Sector Programmes is 35.36% which is above the hurdle rate of 12.0%. The computed Net Present Value (NPVs) for the Sector Programme using 12% discount rate is GHC 230 million.

**Table 16.7.4 Economic Flow of Solid Waste Management Sector Programmes**

Unit: GHc 1,000

Year	Benefit	Cost		Cost Total C	Benefit Total B	B-C	Dis. Cost (12%)	Dis. Benefit (12%)	Dis. B-Dis. C (12%)
		O & M, Disposal	Investment						
2015	0	9,222	3,400	12,622	0	-12,622	12,622	0	-12,622
2016	6,418	10,183		10,183	6,418	-3,765	9,092	5,730	-3,361
2017	6,664	10,803		10,803	6,664	-4,139	8,612	5,313	-3,300
2018	6,915	11,424	3,400	14,824	6,915	-7,908	10,551	4,922	-5,629
2019	20,462	12,648		12,648	20,462	7,814	8,038	13,004	4,966
2020	21,211	13,532		13,532	21,211	7,679	7,678	12,036	4,357
2021	21,982	14,416	3,400	17,816	21,982	4,166	9,026	11,137	2,110
2022	37,423	15,641		15,641	37,423	21,783	7,075	16,928	9,853
2023	31,920	16,536		16,536	31,920	15,384	6,679	12,892	6,213
2024	37,780	17,711	3,400	21,111	37,780	16,669	7,613	13,624	6,011
2025	57,772	19,227		19,227	57,772	38,545	6,190	18,601	12,411
2026	67,970	20,402		20,402	67,970	47,568	5,865	19,540	13,675
2027	70,358	21,577	3,400	24,977	70,358	45,381	6,411	18,059	11,648
2028	93,316	23,092		23,092	93,316	70,224	5,292	21,386	16,094
2029	96,015	24,775		24,775	96,015	71,240	5,069	19,647	14,577
2030	98,797	26,458	3,400	29,858	98,797	68,939	5,455	18,050	12,595
2031	123,841	28,481		28,481	123,841	95,360	4,646	20,201	15,555
2032	127,398	30,164		30,164	127,398	97,234	4,393	18,555	14,162
2033	131,069	31,847	3,400	35,247	131,069	95,822	4,584	17,044	12,461
2034	154,462	32,187		32,187	154,462	122,274	3,737	17,934	14,197
2035	154,462	32,187		32,187	154,462	122,274	3,337	16,013	12,676
2036	154,462	32,187		32,187	154,462	122,274	2,979	14,297	11,318
2037	154,462	32,187		32,187	154,462	122,274	2,660	12,765	10,105
2038	154,462	32,187		32,187	154,462	122,274	2,375	11,397	9,022
2039	154,462	32,187		32,187	154,462	122,274	2,121	10,176	8,056
2040	154,462	32,187		32,187	154,462	122,274	1,893	9,086	7,193
2041	154,462	32,187		32,187	154,462	122,274	1,691	8,112	6,422
2042	154,462	32,187		32,187	154,462	122,274	1,509	7,243	5,734
2043	154,462	32,187		32,187	154,462	122,274	1,348	6,467	5,120
2044	154,462	32,187		32,187	154,462	122,274	1,203	5,774	4,571
2045	154,462	32,187		32,187	154,462	122,274	1,074	5,156	4,081
	2,910,850	744,385	23,800	768,185	2,910,850	2,142,664	160,819	391,089	230,269

B / C	2.4319
EIRR %	35.36
NPV (GHc)	230,269

## (6) Indirect Benefits

### 1) Increase in production and job creation

The term 3R, as defined stands for reduce, reuse and recycle, while the intermediate treatment system is composting and incineration. Accordingly, the resource recovery and recycling plan will be formulated in line with the policy of waste utilization in industry as a potential material resource in the future. It is highly expected that growth of industrial production and job creation will be accelerated in this proposed development area.

### 2) Avoidance of illegal dumping

The delay of a new disposal landfill may also encourage the illegal dumping of waste due to the inhabitants having no proper destination for its final disposal. Such improper dumping of waste, as already found in some areas, causes various negative impacts upon the living environment e.g. flood due to blockage of water flow by dumped waste, river pollution, aggravation of urban sanitation and damage to the

urban landscape. Table 16.7.5 shows the estimated amounts that will be collected in the “With” and “Without” cases in 2033 for indication. Development and operation of a new disposal site will prevent an increase in illegal dumping of waste.

**Table 16.7.5 Amount to be collected in the “With” and “Without” cases in 2033**

(Unit: Ton/day)

MMDAs	“With”	“Without”	Balance of unknown Waste
KMA	6,012	5,318	694
Afigya Kwabre	278	125	153
Kwabre East	259	161	98
Ejisu-Juaben	473	279	194
Bosomtwe	179	140	39
Atwima Kwanwoma	209	125	84
Atwima Nwabiagya	274	71	203
Total	7,685	5,843	1,842

Source: JICA Study Team

## 16.7.2 Financial Analysis

The proposed Sector Programme for the solid waste management sector shall involve an adequate amount of capital investment for the operation body. A financial analysis, therefore, has been undertaken to determine the financial viability of the proposed facilities. The following form some of the assumptions:

- A possible source of funding is not considered
- The current tariff structure and level have been analysed
- Operation profit to be implemented by the private sector is not considered
- Income from selling compost materials produced in the compost plant is not considered
- A detailed financial projection and analysis to examine the financial viability of the proposed programme has been conducted; the Financial Internal Rate of Return (FIRR) has been calculated.

### (1) Financial Costs

Financial costs of the Sector Programme are summarized in Table 16.7.6, consisting of: i) capital investment cost, ii) operation and maintenance cost (O&M) and iii) disposal cost. Facilities will be constructed every 3 years in the proposed Sector Programme. And O&M cost is assumed to be 10% of the investment cost every year.

**Table 16.7.6 Financial Costs for Capital**

	Year						
	2015	2018	2021	2024	2027	2030	2033
Capital Investment Cost (GHC Thousand)	4,000	4,000	4,000	4,000	4,000	4,000	4,000

Source: JICA Study Team

**(2) Financial Benefit**

The revenue from the increase in the number of users who are currently utilizing their own disposal facilities is also calculated as a financial benefit. The average tariff level of GHC 10/month per household in 2012 is applied as the unit treatment price and the number of households is shown in Table 16.7.7 based on the “Forecast of Future Population of MMDAs of Greater Kumasi Sub-Region.”

The average household size in Greater Kumasi Sub-Region was 5.1 persons in 2000 and 4.1 persons in 2010 while that of Greater Accra Region in 2010 is 3.8 persons, according to Population and Household Census 2000 and 2010 by Ghana Statistical Services. Future household size in Greater Kumasi Sub Region is assumed to decrease to 3.8 persons in 2033, at the same level as the current size of that of the Greater Accra Region.

**Table 16.7.7 Users of Proposed Treatment Facilities**

	Year				
	2013	2018	2023	2028	2033
Number of Households	752,139	904,202	1,085,406	1,307,583	1,516,174

Source: JICA Study Team

**(3) Result of Financial Analysis**

The cash flow projection based on the above assumptions is presented in Table 16.7.8. The computed Financial Internal Rate of Return (FIRR) for the sector programme is 27.16%. The capital investment is not very high for the proposed programme and this has contributed to the relatively reasonable FIRR.

However, revenue from households was assumed in accordance with the existing charge of house-to-house collection and communal collection so the study team adjusted the level to reflect the current collection situation.

**Table 16.7.8 Financial Flow of Solid Waste Management Sector Programmes**

Unit: GHc 1,000

Year	Revenue	Cost		Cost Total C	Revenue Total B	B-C	Dis. Cost (12%)	Dis. Benefit (12%)	Dis. B-Dis. C (12%)
		O & M	Investment						
2015	0	10,850	4,000	14,850	0	-14,850	14,850	0	-14,850
2016	6,726	11,980		11,980	6,726	-5,254	10,696	6,005	-4,691
2017	9,949	12,710		12,710	9,949	-2,760	10,132	7,932	-2,200
2018	10,302	13,440	4,000	17,440	10,302	-7,137	12,413	7,333	-5,080
2019	10,668	14,880		14,880	10,668	-4,212	9,456	6,780	-2,677
2020	22,093	15,920		15,920	22,093	6,172	9,034	12,536	3,502
2021	22,876	16,960	4,000	20,960	22,876	1,916	10,619	11,590	971
2022	23,688	18,401		18,401	23,688	5,287	8,324	10,715	2,392
2023	36,793	19,455		19,455	36,793	17,338	7,857	14,860	7,003
2024	38,098	20,837	4,000	24,837	38,098	13,261	8,956	13,739	4,782
2025	39,450	22,619		22,619	39,450	16,831	7,283	12,702	5,419
2026	54,467	24,002		24,002	54,467	30,465	6,900	15,658	8,758
2027	64,842	25,384	4,000	29,384	64,842	35,458	7,542	16,643	9,101
2028	83,930	27,167		27,167	83,930	56,763	6,226	19,234	13,009
2029	69,527	29,147		29,147	69,527	40,380	5,964	14,227	8,263
2030	88,724	31,127	4,000	35,127	88,724	53,597	6,418	16,210	9,792
2031	90,578	33,507		33,507	90,578	57,071	5,466	14,775	9,310
2032	92,472	35,487		35,487	92,472	56,985	5,169	13,468	8,300
2033	113,287	37,467	4,000	41,467	113,287	71,820	5,392	14,732	9,339
2034	115,657	37,867		37,867	115,657	77,790	4,397	13,429	9,032
2035	134,934	37,867		37,867	134,934	97,066	3,926	13,988	10,063
2036	134,934	37,867		37,867	134,934	97,066	3,505	12,489	8,984
2037	134,934	37,867		37,867	134,934	97,066	3,129	11,151	8,022
2038	134,934	37,867		37,867	134,934	97,066	2,794	9,956	7,162
2039	134,934	37,867		37,867	134,934	97,066	2,495	8,890	6,395
2040	134,934	37,867		37,867	134,934	97,066	2,227	7,937	5,710
2041	134,934	37,867		37,867	134,934	97,066	1,989	7,087	5,098
2042	134,934	37,867		37,867	134,934	97,066	1,776	6,328	4,552
2043	134,934	37,867		37,867	134,934	97,066	1,585	5,650	4,064
2044	134,934	37,867		37,867	134,934	97,066	1,416	5,044	3,629
2045	134,934	37,867		37,867	134,934	97,066	1,264	4,504	3,240
	2,478,397	875,748	28,000	903,748	2,478,397	1,574,650	189,199	335,591	146,391

B / C	1.7737
FIRR %	27.16
NPV (GHc)	146,391

## 16.8 IEE of Solid Waste Sector Programme

This Section of the chapter discusses the Initial Environmental Examination (IEE) for this Sector programme at an early level of planning regarding impacts caused by the implementation of the sector programme. Such assessment is drawn based on the results of the analysis of the existing conditions and on the initial screening process undertaken by the Project Team using the Environmental Impact Matrix. The detailed analyses of environmental impacts such as an Environmental Impact Assessment (EIA) will be conducted at the feasibility study phase. The conduct of an IEE study under the sector programme is done in the following manner:

### (1) Targets of the IEE Study

This Sector Programme consists of four components. The targets of the IEE study are shown in Table 16.8.1.

**Table 16.8.1 Targets of IEE Study for Solid Waste Management Sector Programmes**

- |   |
|---|
| <ul style="list-style-type: none"><li><input type="checkbox"/> Expansion of Oti Sanitary Landfill</li><li><input type="checkbox"/> Continuation of Kumasi Composting and Recycling Plant (KCRP) Project at Adagya</li><li><input type="checkbox"/> Enhancement of the SWM Unit of EHD, MMDAs especially MDAs</li><li><input type="checkbox"/> Construction of Final Sanitary Landfill Sites in MDAs</li></ul> |
|---|

**(2) Phasing of the IEE Study**

To study the IEE, programme components are divided into three phases, namely the Pre-Construction Phase, Construction Phase, and Operation and Maintenance Phase. The activities of each phase are as follows:

- **Pre-construction Phase:** which includes land acquisition, resettlement, mobilization of heavy equipment, transport of construction materials, construction of office buildings and labour camps, etc.
- **Construction Phase:** consisting of the setting up of equipment, demolition of the existing structures, implementation of construction works, generation of construction waste etc.
- **Operation and Maintenance Phase:** which includes the operation and maintenance of facilities, maintenance works, etc.

**(3) Result of the IEE Study**

In Ghana, there are 4 pillars in an environmental impact study as follows:

- Institutions
- Natural resources
- Socio-culture
- Economy

The environmental impacts on the above parameters are identified at the Pre-construction Phase, Construction Phase and Operation and Maintenance Phase using an Environmental Impact Matrix. The Environmental Impact Matrix shows the identified positive and negative environmental impacts caused by implementation of the programme. The Environmental Impact Matrix of the solid waste sector is shown in Table 16.8.2.

**Table 16.8.2 Environmental Impact Matrix for the IEE Study of Solid Waste Management Sector Programmes**

Environmental Parameters		Institution		Natural Resources													Socio-Culture										Economy										
Components	Phases	Existing policy	Legal basis	Topography/Geology	Soil	Ground subsidence	Air quality	Hydrology	Water quality	Groundwater	Noise/Vibration	Offensive odor	Terrestrial flora and fauna	Aquatic flora and fauna	Biodiversity	Terrestrial ecosystem	Aquatic ecosystem	Natural disaster	Climate change factors	Population	Land use	Water use	Landscape	Human health	Involuntary resettlement	Cultural heritage	Material assets	Transportation	Power supply	Water supply	Solid waste	Other infrastructure	Local economy				
		SW Sub-Programme 1: Expansion of Oti Sanitary Landfill	Pre-construction																																		
Construction				-1	-2		-1	-1	-1	-1	-1		-2		-2	-2																					
Operation & Maintenance							-2	-1	-2	-2		-2																									
SW Sub-Programme 2: Continuation of Kumasi Composting and Recycling Plant (KCRP) Project at Adagya	Pre-construction																																				
	Construction						-1						-1	-1	-1	-1																					
	Operation & Maintenance								-1	-1		-2																									
SW Sub-Programme 3: Enhancement of SWM Unit of EHD, MMDAs especially MDAs	Pre-construction																																				
	Construction			-1	-1		-1	-1	-1	-1	-1		-1	-1	-1	-1																					
	Operation & Maintenance								-1	-1		-1																									
SW Sub-Programme 4: Construction of Final Sanitary Landfill Sites in MDAs	Pre-construction																																				
	Construction			-1	-2		-1	-1	-1	-1	-1		-2	-2	-2	-2																					
	Operation & Maintenance						-2	-1	-2	-2		-2																									

+1: Negligible Positive Impact  
+2: Moderately Positive Impact  
+3: Significant Positive Impact  
-1: Negligible Negative Impact  
-2: Moderately Negative Impact  
-3: Significant Negative Impact  
+/-: Likely to have both positive and negative environmental impact  
?: Uncertain or unpredictable environmental effect

Source: JICA Study Team

## Chapter 17 Drainage Sector Plan and Programme

### 17.1 Objectives for Drainage Sector Development

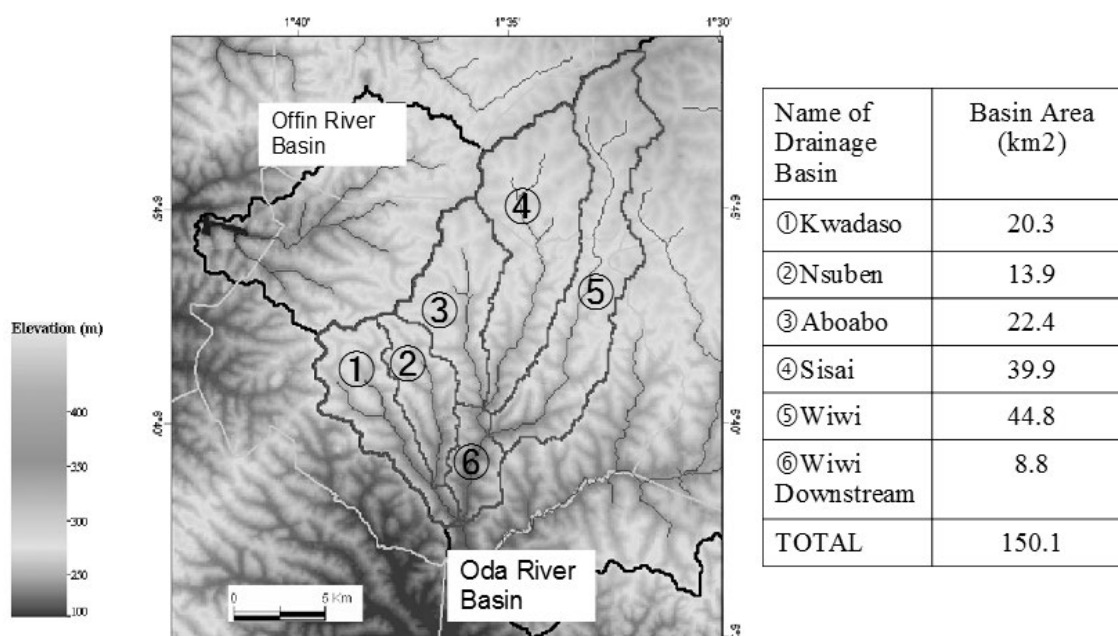
For development of the Drainage Sector in the Greater Kumasi Sub-Region, the following objectives are set:

- To limit sanitary nuisances and vector breeding
- To prevent rainwater stagnation and erosion
- To prevent serious flooding in downstream river sections

#### 1) To Limit Sanitary Nuisances and Vector Breeding

There are 5 main drainage basins in the Kumasi Metropolitan Area, namely Aboabo, Kwadaso, Nsuben, Sisai and Wiwi drainage basins, which generally run in a north to south direction.

The target for 2033, in order to limit sanitary nuisances and vector breeding, the lined drainage rate should be up to 40%, in other words Primary Drainage with a length of 60 km should be lined.



Source: JICA Study Team, The basin area was calculated based on GIS using SRTM3.

**Figure 17.1.1 Primary Area for Drainage Basins and Areas**

Maintenance is generally lacking in all basins resulting in overgrown weeds and a high degree of siltation along channel beds. Refuse dumping along drain banks is

common in all five basins, but most serious in the Aboado, Nsuben and the Sisai.

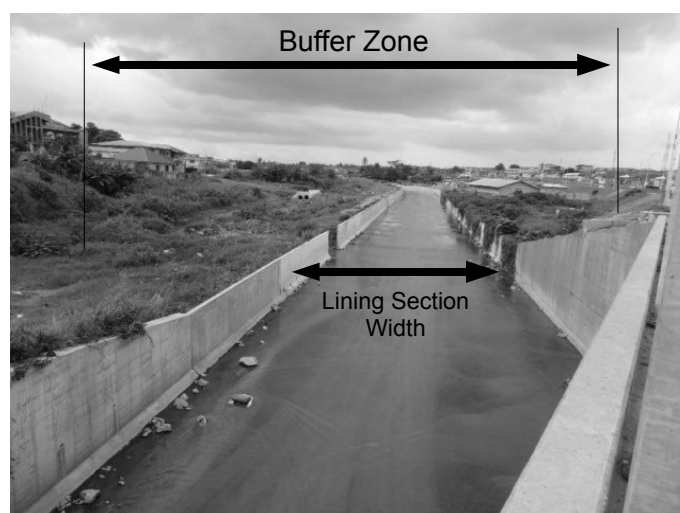
## 2) To Prevent Rainwater Stagnation and Erosion

As the target for 2033 responding to the expansion of the urban areas, the pavement of streets in not only business areas but also residential areas should be implemented.

Refuse eventually gets washed into the drains. The effect of refuse and siltation is even worse at culvert entrances where they sometimes get completely blocked. Utility lines crossing drains are sometimes laid within flood levels. These also tend to obstruct debris transport and impede flow. The net effect of these factors is flooding at critical locations.

## 3) To Prevent Serious Flooding in Downstream River Sections

As the paving of streets and the street drainage facilities progress, in order to prevent flooding in downstream river sections it will be necessary to implement lining works and enforce laws to ensure that the existence of Buffer Zones around the water bodies will be secured.



Source: JICA Study Team

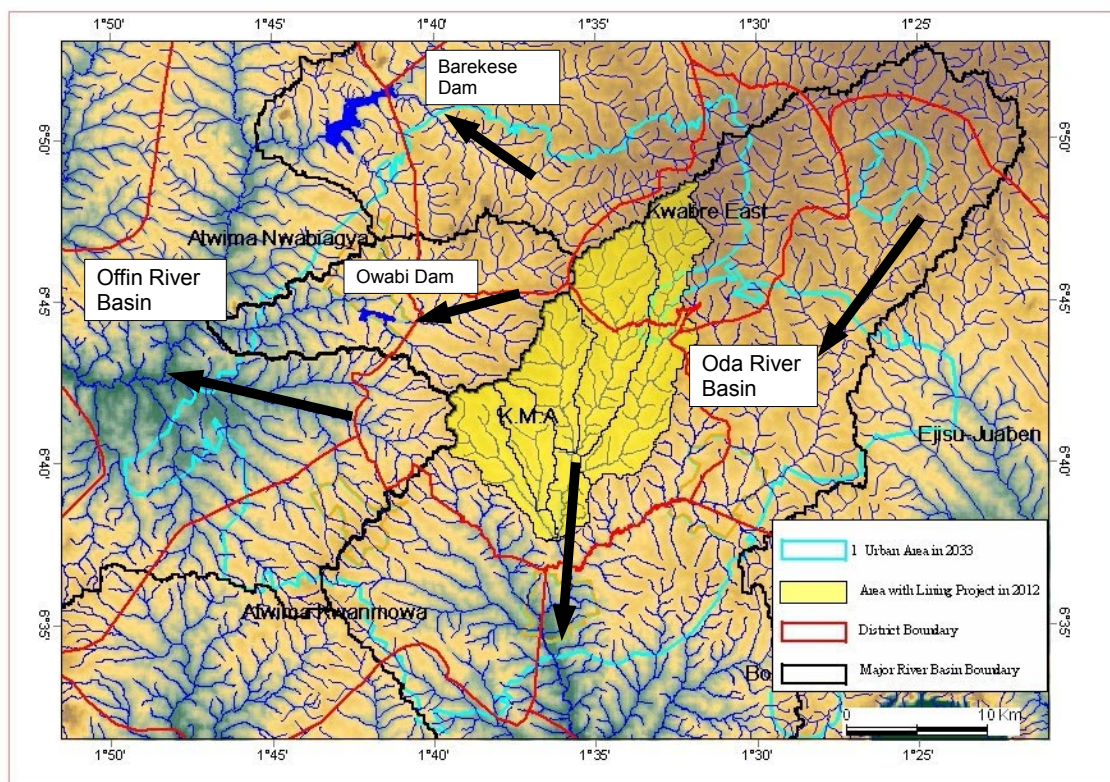
**Figure 17.1.2 Lining and Buffer Zone**

## 17.2 The Future of the Drainage Sector

KMA is located in the upper most part of the Pra River basin on the catchment divide between the Offin and Oda Rivers. In this topographical sense, the KMA is free from danger of prolonged flooding due to high water in the rivers.

But KMA and her surrounding Districts and Municipalities have few lined drains. Due to insufficient drains, erosion occurs and buildings might collapse if the erosion continues.

The limits of the future urbanized areas are shown in Figure 17.2.1 as a light blue line, and the area is 858 km<sup>2</sup>. It is clear that the rainwater runoff will discharge into the KMA's surroundings due to its topography.



Source: JICA Study Team

**Figure 17.2.1 Future Urban Extent and Major River Basin Boundaries**

Consequently, the new urbanized area should have proper drainage infrastructure as well as wastewater sewerage as soon as possible in order to assure an appropriate water-related environment.

Therefore, in terms of the drainage sector, Greater Kumasi Sub-Region, especially KMA, has to prepare for a huge amount of investment in the future.

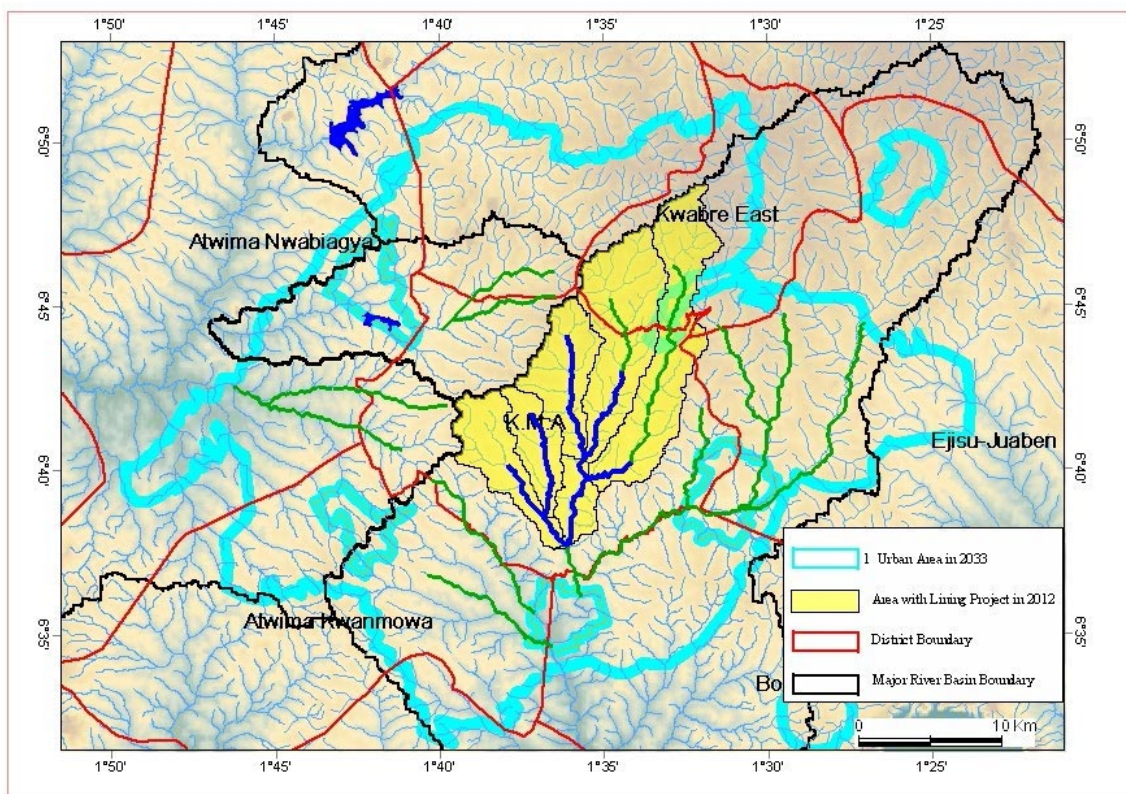
The preliminary cost for the future drainage work is estimated as follows,

**Table 17.2.1 Preliminary Cost Estimation for Future Drainage**

Typical Lengths of Drainage Channels in Residential Areas	Urbanized Area in 2033	Cost for 1 km of Drainage	Total Cost
20 km / km <sup>2</sup>	858 km <sup>2</sup>	20,000 GHC	343 million GHC

Source: JICA Study Team

Regarding the lining works, the extension of the lined sections is necessary according to the future urbanization in the Greater Kumasi Sub-Region. Candidate sections for future lining are shown in Figure 17.2.2. It should be certain that these lining sections must be decided based on further studies under the concept of comprehensive storm water management. The preliminary cost estimation for future lining work is shown in Table 17.2.2 just as a reference.



— Planned Lining Section by KMA     
 — Considerable Lining Section according to future urbanization

Source: JICA Study Team

**Figure 17.2.2 Candidate Lining Sections According to Future Urbanization**

**Table 17.2.2 Preliminary Cost Estimation for Future Lining Work**

Candidate Length of Lining Sections According to Future Urbanization	Cost for 1 km Drainage	Total Cost
200 km	4,000,000 GHC	800 million GHC

Source: JICA Study Team

The above cost for drainage and lining is 1,143 million GHC and this is about 57 million GHC annually. Considering the annual budget of KMA (97 million GHC in 2012), this investment is not realistic.

The actual implementation volume would be limited. The preliminary cost for the drainage sector is estimated tentatively.

### 17.3 Strategies for Drainage Sector Programme

#### (1) Adequate Drainage Maintenance

In order to limit sanitary nuisances and vector breeding, drainage management should be integrated and continuous improvement of the drainage systems should be conducted and a Drain Maintenance Unit (DMU) should be established.

From another aspect, assemblies are making efforts to provide containers for solid

waste in the communities so that people will not dump rubbish into the drains. It is also essential to educate people for not littering by presenting educational campaigns.

**(2) Continuous Lining of Drainage and Erosion Control**

Lining of the remaining sections of the drainage channels that have already been proposed by KMA should be continuously conducted by KMA (DMU) to limit sanitary nuisances, vector breeding, and the physical hazards of flooding and to reduce the future maintenance cost.

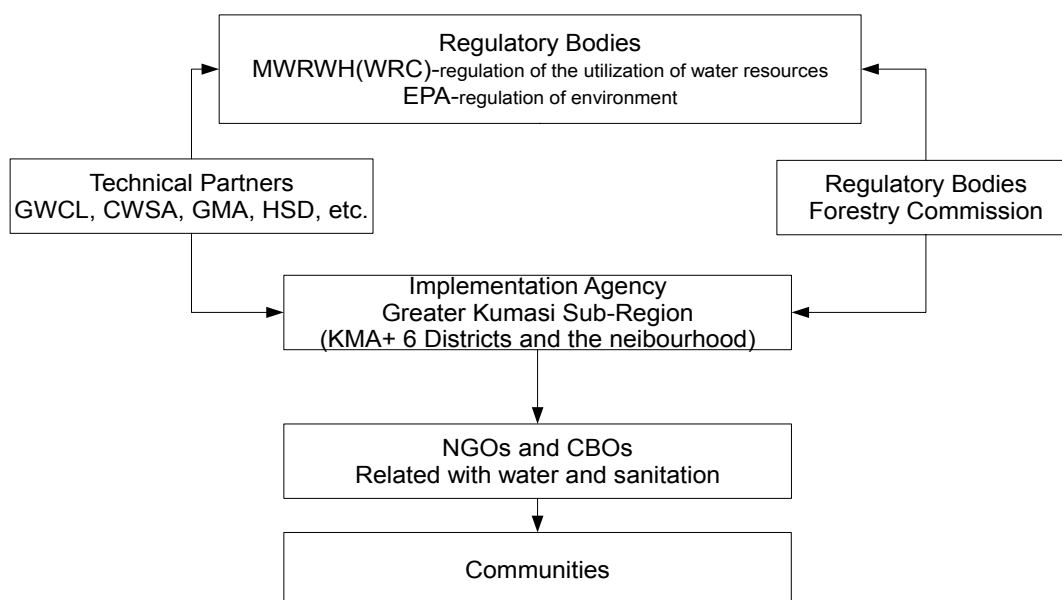
**(3) Prevent Flooding in Downstream River Sections**

The lined river sections in the Oda River catchment could basically accept the flood flow from upstream urban areas. As the expansion of the current urban area progresses, comprehensive storm water management planning should be conducted by KMA with coordination by the Water Resources Commission.

The comprehensive storm water management shall include the following,

- Introduction of an integrated watershed management concept coordinated by WRC.
- Basin-wide flood control based on hydrological analysis
- Rainwater storage in urban areas
- Lining and applying a Buffer Zone Policy for Managing River Basins in Ghana

The institutional framework for comprehensive storm water management for Greater Kumasi Sub-Region is shown in Figure 17.3.1.



Source: JICA Study Team

**Figure 17.3.1 Institutional Framework for Comprehensive Storm Water Management in Greater Kumasi Sub-Region**

## 17.4 Drainage Sector Programme

### (1) Outline of Programmes for the Drainage Sector

There are 3 sub-programmes for the drainage sector for the Greater Kumasi Sub-Region.

- Sub-Programme 1: Adequate drainage maintenance
- Sub-Programme 2: Continuous lining of drainage systems and erosion control
- Sub-Programme 3: Prevention of flooding in downstream river sections

The detailed plans of each project are as follows:

- a) Sub-Programme 1: Adequate drainage maintenance
  - Prevent solid waste from being dumped into the drainage
  - To integrate drainage management
- b) Sub-Programme 2: Continuous lining of drainage systems and erosion control
  - Acceleration of drainage lining work for primary drains
  - Paving of streets in residential areas
- c) Sub-Programme 3: Prevention of flooding in downstream river sections
  - Formulate plan preventing flooding
  - Enforce laws to ensure Buffer Zones

### (2) Sub-Programme for Adequate Drainage Maintenance

#### 1) Prevent Solid Waste from being Dumped into the Drainage

Assemblies are making efforts to provide containers for solid waste in the communities so that people will not dump rubbish into the drains, and educate people for not littering. Moreover, assemblies are making efforts to implement some projects in the solid waste management sector programmes.

#### 2) Integrate Drainage Management

In order to aid in the establishment of the Drain Maintenance Unit (DMU), KMA has conducted a drainage inventory survey and prepared a maintenance program. Therefore, KMA should establish and run the DMU, and integrate drainage management.

The drainage maintenance includes the following:

- Dredging the main, the secondary and the tertiary drains (weed clearing, refuse removal, drain dredging and desilting)
- The dredged/desilted material should be carried away from the drain banks.
- Culvert outfalls should also be protected against scouring and erosion using rip-rap for example.

**(3) Sub-Programme for Continuous Lining of Drainage systems and Erosion Control**

**1) Acceleration of Drainage Lining Work for Primary Drains**

There are 5 main drainage basins in Kumasi Metropolitan Area, namely Aboabo, Kwadaso, Nsuben, Sisai and Wiwi drainage basins, which generally run in a north to south direction. Each basin is drained by a number of tributaries categorized into primary, secondary and tertiary drains as shown in the table below.

**Table 17.4.1 Lengths (in meters) of Drains in KMA, as of October 2012**

Drain	Primary	Secondary	Tertiary	Total	Lined* <sup>1</sup>	Unlined* <sup>2</sup>
Aboabo	11,299	15,608	1,969	28,876	9,999	18,877
Kwadaso	13,746	11,419	2,000	27,165	0	27,165
Nsuben	8,060	8,653	2,020	18,733	6,670	12,063
Sisai	15,532	20,174	805	36,511	7,166	29,345
Wiwi	11,461	15,897	3,300	30,658	0	30,658
Total	60,098	71,751	10,094	141,943	23,835	118,108
Percentage	42.3%	50.5%	7.1%	100.0%	16.8%	83.2%

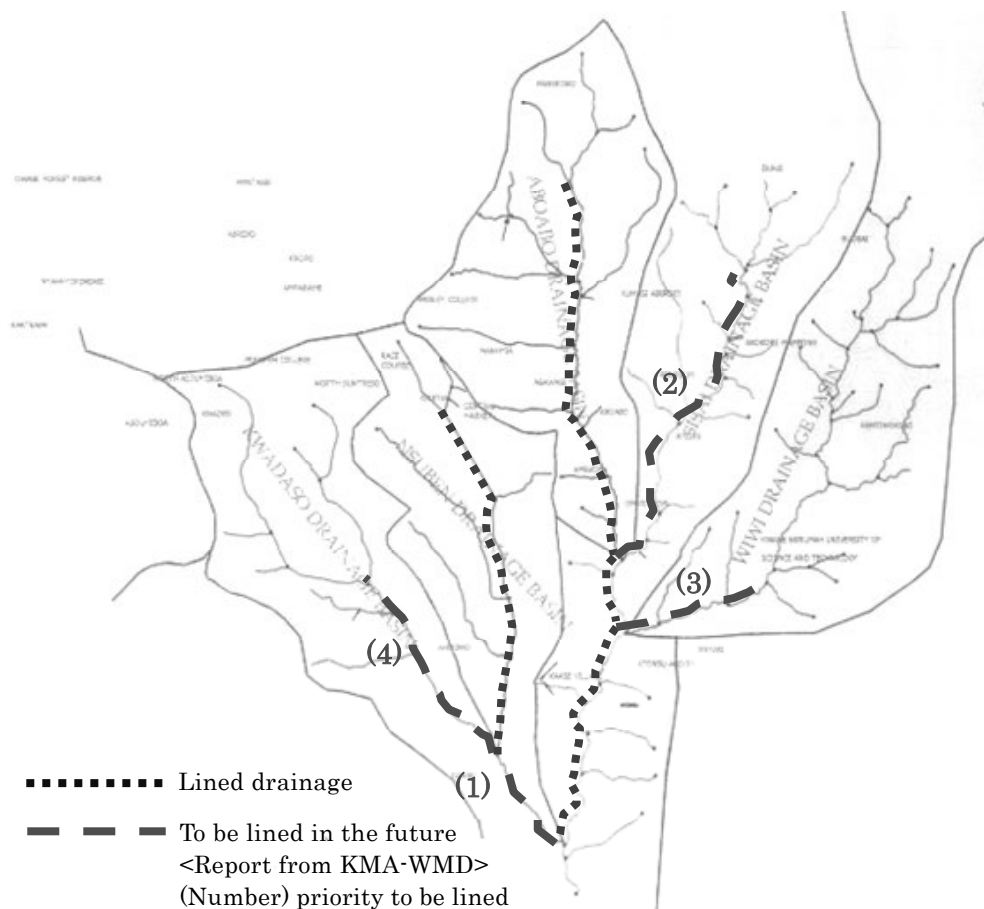
Source 1: <Definition of Drainage> KMA (2007), Preparation of a storm water drain maintenance programme - Drainage Inventory Report, Volume I - Main Report

Source 2: Lined/Unlined lengths are calculated based on Figure 17.4.1

Note\*1: drain that is open or covered which is concreted / piped

Note\*2: drain that has been created by runoff water or sludge from nearby homes and follows the natural low points of the topography of the area

It is recommended that KMA (DMU) conducts lining works for primary drainage based on Figure 17.4.1.



Source 1: <Drainage Network > KMA (2007), Preparation of a storm water drain maintenance programme - Drainage Inventory Report, Volume I - Main Report

Source 2: <Lined / Urgent to be lined sections > report from director of KMA-WMD

**Figure 17.4.1 Drainage Network in KMA**

## 2) Pavement of Streets in Residential Areas

Erosion is also a serious issue in KMA. Erosion has degraded some settlements leaving many building hanging. This is mainly due to inadequate drainage systems.

In order to prevent erosion, the paving of residential roads and construction of small roadside drains are necessary.

Therefore, the paving and construction of roadside drains should be conducted gradually, according to the development of the city.

As described in section 16.2, the subject area should be prioritized in a practical sense. Here, tentatively, it is proposed that drains in an additional 150 km<sup>2</sup> should be implemented. The preliminary cost for the drainage is as follows.

**Table 17.4.2 Preliminary Cost Estimation for Future Drainage**

Typical Length of Drainage Channel in Residential Area	Subject Area by 2033	Cost for 1 km of Drain	Total Cost
20 km / km <sup>2</sup>	150 km <sup>2</sup>	20,000 GHC	60 million GHC

Source: JICA Study Team

#### **(4) Sub-Programme for Prevention of Flooding in Downstream River Sections**

##### **1) Formulation of a Flooding Prevention Plan**

In the future, surface penetration of rainwater will be reduced by urbanization. As a result, the amount of storm water runoff will be increased. Then the risk of flooding will increase.

It is also necessary to enter into discussions in terms of effective use of rainwater such as rainwater harvesting.

Based on the above, it is necessary to formulate a plan for preventing flooding including effective use of stored storm water.

##### **2) Enforcement of Laws to Ensure Buffer Zones**

Assemblies are making efforts to enforce laws to ensure the Buffer Zones around the water bodies will be secured.

Take measures to prevent houses from being built in the drains

The land to be secured from the water bodies shall include a buffer in accordance with relevant policies/laws such as the “Buffer Zone Policy for Managing River Basins in Ghana”.

The necessary actions are as follows:

- Protect, restore and maintain riparian buffers and flood plains as natural and long term defences against the harmful effects of floods
- Enforce zones of no development around streams and water bodies by the removal, demolition and the prohibition of unauthorised structures and incompatible land use practices on flood plans, fringes and corridors
- Manage runoff as close to the source as possible by trapping rain water or by directing runoff to natural infrastructure such as gardens, and green parks
- Promote the development/establishment of green spaces with native grass along waterways and protect them from future development and environmental damage by prohibiting the removal of soil, trees and other natural features except for purposes of conservation, research, recreation or uses accessory to permitted uses
- Encourage approved edge gardening and flood recession farming only for the purposes of mitigating erosion and water pollution and for sustenance of livelihoods
- Encourage a sense of municipal and community ownership of green spaces and provide local communities access to green space facilities (recreational parks, walkways etc.) at all times
- Ensure that economically important trees such as bamboo and fruit trees (e.g., mango, coconut, palm nut, pawpaw and rubber) are planted along and within the buffer for the benefit of local communities

In order to implement the buffer zone policy it is necessary to formulate a plan to prevent flooding, including effective use of the stored storm water, under the coordination of a regulatory body such as WRC. In the course of discussion of the

flood control plan, the future lining sections can be prioritized.

## 17.5 Implementation Plan for the Drainage Sector Programme

The JICA Study Team will prepare an implementation plan for the Drainage Sector Programme.

The goals of the Sector Programme for the drainage sector of the project are outlined in Table 17.5.1 with prospective target levels to be achieved by the year 2018 for the Short-Term Plan, year 2028 for the Mid-Term Plan and year 2033 for the Long-Term Plan.

**Table 17.5.1 Project Outline for Drainage Sector Programme**

	Short-Term Plan						Mid-Term Plan						Long-Term Plan								
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Sub-Programme 1: Adequate drainage maintenance																					
a) Prevent solid waste from being dumped into the drainage	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
b) Integrate drainage management	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sub-Programme 2: Continuous lining of drainage and erosion control																					
a) Acceleration of drainage lining work for primary drains	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
b) Paving of streets in residential areas	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Sub-Programme 3: Prevent flooding in downstream river sections																					
a) Formulate plan for preventing flooding																					
b) Enforce laws to ensure Buffer Zones	●	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Source: JICA Study Team

## 17.6 Cost of Sector Programme

Preliminary cost estimation for the program is as follows.

**Table 17.6.1 Preliminary Cost for Drainage Sector Programme**

(Unit: Million GHC)

	Short term	Mid term	Long term	Total
Sub-Programme 1: Adequate drainage maintenance				
Sub-Programme 2: Continuous lining of drainage and erosion control	20	20	20	60
Sub-Programme 3: Prevent flooding in downstream river sections				

Source: JICA Study Team

## Chapter 18 Electricity Sector Plan and Programme

### 18.1 Objective for Electricity Sector Development

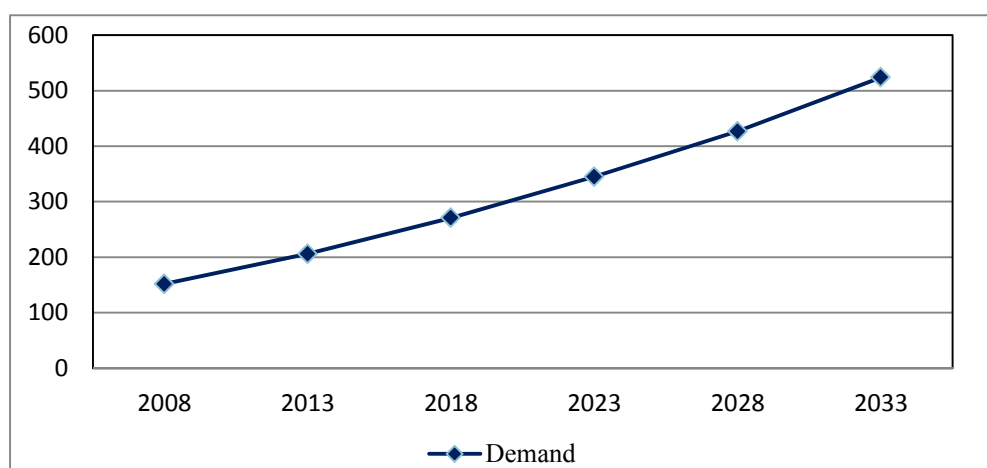
The objective of the Electrical Sector is “Stable and Reliable Power Supply” to the consumers. And especially industrial developing areas require “Stable and Reliable Power Supply” for their competitive operation.

### 18.2 Future Demand Analysis

In 2033, the maximum demand of Kumasi Sub-Regions is forecast to reach 528MVA, while total generation capacity of Ghana is expected to be about 4200MW by 2021 according to Ministry of Energy. Therefore, generation capacity in Ghana will be able to cover the demand of Ghana for the mean time.

#### (1) Future Maximum Demand Forecast

The following chart shows forecast maximum demand based on the record of the past 9 years maximum demand for electricity and the growth of population and GDB, and forecast growth of population and GDP.



Source: JICA Study Team

Unit: MVA

**Figure 18.2.1 Forecast Future Maximum Demand for Electricity**

**Table 18.2.1 Past 9 Years Data on Electricity**

Year	Unit	2003	2004	2005	2006	2007	2008	2009	2010	2011
Past 9 years Max Demand	MVA	110	103	120	142	130	152	157	178	175
Population	Thousand	2,014	2,107	2,204	2,307	2,413	2,525	2,642	2,764	2,885
GDP	Million GHC	329,510	347,020	367,920	390,440	415,660	450,710	468,700	504,870	573,560

Source: ECG and JICA Study Team

**Table 18.2.2 Forecast Future Maximum Demand**

Year	Unit	2008	2013	2018	2023	2028	2033
Future Max. demand -1	MVA	152	206	271	345	427	524
Future population	Thousand	2,525	3,127	3,749	4393	5,050	5,761
Future GDP	Million GHC	450,710	623,990	848,770	121399	177,147	286,216

Source: JICA Study Team

A regression analysis was used for forecasting the above Future Max Demand for Electricity. The future population and GDP shown in the above table are forecast in another chapter.

In almost all countries, the growth of electrical demand is linked with the growth of population and GDP, therefore the electrical future demand is forecast based on the growth of population and GDP.

The following formula is used:

$$D_i = K \times GDP_i^e \times P_i^p$$

$D_i$  : Maximum Demand for Electricity

$K$ : Constant Term

$GDP_i$ : Gross Domestic Product

$P_i$ : Population

$e$ : Value of elasticity related to GDP

$p$ : Value of elasticity related to Population

## (2) Spot Demand

According to the Future Land Use Plan, many areas in Greater Kumasi Sub-Regions will be developed as industrial areas, urban and city centers, especially the industrial area is estimated to have a high demand, therefore spot demand will be considered in addition to the above forecast demand.

**Table 18.2.3 Spot Demand for Electricity**

Unit: MVA

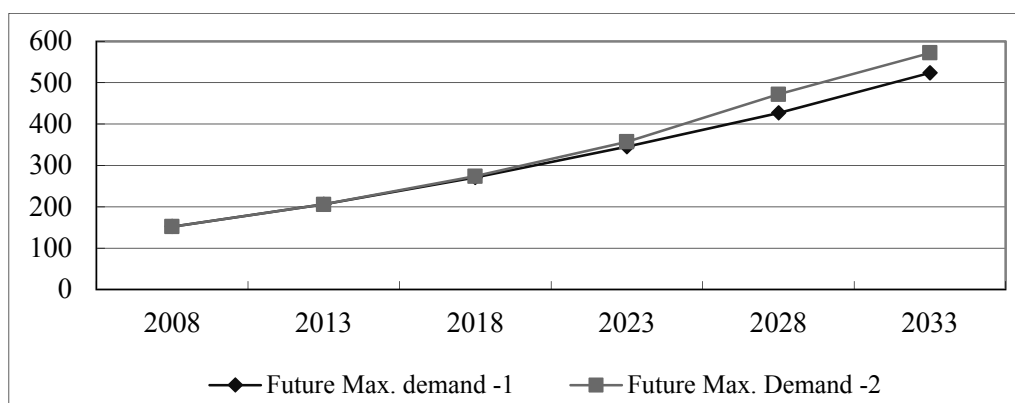
Year	2008	2013	2018	2023	2028	2033
Future Max. Demand -1	152	206	271	345	427	524
Spot Demand	0	0	3	12	45	49
Future Max. Demand -2	152	206	274	357	472	573

Source: JICA Study Team

## (3) Future Demand of Greater Kumasi Sub-Regions

The following graph shows the relationship between future demand-1 and demand-2 of Greater Kumasi Sub-Region. The value of Future Max. Demand-2 (MVA) is

adjusted based on the spot demand shown in (2) above.



Source: JICA Study Team

Unit: MVA

**Figure 18.2.2 Relationship between Future Max. Demand-1 and -2**

### 18.3 Strategies for Electricity Sector Development

#### (1) Power Generation Capacity

As mentioned in 9.7.1 (1) Power Generation Capacity in Ghana, if planned power stations will be constructed on schedule, the power generation capacity is deemed enough for the mean time.

#### (2) 161kV Transmission Line and Bulk Supply Point (BSP)

Two 161kV Transmission Lines are connected to a BSP and the expected capacity of transformer will cover the forecast maximum demand of Greater Kumasi Sub-Regions. Further expansion of the BSP would not be required in the near future.

#### (3) Stable and Reliable Power Supply

Enhancement of the quality of power supply and Improvement of Sub-transmission and low voltage distribution systems for stable and reliable power supply.

##### 1) Improve and Modernize Sub-transmission and Low Voltage Distribution Systems

Small size overhead wires should be replaced by proper size, then technical loss will be decreased.

The clearance between the overhead wires and obstacles such as trees should be monitored and if the clearance is less than ECG standard, actions such as tree trimming/replacing overhead poles should be carried out in a focused and planned manner. By this measure, distribution trouble such as short-circuits and earth faults should be decreased.

Power factor on low voltage distribution system is also one of the major factors that reduces the current in low voltage distribution lines. ECG should manage and instruct consumers such as commercial and office buildings to provide power factor correction devices.

## **2) Replacement of Deteriorated Equipment**

Deteriorated equipment such as insulators, overhead wires and cables should be replaced with new ones.

## **3) Electrification in Rural Areas**

As per the “Energy Sector Strategy and Development Plan” (by the Ministry of Energy, 2010) and the National Energy Policy (by the Ministry of Energy, 2010), the rating of access to electricity for communities with more than 500 population is to increase to 80% by 2015 and to 100% by 2020.

## **4) Expansion of Sub-transmission and Distribution Systems**

Sub-transmission/distribution systems will be expanded for supplying stable and reliable power to the areas that are shown in the Future Land Use Plan.

In the beginning, expansion of Sub-transmission/distribution lines will be proposed according to the above Future Land Use Plan and transformers will be installed based on the demands of the consumers.

## **(4) Management of ECG**

To reduce the commercial losses, the following measures will be proposed:

- Reduce the number of consumers that are in arrears by providing pre-paid meters, according to ECG, currently 20% of residential consumers are provided with pre-paid meters.
- Strict control of consumers involved in illegal connections
- Instruct non residential consumers such as commercial/office buildings to provide power factor correction devices.

## **18.4 Electricity Sector Plan**

### **(1) Enhancement and Improvement of Sub-transmission and Distribution Systems**

To achieve stable and reliable power supply, enhancement and improvement of Sub-transmission and Distribution Systems needs to be taken care of first. Therefore, the following sector plans are considered:

- Replacement of small size wires of sub-transmission and distribution systems
- Replacement of deteriorated equipment

### **(2) Electrification in Rural Areas**

The target for electrification in rural areas is to increase access rating to electricity for communities with more than 500 population to 80% by 2015 and to 100% by 2020.

### (3) Expansion of 33kV Sub-Transmission and Distribution Systems

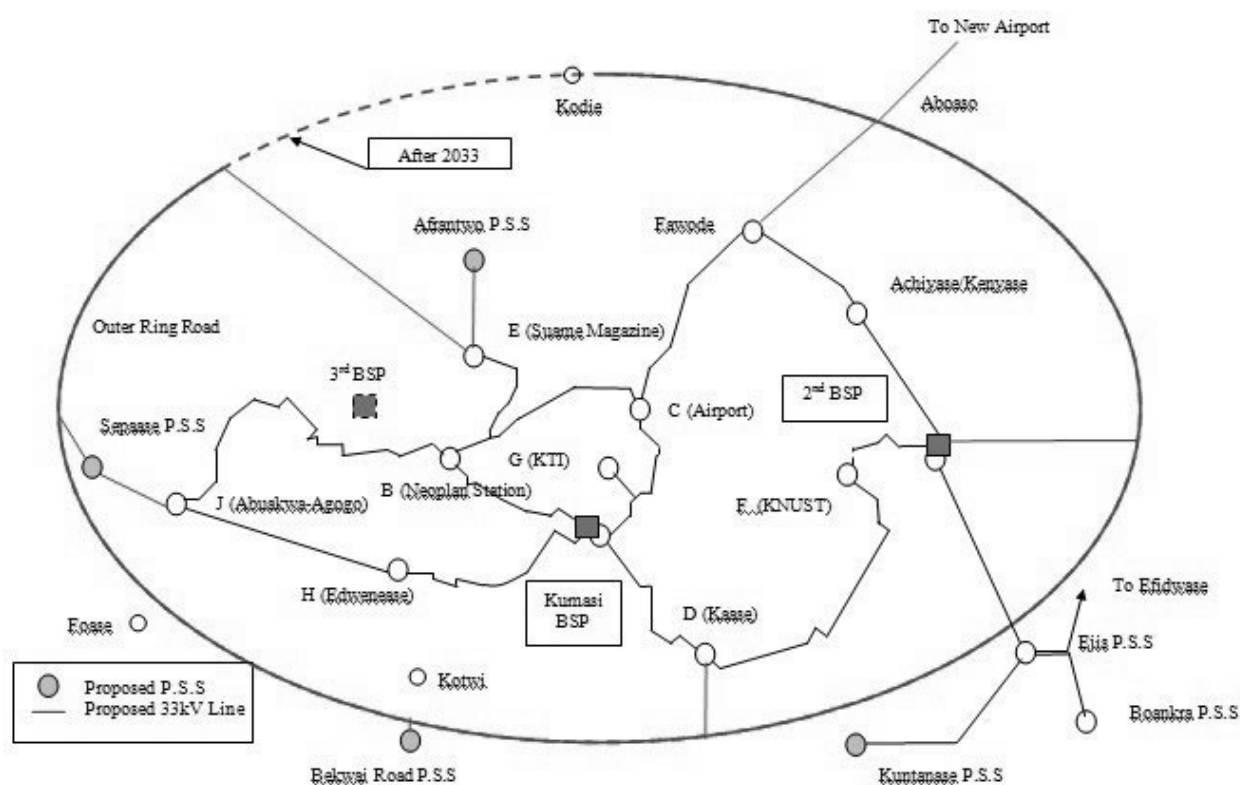
Sub-transmission and distribution lines are to be expanded based on the electrical demand shown in the Future Land Use Plan.

### (4) Future Sub-Transmission System

Expanding the 33kV sub-transmission system based on the demand in the above Future Land Use Plan is deemed to create a more reliable system compared to the current 33kV Sub-transmission system.

Since the 33kV sub-transmission system is a key system of electrical power supply, a 33kV ring main system will be planned. The ring main system will result in increased distribution capacity and supply reliability to the consumers.

Future Sub-Transmission systems including the ring main system are shown in Figure 18.4.1.



Source : JICA Study Team

**Figure 18.4.1 Future 33kV Sub-Transmission and Ring Main Systems**

## 18.5 Electricity Sector Programme

### (1) Modernization of Sub-Transmission and Low Voltage Distribution Systems

To improve and modernize sub-transmission and low voltage distribution systems, the following programme will be offered during the period of 2013 to 2017:

- Replace small size overhead wires with proper size wires

- Realignment of distribution lines to meet the ECG standard by tree trimming/replacing overhead poles
- Replacement of deteriorated equipment
- Deteriorated equipment such as overhead wires, insulators and cables should be replaced with new ones.
- Installation of new Sub-transmission lines based on forecast demand.
- In the year of 2017, the maximum demand of Great Kumasi Sub-Region will reach 270MVA. To prevent over current and considering redundancy of 33kV Sub-transmission line, the following additional 33kV sub-transmission lines will be proposed:
  - a) A to KTI, Installation of 670sq. mm AL/XLPE 1- Line
  - b) A to C, Installation of 240sq.mm AL/XLPE 1- Line
  - c) A to B, Installation of 240sq.mm AL/XLPE 1- Line
  - d) B to E, Installation of 240sq.mm AL/XLPE 1- Line
  - e) A to D, Installation of 400 AL Bare 1- Line

The above additional 33kV lines were proposed in the “Power Distribution System Master Plan Study for Ghana, 2008” prepared by JICA technical assistance.

## **(2) Electrification in Rural Areas**

Installation of the 11kV distribution overhead lines and transformers for currently non electrified communities in Rural Areas to increase access to electricity to 80% by 2015 will be undertaken.

## **(3) Expansion of Sub-transmission and Distribution Systems**

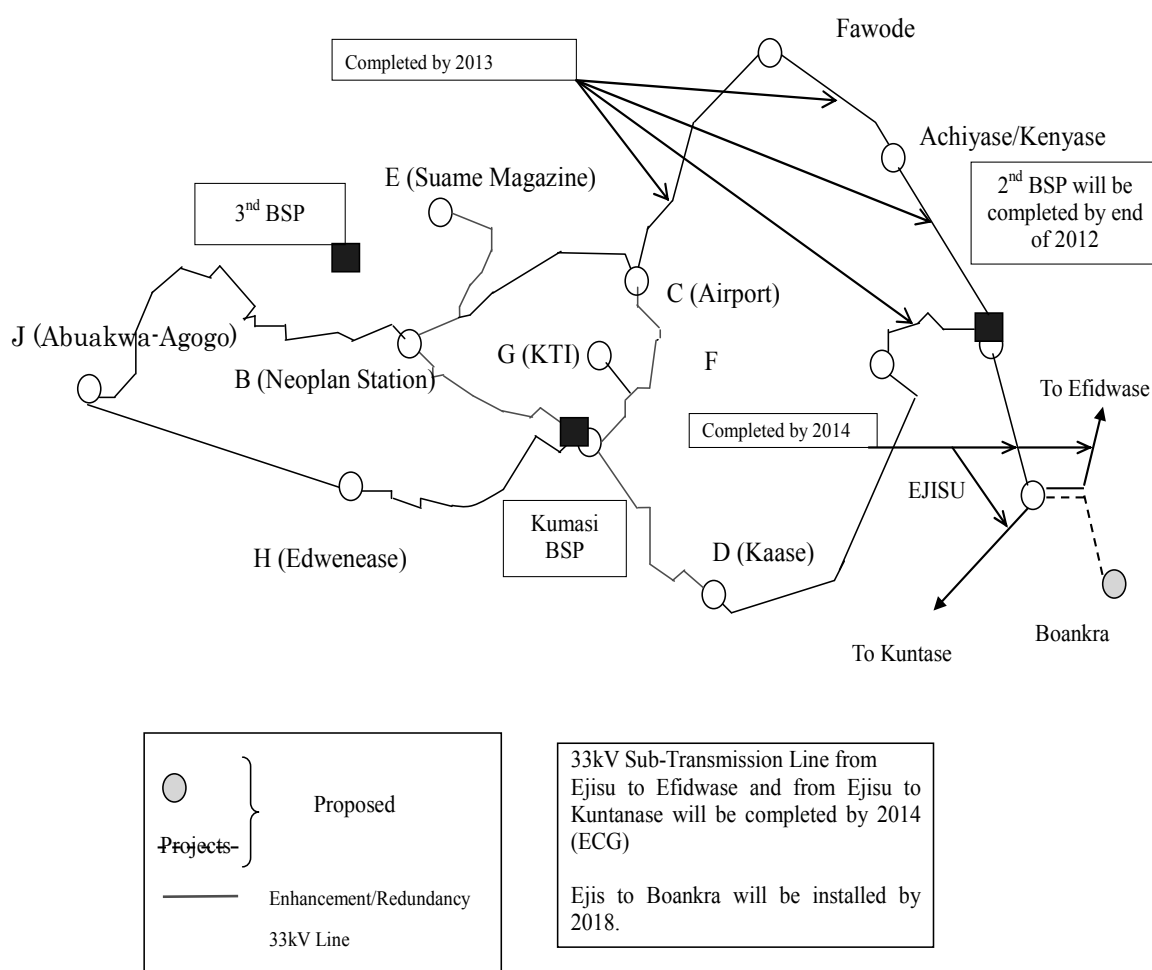
Sub-transmission/distribution systems will be expanded to supply stable and reliable power to the areas shown in the Future Land Use Plan.

The following projects are proposed for the Sector Programme:

### From 2013 to 2018

- Installation of 11kV underground distribution lines in KNUST campus area for future demand. Primary cables will be connected to 2nd BSP
- Currently the 33kV Sub-transmission line from 2nd BSP to Ejisu and 33kV switching station in Ejisu are under construction and will be completed by 2014.
- Therefore, installation of a 33kV Sub-transmission line from the above switching station in Ejisu to Boankra (length : 9km) and a 33/11kV sub-station at Boankra (capacity : 10MW-2 unit) will be proposed.
- Installation of distribution lines and transformers for non electrified communities in Rural Areas

Conceptual diagram of 33kV Sub-transmission system in the year 2018 is shown below:



Source: JICA Study Team

**Figure 18.5.1 Conceptual Diagram of 33kV Sub-transmission Line in the Year 2018**

From 2018 to 2023

- The area along Ejisu to Kuntanase road will be developed for industry. Currently ECG is installing a 33kV switching station in Ejisu and 33kV Sub-transmission lines to Kuntanase are under construction, and this project will be completed by 2014.

Therefore, installation of a 33/11kV substation in Kuntanase is proposed.

- Installation of 11kV/433V transformers (500kVA- 2) in Kodie and connect existing 11kV distribution line
- Installation of 11kV/433V transformers (500kVA- 2) at Kumasi-Manpong Road.
- Installation of 11kV/433V transformers (500kVA- 2) at Ejisu City Centre
- Installation of distribution lines and transformers for non electrified communities in Rural Areas

From 2023 to 2028

- Installation of P.S.S in Afrantwo (industrial area) and 33kV Sub-transmission from E (Suame Magazine) to the above P.S.S.

- Installation of P.S.S in Kotwi (along New Bekwai Road) and 33kV Sub-transmission line from the above P.S.S. to new 33kV Sub-transmission line along the ring road.
- Installation of P.S.S. in Sepaase (industrial area) and 33kV Sub-transmission line from J (Abuakwa-Agogo) to the above P.S.S. and the P.S.S. in Sepaase to a new 33kV Sub-transmission line along the ring road.
- Installation of 33kV Sub-transmission line along the outer ring road between Ejisu and Kodie
- Installation of 11kV/433V transformers (500kVA-1) at Ahwiaa, Fumesua, Aputuogya, Kotwi, and Foase for future demand as Suburban Centres
- Installation of 11kV/433V transformers (100kVA -10) for future Atwima New Town

#### 2028 to 2033

- Installation of 33kV Sub-transmission line along the outer ring road between Kotowi, Foase and Sepaase
- Installation of 33kV Sub-transmission line along the outer ring road (between Ejisu, Aputuogya and Kotwi)
- Installation of 33kV Sub-transmission line between the Sub-Transmission line along the outer ring road (near by Aboaso) to New Airport for the future logistic center
- Installation of 33kV Sub-transmission line for redundancy between 33kV Sub-transmission line along the outer ring road and the following substations:
  - a) E (Suame Magazine)
  - b) D (Kaase)
  - c) 2nd BSP
  - d) Fawode

#### **(4) Management of ECG**

To reduce the commercial losses, the following measures is proposed:

- Reduce the number of consumer that are in arrears by providing pre-paid meter
- Strict control of consumers involved in illegal connections

## **18.6 Cost of Electricity Sector Programme**

Preliminary Electricity Sector Programme cost is shown below:

**Table 18.6.1 Cost of Electricity Sector Programme**

Phase	Sector Programme	Cost (US\$ 1,000)
2013 to 2018	Replace small size overhead wires with proper size wires Realignment of distribution lines to meet the ECG standard by tree trimming/replacing overhead poles Replacement of deteriorated equipment <ul style="list-style-type: none"> <li>• Deteriorated equipment such as overhead wires, insulators and cables should be replaced with new ones.</li> </ul>	23,365

Phase	Sector Programme	Cost (US\$ 1,000)
	<p>Installation of new Sub-transmission lines</p> <ul style="list-style-type: none"> <li>• A to KTI, 1- Line</li> <li>• A to C, 1- Line</li> <li>• A to B, 1- Line</li> <li>• B to E, 1- Line</li> <li>• A to D, 1- Line</li> </ul> <p>Installation of 11kV underground distribution system in KNUST campus area for future demand. Primary cables will be connected to 2nd BSP</p> <p>Installation of 33kV Sub-transmission line from the Ejisu switching station to Boankra and 33/11kV sub-station at Boankra</p> <p>Installation of distribution lines and transformers for non electrified communities in Rural Areas (Target:80% electrification of communities with more than 500 population)</p>	
2018 to 2023	<p>Installation of 33/11kV substation in Kuntanase</p> <p>Installation of 11kV/433V transformers (500kVA- 2) in Kodie and connect existing 11kV distribution line</p> <p>Installation of 11kV/433V transformers (500kVA- 2) at Kumasi-Manpong Road.</p> <p>Installation of 11kV/433V transformers (500kVA- 2) at Ejisu City Centre</p> <p>Installation of distribution lines and transformers for non electrified communities in Rural Areas (Target:100% electrification of communities with more than 500 population)</p>	14,381
2023 to 2028	<p>Installation of P.S.S in Afrantwo (industrial area) and 33kV Sub-transmission line from E (Suame Magazine) to the above P.S.S.</p> <p>Installation of P.S.S in Kotwi (along New Bekwai Road) and 33kV Sub-transmission line from the above P.S.S. to new 33kV Sub-transmission line along the ring road.</p> <p>Installation of P.S.S. in Sepaase (industrial area) and 33kV Sub-transmission line from J (Abuakwa-Agogo) to the above P.S.S. and the P.S.S. in Sepaase to new 33kV Sub-transmission line along the ring road.</p> <p>Installation of 33kV Sub-transmission line along the outer ring road between Ejisu and Kodie</p> <p>Installation of 11kV/433V transformers (500kVA-1) at Ahwiaa, Fumesua, Aputuogya, Kotwi, and Foase for future demand as Suburban Centres</p> <p>Installation of 11kV/433V transformers (100kVA -10) for future Atwima New Town</p>	6,512
2028 to 2033	<p>Installation of 33kV Sub-transmission line along the outer ring road between Kotwi, Foase and Sepaase</p> <p>Installation of 33kV Sub-transmission line along the outer ring road between Ejisu, Aputuogya and Kotwi)</p> <p>Installation of 33kV Sub-transmission line between the Sub-Transmission line along the outer ring road (near Aboaso) to New Airport for the future logistic center</p> <p>Installation of 33kV Sub-transmission line for redundancy between 33kV Sub-transmission line along the outer ring road and the following substations:</p> <ul style="list-style-type: none"> <li>• E (Suame Magazine)</li> <li>• D (Kaase)</li> <li>• 2nd BSP</li> <li>• Fawode</li> </ul>	2,840
	Total	47,098

Source: JICA Study Team

Note: Most unit prices of electrical equipment were quoted from the cost shown in the “Power Distribution System Master Plan Study for Ghana”, Sep. 2008, JICA

## **18.7 Preliminary Economic and Financial Analysis**

### **18.7.1 Economic Analysis**

#### **(1) Methodology**

The economic analysis including the determination of EIRR is based on streams of benefits and costs resulting from the construction, installation and operation of the Sector Programme components. For those components where the benefits are not easily quantifiable, the benefits have been presented in qualitative terms employing usual practice. However, the JICA Study Team estimated the quantifiable economic benefits by equating the increase in economic benefits in monetary terms using the willingness to pay analysis and estimating the non-supply cost of power in this sector. The following steps shall be applied to quantify the benefit;

Step 1: Identification of “with” and “without” cases,

Step 2: Assumption of parameters for direct benefits such as willingness to pay and saving on non-supply cost of power,

Step 3: Estimation of economic costs based on the estimated capital investment cost

Step 4: Economic evaluation using economic benefits and economic costs.

#### **(2) “With” and “Without” Cases**

To test the economic viability, the EIRR shall be calculated based on the increase in the cost and benefit streams associated with the whole investment. The economic analysis evaluates the economic performance of the proposed components by comparing the "With " and "Without" cases.

Thus, the proposed Sector Programme inputs and outputs should be identified, quantified and valued by comparing the “Without” situation with that of the “With” case to derive the economic benefit.

##### **1) “With” Case**

The proposed increase in the power transmission facilities and distribution system are described in the Sector Programme.

##### **2) “Without” Case**

The current facilities and system shall continue to operate in the future.

#### **(3) Assumption of Benefits**

##### **1) Application of Willingness to Pay**

In its effort to analyse the benefits the JICA Study Team applied the willingness to pay survey conducted in the socio economic survey based on the “Power Distribution System Master Plan Study for Ghana of September, 2008”. According

to this survey, the monthly willingness to pay for electricity supply per household was GHC 19.60/month. The JICA Study Team assumes that the present value of willingness to pay in 2012 is GHC 27.05/month based on the rate of GDP growth.

On the other hand, industrial or commercial companies also answered regarding the “Respondent’s Willingness to Pay for Improved Service Delivery”. The figure was more than 2.25 times that of the current electricity bill. The reason for the high rate of willingness to pay is to avoid the loss incurred by the respondents due to supply interruptions. The JICA Study Team quantified the damage or loss in case of unreliable supply and occurrence of outage in the industrial area based on the report the “Power Distribution System Master Plan Study for Ghana” as the “Without” case. The non-supply cost by the production loss method is calculated by dividing the value of total loss by the duration time of the power supply shortfall (in terms of the hours of using stand-by generators).

## 2) Reduction of the Overall Distribution Losses

This sector would allow improved reconciliation of the electricity flows and help reduce the losses in the distribution network. The propose system can reduce losses in the distribution networks by installing a metering system at the distribution level. ECG can establish the basis for accurate tracking of power flows, identify areas of high losses, implement internal controls and maintain an accountable operational environment.

The target for reduction of distribution losses is shown in Table 18.7.1.

**Table 18.7.1 Reduction of Ratio of Distribution Losses**

	Unit	Year 2012	Year 2015	Year 2033
Ratio of Losses	%	25%	18%	15%
Annual Losses of Power Supply	GWh	153	133	250

Source: JICA Study Team

## (4) Estimation of Economic Cost

The whole Sector Programme cost is estimated at GHC 94.2 million. In this study, the economic cost was estimated by deducting government taxes and import duty from project cost so that a conversion factor of 0.85 was assumed. Hence, the total economic cost is estimated at GHC 80.0 million as shown in Table 18.5.2. Operation and maintenance (O&M) cost is applied based on 95% of revenue in accordance with the “Power Distribution System Master Plan Study for Ghana”.

**Table 18.7.2 Economic Cost of Distribution and Sub-Transmission**

Phase	Financial Cost (GHC Thousand)	Conversion Factor	Economic Cost (GHC Thousand)
Year 2013 – 2018	46,730	0.85	39,720
Year 2018 – 2023	28,762	0.85	24,448
Year 2023 – 2028	13,024	0.85	11,070
Year 2028 – 2033	5,680	0.85	4,828
Total	94,196	0.85	80,066

Source: JICA Study Team

## (5) Result of Economic Analysis

The analysis flow projection based on the above assumptions is presented in Table 18.7.3. All the sub-programs together will have an EIRR of 28.3%. The Sector Programme is economically viable. The NPV of the whole Sector Programme is GHC 247 million using a 12% discount rate.

**Table 18.7.3 Economic Flow of Electricity Sector Programmes**

Unit: GHc 1,000

Year	Benefit	Cost		Cost Total C	Benefit Total B	B-C	Dis. Cost (12%)	Dis. Benefit (12%)	Dis. B-Dis. C (12%)
		O & M	Investment						
2013			7,944	7,944	0	-7,944	7,944	0	-7,944
2014	124,088	147,532	7,944	155,476	124,088	-31,388	138,818	110,792	-28,025
2015	142,024	156,384	7,944	164,328	142,024	-22,303	131,001	113,221	-17,780
2016	160,447	164,516	7,944	172,460	160,447	-12,013	122,753	114,203	-8,551
2017	180,572	173,235	7,944	181,179	180,572	-607	115,143	114,757	-385
2018	197,299	182,070	4,889	186,959	197,299	10,340	106,086	111,953	5,867
2019	214,648	190,809	4,889	195,698	214,648	18,950	99,147	108,747	9,600
2020	232,540	199,396	4,889	204,285	232,540	28,255	92,408	105,189	12,781
2021	251,367	208,169	4,889	213,058	251,367	38,309	86,051	101,523	15,472
2022	270,881	216,912	4,889	221,801	270,881	49,080	79,984	97,682	17,699
2023	285,934	225,589	2,214	227,803	285,934	58,132	73,346	92,063	18,717
2024	301,469	234,387	2,214	236,601	301,469	64,868	68,017	86,665	18,648
2025	309,216	236,965	2,214	239,179	309,216	70,037	61,391	79,368	17,977
2026	324,939	245,496	2,214	247,710	324,939	77,229	56,769	74,468	17,699
2027	341,392	254,333	2,214	256,548	341,392	84,845	52,495	69,856	17,361
2028	355,488	263,235	966	264,201	355,488	91,287	48,268	64,946	16,678
2029	370,151	272,448	966	273,414	370,151	96,737	44,600	60,380	15,780
2030	385,406	281,984	966	282,950	385,406	102,457	41,210	56,132	14,922
2031	401,275	291,853	966	292,819	401,275	108,456	38,078	52,182	14,104
2032	418,426	302,068	966	303,034	418,426	115,392	35,184	48,582	13,398
2033	433,071	312,641		312,641	433,071	120,430	32,410	44,895	12,485
2034	433,071	312,641		312,641	433,071	120,430	28,938	40,085	11,147
2035	433,071	312,641		312,641	433,071	120,430	25,837	35,790	9,953
2036	433,071	312,641		312,641	433,071	120,430	23,069	31,955	8,886
2037	433,071	312,641		312,641	433,071	120,430	20,597	28,532	7,934
2038	433,071	312,641		312,641	433,071	120,430	18,391	25,475	7,084
2039	433,071	312,641		312,641	433,071	120,430	16,420	22,745	6,325
2040	433,071	312,641		312,641	433,071	120,430	14,661	20,308	5,647
2041	433,071	312,641		312,641	433,071	120,430	13,090	18,132	5,042
2042	433,071	312,641		312,641	433,071	120,430	11,688	16,190	4,502
2043	433,071	312,641		312,641	433,071	120,430	10,435	14,455	4,020
	10,031,340	7,686,426	80,066	7,766,492	10,031,340	2,264,849	1,714,229	1,961,272	247,043

B / C	1.1441
EIRR %	28.31
NPV (GHc)	247,043

### 18.7.2 Financial Analysis

The financial analysis of the Electricity Sector Programme is straight forward. The investment has been identified along with the increase in demand that the proposed Sector Programme satisfies. The Sector Programme for the electricity sector shall require an adequate amount of capital investment for the operation body. A financial analysis, therefore, has been undertaken to determine the financial viability of the proposed facilities. The followings are part of the assumptions made for

financial analysis:

- A possible source of funding is not considered
- Current tariff structure and level have been analysed
- A detailed financial projection and analysis have been conducted to examine the financial viability of the proposed programme; the Financial Internal Rate of Return (FIRR) has been calculated.

## (1) Financial Costs

Financial costs of the sector programme are summarized in Table 18.7.4, consisting of capital investment cost and operation and maintenance (O & M) cost.

O & M cost is assumed based on 95 % of revenue level. This figure comes from the “Power Distribution System Master Plan Study for Ghana of September, 2008”.

**Table 18.7.4 Financial Costs of Electricity Sector Programmes**

Description	Cost (GHC Thousand)	Remarks
Project Cost	94,196	See Table 18.5.2

Source: JICA Study Team

## (2) Financial Benefits

### Revenue

The average tariff level is GHC 0.18/kWh for non-industrial users and GHC 0.28/kWh for industrial. Revenue collection is applied based on the actual records of the ECG account book in the year 2010 and 2011 operational period. The JICA Study Team assumed the ratio of increase according to future demand of Greater Kumasi Sub-Region from year 2012 onwards.

Another benefit comes from the decrease in loss. It is assumed that the improvement of the primary substations will bring a 0.2 % improvement in the loss, and the reinforcement of the distribution network will also bring a 3.1% improvement in the loss of the affected system. This will result in the cost savings for the bulk power purchase, which would bring huge financial and economic benefits. The figures for the reduction in loss are in accordance with the “Power Distribution System Master Plan Study for Ghana of September, 2008”.

**Table 18.7.5 Revenue Projection**

	2010	2011	2013	2018	2023	2028	2033
Amount of Revenue Non-Industrial (GHC Thousand)	72,597	99,899	112,246	146,558	181,589	211,892	251,661
Amount of Revenue Industrial (GHC Thousand)	39,091	53,792	60,440	78,916	97,778	114,095	135,510
Total	111,688	153,691	172,686	225,474	279,367	325,987	387,171

Source: JICA Study Team

### (3) Result of Financial Analysis

The cash flow projection based on the above assumptions is presented in Table 18.7.6 below. The computed Financial Internal Rate of Return (FIRR) for the programme is 18.08%. The figures, however, depend heavily on the profit margin assumptions. It can be seen that a level of operation and administration cost, a maximum of 95% of revenue, is required to make the sub-programs financially viable. Otherwise, utilities will have a hard time sustaining the facilities.

**Table 18.7.6 Financial Flow of Electricity Sector Programme**

Unit: GHc 1,000

Year	Revenue	COST		COST TOTAL C	Revenue TOTAL B	B-C	Dis. Cost (12%)	Dis. Benefit (12%)	Dis. B-Dis. C (12%)
		O & M	Investment						
2013	0	0	9,346	9,346	0	-9,346	9,346	0	-9,346
2014	182,702	177,221	9,346	186,567	182,702	-3,865	166,577	163,127	-3,451
2015	193,664	187,854	9,346	197,200	193,664	-3,536	157,207	154,388	-2,819
2016	203,734	197,622	9,346	206,968	203,734	-3,234	147,316	145,014	-2,302
2017	214,532	208,096	9,346	217,442	214,532	-2,910	138,189	136,339	-1,849
2018	225,473	218,709	5,752	224,461	225,473	1,012	127,365	127,940	574
2019	236,296	229,207	5,752	234,959	236,296	1,337	119,038	119,715	677
2020	246,930	239,522	5,752	245,274	246,930	1,656	110,949	111,698	749
2021	257,794	250,061	5,752	255,813	257,794	1,982	103,318	104,119	800
2022	268,622	260,563	5,752	266,315	268,622	2,307	96,036	96,868	832
2023	279,367	270,986	2,605	273,591	279,367	5,776	88,089	89,949	1,860
2024	290,262	275,749	2,605	278,354	290,262	11,908	80,020	83,443	3,423
2025	293,455	278,782	2,605	281,387	293,455	12,068	72,225	75,323	3,097
2026	304,019	288,818	2,605	291,423	304,019	12,596	66,787	69,673	2,887
2027	314,964	299,216	2,605	301,821	314,964	13,143	61,759	64,448	2,689
2028	325,988	309,688	1,136	310,824	325,988	15,163	56,786	59,557	2,770
2029	337,397	320,527	1,136	321,663	337,397	15,734	52,470	55,037	2,567
2030	349,206	331,746	1,136	332,882	349,206	16,324	48,482	50,860	2,378
2031	361,428	343,357	1,136	344,493	361,428	16,935	44,798	47,000	2,202
2032	374,078	355,374	1,137	356,511	374,078	17,567	41,393	43,433	2,040
2033	387,171	367,813		367,813	387,171	19,359	38,130	40,137	2,007
2034	387,171	367,812		367,812	387,171	19,359	34,045	35,836	1,792
2035	387,171	367,812		367,812	387,171	19,359	30,397	31,997	1,600
2036	387,171	367,812		367,812	387,171	19,359	27,140	28,569	1,428
2037	387,171	367,812		367,812	387,171	19,359	24,232	25,508	1,275
2038	387,171	367,812		367,812	387,171	19,359	21,636	22,775	1,139
2039	387,171	367,812		367,812	387,171	19,359	19,318	20,335	1,017
2040	387,171	367,812		367,812	387,171	19,359	17,248	18,156	908
2041	387,171	367,812		367,812	387,171	19,359	15,400	16,211	811
2042	387,171	367,812		367,812	387,171	19,359	13,750	14,474	724
2043	387,171	367,812		367,812	387,171	19,359	12,277	12,923	646
	9,518,794	9,089,036	94,196	9,183,232	9,518,794	335,561	2,041,723	2,064,848	23,125

B / C	1.0113
FIRR %	18.08
NPV (GHc)	23,125

## 18.8 IEE of Electricity Sector Programme

This Section of the chapter discusses the Initial Environmental Examination (IEE) for this Sector programme at an early level of planning regarding impacts caused by the implementation of the sector programme. Such assessment is drawn based on the results of the analysis of the existing conditions and on the initial screening process undertaken by the Project Team using the Environmental Impact Matrix. The

detailed analyses of the environmental impacts such as an Environmental Impact Assessment (EIA) will be conducted at the feasibility study phase. The conduct of an IEE study under the sector programme is done in the following manner:

**(1) Targets of the IEE Study**

This Sector Programme consists of four components. The targets of the IEE study are shown in Table 18.8.1.

**Table 18.8.1 Targets of IEE Study for Electricity Sector Programme**

<ul style="list-style-type: none"><li><input type="checkbox"/> Improvement and Modernization of Sub-Transmission and Low Voltage Distribution Systems</li><li><input type="checkbox"/> Electrification in Rural Areas</li><li><input type="checkbox"/> Expansion of Sub-Transmission and Distribution Systems</li><li><input type="checkbox"/> Management of ECG</li></ul>
--

**(2) Phasing of the IEE Study**

To study the IEE, the programme components are divided into three phases, namely the Pre-Construction Phase, Construction Phase, and Operation and Maintenance Phase. The activities of each phase are as follows:

- **Pre-construction Phase:** which includes land acquisition, resettlement, mobilization of heavy equipment, transport of construction materials, construction of office buildings and labour camps, etc.
- **Construction Phase:** consisting of the setting up of equipment, demolition of the existing structures, implementation of construction works, generation of construction waste etc.
- **Operation and Maintenance Phase:** which includes the operation and maintenance of facilities, maintenance works, etc.

**(3) Result of the IEE Study**

In Ghana, there are 4 pillars in an environmental impact study as follows:

- Institutions
- Natural resources
- Socio-culture
- Economy

The environmental impacts on the above parameters are identified at the Pre-construction Phase, Construction Phase and Operation and Maintenance Phase using an Environmental Impact Matrix. The Environmental Impact Matrix shows the identified positive and negative environmental impacts caused by implementation of the programme. The Environmental Impact Matrix of the electricity sector is shown in Table 18.8.2.

Table 18.8.2 Environmental Impact Matrix for the IEE Study for Electricity Sector

Environmental Parameters	Institution		Natural Resources														Socio-Culture						Economy																
	Existing policy	Legal basis	Topography/Geology	Soil	Ground subsidence	Air quality	Hydrology	Water quality	Groundwater	Noise/Vibration	Offensive odor	Terrestrial flora and fauna	Aquatic flora and fauna	Biodiversity	Terrestrial ecosystem	Aquatic ecosystem	Natural disaster	Climate change factors	Population	Land use	Water use	Landscape	Human health	Involuntary resettlement	Cultural heritage	Material assets	Transportation	Power supply	Water supply	Solid waste	Other infrastructure	Local economy							
EL Sub-Programme 1: Improvement and Modernization of Sub-Transmission and LV Distribution Systems	Phases																																						
	Pre-construction																																						
	Construction Operation & Maintenance			-1						-1																													
EL Sub-Programme 2: Electrification in Rural Areas	Pre-construction																																						
	Construction Operation & Maintenance					-1																																	
	Pre-construction																																						
EL Sub-Programme 3: Expansion of Sub-Transmission and Distribution Systems	Pre-construction																																						
	Construction Operation & Maintenance					-1																																	
	Pre-construction																																						
EL Sub-Programme 4: Management of ECG	Pre-construction																																						
	Construction Operation & Maintenance																																						
	Pre-construction																																						

+1: Negligible Positive impact  
+2: Moderately Positive impact  
+3: Significant Positive impact  
-1: Negligible Negative impact  
-2: Moderately Negative impact  
-3: Significant Negative impact  
+/-: Likely to have both positive and negative environmental impact  
?: Uncertain or unpredictable environmental effect

Source: JICA Study Team



# PART VII

## Implementation Plan



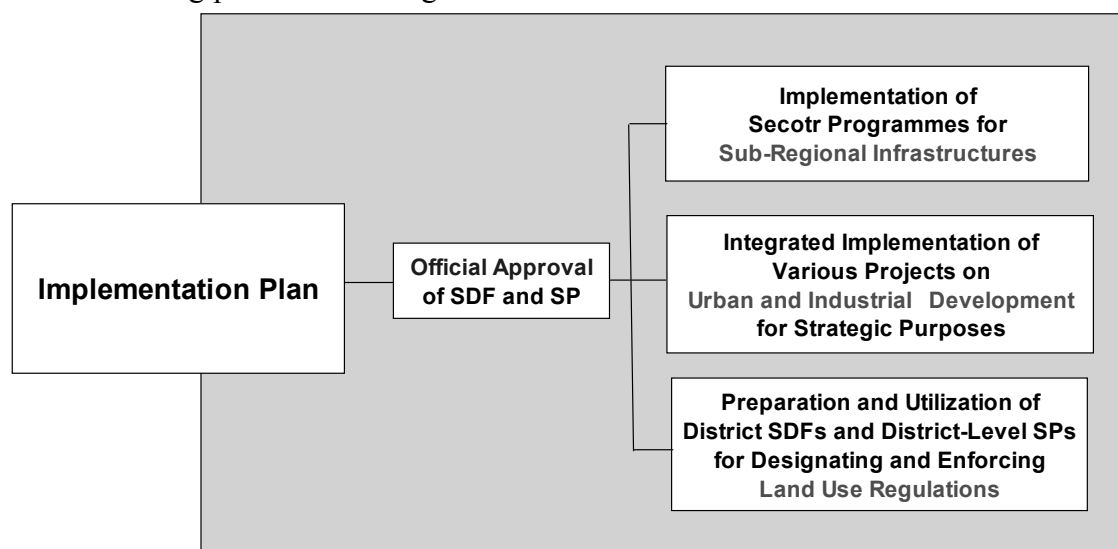
## Chapter 19 Introduction: Implementation Plan

### 19.1 Four Key Types of Actions for Implementation of Greater Kumasi Sub-Regional SDF and Greater Kumasi Conurbation SP

For implementing the Greater Kumasi Sub-Regional SDF and Greater Kumasi Conurbation SP, the following four key types of actions are required:

- Official approval of the SDF for Greater Kumasi Sub-Region and the SP for Greater Kumasi Conurbation (In fact, based on this recommendation, the master plan for Greater Kumasi Sub-Region was approved by the Regional Co-ordinating Council (RCC) of Ashanti Region)
- Implementation of sector programmes for sub-regional infrastructures
- Integrated implementation of various projects for strategic purposes
- Preparation and utilization of district-level SDFs and SPs for designating and enforcing land use regulations.

The SDF and SP, once approved, have three broad kinds of development proposals. The first is sub-regional level infrastructures, such as the outer ring road and dams. The second is related to the promotion of integrated development of different sectors and different levels of actors for strategic projects, such as Kumasi-Ejisu Urban Corridor Development and Boankra Industrial-Logistics Centre Development. The third is district-level land use administration, including development control and building permission using district-level SDFs and SPs.



JICA Study Team

**Figure 19.1.1 Framework of Implementation Plan**

## **19.2 Official Approval of the SDF for Greater Kumasi Sub-Region and the SP for Greater Kumasi Conurbation**

While the sub-regional level SDF has legal status in the new draft land use law (which is undergoing due process through parliament), the sub-regional SP does not have legal status. The sub-regional SP has detailed plans for land use and infrastructure, which will guide district-level SDFs and SPs. Therefore, their official approval, which should be administered by planning authorities (NDPC and TCPD at the national level and RPCU under RCC at the regional level), is very important so that the sub-regional SDF and SP can gain the official status to be used to officially and formally guide development and land administrations in the Greater Kumasi Sub-Region and Conurbation.

The process for the official approval of the SDF for Greater Kumasi Sub-Region and the SP for Greater Kumasi Conurbation should be started immediately after the completion of this planning study.

The SDF and SP should be sent to NDPC and TCPD for further examination and official approval at the national level. Once approved, they will be sent to the RCC of Ashanti Region for official approval by the RCC at the regional level.

Currently, a Spatial Development Framework (SDF) at the national level is being prepared under TCPD in collaboration with the NDPC. The Greater Kumasi Sub-Regional SDF and Conurbation SP should be incorporated into the national-level SDF.

With official approval, the SDF and SP could gain official power to technically and financially help and guide the RCC and the assemblies of participating MMDAs in promotion of various development proposals and land use plans at national, regional and district levels.

However, at the same time, it is important for national, regional and district institutions to begin to take necessary actions for implementation of priority proposals in the SDF and SP, while waiting for official approval.

## **19.3 Implementation of Sector Programmes for Sub-Regional Infrastructures**

The sub-regional infrastructures proposed in the Greater Kumasi Sub-Regional SDF and Conurbation SP are compiled into the following sector programmes for infrastructure, as shown in Chapters 12 through 18 of Part V.

- Transportation Sector
- Water Resources Sector
- Water Supply Sector
- Liquid Waste Treatment Sector
- Drainage Sector
- Solid Waste Management Sector
- Electricity Sector

The main, distinctive difference between the sub-regional SDF/SP and district-level SDF/SP is the large-scale infrastructure. The sub-regional SDF/SP deals with relatively large-scale infrastructure which serves the sub-region beyond the district level. District-level SDF/SPs deal with infrastructure only for their own districts, which is relatively small-scale infrastructure.

Since the regional-level departments are effectively branch offices of national-level departments and agencies, they do not have the power for decision-making and financing for actual implementation. The implementation of sub-regional infrastructure needs decisions and financial arrangements to be made at the national level.

For this kind of national-level decisions and resources allocation, the following two types of actions are required:

- Incorporation of sub-regional infrastructure proposed by the sub-regional SDF and SP into national-level sector policies and development plans by the relevant national ministries, departments and agencies
- Collective appeal by regional and district institutions (through the RPCU or a regional platform for the Greater Kumasi) to the national-level ministries, departments and agencies for implementation of proposed sub-regional infrastructures

The priority projects for infrastructure for Greater Kumasi Spatial Development are as follows:

- Construction of the Outer Ring Road for providing high-speed roads for bypassing Kumasi City as well as for creating new Suburban Residential Areas and Developing Multi-Nucleus Urban Centres.
- Upgrading of the Middle Ring Road for promoting suburban development
- Establishment of Bus Rapid Transit (BRT) routes covering the Greater Kumasi Conurbation
- Intersection Improvement by Signalization for Kumasi City for traffic congestion reduction
- Water Resources Development for long term sustainable urban development
- Short-Term increase of the water supply capacity for satisfying basic needs for urban livelihood
- Short-Term Improvement of the Electricity Distribution for Kumasi City for reducing power outages.

#### **19.4 Integrated Implementation of Various Actions for Strategic Purposes**

For achieving the vision for the Greater Kumasi Sub-Region, it is essential to pursue the integrated implementation of certain actions for the following high-priority strategic initiatives for industrialisation and encouraging modern developments:

- Redevelopment of Kaase Industrial Area
- Development of Boankra Industrial-Logistics Centre

- Development of Kumasi-Ejisu Urban Corridor
- Redevelopment of Kumasi City Centre
- Development of New Towns
- Modernization of Informal Sectors

These strategic initiatives are very important for revitalizing and modernizing the economy of Greater Kumasi Conurbation. At the same time, these require committed and collaborative efforts of both government and private sectors.

These initiatives could be promoted by multi-sector collaboration and should be supported not only by regional and district levels, but also by national resources.

To pursue these development initiatives by combining efforts of government and private sectors, collaboration of multi-sectors and mobilizing different levels of resources and commitments is a very challenging necessity.

## **19.5 Preparation and Utilization of District-Level SDFs and SPs for Designating and Enforcing Land Use Regulation**

Any spatial and physical development requires use of land. In accordance with the new land use law being introduced in Ghana, land uses including construction of buildings and infrastructures should be regulated by district assemblies and by district-level SDFs and SPs.

However, for a large urban area composed of a central city like KMA and adjoining districts, the formulation of individual districts' SDFs and SPs in a separated manner tends to cause unordered and inefficient spatial situations. Therefore, it is necessary to prepare a SDF for the sub-region by combining individual MMDAs and furthermore to formulate a SP for the conurbation covering future urban areas.

The SDF for Greater Kumasi Sub-Region and SP for Greater Kumasi Conurbation should be used for guiding the formulation of individual SDFs and MTDPs for the MMDAs within the Greater Kumasi Sub-Region and individual SPs for specific MMDAs' urban areas within the Greater Kumasi Conurbation.

The actual SDF for Greater Kumasi Sub-Region and SP for the Greater Kumasi conurbation can functionally and partially substitute for the individual district-level SDFs and SPs while these are being prepared. However, in order to have legal status of those district-level SDFs and SPs, for law enforcement, it is necessary for each MMDA to prepare a district SDF and SPs and to get those SDF and SPs approved by the district assembly.

Under the new land use law (to be introduced in the near future), each District must prepare a district SDF and SPs and its assembly should approve them officially. Otherwise, under the prospective land use law, they are legally punishable.

## **19.6 Development of Implementation Measures for Urban Development**

The preparation of spatial development plans including SDF and SP does not assure

the possibility of plan implementation. Implementation plans and capacity development for implementation are required for smooth and efficient implementation of the spatial development plan. Furthermore, it is necessary to develop implementation measures for urban development, such as urban redevelopment and new town development.

In various countries, measures for implementing urban redevelopment and new town development have been discussed and experimented. Ghana needs to learn principles and experiences on those implementation measures. Implementation measures would include laws, financial arrangement and institutional aspects.

For this purpose, pilot projects are proposed for the Programme for Redevelopment of Kumasi City Centre and designing of models and financial arrangements are also proposed for the Programme for Development of New Towns (See Sections 21.2.5 and 21.2.6).

In Ashanti Region, traditional authorities under the leadership of Asantehene have been heavily engaged in land matters. For studying models and conducting pilot projects, traditional authorities should be involved from early stages of such studies and projects.

## **19.7 Financial Arrangements for Implementation of Programmes and Projects**

In addition to the four aspects discussed above, financial arrangements for implementing programmes and projects are also very important. Different financial arrangements are proposed for different economic sectors and infrastructures/services as shown in Table 19.7.1.

**Table 19.7.1 Financial Arrangements suitable for Different Types of Programmes and Projects**

Sectors	Subjects of Investment	Recommended Financial Arrangement
<b>Economic Sectors</b>		
Industry	Industrial Parks	The first industrial park should be constructed by public investment. Subsequent industrial park development should be done by private developers with land arrangement by government and traditional authorities.
Commerce	Industrial Operation	Private investment should be promoted.
	Satellite Market Places Shopping Centres	Private investment is necessary. Private investment should be promoted.
Agriculture	Mid-Scale and Large-Scale Plantations	Private investment should be promoted, while the arrangement of lands for agricultural investment should be assisted by public sectors.
<b>Infrastructure Sectors</b>		
Roads	The first section of Outer Ring Road The other sections of Outer Ring Road Other Major Roads	It is strongly recommended to construct the first section of the Outer Ring Road by public investment including development partners' assistance. It is desirable to seek the possibility of arranging a PPP. Public investment is necessary.
BRT	BRT Dedicated Lanes	Public investment should be sought in order to prevent delaying the implementation of the project.
	BRT Operation	BRT operation should be done by the private sector.
Water Resources	New Dams	Although Ghana Water Company Limited (GWCL) is a privatized company, it is necessary to assist with the development of a new dam for water supply because the financial situation of GWCL is not very good and it provides basic public
Water Supply	Water Treatment Plant Expansion	Although Ghana Water Company Limited (GWCL) is a privatized company, it is necessary to assist with the development of a new dam for water supply because the financial situation of GWCL is not very good and it provides basic public
Liquid Waste Treatment	Liquid Waste Treatment Pond	Public investment is necessary.
	Septage Treatment Pond	Public investment is necessary.
Solid Waste Treatment	Final Disposal Sites	Public investment is necessary.
	Recycling Plants	Private companies should invest in and operate recycling plants.
Drainage	Solid Waste Collection, Transport and Final Disposal	Outsourcing to private companies has been done and will be continued.
	Drainage Lining	Public investment is necessary.
Electricity Supply	Overhead Wires and Transformers	Electricity companies need assistance from development partners because their financial situation is not very good and they are providing basic public services.
	Substations and Sub-Transmission	Electricity companies should invest in these facilities.
<b>Services Sectors</b>		
Health Sector	District Hospitals outside Kumasi City	Public investment is necessary.
	Private Hospitals outside Kumasi City	Private investment should be promoted.
Education Sector	Clinics outside Kumasi City	Private investment should be promoted.
	Senior High Schools outside Kumasi	Both public investment and private investment are necessary.
	Universities outside Kumasi City	Private universities should be encouraged to operate outside Kumasi City.

## **Chapter 20 Institutional Frameworks for Implementation of Greater Kumasi Sub-Regional SDF and Greater Kumasi Conurbation SP**

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### **20.1 Present Institutional Issues on Implementing Greater Kumasi Sub-Regional SDF and Greater Kumasi SP**

The current Ghanaian development planning system does not demand the regional level to prepare its own development plans (socio-economic plans). The current Ghanaian budgetary system does not provide the regional level any development budget to be spent for its own regional initiatives. The main function and responsibility of the regional level administration is to harmonize different department programmes/projects and bundle district initiatives within the region.

No strong regional-level leadership has been expressed partly because no regional-level development budgets are available and partly because no important decision-making power is necessary. As a result, no development plans for a region have been prepared.

However, it is essential to make concerned efforts at the regional level in collaboration with districts for achieving efficient, effective and sustainable development. It is important especially for the purpose of mobilizing national resources for regions or sub-regions.

### **20.2 Alternative Ways to Achieve the Vision and Overall Objectives of Greater Kumasi Sub-Regional Development**

#### **(1) Alternative Institutional Strategies**

There are broadly, the following four alternative ways (institutional strategies) to promote the implementation of Greater Kumasi Sub-Regional SDF and Conurbation SP:

- **Town Development Project**
  - Implementing a Town Development Project under the prospective Land Use and Spatial Planning Authority under the New Land Use Law and New Spatial Planning System for the purpose of Managing Actual Land Use Permits or Construction Permits by guiding District SDFs and SPs.
  - The board of the New Land Use and Spatial Planning Authority is to have key infrastructure agencies, which might be able to mobilize necessary resources to implement sub-regional infrastructures.
- **Regional Platform**
  - Managing a Regional Platform consisting of various Entities (Regional

Departments and District Assemblies) for the purpose of making an effort to mobilize national-level resources for implementing various projects, as well as monitoring land use management at the district level.

- The capacity for this type of regional collective effort should be developed for sustainable development.
- However, this effort might result in implementation of projects in a fragmented way.
- **Component of Forest Belt Development Initiative**
  - Implementing the Greater Kumasi Sub-Regional SDF and Conurbation SP, as a Component of the Forest Belt Development Initiative.
  - It is necessary to wait for the establishment of the Forest Belt Development Authority.
  - However, this might have a low priority at the national level.
- **Stand-alone National Programme for Greater Kumasi**
  - Implementing a Stand-alone National Program for Greater Kumasi Sub-Regional Development for the purpose of mobilizing a larger volume of resources for implementing various projects in an integrated manner.
  - For this purpose, the establishment of an independent authority for Greater Kumasi with special budgetary arrangements is required.
  - This way might be suitable for implementing various projects in an integrated manner.

## (2) **Recommended Institutional Strategy**

Considering the current and past situations of sub-national, regional and sub-regional development efforts, the JICA Study Team recommends the following method by combining the first and second options above for implementing the Greater Kumasi Sub-Regional SDF and Conurbation SP:

- To manage a Regional Platform under the RCC of Ashanti Region, and
- At the same time, to rely on national-level coordination by the board members of the prospective Land Use and Spatial Planning Authority (to be established after the new Land Use Law is approved by the parliament).

In addition to this combined institutional strategy of regional platform and national-level coordination, it might be necessary to create another instrument for promoting the implementation of critical infrastructures. It is the national-level infrastructure agencies that should play the role of promoter from the side of infrastructure development.

## **20.3 Institutional Framework Necessary for Implementing Greater Kumasi SDF and Greater Kumasi SP**

This section describes the institutional frameworks which the JICA Study Team recommended in the previous section.

## **(1) Regional Platform**

It is necessary to organize a regional platform for carrying out collective efforts at the regional level. Such a regional platform should be established as a government unit under the Regional Co-ordinating Council (RCC) of Ashanti Region. The existing Regional Planning Coordinating Unit (RPCU)<sup>1</sup> could perform the function of the regional platform for the Greater Kumasi Sub-Regional SDF and Conurbation SP. Or the Regional Spatial Planning Committee, to be established under the RPCU in accordance with the new Land Use Law, could perform the function of the regional platform.

### **1) Proposed Members of Regional Platform**

The proposed member institutions of the regional platform are as follows:

- RCC (as Chairperson)
- Physical Planning Department, RCC (as Secretariat, currently Regional Office of TCPD)
- Physical Planning Department (Town Planning Department), KMA (as co-secretariat)
- Economic Planning Department, RCC
- Manhiya Palace
- Kumasi Traditional Council
- Department of Urban Roads, KMA
- Department of Feeder Roads, KMA
- Ashanti Regional Office, Ghana Highway Authority
- Kumasi Branch, Ghana Water Company Ltd.
- Ashanti West, Electricity Company of Ghana (ECG)
- Land Commission
- Office of Administrator for Stool Land
- Department of Trade and Industry, Ministry of Trade and Industry
- Department of Food and Agriculture, Ministry of Food and Agriculture
- Department of Health, Ministry of Health

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<sup>1</sup> In accordance with the NDCP's Guidelines for the Preparation of District Medium-Term Development Plan under the Medium-Term Development Policy Framework 2010-2013 (October 2009), the members of the Regional Coordinating Planning Unit (RCPU) are as follows:

- The Regional Coordinating Director as head
- The Regional Economic Planning Officer as the Secretary
- Regional Budget Officer
- Regional Local Government Inspector
- Regional Director of Health
- Regional Director of Education
- Regional Director of Agriculture
- Chief Works Superintendent
- Regional Town and Country Planning Officer
- Regional Statistical Officer
- Regional Coordinating Council Nominee
- Representatives of NGOs, Private Sector and Other Relevant Regional Departments and Agencies (one each)

- Department of Education, Ministry of Health
- Assemblies of KMA and Adjoining Municipalities/Districts

## **2) Regular Monitoring & Evaluation Meetings**

Regularly, every two months or so, official meetings of the Regional Platform should be held for monitoring and evaluating the activities and results of implementation promotion by the members of the Regional Platform.

In these regular meetings, the chairman of the Regional Platform is to keep encouraging members to promote the implementation of the SDF and SP in the following three directions:

- To appeal to the national-level institutions (departments and authorities) for implementing priority projects and other sub-programmes
- To attract private investment in strategic sub-programmes/projects
- To manage land use and development at the district level

## **3) Working Groups for Implementing High-Priority Strategic Actions**

For active promotion for implementation of the following selected strategic purposes, flexible, action-oriented Working Groups should be formed and their activities should be managed. Private groups should be included as formal members of the Working Groups. Even the appointment of private sector persons as leaders for the Working Groups should be encouraged.

- Redevelopment of Kaase Industrial Area
- Development of Boankra Industrial-Logistics Centre
- Development of Kumasi-Ejisu Urban Corridor
- Redevelopment of Kumasi City Centre
- Development of New Towns
- Modernization of Informal Sectors

Different working groups for these thematic implementation purposes should be organized. Members of these thematic implementation “working groups” should include private sector entities and non-governmental groups.

## **(2) National-Level Coordination Functions for Implementation of Greater Kumasi Sub-Regional SDF and Greater Kumasi Conurbation SP**

At the national level, some national-level organizations should play coordinating roles for promoting the implementation that the Greater Kumasi SDF and SP require.

Such national-level coordination should be complementary with the function of the regional platform to be established for implementing the Greater Kumasi SDF and SP.

One of the candidate organizations is the National Development Planning Commission (NDPC), by which a national infrastructure master plan has being formulated in consultation with infrastructure sector agencies.

Another of the candidate organizations is the prospective “Land Use and Spatial

Planning Authority” to be established under the new law on Land Use and Spatial Planning. The board for the Land Use and Spatial Planning Authority should have the representatives from the following organizations:

- Ministry of Local Government and Rural Development
- Ministry of Environment, Science, Technology & Innovation
- Ministry of Lands and Natural Resources
- Ministry of Roads and Highways
- Environmental Protection Agency
- Lands Commission
- Office of the Administrator of Stool Lands
- Ministry of Water Resources, Works and Housing
- National Development Planning Commission
- Three persons from the private sector appointed by the President being persons appointed from the built environment, the business community, the Ghana Institute of Planners, or from the class of retired physical planners.
- National House of Chiefs.

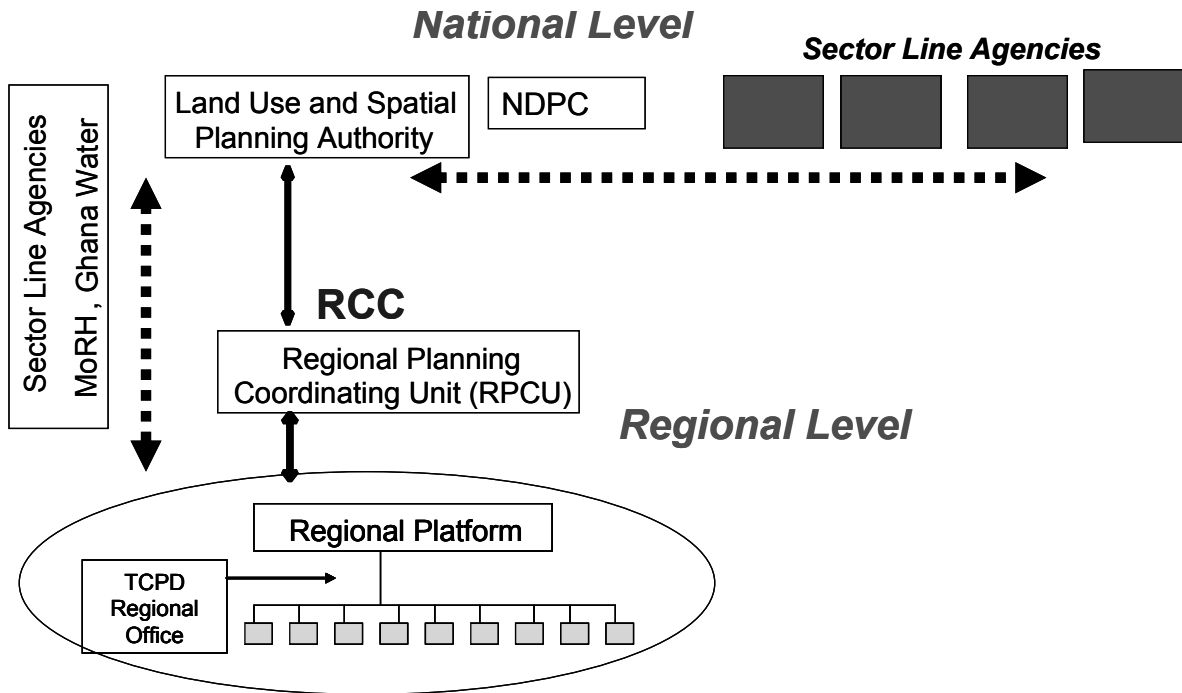
### **(3) Key National Infrastructure Agencies for Greater Kumasi Sub-Region**

In addition to the regional platform and national-level coordination function, the vertical relation of certain infrastructure sector agencies should be utilized for promoting the implementation of important infrastructures.

This is because certain infrastructures, for example, the Outer Ring Road and water resources development and water supply, are very critical in the future development of Greater Kumasi’s urban and industrial development.

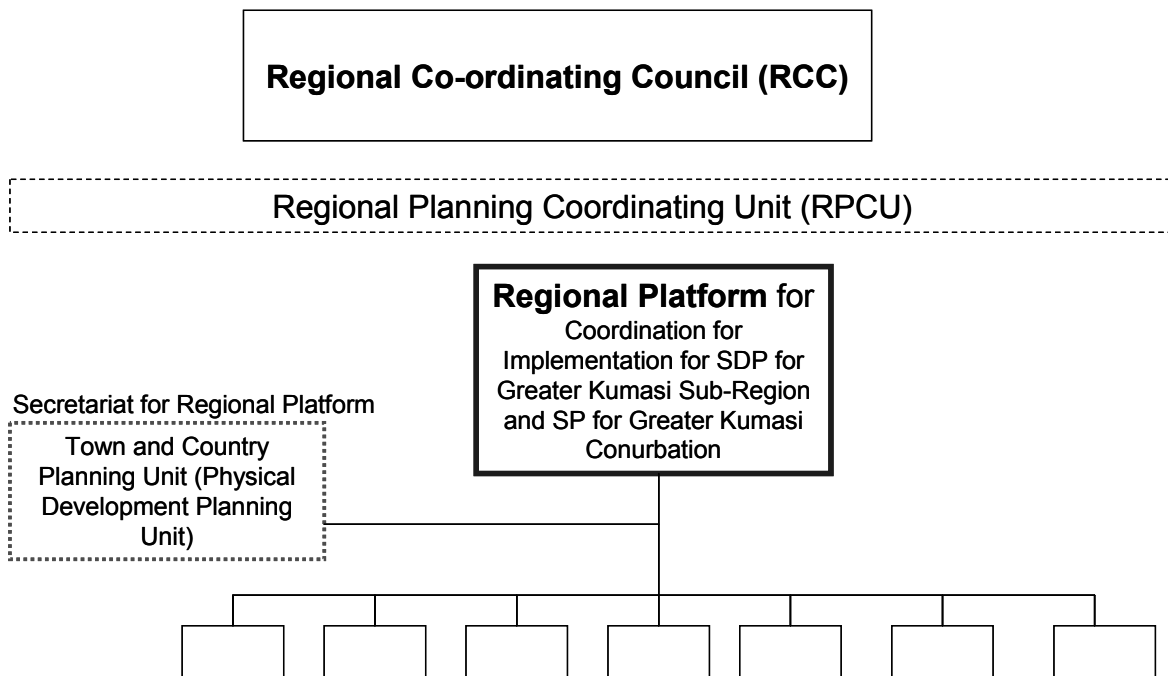
The following two infrastructure agencies are selected as Key national infrastructure agencies:

- Ministry of Roads and Highways for implementing the Outer Ring Road Project
- Ghana Water Company Ltd. for implementing a long-term New Water Resources Dam Project, as well as short-term water supply capacity upgrading project



Source: JICA Study Team

**Figure 20.3.1 Relationship between Regional Level and National Level in the Proposed Institutional Framework for Implementation**



Source: JICA Study Team

**Figure 20.3.2 Regional Platform for the Proposed Institutional Framework for Implementation**

## **Chapter 21 Priority Strategic Programmes for Urban and Industrial Development**

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### **21.1 Introduction**

The urban and industrial development efforts needed for Greater Kumasi Sub-Region are multi-sector and private-public collaboration efforts. The following programmes are priority strategic efforts to be made for promoting urban and industrial development for Greater Kumasi Sub-Region:

- Programme for Investment Promotion for Greater Kumasi
- Programme for Revitalization of Kaase Industrial Area
- Programme for Development of Boankra Industrial-Logistics Centre
- Programme for Development of Kumasi-Ejisu Urban Corridor
- Programme for Redevelopment of Kumasi City Centre
- Programme for Development of New Towns
- Programme for Modernization of Informal Sectors

As recommended in Chapter 21 on the institutional framework, the establishment and operation of Working Groups by the Spatial Planning Subcommittee of the RPCU of the RCC is important for mobilizing multi-sector efforts and private sector contribution.

Profiles of these programmes are provided in this chapter.

### **21.2 Priority Strategic Programmes for Urban and Industrial Development**

#### **21.2.1 Programme for Investment Promotion for Greater Kumasi**

**(1) Objectives**

- To promote private investment in strategic areas within Greater Kumasi Sub-Region for revitalizing the economy of Greater Kumasi

**(2) Main Executive Agencies**

- Ghana Investment Promotion Centre

**(3) Sub Executive Agencies**

- RCC of Ashanti Region
- KMA
- Adjoining Districts including Afigya-Kwabre District, Kwabre East District, Ejisu-Juaben Municipality, Asokore-Mampong Municipality, Bosomtwe District,

Atwima-Kwanwoma District and Atwima-Nwabiagya District

- Ghana Free Zones Board
- Regional Department, Ministry of Trade and Industry
- Ashanti Branch, Ghana Association of Industries
- Ghana Real Estate Developers Association
- Possible investors such as SNIT and Ghanaian banks

**(4) Steps of Actions**

- Establishment of Working Group for investment promotion for Greater Kumasi
- Discussion on investment promotion strategies for Greater Kumasi
- Preparation of pamphlets for investment promotion for Greater Kumasi
- Holding of investment seminars for Greater Kumasi in Accra and Overseas

**21.2.2 Programme for Revitalization of Kaase Industrial Area**

**(1) Objectives**

- To reactivate industrial sectors in KMA
- To promote private investments in industrial sectors in Kaase Industrial Area
- To promote industrial sector production in Kaase Industrial Area

**(2) Main Executive Agencies**

- KMA

**(3) Sub Executive Agencies**

- Regional Department, Ministry of Trade and Industry
- RCC of Ashanti Region
- Ghana Investment Promotion Centre
- Ghana Association of Industries

**(4) Steps of Actions**

- Establishment of Working Group for Redevelopment of Kaase Industrial Area
- Discussion on redevelopment strategies of Kaase Industrial Area by involving land owners and stakeholders
- Identification of possible sites and changing land use regulations for attracting industries within Kaase Industrial Area
- Preparation of pamphlets for attracting investments in Kaase Industrial Area
- Participation in investment seminars to be organized for Greater Kumasi in Accra and Overseas
- Identification of necessary rehabilitation of infrastructures for Kaase Industrial Area
- Promotion of mobilizing funds for infrastructure rehabilitation for Kaase Industrial Area

**21.2.3 Programme for Development of Boankra Industrial-Logistics Centre**

**(1) Objectives**

- To promote the development of Boankra Industrial-Logistics Centre (not only the Dry Port and Export Processing Zone, but also surrounding areas)

- To promote the development of Ashanti Technology Centre (Export Processing Zone)
- To promote the development of Boankra Dry Port
- To promote infrastructure provision (including roads, electricity and water supply) for the Boankra Industrial-Logistics Centre

**(2) Main Executive Agencies**

- Ghana Free Zones Board

**(3) Sub Executive Agencies**

- Ejisu-Juaben Municipality
- Ghana Shippers' Authority
- Regional Department, Ministry of Trade and Industry
- Ghana Investment Promotion Centre
- RCC of Ashanti Region
- Ghana Real Estate Developers Association
- Ghana Association of Industries

**(4) Steps of Actions**

- Establishment of Working Group for Boankra Industrial-Logistics Centre
- Sharing with participants of the Working Group of information on the current situation for Boankra area development
- Preparation of layout plans/local plans for Boankra area including suburban centres and feeder roads
- Monitoring of electricity supply to Boankra area
- Speed up of electricity supply projects to Boankra area including Boankra Industrial-Logistics Centre
- Preparation of pamphlets to promote private investments in Boankra Industrial-Logistic Centre
- Participation in investment seminars to be organized for Greater Kumasi Sub-Region

#### **21.2.4 Programme for Development of Kumasi-Ejisu Urban Corridor**

**(1) Objectives**

- To create a Knowledge-Based Urban Corridor between Kumasi and Ejisu and further to Boankra
- To provide advanced infrastructures for supporting the development of knowledge industries
- To promote private investment in knowledge industrial development in the urban corridor
- To promote urban mixed development of residential, business-commercial and industrial sectors

**(2) Main Executive Agencies**

- KMA
- Ejisu-Juaben Municipality

- KNUST
- CSIR
- Kumasi Polytechnic

**(3) Sub Executive Agencies**

- RCC of Ashanti Region
- Ghana Investment Promotion Centre
- Department of Urban Roads, Ministry of Roads and Highways
- Department of Urban Roads, KMA
- Urban Transportation Project, KMA
- Urban Transportation Project, Ejisu-Juaben Municipality
- Regional Department, Ministry of Trade and Industry
- Ghana Real Estate Developers Association
- Ghana Association of Industries

**(4) Steps of Actions**

- Establishment of Working Group for Development of Kumasi-Ejisu Urban Corridor
- Discussion on strategies for Kumasi-Ejisu Urban Corridor
- Securing Space for Widening of Accra Road to accommodate BRT route
- Determination of upgrading of parallel road along Accra Road within the urban corridor
- Preparation of layout plans/local plans including land use plans for economic development
- Encouragement of KNUST to prepare a business plan for developing Knowledge City within the urban corridor
- Preparation of pamphlets for promoting private investment in Kumasi-Ejisu Urban Corridor
- Participation in investment seminars for Greater Kumasi
- Private investment promotion for knowledge industries and hotel-conference facilities within the urban corridor

### **21.2.5 Programme for Redevelopment of Kumasi City Centre**

**(1) Objectives**

- To promote the development of advanced urban functions within Kumasi City Centre for widely serving Greater Kumasi Sub-Region, as well as Ashanti Region and northern areas
- To attract private investment in real estate development within Kumasi City Centre

**(2) Main Executive Agencies**

- KMA

**(3) Sub Executive Agencies**

- Asantehene
- Kumasi Traditional Council

- Office of the Administrator of Stool Lands (OASL)
- Land Commission
- RCC of Ashanti Region
- Ghana Investment Promotion Centre
- Ghana Real Estate Developers Association
- Major corporate entities either present or planning to locate in Kumasi City Centre

**(4) Steps of Actions**

- Establishment of Working Group for Redevelopment of Kumasi City Centre
- Discussion on redevelopment strategies of Kumasi City Centre
- Designing of pilot projects for redeveloping within Kumasi City Centre
- Encouragement of involvement of Asantehene for land arrangement for redevelopment projects
- Encouragement of involvement of Kumasi Traditional Council
- Encouragement of involvement of private real estate developers
- Discussion on financial strategies by involving banks and private real estate developers

### **21.2.6 Programme for Development of New Towns**

**(1) Objectives**

- To promote the speedy development of well-ordered suburban residential areas
- To promote the development of infrastructures for suburban residential areas

**(2) Main Executive Agencies**

- Ghana Real Estate Developers Association

**(3) Sub Executive Agencies**

- Private real estate developers
- Banks and finance companies (e.g. Ghana Home Loans, HFC) providing Housing Loans
- Asantehene
- Traditional Council
- State Housing Corporation
- Lands Commission
- Department of Urban Roads
- Department of Feeder Roads
- District Assemblies where New Towns are located

**(4) Steps of Actions**

- Establishment of Working Group for new town development in suburban areas of Greater Kumasi Conurbation
- Designing of models for new towns in suburban areas of Greater Kumasi Conurbation
- Discussion of financial arrangements for private real estate developers for new town development

- Establishment of financial schemes for new town development

### **21.2.7 Programme for Modernization of Informal Sectors**

#### **(5) Objectives**

- To promote the modernization of informal sectors, such as car and machine repairing industries
- To promote the modernization of logistics sectors, such as trucking and warehouse sectors
- To promote the modernization of commercial sectors
  - By making linkage between universities/polytechnic and informal sectors
  - By making linkage between formal sectors and informal sectors

#### **(6) Main Executive Agencies**

- Regional Office for Ministry of Trade and Industry
- KMA

#### **(7) Sub Executive Agencies**

- Suame Association
- Trucking Association
- Association for Small Scale Industries
- KNUST
- Kumasi Polytechnic
- Association of Ghana Industries
- Banks and finance companies

#### **(8) Steps of Actions**

- Establishment of Working Group for informal sector modernization
- Investigation on potential technologies to be utilized for informal sectors
- Designing of models for linkages between formal sectors and informal sectors
- Discussion of financial arrangements for informal sectors
- Implementation of pilot projects

### 21.3 Implementation Schedule for Priority Strategic Programmes

The priority strategic programmes requires an integrated effort at implementation of the priority strategic programmes for urban and industrial development. The time framework for implementation is proposed as shown in Figure 21.3.1.

Urban and Industrial Development	2013-2015	2015-2018	2018-2023	2023-2028	2028-2033
(1) Approval of Greater Kumasi Sub-Regional SDF and Greater Kumasi Conurbation SP	Approval by the End of 2013				
(2) Establishment of Regional Platform for Promoting Implementation of Greater Kumasi Sub-Regional SDF, SP and Sector Programmes	Kick Off by th End of 2013 and Operation of 1st Phase	1st Phase	2nd Phase		
(3) Establishment of National Mechanism for Promoting Implementation of Greater Kumasi Sub-Regional SDF, SP and Sector Programmes	Kick Off by th End of 2013 and Operation of 1st Phase	1st Phase	2nd Phase		
(4) Programme for Investment Promotion	Kick Off and 1st Phase	1st Phase	2nd Phase	3rd Phase	4th Phase
(5) Programme for Revitalization of Kaase Industrial Area	Preparation	Investment Promotion	Investment Promotion		
(6) Programme for Development of Boankra Industrial-Logistic Centre	Preparation	Construction of Industrial Park	Investment Promotion	Construction of Dry Port	Investment Promotion
(7) Programme for Development of Kumasi-Ejisu Urban Corridor (Knowledge City)	Preparation	Construction of Parallel Road	Widening of Accra Road	Introductio of BRT	Introduction of BRT
(8) Programme for Redevelopment of Kumasi City Centre	Preparation for Pilot Project	Implementation of Pilot Project and Preparation for Other Projects	Implementation of Full-Scale Projects	Implementation of Full-Scale Projects	Implementation of Full-Scale Projects
(9) Programme for Development of New Towns	Preparation	Preparation	Construction	Construction	Construction
(10) Programme for Modernization of Informal Sectors	Preparation incl. Preparation of Pilot Projects	Implementation of Pilot Projects	Implementation of Full-Scale Projects	Implementation of Full-Scale Projects	Implementation of Full-Scale Projects
(11) Development of the Outer Ring Road and its Surrounding Areas	FS, BD, Land Acquisition (1st Phase)	Land Acquisition (1st Phase) and DD	Construction for North-Eastern Section	Construction for South-Western Section	Construction for South-Eastern Section

**Figure 21.3.1 Implementation Schedule for Priority Strategic Programmes for Urban and Industrial Development**

## **Chapter 22 Priority Projects and Actions for Infrastructure Sectors**

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### **22.1 Introduction: Priority Projects and Actions for Infrastructure Sectors**

In addition to the SDF and SP, sector programmes for infrastructure sectors are formulated for the following seven infrastructure sectors:

- Transportation Sector
- Water Resources Sector
- Water Supply Sector
- Liquid Waste Treatment Sector
- Drainage Sector
- Solid Waste Management Sector
- Electricity Sector

These sector programmes are important elements of the SDF for Greater Kumasi Sub-Region and SP for Greater Kumasi Conurbation. These are tools for implementing the SDF and SP.

Under each sector programme, sub-programmes are prepared. Each sub-programme is composed of several projects and actions.

The following 10 priority projects are identified within the projects composing the infrastructure sector programmes.

- Outer Ring Road Project
- Middle Ring Road Project
- Project for Introduction of Type B Bus and Establishment of BRT System
- Feasibility Study on Water Resources Development for Greater Kumasi Sub-Region
- Project for Expansion of Water Supply Capacity of Barekese Water Treatment Plant
- Project for Effective Use of Existing Distribution Pipes
- Project for Development of Septage Treatment Ponds in Adjoining Districts/Municipalities within Greater Kumasi Sub-Region
- Expansion of Asafo Simplified Sewerage System for CBD Area
- Project for Solid Waste Management Improvement in MDAs Adjoining KMA within Greater Kumasi Sub-Region
- Project for Replacement of Small-Sized Wires and Deteriorated Equipment, and Realignment of Distribution Lines

In this chapter, selected priority projects and actions out of the formulated sub-programmes are shown in the form of profiles of projects and actions. These profiles are important tools for preparing for implementation of necessary projects and actions.

## **22.2 Priority Projects and Actions for Transportation Sector**

### **22.2.1 Outer Ring Road Project**

#### **(1) Background**

The Department of Urban Roads (DUR) proposed the construction of a 70 kilometre long Outer Ring Road based on the Kumasi Transport Study 2005. This will re-direct traffic away from the city centre as well as improving access to the planned dry inland port at Boankra. The Outer Ring Road was expected to enhance the function of the road network to eliminate vehicle flow through urban areas of Kumasi and also to disperse traffic coming into the urban centre.

A project for a feasibility study and preliminary design for the Outer Ring Road was commenced in 2008, but it was stopped because urbanization pressure along the original proposed alignment of the Outer Ring Road made land acquisition and property compensation very difficult.

Considering this situation, the DUR have requested TCPD to revise and select an appropriate corridor for the Outer Ring Road from the viewpoint of future spatial development of the Greater Kumasi Sub-Region.

#### **(2) Objectives of the Project**

- To improve traffic circulation by expanding the capacity of the road network and by removing bottleneck sections of the road network
- To support socioeconomic development of Kumasi and surrounding districts by improving movement of people and goods
- To strengthen socioeconomic integration between Kumasi and surrounding districts and among the districts themselves

#### **(3) Location of the Project**

The engineering route study normally should be conducted at the alignment study level at a scale of 1: 2,500-5,000. But the control checkpoint study could be carried out based on information from the following perspectives:

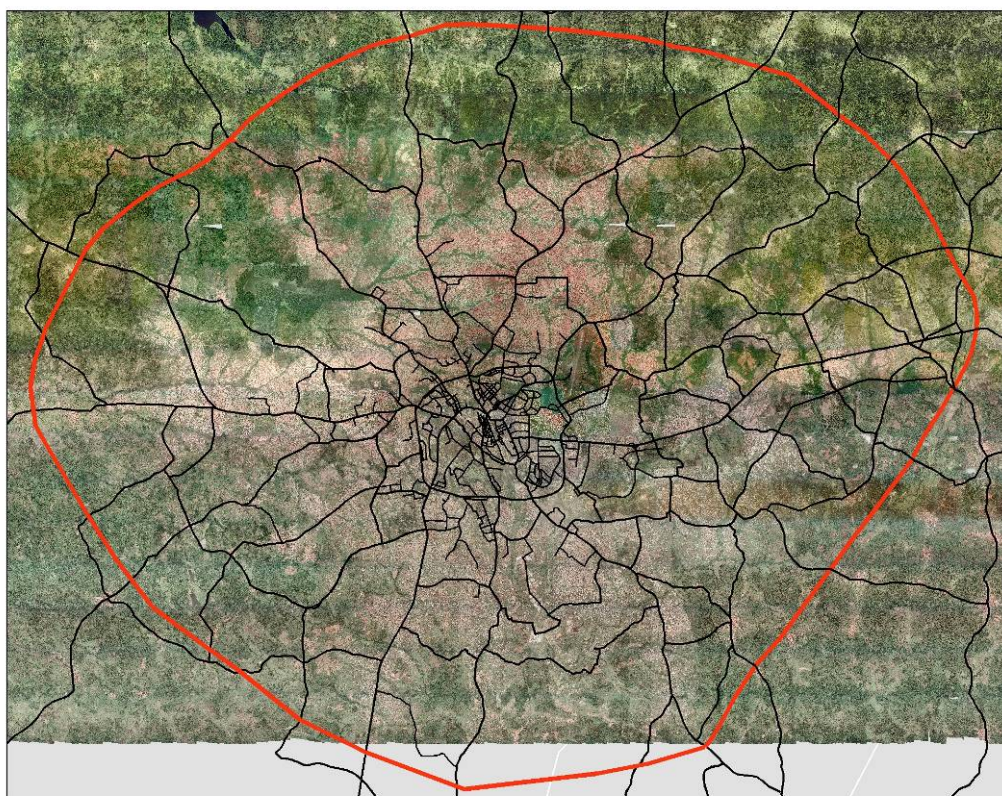
- Future city structure, development plan and land use plan
- Natural conditions (topography, geology, soil, weather)
- Social environmental conditions and impacts (schools, hospitals and other residential areas)
- Natural environmental conditions and impacts (nature conservation area, cultural sites and monuments)
- Public facilities (airports, railway stations, port facilities, radio antenna towers, water reservoirs, power plants and so on)

- Public works Projects (road and rail intersections, housing estates, industrial Parks, other development projects)

An Outer Ring Road route study was carried out by using satellite imagery because detailed topographic maps are not available. After that a field study was carried out to adjust the route and to avoid unnecessary resettlement due to road construction.

The result of route selection for the Outer Ring Road is shown in Figure 22.2.1. The total length is about 98.9 km, located about 15 km radius from the Kumasi centre. The scope of the Outer Ring Road project is summarized as follows:

- Length: 98.9 km
- Design speed: 100 km/h
- No. of driving Lanes: 4 (based on this study's demand forecast)
- No. of Ramps: 11 locations with arterial roads
- Intersection type: roundabout (up to 2033), grade separation (after 2033 depending on future traffic demand)
- Future demand: 8,200 PCU per day in 2033



Source: JICA Study Team

**Figure 22.2.1 Proposed Route of the Outer Ring Road**

#### **(4) Scope of the Project**

##### **1) Road Classification**

The Ghana Highway Authority has jurisdiction over national trunk roads, which are classified into national road, inter-regional road, or regional road base on their

functions.

The Department of Urban Roads (DUR) administers roads in urban areas, which are functionally classified into arterial roads, distributor/collector roads, and small roads.

The road classification system in Ghana is basically a jurisdictional system rather than functional classification and it is not a unique system across road management bodies. From the road planning and engineering viewpoints, it is necessary to clarify the functional classifications and road hierarchy system on roads in Greater Kumasi Sub-Region.

The WB assisted “2011 Kumasi Transport Plan Study” proposed a road functional hierarchy for strategic access routes (national highway), urban corridors, district collectors, local collectors, access roads, and non-motorized (NMT) streets. This JICA Study Team proposed a clearer functional hierarchy system as follows:

- Primary Urban Arterial Road (including National Road, Inter-Regional Road and Regional Road)
- Major Urban Arterial Road (including Urban Corridor)
- Minor Urban Arterial Road
- Urban Collector Road
- Urban Local Road

These roads of the functional hierarchy system are characterized as shown in Table 22.2.1. In this system, the Outer Ring Road is classified as a primary urban arterial road.

**Table 22.2.1 Proposal for Road Functional Hierarchy for Greater Kumasi Sub-Region**

Road Classification	Desired Grid Distance	Access	Transit	Desirable (Minimum) Speed (km/h)
Primary Urban Arterial	5,000m – 10,000m	No plot access, No intersections with local roads	City-wide transit, and link to higher networks, No Non-motorised transits allowed	100 (80) or 80 (60)
Major Urban Arterial	2,000m – 5,000m	No plot access, No intersections with access roads	City-wide transit, and link to higher networks, Non-motorized transits are separated	80 (60)
Minor Urban Road	1,000m – 2,000m	Access to plots and buildings, connection to Local roads	Transit to/from/in city districts. Limited use for city-wide transit traffic	60 (40)
Urban Collector Road	500m – 1,000m	Access to plots and buildings, connection to Access roads	Strongly discourage Motorized transits, by the type of traffic calming measures that are used	40 (30)
Urban Local Road	100m – 500m	Access to plots and buildings	No MT transit and Eliminate MT through-traffic, Can be part of main NMT network	30 (20)

Source: JICA Study Team

## 2) Road Design Elements

The key elements of road design criteria are determined by its design speed from engineering aspects. By reference to the British Standard and Japanese Road Structure Ordinance, design elements are arranged by design speed as shown in Table 22.2.2. The design elements for the Outer Ring Road are those of 100km/h

design speed.

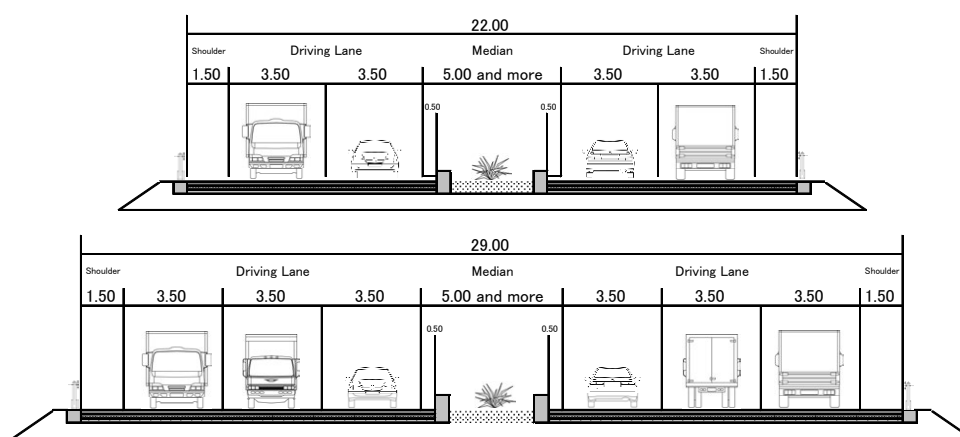
**Table 22.2.2 Road Design Criteria by Design Speed**

Design Speed (km/h)	Minimum curve radius (m)		Maximum longitudinal slope (%)	
	Standard	Exceptional	Standard	Exceptional
120	710	570	2	5
100	460	380	3	6
80	280	230	4	7
60	150	120	5	8
50	100	80	6	9
40	60	50	7	10
30	30	-	8	11
20	15	-	9	12

Source: JICA Study Team

### 3) Standard Cross Section

Ghana does not have his own road design criteria document, the design consultant on road projects has set up their project design criteria and standard road cross section plan by reference to the British Standard. The JICA Study has proposed the following standard cross section plan for the Outer Ring Road as shown in Figure 22.2.2, with reference to the British Standard and Japanese Road Structure Ordinance.



Source: JICA Study Team

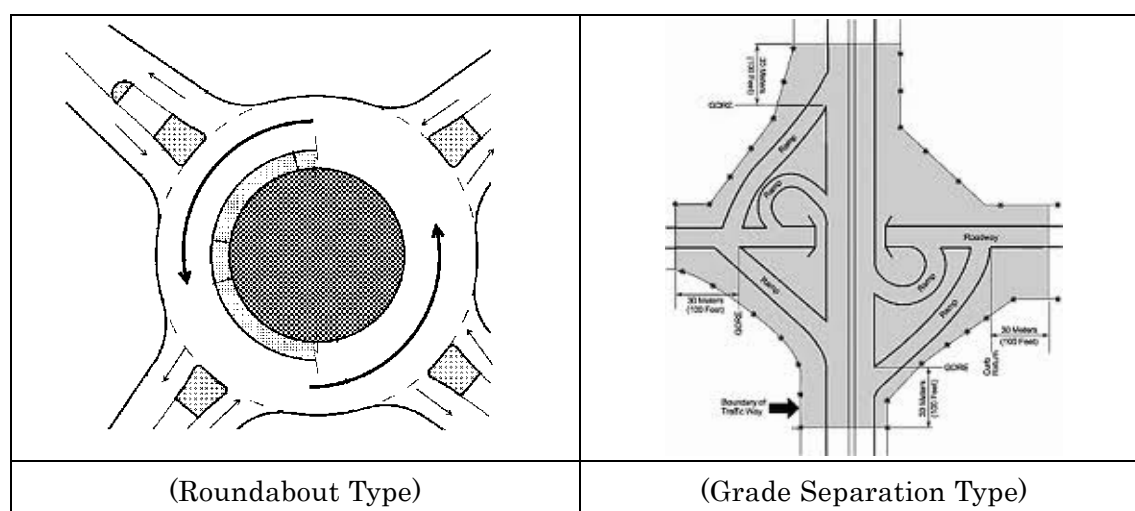
**Figure 22.2.2 Standard Cross Section for Outer Ring Road**

The access road to/from primary arterials and secondary arterial roads will be limited to access from lower hierarchal roads. When primary arterial roads pass through urbanized areas additional service roads along or behind the primary arterial roads should be prepared. Then direct access from urbanized roadsides with primary arterial/ secondary arterial roads can be prohibited. The criteria of the number of driving lanes, 4 or 6 lanes, will be determined based on the forecast traffic demand.

#### 4) Crossing with Other Arterial Roads

The Outer Ring Road is allowed to have junctions with primary arterial and secondary arterial roads. It is not allowed to cross lower hierarchical roads directly, with the only permitted access via service roads. The intersection method with the Outer Ring Road and primary and secondary arterial roads is by a roundabout or grade separation. The choice between a grade separation or roundabout depends on traffic demand, whether or not the hourly traffic volume flowing into the intersection is 2000-2200 PCU per hour.

Judging from the predicted traffic demand estimation conducted in the study, the intersections in short and medium term until 2033 should be roundabouts, the long term after 2033 should be upgraded to a grade separation system. The outer diameter of the roundabout in the case of a total four-lane road, two lanes in both directions is approximately 40-60m.



Source: JICA Study Team from various documents

**Figure 22.2.3 Type of Intersection on Outer Ring Road**

#### (5) Agencies Responsible

- Land Acquisition and Property Resettlement     DUR
- Project Implementation     DUR
- Maintenance     DUR

#### (6) Estimated Cost

- Construction cost: about US\$190.6 million (based on DUR unit cost)

#### (7) Financial Sources Expected

- Land Acquisition and Property Resettlement     DUR
- Project Implementation     DUR with International Organization Aid
- Maintenance     DUR

#### (8) Implementation Schedule

The high-priority section of North-East arc should be constructed by 2023, the South-West Arc by 2028, South-East Arc by 2033, but the North-West Arc will be

installed after 2033 depending on the situation.

	Year				
	2014-2018	2019-2023	2024-2028	2029-2033	2034-
New Outer Ring Road (North-East Arc)					
New Outer Ring Road (North-West Arc)					
New Outer Ring Road (South-West Arc)					
New Outer Ring Road (South-East Arc)					
Legend:		: Implementation			

**(9) Relationship with Other Projects**

- Related land use plans development projects proposed in this Master Plan
- Highway development project, especially the radial road network improvement

**(10) Effects and Evaluation of the Projects**

The Outer Ring Road enhances the function of the road network and to eliminate transit traffic through urban areas of Kumasi and also to disperse incoming traffic to urban centers.

It is also recognized that the importance of constructing the first section of the Outer Ring Road between Ejisu and Kodie to accelerate new development in Mampong and Kodie.

**1) Positive Impacts**

It is expected that travel speed in Kumasi will improve which would be translated into economic gains after the execution of the projects. As a result, it will reduce vehicle-km and vehicle operating cost. Less vehicle km means less source of pollution thus less greenhouse gas emissions. Likewise passengers' hour spent on board the vehicle will also decrease thus they can use the time to more productive activities. The table below presented the likely benefits derived from the projects.

- |                  |  |
|------------------|--|
| Direct Effects   | <ul style="list-style-type: none"> <li>– Improvement of travel speed</li> <li>– Reduction of transport cost</li> <li>– Reduction of traffic accident</li> <li>– Improvement of traveller's amenity and increase of travel's comfort</li> </ul>   |
| Indirect Effects | <ul style="list-style-type: none"> <li>– Transport cost reduction (commodity Prices)</li> <li>– Mitigation of load to environment (traffic pollution)</li> <li>– Facilitating regional development</li> <li>– Settlement of people and increase in population</li> <li>– Expansion of community activities</li> <li>– Improve access to public facilities</li> <li>– Strengthening of exchange and cooperation among districts and city</li> <li>– Growth of production and income</li> <li>– Increase in employment by the growth of production</li> <li>– Increase in revenue by the growth of production</li> </ul> |

**2) Negative Impacts (Land Acquisition, Resettlement, Environment)**

Particular attention should be paid to construction works of new roads. A number of negative impacts such as acquisition of private land, involuntary resettlement,

cutting of trees, slope modification, disruption of service utilities and infrastructures are expected. In essence the following negative impacts are expected thus mitigation measures shall be put in place.

- ROW Acquisition particularly to construction of new roads
- Involuntary Resettlement
- Increase in noise level during construction especially those inside the city center
- Slope modification
- Disruption of service utilities and infrastructures in some cases
- Demolition of structures
- Construction wastes
- Noise due to pile driving
- Dust caused by construction work
- Increased housing requirement for transient workers, and project management staff
- Increased hazards due to construction activities
- Cutting trees

**(11) External Condition**

- Peace and order is maintained
- Responsible agency for implementation and maintenance has sufficient capacity

**(12) Precondition**

- The Project should be committed and kept the necessary fund
- Clear Right of the Way (ROW)
- The development project proposed in this Master plan should be committed and implemented along the schedule

### **22.2.2 Middle Ring Road Project**

**(1) Background**

The imbalance of road development between Kumasi and surrounding districts was noted. Although road connections and road surface are good in Kumasi City Centre (within the Inner Ring Road) and its surrounding areas within KMA, road conditions are bad in the surrounding districts. The road network of neighbouring districts is characterized by deteriorated road surfaces and missing links. Most areas rely on radial arterial roads, since there are no connecting roads between radial roads. Due to the missing links, some areas lacked good access and vehicles are forced to take long routes. Traffic congestion is also prevalent due to convergence of vehicles into limited road network and limited capacity.

To solve this status, the Outer Ring Road project had been proposed in various transportation studies, located 10 km from Kumasi CBD, then a revised route and design criteria were studied. Since the previous route ran over the developed and urbanized area and would have had difficulty with land acquisition, the outer ring road project did not progress.

Considering this situation the Outer Ring Road is newly proposed 20 km from Kumasi CBD. In addition to the inner ring road and the newly proposed Outer Ring

Road, a new circular road should be promoted for a Middle Ring Road for better traffic circulation by upgrading existing roads that can be improved to form a Middle Ring Road.

**(2) Objectives of the Project**

- To improve traffic circulation by expanding the capacity of the road network and by removing bottleneck sections of the road network
- To support socioeconomic development of Kumasi and surrounding districts by improving movement of people and goods
- To strengthen socioeconomic integration between Kumasi and surrounding districts and among the districts themselves

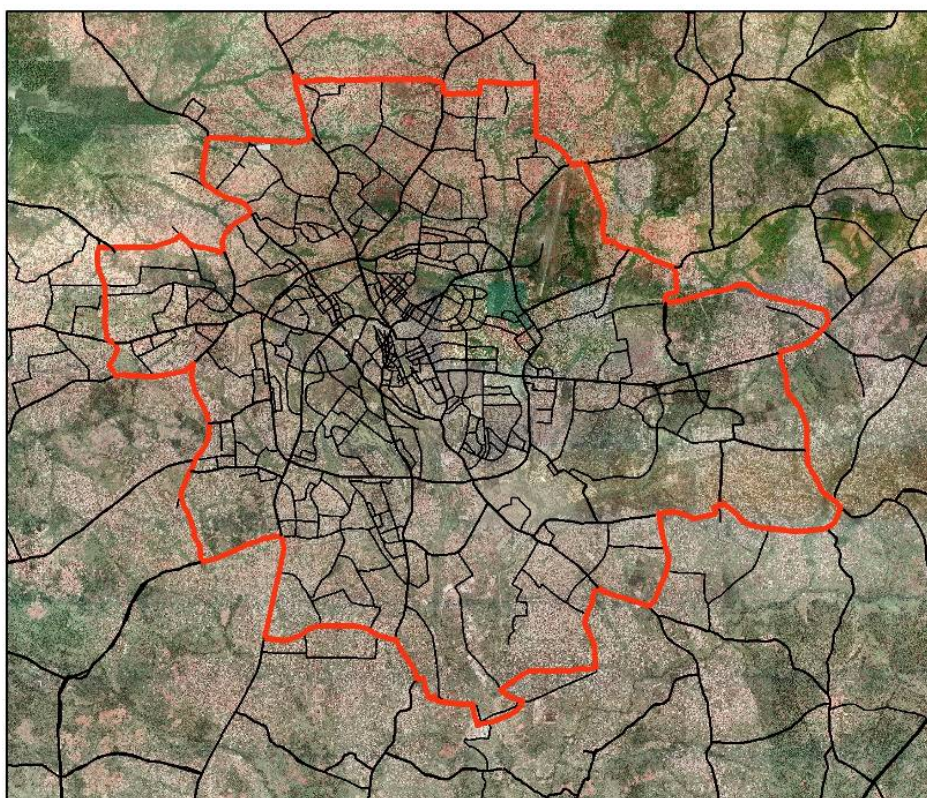
**(3) Location of the Project**

The basic route of the Middle Ring Road entails upgrading of the existing local roads and constructing the missing links between the existing local roads. Throughout the discussions with TCPD and the District planner, the Middle Ring Road route study was carried out using satellite image maps because adequate topographic information is not available. The result of route selection for the Middle Ring Road is shown in blow Figure. The total length is about 48 km located about 10 km from the Kumasi CBD.



Source: JICA Study Team

**Figure 22.2.4 Existing Situation of Middle Ring Road Route**



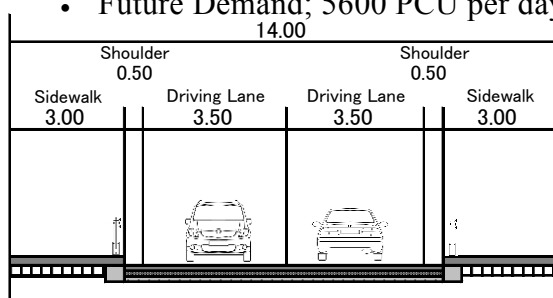
Source: JICA Study Team

**Figure 22.2.5 Proposed Route for Middle Ring Road**

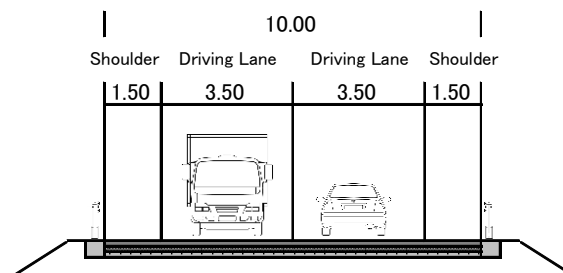
**(4) Scope of the Project**

The Middle Ring Road is defined as a collector road connecting between the radial arterial roads. Based on the road functional classifications shown in Table 22.2.1 and Table 22.2.2, the design criteria and the standard cross section for the Middle Ring Road are proposed as follows.

- Length; 48 km
- Design Speed; 60 km/h
- No. of Driving Lanes: 2
- Intersection Type; Roundabout or signalized with arterial road
- Future Demand; 5600 PCU per day in 2033



(Urbanized Section)



(Un-urbanized Section)

Source: JICA Study Team

**Figure 22.2.6 Proposed Cross Section for Middle Ring Road**

**(5) Agencies Responsible**

- Land Acquisition and Property Resettlement      DUR
- Project Implementation                                      DUR
- Maintenance    DUR

**(6) Estimated Cost**

- Construction Cost; 72 million US\$ (Based on DUR unit cost)

**(7) Financial Sources Expected**

- Land Acquisition and Property Resettlement      DUR
- Project Implementation                                      DUR
- Maintenance    DUR

**(8) Implementation Schedule**

The high-priority section of North-East Arc should be constructed by 2016, the other sections should be constructed by 2023.

**(9) Relationship with Other Projects**

- Related land use plans development projects proposed in this Master Plan
- Highway Development Project, especially the radial road network improvement

**(10) Effects and Evaluation of the Projects**

The Middle Ring road is constructed by upgrading minor local roads to regional roads, which should serve as the connections between major radial roads within a 10 km radius from the city centre. In addition, the Middle Ring Road promotes the better traffic circulation by identifying existing roads that can be improved to form a Middle Ring Road.

**1) Positive Impacts**

It is expected that travel speed in Kumasi will improve which would be translated into economic gains after the execution of the projects. As a result, it will reduce vehicle-km and vehicle operating cost. Less vehicle km means less source of pollution thus less greenhouse gas emissions. Likewise passengers' hour spent on board the vehicle will also decrease thus they can use the time to more productive activities. The list below presented the likely benefits derived from the projects.

- |                  |  |
|------------------|--|
| Direct Effects   | <ul style="list-style-type: none"> <li>– Improvement of travel speed</li> <li>– Reduction of transport cost</li> <li>– Reduction of traffic accident</li> <li>– Improvement of traveller's amenity and increase of travel's comfort</li> </ul>   |
| Indirect Effects | <ul style="list-style-type: none"> <li>– Transport cost reduction (commodity Prices)</li> <li>– Mitigation of load to environment (traffic pollution)</li> <li>– Facilitating regional development</li> <li>– Settlement of people and increase in population</li> <li>– Expansion of community activities</li> <li>– Improve access to public facilities</li> <li>– Strengthening of exchange and cooperation among districts and city</li> </ul> |

- Growth of production and income
- Increase in employment by the growth of production
- Increase in revenue by the growth of production

## **2) Negative Impacts (Land Acquisition, Resettlement, Environment)**

Particular attention should be paid to construction works of new roads. A number of negative impacts such as acquisition of private land, involuntary resettlement, cutting of trees, slope modification, disruption of service utilities and infrastructures are expected. In essence the following negative impacts are expected thus mitigation measures shall be put in place.

- ROW Acquisition particularly to construction of new roads
- Involuntary Resettlement
- Increase in noise level during construction especially those inside the city center
- Slope modification
- Disruption of service utilities and infrastructures in some cases
- Demolition of structures
- Construction wastes
- Noise due to pile driving
- Dust caused by construction work
- Increased housing requirement for transient workers, and project management staff
- Increased hazards due to construction activities
- Cutting trees

### **(11) External Condition**

- Peace and order is maintained
- Responsible agency for implementation and maintenance has sufficient capacity

### **(12) Precondition**

- The Project should be committed and kept the necessary fund
- Clear Right of the Way (ROW)
- The development project proposed in this Master plan should be committed and implemented along the schedule

## **22.2.3 Project for Introducing Type B Bus and BRT System**

### **(1) Background**

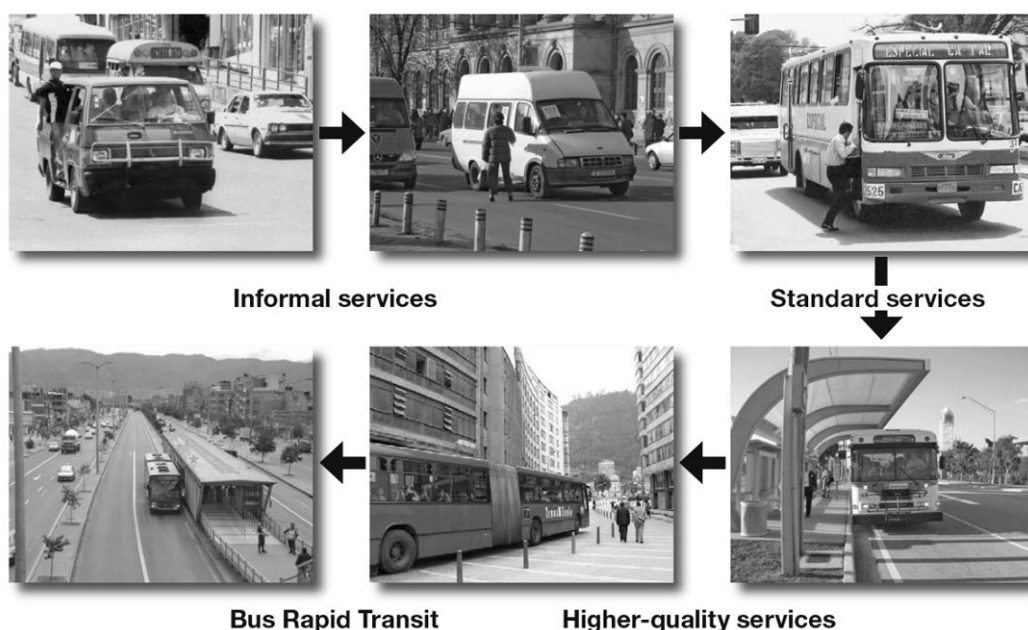
Conventional transit systems can vary significantly in size and quality, even within the same city. Transit service can range from relatively modest van services to bus systems approaching the performance of a BRT system. The quality of public transit can be seen as a spectrum of possibilities ranging from customer unfriendly informal operations to full-feature mass transit systems that achieve mass transit speeds and capacities (Figure 22.2.7) It is worth noting that this spectrum can encompass both road and public transit options. In general, most developing cities should be attempting to move towards higher-quality services. The BRT has provided a means to enter the higher-quality, higher-capacity end of the spectrum but at a substantially

reduced cost in comparison to other options.

**Table 22.2.3 Spectrum of Public Transit Transport Possibilities**

	Informal Transit service	Standard Transit Service (Type A and B Bus)	Higher-quality Transit Service (Hyper Type B Bus)	Bus Rapid Transit (BRT)
Characteristic	Non-regulated operators Taxi-like services Poor quality customer service Relatively unsafe and insecure Very old, smaller vehicles	Publicly-owned Often Subsidised On-board fare collection Stops with basic shelters Relatively infrequent service Older vehicles	Pre-board fare system On-board fare verification Higher quality shelters Marketing Identity	Metro-quality service Closed station Pre-board fare collection and fare verification Modern, clean vehicles Integrated Transfer stations

Source; GTZ, 2007, Bus Rapid Transit



Source: GTZ, 2007, Bus Rapid Transit

**Figure 22.2.7 Public Transport Evolution.**

Mini-buses and vans, both formal and informal, are quite evident in the cities of Ghana. While these services are sometimes of relatively low quality, they often provide transit options for communities with few other choices. Standard bus services encompass the conventional 70 passenger buses (12 metres long). These conventional services are typically safer than informal mini-buses, but nevertheless still are not an attractive, comfortable, or convenient option. The next stage in transit evolution is towards more organised and higher-quality bus services. Such services may feature newer and cleaner vehicles, more sophisticated fare collection systems, bus lanes, and improved stations. Higher-quality conventional bus services, while not BRT, can be a significant improvement for residents. The conventional bus systems have achieved considerable success without the full application of BRT attributes.

## (2) Existing Situation of Public Transport

In Greater Kumasi Conurbation, the public transport services are provided

predominantly by the private sector, which operates a mix of buses, Trotro and taxis. Trotro is defined as an efficient and inexpensive, minibus used for short distance travel. The services being provided are usually unscheduled and often, on demand-responsive routes, filling gaps in informal transit provision, resulting in overcrowding, undependable, and insufficient services. Furthermore the vehicles used for service are old and poorly maintained buses and minibuses. The unreliable nature of public transport services has resulted in the gradual increase in cars, which further congest the roads in the CBD and the major radial roads and worsen air pollution, noise, and safety problems.

This passenger transport is largely provided by private operators that have organized themselves into unions, associations and cooperatives. The Government has also set up the Metro Mass Transit (MMT) Company together with other public sector investors to operate large buses in the cities. These operators largely regulate themselves with very limited input from the assemblies. The Government intends to support the participating assemblies to take over their responsibility to regulate urban passenger transportation.

### **(3) Concept of Type B Bus Scheme**

Urban Passenger Transport Units (UPTUs) in DUR have been set up in both Accra and Kumasi to plan, register, license, monitor and enforce urban public transport operations. An early role has been to collect information on existing routes operated in each city, with the progression to route licensing to move to a planned and regulated public transport network. Type A permits will be given to the operators on existing routes who fulfil the minimum requirements for operations (vehicle roadworthiness, correct driving license etc.). These licenses will be of one year duration.

In addition, an enhanced type of license will be piloted on selected routes exhibiting the appropriate attributes. The Type B license will permit operators using large buses to operate on these high demand corridors, offering higher quality and more efficient public transport on these routes.

The initial steps in the process are to register and rationalise, and determine the best regulatory environment for each route. Operators will require either a Permit Type A or Permit Type B for commercial activities along a route. Initially a Permit Type A is likely to be issued to all eligible operators.

### **(4) Concept of BRT Scheme**

The BRT is a bus-based mass transit system that delivers fast, comfortable, and cost-effective urban mobility. Through the provision of exclusive ROW lanes and excellence in customer service, the BRT essentially emulates the performance and amenity characteristics of a modern rail-based transit system but at a fraction of the cost. While the BRT utilises rubber -tyre vehicles, it has little else in common with conventional urban bus systems. The following is a list of features found on some of the most successful BRT systems implemented to date:

- Exclusive right-of-way lanes
- Rapid boarding and alighting
- Free transfers between lines
- Pre-board fare collection and fare verification
- Enclosed stations that are safe and comfortable
- Clear route maps, signage, and real-time information displays
- Automatic vehicle location technology to manage vehicle movements
- Modal integration at stations and terminals
- Clean vehicle technologies
- Excellence in marketing and customer service

**(5) Location of the Project**

The proposed Type B and BRT network consists of a combination of radial and circumferential routes that together will form a network of routes that cover most major development areas. Due to the capital costs involved in providing the Type B and BRT running-ways and transit terminal /stops, the proposed Type B and BRT network is restricted to major corridors of demand. Based upon the general criterion of hourly peak passenger bi-directional flows greater than 10,000 passengers in 2012 and 2033, and the need to provide an integrated public transport network, the following routes were identified as routes on which the BRT services should operate in an exclusive running-way:

**Table 22.2.4 Proposed Type B Bus and BRT**

Scheme	No	Route Name	2023 Demand Person per day	2033 Demand Person per day	Length (km)	Cost (M\$)
Type Bus	1	Antoa Road Type B Routes	31,500	40,700	8.80	3.68
	2	Mampong Road Type B Routes	160,000	-	8.80	2.18
	3	Offinso Road Type B Routes	177,000	-	8.20	2.12
	4	Abrepo Road Type B Routes	98,600	117,900	7.40	2.04
	5	Sunyani Road Type B Routes	124,000	-	8.30	2.13
	6	Bekwai Road Type B Routes	172,000	-	8.40	3.64
	7	Old Bekwai Type B Routes	111,000	161,400	9.90	2.29
	8	Lake Road Type B Routes	132,000	-	10.40	2.34
	9	Accra Road Type B Routes	179,000	-	15.30	4.38
	10	Orbital Route Type B Route	59,000	-	18.30	7.53
BRT Route	1	BRT Mampong Road	-	208,300	8.80	20.22
	2	BRT Offinso Road	-	240,800	8.20	19.08
	3	BRT Sunyani Road	-	175,000	8.30	19.27
	4	BRT Bekwai Road	-	208,600	8.40	19.46
	5	BRT Accra Road	-	216,100	15.30	34.57
	6	BRT Lake Road	-	156,700	10.40	23.26
	7	BRT Inner Ring Road	-	83,400	7.96	18.30
	8	BRT CBD New Road	-	25,000	1.31	3.00

Source: JICA Study Team



Source: JICA Study Team

**Figure 22.2.8 Location of Type B Bus Route**

## (6) Scope of the Projects

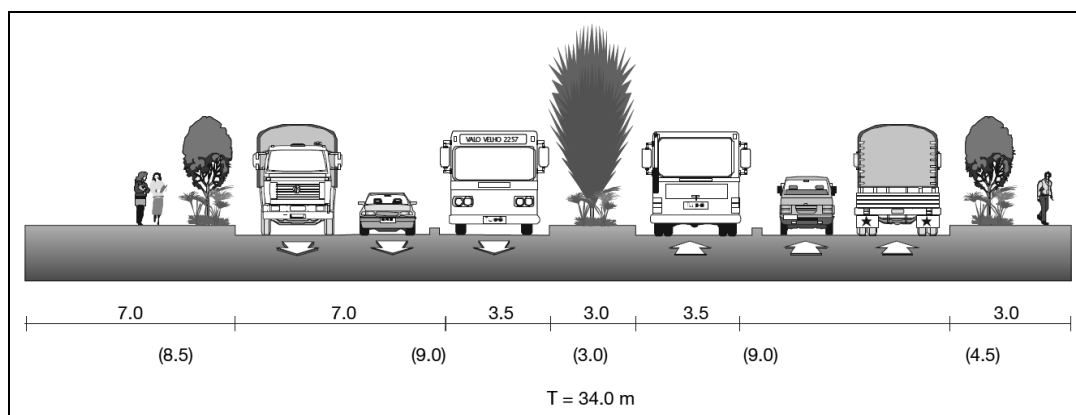
### 1) BRT Busway dimensions

The availability of road space will likely be a significant design consideration in the development of the runway. Providing space for runways, pedestrian and bicycle access areas, and mixed traffic lanes can be a challenge when given the inherent limitations of existing road widths. However, typically solutions can be found for even the most space-limited streets.

Most buses are approximately 2.6 metres in width. To provide safe manoeuvring space for the vehicles, a standard lane of 3.5 metres is typically provided. As lanes narrow, the safe operating speed of the vehicle will likely be reduced. The width of a median station will vary depending on customer flows, but, in general, a median station will range from 2 metres to 5 metres in width. A typical roadway cross-section is presented in Figure 22.2.9.

If sufficient road space is not available to meet a preferred design option, there are still options for municipal officials to consider. Eliminating some mixed traffic lanes may seem politically difficult to achieve, but by doing so, the resulting design

provides a strong incentive for shifting to the new system. Further, the promise of a new, high-quality mass transit system can help stem concerns over reduced space for private vehicles.

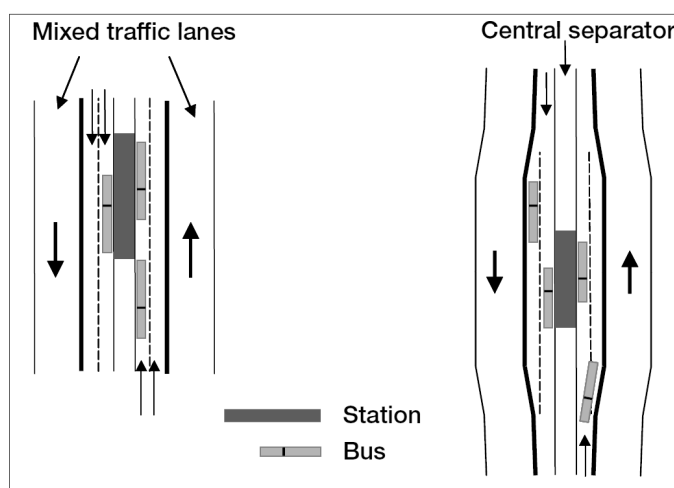


Source: GTZ, 2007, Bus Rapid Transit

**Figure 22.2.9 Typical Roadway Configuration for a Median Busway**

## 2) Passing lanes

With a single busway lane in each direction, a BRT system will reach a capacity limit at approximately 14,000 passengers per hour per direction (pphd). This capacity level can be increased with the platooning of vehicles and multiple stopping bays, but such a configuration is relatively complex to manage and control. Instead, for capacities above 14,000 pphpd the best option may be to consider a passing lane at stations or even a second lane throughout the full corridor as in Figure 22.2.10. By permitting a passing lane at stations, buses can comfortably overtake other buses. Thus, multiple stopping bays and express services can be accommodated with a passing lane. A passing lane also gives a system considerable flexibility in terms of future ridership growth.

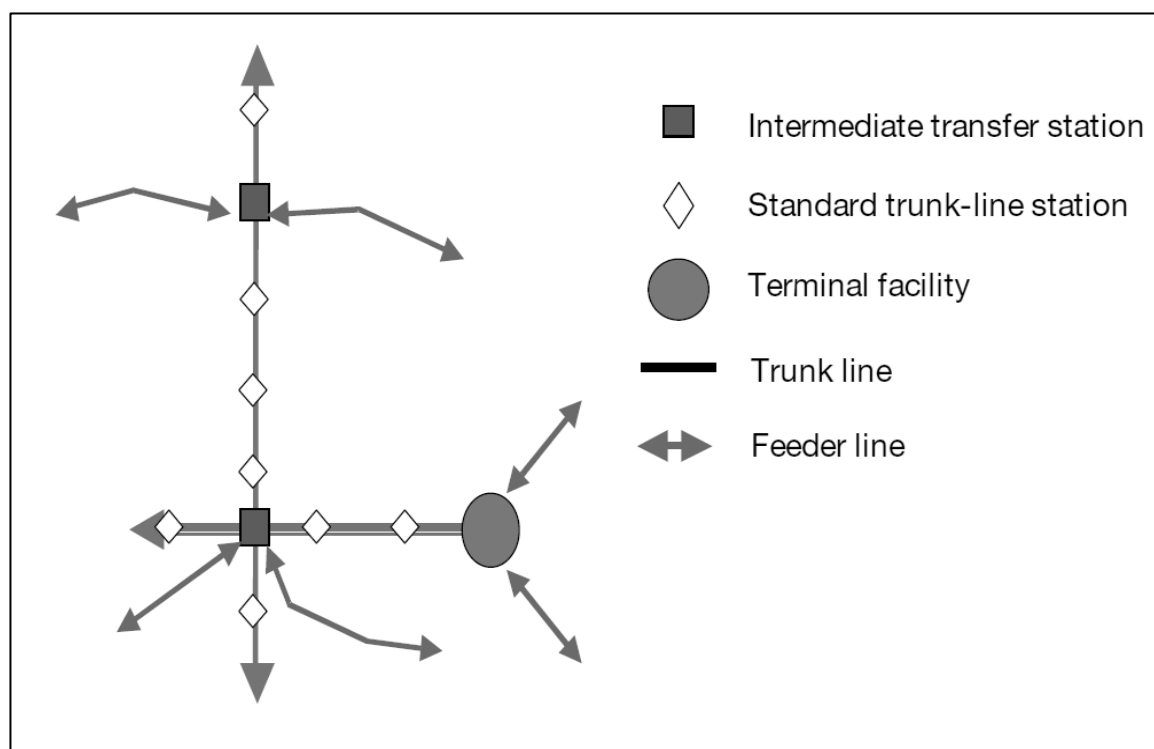


Source: GTZ, 2007, Bus Rapid Transit

**Figure 22.2.10 Provision of Passing Lane System for BRT Stations**

### 3) Transfer Stations Connecting to Feeder Transit Systems

Feeder connections to the trunk lines do not necessarily occur only at major terminal facilities. Feeders can also intersect the trunk corridors at what are known as intermediate transfer stations. These stations are somewhat a hybrid facility between ordinary local stations and terminal facilities. Figure 22.2.11 provides an overview of the relationship between standard stations, intermediate stations, and terminal facilities



Source: GTZ, 2007, Bus Rapid Transit

**Figure 22.2.11 Intermediate Transfer station and Feeder Transit Service**

Unlike terminal sites, intermediate transfer stations may not have the luxury of space to easily accommodate both feeder platforms and trunk-line platforms. Thus, a bit of creativity is required to design and control the transfer process. Ideally, the feeder vehicles can enter a “closed” space in which a fare-free transfer can take place without concerns over fare evasion. However, this ideal is typically not the case. Instead, feeder vehicles arrive from a smaller side street, and passengers must walk from the feeder station to the trunk-line station. A crosswalk or pedestrian bridge will often link the two stations.

#### (7) Agencies Responsible

- |  |                       |
|--|-----------------------|
| • Land Acquisition and Property Resettlement | DUR                   |
| • Project Implementation (Infrastructure)    | DUR                   |
| • Operation (Bus and BRT)                    | Private Bus Operators |
| • Maintenance (Infrastructure)               | DUR                   |
| • Maintenance (Bus and BRT)                  | Private Bus Operators |

**(8) Estimated Cost**

The infrastructure project costs are shown in Table 22.2.4 for each Type B and BRT routes. This does not cover the road widening for Type B bus and BRT routes. This does not cover the cost for bus and BRT vehicles for operation.

**(9) Financial Sources expected**

- Land Acquisition and Property Resettlement      DUR and Local Governments along the Routes
- Project Implementation (Infrastructure)      DUR and Local Governments with International Organization Aids
- Operation (Bus and BRT)      Private Bus Operators
- Maintenance (Infrastructure)      DUR and Local Governments
- Maintenance (Bus and BRT)      Private Bus Operators

**(10) Implementation Schedule**

Type B Bus System should be installing by 2023, and then the BRT routes should be implemented by 2033.

**(11) Relationship with Other Projects**

- Related land use plans development projects proposed in this Master Plan
- The radial road network improvements where are overlapped Type B bus and BRT routes

**(12) Effects and Evaluation of the Projects**

An effective public transit system can underpin a city's progress towards social equality, economic prosperity, and environmental sustainability. By leap-fogging past a car-dependent development path, cities can avoid the many negative costs associated with uncontrolled growth that ultimately disrupts urban coherence and a sense of community.

Table 22.2.5 outlines some of the direct benefits that BRT has provided to developing cities. Beyond these benefits, though, there exist multiplier impacts that can further increase the value of BRT to a municipality. For example, BRT can lead to reduced public costs associated with vehicle emissions and accidents. Such impacts include costs borne by the health care system, the police force, and the judicial system. In turn, by reducing these costs, municipal resources can be directed towards other areas such as preventative health care, education, and nutrition.

**Table 22.2.5 Benefits of BRT**

Category	Description
Economic	<ul style="list-style-type: none"> <li>• Reduced travel times</li> <li>• More reliable product deliveries</li> <li>• Increased economic productivity</li> <li>• Increased employment</li> <li>• Improved work conditions</li> </ul>
Social	<ul style="list-style-type: none"> <li>• More equitable access throughout the city</li> <li>• Reduced accidents and illness</li> <li>• Increased civic pride and sense of community</li> </ul>
Environmental Urban form	<ul style="list-style-type: none"> <li>• Reduced emissions of pollutants that impact on human health (CO, SOx, NOx, particulates, CO<sub>2</sub>)</li> <li>• Reduced noise levels</li> <li>• More sustainable urban form, including densification of major corridors</li> <li>• Reduced cost of delivering services such as electricity, sanitation, and water</li> </ul>
Political	<ul style="list-style-type: none"> <li>• Delivery of mass transit system within one political term</li> <li>• Delivery of high-quality resource that will produce positive results for virtually all voting groups</li> </ul>

Source: JICA Study Team

**(13) External Condition**

- Peace and order is maintained
- Responsible agency and Bus operation companies for implementation and maintenance has sufficient capacity

**(14) Precondition**

- The Project should be committed and kept the necessary fund
- Clear the Right of Way (ROW) for keeping Bus Priority lanes and segregated lanes.
- The development project proposed in this Master plan should be committed and implemented along the schedule
- On-going Bus Licensing system project by DUR and WB should be completed and Bus Company and their operation should be well-organized and unified.

**22.3 Priority Projects and Actions for Water Resources Sector**

**22.3.1 Feasibility Study on Water Resources Development for Greater Kumasi Sub-Region**

**(1) Background, Present Situation and Rationale of the Project**

Greater Kumasi Sub-Region is located on the most upper part of the watershed of Pra River. Consequently the available water resources of both surface water and groundwater are quite limited in Greater Kumasi in terms of the possible volume of water utilization.

The Greater Kumasi Sub-Region depends on 2 dams (Owabi and Barekese) and a number of existing shallow wells and deep boreholes for supplying urban water and

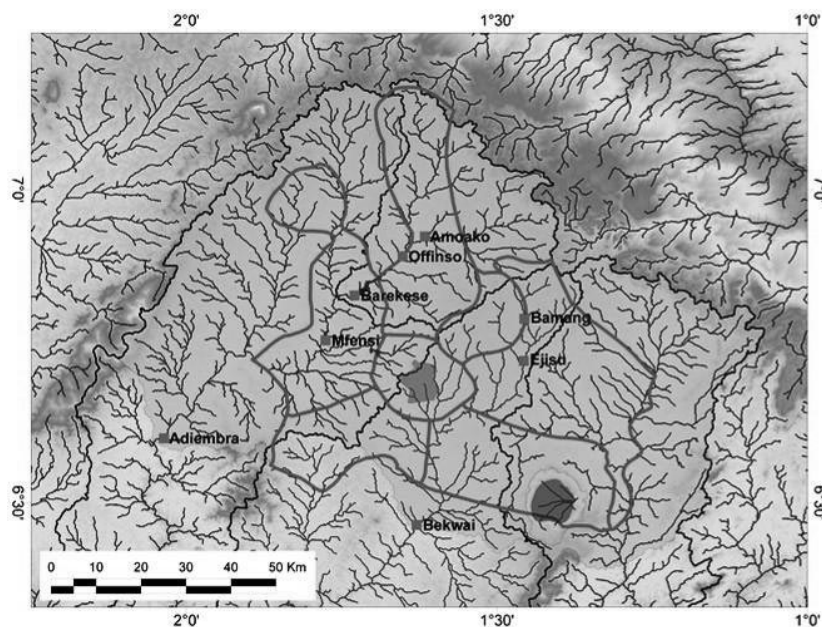
rural water. However, water supply is insufficient in terms of volume and quality at present.

Considering the expected rapid increase in population and increasing water demand per capita, the water supply capacity will be in shortage and unstable to satisfy the increase in water demand. This is because water resources would become insufficient in volume and quality for Greater Kumasi Sub-Region, if the inhabitants in the region continue to depend only on the currently used water resources (surface water from 2 dams and groundwater).

This is because the present heavy and increasing utilization of groundwater without proper monitoring would create a risky and unstable situation of groundwater utilization in the future, considering topographical positions that Greater Kumasi Sub-Region occupies the upper streams of rivers and the capacity of groundwater resources is limited.

Moreover, the data on river water discharge is sparse in that the period of data collection is not long enough and the locations of stations for river water discharge too few to scientifically prepare water resources development plans.

It is clear that water resources should be developed somehow by finding new water sources for Greater Kumasi Sub-Region in the future. Therefore, it is necessary to conduct a full-scale feasibility study on water resources development for Greater Kumasi Sub-Region, based on field data collection on surface water and groundwater.



Source: JICA Study Team

**Figure 22.3.1 Location Map of Existing Hydrological Stations**

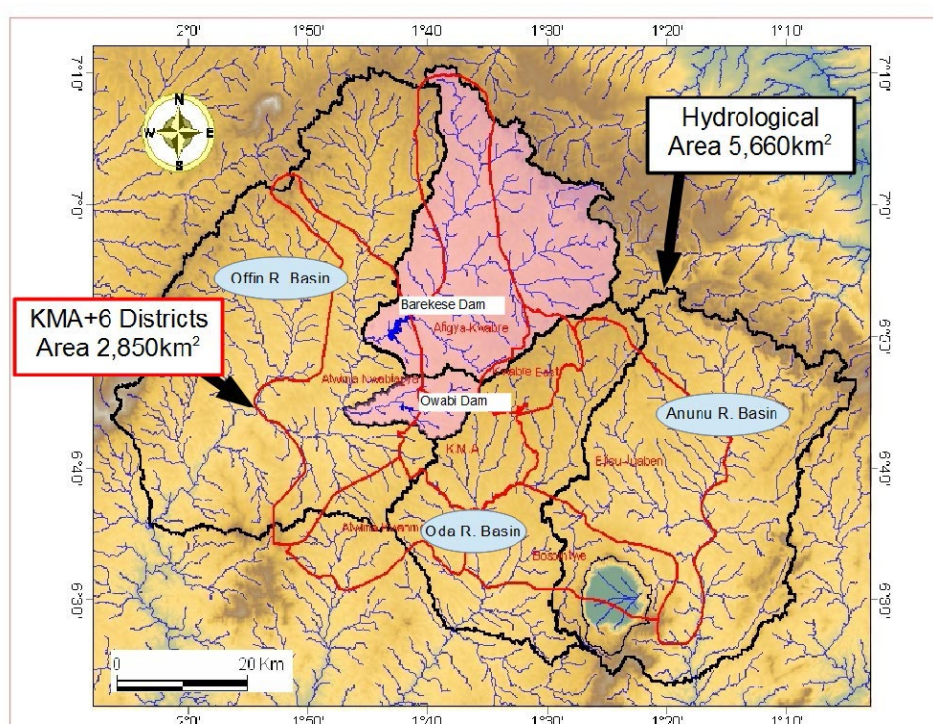
**(2) Objectives of the Project**

- To obtain more hydrological data for planning of water resources development during the study project

- To examine the water balance between water demand and water supply considering both surface water and groundwater resources
- To identify additional surface water sources to be developed, such as those by constructing new dams
- To prepare a basic design for surface water sources development
- To prepare necessary actions to mitigate impacts of water resources development on the natural and social environments

### (3) Study Area for the Project

The study should not only cover the administrative areas of MMDAs of the Greater Kumasi Sub-Region, but also the hydrological areas in relation to the Greater Kumasi Sub-Region.



Source: JICA Study Team

**Figure 22.3.2 Study Area for the Proposed Feasibility Study**

### (4) Scope of the Project

A feasibility study on water resources development should be conducted in order to design plans to satisfy future demand for water supply in the Greater Kumasi Sub-Region. The feasibility study should cover the following items:

- Hydrological measurement of surface water and groundwater
- Clarification of water budget in and around the Greater Kumasi Sub-Region
- Topographic and geological investigation for candidate dam sites
- Basic design of Dams and appurtenant works
- Consideration of social and environmental impacts and preparation of mitigation measures for social and environmental impacts

- Economic and financial analyses for examining economic and financial feasibility

The necessary surveys are as follows:

- Topographical & geological surveys around the candidate dam sites and reservoir sites

In order to conduct the study to recommend appropriate usage of groundwater in terms of volume and location, it is essential to collect data regarding current groundwater usage by the following:

- Inventory of existing boreholes
- Monitoring of groundwater levels and groundwater quality (monthly)
- Recording of the volume of groundwater extracted from each borehole
- Hydrogeological survey to clarify the aquifer conditions in the designated areas (using electrical prospecting methods)

**(5) Agencies Responsible**

Ghana Water Company Limited under the Ministry of Water Resources, Works and Housing

**(6) Estimated Cost**

US\$ 3 million

**(7) Financial Sources Expected**

GOG should prepare the financial source.

**(8) Implementation Schedule**

Prior to the conducting of the main items of this feasibility study, the hydrological monitoring should be started first and continued for at least for 5 years (for example, 2014-2018) in order to accumulate the basic hydrological data. That is, other study items in the feasibility study should be conducted after the hydrological data has been accumulated.

**(9) Relationship with Other Projects**

GWCL undertook the Master Plan for Kumasi Water Capacity Extension, whose final report was issued in December 2010, which includes a pre-feasibility study on some new surface water sources. However, this 2010 master plan study did not use the results of the 2010 population and housing census. As a result, the 2010 master plan study was based on greatly underestimated future populations.

The above proposed feasibility study can be regarded as a supplemental and updated version of the 2010 master plan in respect to the component for water resources development.

## **22.4 Priority Projects and Actions for Water Supply Sector**

### **22.4.1 Project for Effective Use of Barekese Water Treatment Plant**

#### **(1) Background, Present Situation and Rationale**

##### **1) Background**

The water treatment capacity of the existing facilities is not able to provide sufficient water supply. Moreover, it will not be able to supply water for the rapidly growing populations. In the future, the water supply situation will become worse in Greater Kumasi Conurbation.

On the other hand, the Barekese dam reservoir has had its original water storage capacity greatly reduced due to sedimentation. The Barekese Water Treatment Plant currently only has the capacity to treat about 60% of the volume of water that could be provided by the Barekese dam reservoir.

Therefore, immediate action is necessary for urgent increase in the water supply.

##### **2) Existing and Future Situation**

The present capacities of Barekese dam reservoir and Water Treatment Plant are about 180,000m<sup>3</sup>/day and 136,500m<sup>3</sup>/day respectively. The average per capita water consumption for domestic household use is estimated to be just 20 litres per day.

If Barekese dam and Water Treatment Plant are not improved and expanded in the future, the average water consumption must decrease due to the increase in population growth.

If this project is implemented the capacity of Barekese water treatment plant will be increased to about 218,400m<sup>3</sup>/day. The average per capita water consumption for domestic household use is predicted to rise to 40-50 litres per day.

##### **3) Rationale of the Project**

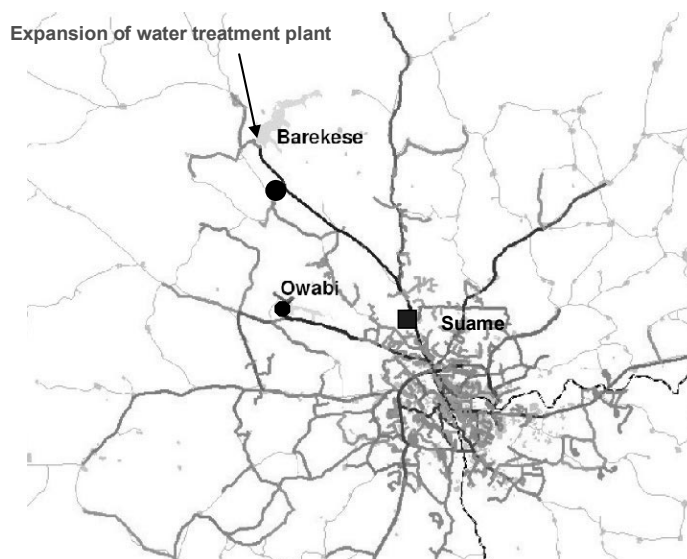
The current piped water supply area covers the CBD and high density population areas. These areas will continue to develop as residential areas and as a main commercial area. Therefore, stable water supply to these areas is essential for the development of Greater Kumasi Sub-Region.

#### **(2) Objectives of the Project**

- To upgrade the water supply capacity in response to an increasing water demand.
- To supply water in response to increasing water demand

**(3) Location of the Project**

- The location of the Barekese Dam and Water Treatment Plant is shown below.



Source: JICA Study Team

**Figure 22.4.1 Location of Barekese Dam and Water Treatment Plant**

**(4) Scope of the Project**

- Feasibility study, basic design services
- Detailed design, tendering and contracting services
- Dredging of the reservoir for Barekese Dam
- Construction of water treatment modules at Barekese Water Treatment Plant

**(5) Agencies Responsible**

- Project Implementation: Ghana Water Company Lt. (GWCL)
- Operation: Ghana Water Company Lt. (GWCL)
- Maintenance: Ghana Water Company Lt. (GWCL)

**(6) Estimated Cost**

- Dredging: GHC 36.0 million
- Construction:
  - Water treatment modules: GHC 41.0 million
- Total Cost: GHC 77.0 million

**(7) Financial Sources Expected**

Basically, it should be carried out by funding of GWCL. However, the construction of the fifth module used funding from the Netherlands. Considering this situation it is considered that funding from donor agencies is necessary.

**(8) Implementation Schedule**

	2013	2014	2015	2016	2017	2018
Dredging	□					
		■				
Water treatment module	□					
			■			

□

Lead time (feasibility study, basic design, financial arrangement, detailed design, tendering and contracting)

■

Construction/ implementation

**(9) Relationship with Other Projects**

- This project is the first step in order to achieve a stable water supply. For further stable water supply, other projects are necessary such as rehabilitation and replacement of aged pipes and construction of new water tanks.

**(10) Effects of the Project**

**1) Target Beneficiaries:**

- The 1.9million residents that live in existing piped water supply area in year 2013.
- The 2.7million residents that will live in the existing piped water supply area in year 2023.

**2) Effects:**

- Increase in the number of residents who are able to obtain clean water from a water supply pipeline.
- Increase in water consumption volume per capita

**(11) Evaluation of the Project**

**1) Economic Viability**

Although no economic analysis has been done, it is expected that the Project is economically viable because of the great amount of benefits that are expected through the increase in the water volume available for non-domestic as well as domestic use.

**2) Financial Soundness**

In order to improve the financial soundness, it is desirable to carry out the other projects such as rehabilitation and replacement of aged pipes and installation of water meters.

**3) Environmental Impacts**

- Positive Impacts
  - Improvement of the sanitary living environment
  - Decrease in waterborne infections
- Negative Impacts
  - Deterioration of water quality of water bodies due to increase of non-treated grey water

**(12) External Conditions**

- Peace and order is maintained.
- Responsible agency for operation and maintenance has sufficient capacity.

**(13) Preconditions**

- Disposal site for dredged sand is assured.
- Necessary fund is prepared.

**22.4.2 Effective Use of Existing Distribution Pipes Project**

**(1) Background, Present Situation and Rationale**

**1) Background**

The water supply capacity of existing facilities is insufficient due to population growth and changes in demand. In the future, it will not be able to respond further.

On the other hand, Non-revenue water is currently in the magnitude of 35%. One of the causes of NRW is pipe breaks. This means that 35% of the clean water produced has been wasted.

Therefore, it is necessary to take immediate action for reduction of NRW by replacing the existing distribution pipes.

**2) Existing and Future Situation**

In Kumasi it is observed that there are bursts in which pipe breaks of diameters greater than 7.6cm occur every two and one half days and leaks in which pipe breaks of diameters less than 7.6cm occur every other day.

In the future, the frequency of pipe breaks will increase due to the increase in the proportion of aged pipes.

The target of ratio of NRW is 10% by replacing aged pipes.

**3) Rationale of the Project**

The current piped water supply area covers the CBD and high density population areas. These areas will continue to develop as residential areas and as a main commercial area. Therefore, stable water supply to these areas is essential for the development of Greater Kumasi Sub-Region.

**(2) Objectives of the Project**

- To correspond to the increase in water demand.
- To provide water supply

**(3) Location of the Project**

Existing piped water supply area

**(4) Scope of the Project**

- Investigation of causes of NRW
- Replace pipelines based on the investigation results

- Replace aged pipelines

**(5) Agencies Responsible**

- Project Implementation: GWCL
- Operation: GWCL
- Maintenance: GWCL

**(6) Estimated Cost**

- Construction:
  - Replacement of small-diameter pipes: GHC 13.9mil.
  - Replacement of large-diameter pipes: GHC 48.4 mil.
- Total Cost: GHC 62.3 mil.

Note: Replacement volume is estimated in this study. So as a result of further investigation, the amount of pipes to be replaced is likely to increase or decrease significantly.

**(7) Financial Sources Expected**

Basically, it should be carried out through the funding of GWCL.

On the other hand, some support for Ghana water supply system from China and US is planned for replacement and renewal of the distribution systems. Therefore, the appropriate use of these funding sources is preferred.

**(8) Implementation Schedule**

	2013-15	2016-18	2019-23	2024-28
Investigation	□			
Replacement of small-diameter pipes		■		
Replacement of large-diameter pipes			■	

□

Lead time(financial arrangement, feasibility study, basic design, detailed design, tendering contracting)

■

Construction/Implementation

**(9) Relationship with Other Projects**

This project is important in order to achieve a stable water supply. For further stable water supply, the other projects are necessary such as the expansion of water treatment plant modules in Barekese and installation of transport lines to the Suame water tank from Barekese water treatment plant.

**(10) Effects of the Project**

**1) Target Beneficiaries:**

- The 1.9million residents that live in the existing piped water supply area in year 2013.
- The 2.7million residents that will live in the existing piped water supply area in year 2023.

**2) Effects:**

- Increase in the number of residents who are able to obtain clean piped water.
- Increase in the water consumption volume per capita
- Increase in revenue by reduction of NRW

**(11) Evaluation of the Project**

**1) Economic Viability**

Although no economic analysis has been done, it is expected that the Project is economically viable because a great benefit is expected whereby the volume of non-domestic water use is increased as well as the domestic use.

**2) Financial Soundness**

- No financial problem is anticipated.
- Reduction of NRW will increase the revenue, so the financial situation of GWCL would be improved.
- In order to improve the financial soundness, it is desirable to carry out the other projects such as the expansion of the water treatment plant modules in Barekese and installation of transport lines to the Suame water tank from Barekese water treatment plant.

**3) Environmental Impacts**

- Positive Impacts  
Improvement of the sanitary living environment  
Decrease in waterborne infections
- Negative Impacts  
Deterioration of water quality of water bodies due to increase of non-treated grey water  
Traffic restrictions and congestion will be expected in the construction period for the replacement of distribution pipelines.

**(12) External Conditions**

- Peace and order is maintained.
- Responsible agency for operation and maintenance has sufficient capacity.

**(13) Preconditions**

- Documentation is required to verify the status of the existing pipes.
- Necessary fund is prepared.

**22.5 Priority Projects and Actions for Liquid Waste Treatment Sector**

**22.5.1 Project for Development of Septage Treatment Ponds in Adjoining Districts/Municipalities within Greater Kumasi Sub-Region**

**(1) Background, Present Situation and Rationale**

Oti septage treatment pond is the only facility to treat septage in Greater Kumasi Sub-Region. The septage treatment pond was constructed under the Urban

Environmental Sanitation Project in 2004.

The capacity of Oti septage treatment plant is 600m<sup>3</sup>/day (assuming 300m<sup>3</sup>/day of septage and 300m<sup>3</sup>/day of leachate).

An average daily generation volume of septage per capita is assumed to be 0.15 litres/capita/day. Based on this figure the future septage amounts are estimated as shown in the table below.

**Table 22.5.1 Future Septage Volume in Year 2033**

Unit: ton/day

	2013	2018	2023	2028	2033
KMA	349	415	482	523	577
Afigya-Kwabre	21	24	29	33	39
Kwabre East	18	21	24	26	33
Ejisu-Juaben	23	26	30	50	66
Bosomtwe	15	17	20	22	25
Atwima Kwanwoma	14	16	19	22	30
Atwima-Nwabiagya	23	27	31	32	38

Source: JICA Study Team

When the percentage of toilet facilities is still high like in Greater Kumasi, septage treatment ponds are more desirable than the modern sewerage system, because construction costs for septage treatment ponds are relatively low.

Due to the rapid population growth in the future, the amount of septage generated is expected to increase rapidly in Greater Kumasi Conurbation. Then the amount of septage generated will exceed the capacity of Oti septage treatment pond.

At present, septage generated from adjoining districts and municipalities are transported to Oti septage treatment pond through KMA. Vacuum trucks passing through Kumasi City cause problems such as odour.

Therefore, construction of septage treatment ponds in the districts and municipalities is also useful for the improvement of the urban environment.

Considering the above conditions, it is recommended to construct new septage treatment ponds in each district/municipality.

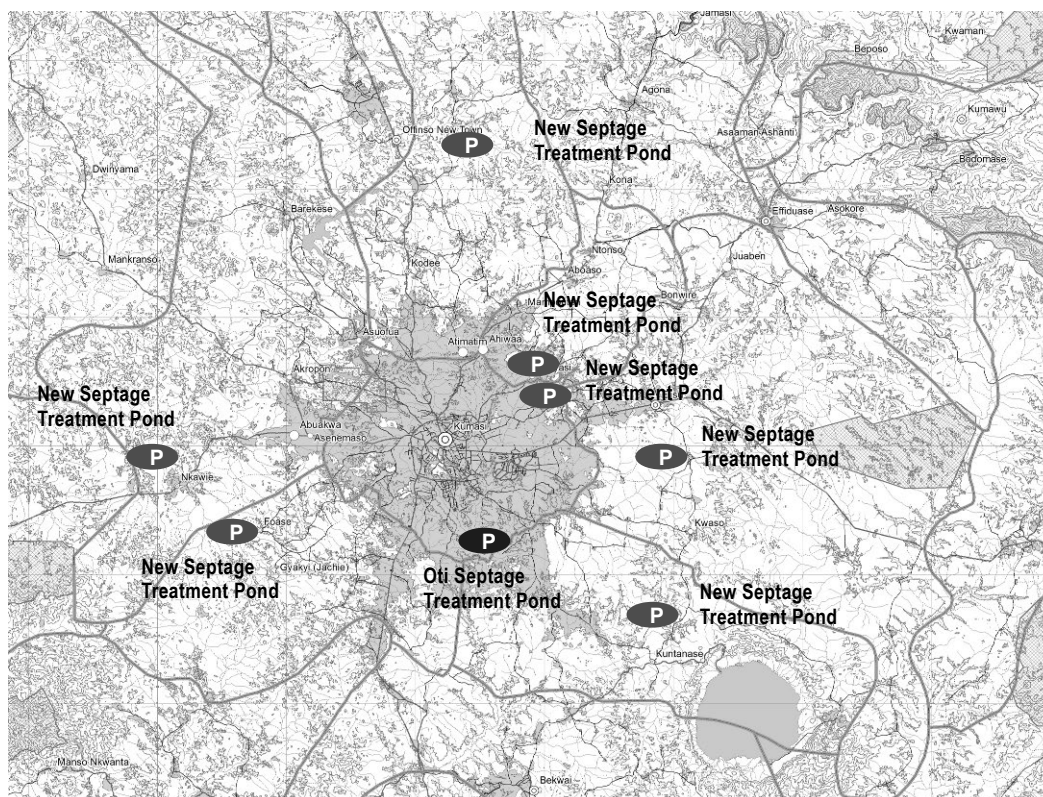
It is also recommended that the septage treatment pond should treat leachate generated from solid waste final disposal sites, like Oti septage treatment pond.

**(2) Objectives of the Project**

- To create a clean living environment in Greater Kumasi Conurbation
- To provide a hygienic environment in Greater Kumasi Conurbation
- To reduce the occurrence of infectious diseases caused by uncontrolled liquid waste

### (3) Location of the Project

The sites for the project are located in suburban areas of the districts and municipalities as shown in the figure below.



Source: JICA Study Team

**Figure 22.5.1 Locations of Proposed Septage Treatment Ponds**

### (4) Scope of the Project

- Feasibility study including site selection of septage treatment ponds and basic design<sup>1</sup>
- Land acquisition
- Detailed design, tendering and contracting
- Construction of new septage treatment ponds and small-scale final land fill sites

### (5) Agencies Responsible

- Project Implementation: Works Department (WD) of District/Municipality
- Operation: Works Department (WD) of District/Municipality
- Maintenance: Works Department (WD) of District/Municipality

### (6) Estimated Cost

- Planning and Design: GHC 0.65 million
- Construction: Afigya-Kawbre : GHC 1.04 million

<sup>1</sup> Sites proposed for new septage ponds are still tentative. The site selection should be done considering the SDF for Greater Kumasi Sub-Region and SP for Greater Kumasi Conurbation.

Kwabre East:	GHC 0.89 million
Ejisu-Juaben:	GHC 1.76 million
Bosomtwe:	GHC 0.67 million
Atwima Kwanwoma:	GHC 0.80 million
Atwima-Nwabiagya:	GHC 1.01 million
• Subtotal Cost of Construction:	GHC 6.17 million
• Total Cost:	GHC 6.82 million

### (7) Financial Sources Expected

The land acquisition and construction of septage treatment ponds should be financed by each District Assembly. However, the capacity development for planning and management of the liquid waste treatment should be assisted by national-level government agencies and/or development partners.

### (8) Implementation Schedule

	2013	2014	2015	2016	2017	2018
Development of Septage Treatment Ponds in Adjoining Districts/Municipalities	[Lead time]		[Construction/implementation]			

[Lead time]

Lead time (financial arrangement, feasibility study, basic design, detailed design, tendering and contracting)

[Construction/implementation]

Construction/implementation

### (9) Relationship with Other Projects

This project (construction of septage treatment ponds) is related to the project of construction of solid waste final disposal sites in adjoining districts/municipalities.

### (10) Effects of the Project

#### 1) Target Beneficiaries

Residents living in Greater Kumasi Conurbation

#### 2) Effects

- Improvement of sanitary living environment
- Creation of clean areas in suburban portions of adjoining districts and municipalities

### (11) External Conditions

- Peace and order is maintained.
- Responsible agency for operation and maintenance has sufficient capacity.

### (12) Preconditions

- Suitable land is secured for new septage treatment pond.
- Necessary fund is prepared.

## 22.5.2 Expansion of Asafo Simplified Sewerage System for CBD Area

### (1) Background, Present Situation and Rationale

The Asafo simplified sewerage system which collects wastewater (black water) from the Asafo community including some hotels and educational institutions was constructed in 1994. The collected wastewater is treated by stabilization ponds in Asafo. The location of the stabilization ponds is shown in Figure 22.5.2.



Source: JICA Study Team

**Figure 22.5.2 Location of Asafo Stabilization Pond**

At present, the Asafo simplified sewerage system covers part of the city centre area (the CBD area) including 300 households, 6 hostels, 5 transport associations, 6 public toilets, 4 educational institutions and 6 hotels.

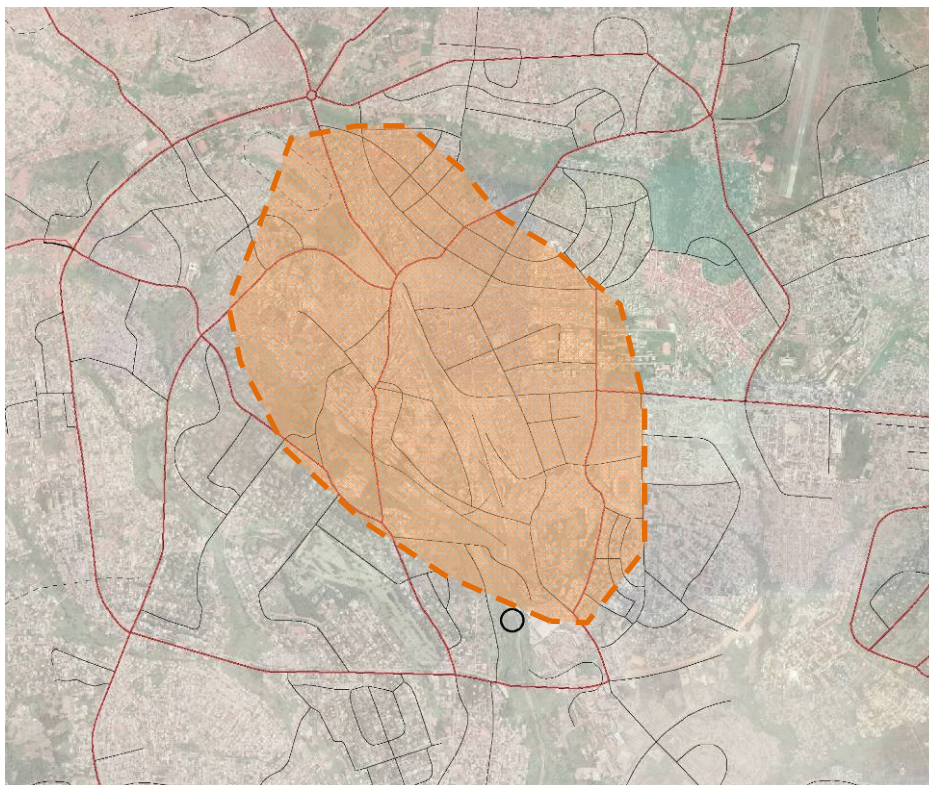
In accordance with the Greater Kumasi Sub-Regional SDF and Conurbation SP, the CBD will be expanded to enhance the urban functions in terms of quality and quantity. The new expanded CBD will have more space and accumulation of advanced urban functions. In response to this CBD expansion and upgrading, it is necessary to expand the capacity of the existing Asafo Simplified Sewerage System to provide sewerage services to the proposed new expanded CBD area of Kumasi City Centre.

### (2) Objectives of the Project

- To create a clean city centre
- To provide a hygienic environment
- To reduce the occurrence of infectious diseases caused by uncontrolled liquid waste

### (3) Location of the Project

The location of the project is around the proposed new CBD area



Source: JICA Study Team

**Figure 22.5.3 Location of Expanded Coverage by the Simplified Sewerage System**

### (4) Scope of the Project

- Capacity Development for Planning and Management of Liquid Waste Treatment
- Feasibility study and basic design
- Detailed design
- Construction of new sewerage pipes and expansion of Asafo stabilization ponds

### (5) Agencies Responsible

- Project Implementation: Waste Management Department of KMA
- Operation: Waste Management Department of KMA
- Maintenance: Waste Management Department of KMA

### (6) Estimated Cost

- Construction:                   GHC 22 mil.

### (7) Financial Sources Expected

Basically, the capital investment for the project should be carried out by KMA. On the other hand, the maintenance of the sewerage system should be done by using fees collected for the sewerage services.

**(8) Implementation Schedule**

	2013	2014	2015	2016	2017	2018
Expansion of Asafo simplified sewerage system						

Lead time (financial arrangement, feasibility study, basic design, detailed design, tendering and contracting)

Construction/Implementation

**(9) Relationship with Other Projects**

This simplified sewerage system project is to serve flush toilets, which require stable piped water supply. More water than at present should be supplied to houses and institutional buildings for proper operation of the simplified sewerage system. That is why that this project is closely related to the projects for improving and upgrading the water supply.

**(10) Effects of the Project**

**1) Target Beneficiaries:**

The residents and visitors in the CBD

**2) Effects:**

- Improvement of the sanitary environment
- Creation of a clean city

**(11) External Conditions**

- Peace and order is maintained.
- Responsible agency for operation and maintenance has sufficient capacity.

**(12) Preconditions**

- It is feasible to use the land on the south side of the existing Asafo stabilization pond for stabilization pond expansion.
- Necessary fund is prepared.

**22.6 Priority Projects and Actions for Solid Waste Management Sector**

**22.6.1 Project for Solid Waste Management Improvement in MDAs Adjoining KMA within Greater Kumasi Sub-Region**

**(1) Background, Present Situation and Rationale**

**1) Background**

A contiguously urbanizing area centring on Kumasi (Greater Kumasi Conurbation) is expanding beyond the boundary of KMA.

The present waste treatment system mostly depending on private service providers should be improved systematically. In particular, MDAs adjoining KMA will need to play more important roles in solid waste management in the Greater Kumasi Sub-Region.

It is necessary to enhance the institutional capacity of the Environmental Health Departments of MDAs in respect to solid waste management, including the formulation of 3R (reduce, reuse, recycle, a composting plan for pilot areas, and formulation of the final small-scale sanitary landfill sites.

## 2) Present Situation and Future Projection for SWM of the MDAs

Present major characteristics and issues to be addressed on solid waste management (SWM) for the MDAs adjacent to KMA are summarized in Table 22.6.1.

**Table 22.6.1 Summary of Present Situation of MDAs Adjoining KMA in Greater Kumasi Sub-Region**

Assembly	Afigya-Kwabre District	Kwabre East District	Ejisu-Juaben Municipality	Bosomtwe District	Atwima Kwanwoma District	Atwima Nwabiagya District
Population(2010)	136,140	115,556	143,762	93,910	90,634	149,025
Waste generation	61 t/day	52 t/day	65 t/day	42 t/day	41 t/day	67 t/day
Collection & transport system	Communal container collection only	Communal container collection only	Communal container collection only	Both house-to-house/communal collection	Both house-to-house/communal collection	Both house-to-house/communal collection
Collection rate	45 %	62 %	59 %	78 %	60 %	26 %
Open dump site	Most communities have an open dump site.					
Final disposal site	No existing final disposal site (the last dump site was fully closed in 2011)	1 existing open dump site (1.5 ha)	2 existing open dump sites (one is almost full, and the other is far from the centre of the municipality)	1 existing open dump site (2 ha)	1 existing open dump site (1 ha)	3 existing open dump sites (2 are almost full, the other far from the centre of the district)
Waste disposal to final landfill	27 t/day	40 t/day	43 t/day	29 t/day	26 t/day	22 t/day
MRF/ Recycling	So far no plan					
For Future Greater Kumasi	Adequate final disposal site is required.					

Source: JICA Study Team

As shown in the table, current collection rates of solid waste in the MDAs are estimated to be more than 26% and the amounts of waste disposed vary from 20 to 40 t/day among the MDAs. Open dump sites are presently the major method at the community level. However, disposed wastes are not properly controlled or managed at the open dump sites.

The future collection rates and waste amounts during the periods between 2013 and 2033 are projected as shown in Table 22.6.2. The amount of waste generation is projected to increase from 429 t/day in 2013 to 2,049 t/day in 2033.

**Table 22.6.2 Collection Rates and Waste Amounts Generated in MDAs in the Future (2013-2033)**

MDAs/ Target Year	2013	2018	2023	2028	2033
<b>Afigya Kwabre District/</b> Collection rate (%)	45	59	73	86	100
Total waste generated (t/day)	79	127	204	293	389
<b>Kwabre East District /</b> Collection rate (%)	62	72	82	92	100
Total waste generated (t/day)	73	117	186	267	355
<b>Ejisu-Juaben Municipality/</b> Collection rate (%)	59	70	80	90	100
Total waste generated (t/day)	86	143	238	347	461
<b>Bosomtwe District/</b> Collection rate (%)	78	83	89	95	100
Total waste generated (t/day)	53	81	124	175	233
<b>Atwima Kwanwoma District/</b> Collection rate (%)	60	71	81	91	100
Total waste generated (t/day)	51	80	125	178	237
<b>Atwima Nwabiagya District/</b> Collection rate (%)	26	45	64	82	100
Total waste generated (t/day)	87	139	221	315	419
Greater Kumasi Sub-Region Waste amount generation in MDAs (t/day)	<b>429</b>	<b>686</b>	<b>1,099</b>	<b>1,575</b>	<b>2,094</b>

Source: JICA Study Team

### 3) Rationale of the Project

In the 6 MDAs adjoining KMA within Greater Kumasi Sub-Region, solid waste has not been properly treated, resulting in a poor hygienic environment. In order to improve the existing hygienic environment in the MDAs, it is necessary to upgrade the capacity of the Environmental Health Department of the MDAs, especially for the purpose of strengthening of 3R, composting by preparation of SWM plans, and small-scale sanitary landfill plans including the land acquisition process for the landfills.

#### (2) Objectives of the Project

To improve the environmental sanitation condition in MDAs Adjoining KMA by providing proper solid waste management

#### (3) Location of the Project

6 MDAs: Afigya Kwabre District, Kwabre East District, Ejisu-Juaben Municipality, Bosomtwe District, Atwima Kwanwoma District and Atwima-Nwabiagya District in Grater Kumasi Sub-Region



← Composting & Recycling Waste Movement    ⊗ : Oti Sanitary Landfill    □ : Proposed Site

Source: JICA Study Team

**Figure 22.6.1 Location of KMA & Adjoining MDAs**

**(4) Scope of the Project**

To conduct capacity development on solid waste management for Environmental Health Departments of MDAs Adjoining KMA through conducting the following tasks on solid waste management:

- To formulate a 3R (reduce, reuse, recycle) and composting plan for pilot areas in MDAs Adjoining KMA
- To prepare a Solid Waste Management (SWM) plan for Adjoining MDAs
- To implement IEC campaign on SWM in MDAs, and
- To prepare development plans for small-scale sanitary landfill sites including a land acquisition process for the landfill sites

**(5) Agencies Responsible**

- Project Implementation: 6 MDAs of Greater Kumasi Conurbation and Ministry of Local Government and Rural Development (MLGRD)
- Operation: MDAs-EHD
- Maintenance: MDAs-EHD

**(6) Estimated Cost**

- Personnel Cost: US\$ 1.5 million
- Direct Expenses: US\$ 1.7 million

- Total Cost: US\$ 3.2 million

**(7) Financial Sources Expected**

International or foreign agencies are expected to assist in the funding.

**(8) Implementation Schedule**

Action Programmes	Phasing for Spatial Developing Planning																				
	Short-Term Plan Phase					Mid-Term Plan Phase					Long-Term Plan Phase					Extra Long-Term Plan Phase					
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
<b>Enhancement of SWM Unit of EHD, MMDAs especially MDAs</b>																					
1-1 Formulation of 3R (reduce, reuse, recycling) & Composting Implementation Plan	-	-	-	-	-																
1-2 Implementation of 3R & Composting Plan																					
1-3 Preparation of MDAs SWM Plans																					
1-4 Implementation of IEC Campaign on SWM																					
1-5 Capacity Development																					
1-6 Preparation of Small-Scale Sanitary Landfill Plan with land acquisition process for landfills																					
Remarks																					
* Target Year of SDF (2013 - 2033) 20 years	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	▼
* Target Year of SP (2013 - 2033) 15 years	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	▼

Sources: JICA Study Team, 2012

Notes: Kumasi Composting and Recycling Plant (KCRP), Bosomtwe District Assembly (BDA), Municipality and Districts Assemblies (6 MDAs) Spatial Development Frameworks (SDF), Structure Plan (SP), Environmental Health Department (EHD), Information Education and Communication (IEC)

**(9) Relationship with Other Projects**

This project on SWM is one of the preconditions for implementing urban and industrial development programmes and infrastructure sector programmes under the Comprehensive Urban Development Plan for Greater Kumasi Sub-Region, such as transportation, water resources/ water supply, sewerage, and electricity supply.

**(10) Effects of the Project**

**1) Target Beneficiaries**

The whole population of 1,917,000 in the 6 MDAs in year 2033

**2) Effects**

- Formation/induction of the planned solid waste management framework for the MDAs
- Formation of a 3R & compost plan for pilot areas
- Implementation of the formulated 3R & composting plan for pilot areas
- Implementation of IEC campaign on SWM and capacity development of MDA-EHD
- Preparation of small-scale sanitary landfill plans and a land acquisition process for the landfills

**(11) Evaluation of the Project**

**1) Economic Viability**

Although no economic analysis has been done, it is expected that the Project is economically viable because a great many benefits are expected to accrue from

environmental sanitation in the MDAs.

## **2) Financial Soundness**

No financial problem is anticipated.

## **3) Environmental Impacts**

### **a) Positive Impacts**

- Betterment of the urban and rural environment
- Improvement of environmental sanitation with proper solid waste management for residents
- Improvement in the health environment due to cleanliness and proper SWM

### **b) Negative Impacts**

- Increase in unhealthy environments such as uncleanness, unhygienic environment, liquid and air pollution as a result of improper SWM (This will be mitigated by improvement of proper solid waste management by the Project)

## **(12) External Conditions**

- Peace and order are maintained.
- Responsible agency for operation and maintenance has sufficient capacity.

## **(13) Preconditions**

- Prohibition and closure of illegal open dump sites.
- Safety measures for scavengers at final disposal sites.

## **22.7 Project for Replacement of Small-Sized Wires and Deteriorated Equipment, and Realignment of Distribution Lines**

### **(1) Background, Present Situation and Rationale**

#### **1) Background**

The total power generation capacity of Ghana is about 2,000MW as of year 2012 and generation capacity will be increased to 4294 MW by 2021. This generation capacity will exceed the forecast electricity demand of 2021. And the capacity of 116kV transmission lines and bulk supply points (BSP) will be able to cover the increased demand.

From the above BSPs, 33kV sub-transmission lines are distributed in Greater Kumasi Sub-Region.

However, at present in Kumasi and its adjoining suburban areas, the reliability of power supply is low, and technical power loss is high due to deteriorated distribution lines/equipment and employing smaller-sized distribution wires than required.

#### **2) Present Electrical Power Supply (Existing and Future Traffic Situation)**

In 2011, approximately 900 power outages caused by distribution line breakdowns

were recorded<sup>2</sup> and the power loss of ECG/NED in 2008 was about 25%<sup>3</sup>. The power loss is one of the critical issues in Ghana.

### **3) Rationale of the Projects**

Reliable/stable power supply is one of the essential infrastructures to achieve sustainable socio-economic development of Greater Kumasi Sub-Region. This reliable and stable power supply should be achieved at first in the already urbanized areas in order to satisfy basic human needs for urban people. The improved situation of electricity supply by this project could also attract private investments to the economic sectors of Greater Kumasi.

#### **(2) Objectives of the Project**

- To reduce the number of power outages in KMA and its adjoining suburban areas
- To reduce power loss in KMA and its adjoining suburban areas

#### **(3) Location of the Project**

KMA and its adjoining suburban areas of the Greater Kumasi Sub-Region

#### **(4) Scope of the Project**

- Feasibility study and basic design
- Detailed design, tendering and contracting
- Replacement of small-sized overhead wires with proper-sized wires
- Realignment of distribution lines to meet the ECG standard.
- Replacement of deteriorated equipment

#### **(5) Agencies Responsible**

- Project Implementation: ECG
- Operation: ECG
- Maintenance: ECG

#### **(6) Estimated Cost**

- Detailed Design & Supervision Cost: USD 0.96 million
- Construction:
  - Replacement of small size overhead wires: USD 1.57 million
  - Realignment of distribution lines: USD 0.39 million
  - Replacement of deteriorated equipment: USD 1.17 million
- Total Cost: USD 4.09 million

#### **(7) Financial Sources Expected**

Basically, this project should be funded by ECG. However, since the current electricity prices are set at a relatively low level by the government, the financial situation of ECG is not good. Therefore, in order to improve the situation of basic needs, it is urgently necessary to rehabilitate the existing deteriorated electricity

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<sup>2</sup> ECG

<sup>3</sup> Energy Commission Annual Report

supply infrastructures by utilizing financial (including grant aid) and technical assistances from development partners.

**(8) Implementation Schedule**

	2013	2014	2015	2016	2017	2018	2019
Key Project			—————				
					—————		

————— Lead Time (Financial arrangement, feasibility study, basic design, detailed design, tendering and contract construction/implementation)  
 ————— construction/implementation

**(9) Relationship with Other Projects**

No other project

**(10) Effects of the Project**

**1) Target Beneficiaries:**

The whole population in Greater Kumasi of 3.5 million in year 2018

**2) Effects:**

- The number of power outages is reduced leading to productivity improvement.
- Operation time of private emergency generators is reduced leading to oil saving.
- By reducing power loss, the following effects are expected:
  - Reduction of energy loss
  - Lower operation cost and increased revenue

**(11) External Conditions**

- Peace and order is maintained.
- Responsible agency for operation and maintenance has sufficient capacity.

**(12) Preconditions**

- Distribution line right-of way is secured.
- Squatters and trees within the right-of-way are removed.
- Necessary fund is prepared.

## **Chapter 23 High Priority Projects for the Infrastructure Sector**

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### **23.1 Selection of High Priority Projects**

Each infrastructure sector programme consists of several sub-programmes. Each sub-programme is composed of two or more projects. Out of the projects composing the 6 infrastructure sector programmes, 10 priority projects are identified as shown in Chapter 22. .

Out of the 10 priority projects, 3 projects are selected as high priority projects, so that economic and financial evaluation is conducted for the 3 selected projects.

This selection of high priority projects is done using the following criteria:

- The cost for implementing the project is relatively greater than other projects.
- There have been no committed funds available for implementing the project.
- The project is neither for planning studies nor for capacity development.
- The executive agency for the project has adequate implementation capacity.
- The project is mature and ready for implementation.

The following 3 projects that satisfy these conditions are selected for economic and financial evaluation:

- Outer Ring Road Project
- Middle Ring Road Project
- Project for the Expansion of the Water Supply Capacity of Barekese Water Treatment Plant

### **23.2 Economic and Financial Analysis for High Priority Projects**

#### **23.2.1 Project for Expansion of Barekese Water Treatment Plant**

##### **(1) Presumption of Economic Evaluation**

The costs and benefits are calculated as the differences between “with” and “without” the Project. The “with” case denotes a situation of how to correspond to an increase in water demand and to provide the water supply to the residents. While, in the “without” case nothing is done and the current situation continues into the future. The share of piped water and other sources is unchanged.

##### **1) Water Consumption Volume**

The estimated consumption volume for “With” and “Without” cases are shown in

Table 23.2.1 and 23.2.2.

**Table 23.2.1 Estimated Consumption Volume “With” Case**

Consumption Group	Year 2013	Year 2018	Year 2023	Year 2028	Year 2033
Domestic Piped Water	38,400	53,900	54,900	53,400	53,100
Non-Domestic Consumers	21,100	29,700	30,200	29,400	29,200
Total (m <sup>3</sup> /day)	59,500	83,600	85,100	82,800	82,300

**Table 23.2.2 Estimated Consumption Volume “Without” Case**

Consumption Group	Year 2013	Year 2018	Year 2023	Year 2028	Year 2033
Domestic Consumers	38,400	38,400	38,400	38,400	38,400
Non-Domestic Consumers	21,100	21,100	21,100	21,100	21,100
Total (m <sup>3</sup> /day)	59,500	59,500	59,500	59,500	59,500

Source: JICA Study Team

## 2) Evaluation Period

The evaluation Period is assumed to be 30 years from 2014 to 2044.

## 3) Estimated Benefit

### Affordability to Pay and Willingness to Pay

Benefit estimation is to be derived from affordability to pay or willingness to pay in this study. The ratio of domestic of water consumption cost in the household budgets is 3% so that the monthly affordability to pay for this sector in households is GHC 13.6/month. This figure is derived based on the expected level of per capita water use, 130 litre/day, in accordance with the “Strategic Investment Programme (SIP)”. However, current realistic supply volume is only 60 litre/capita/day so that the assumption of affordability to pay is GHC 6.3/month, which is used in the base calculation for affordability to pay to compare with the existing tariff rate.

On the hand, industrial or commercial businesses (non-domestic water) also consume a huge amount of water. The calculation shall be done the same as in the Master Plan in Chapter 14.5. In order to obtain a reliable supply of water, the companies and factories would consider to pay, “Willingness to Pay”, 1.75 times the current water bill.

## 4) Estimation of Economic Cost

The capital investment cost of the project is estimated as described in Table 23.2.3. A conversion factor of 0.85 is assumed.

Operational cost and maintenance cost are also estimated based on the “Master Plan for Kumasi Water Capacity Extension” of December, 2010. Maintenance cost for dredging is estimating based on Table 13.5.1 in Chapter 13. And operational cost is GHC 0.66 of the revenue of GHC1.0.

**Table 23.2.3 Economic Cost of Investment**

(GHC Thousand)

Project	Financial Cost	Conversion Factor	Economic Cost
Water Resources			
Dredging of Barekese and Owabi Dam Reservoirs	36,000	0.85	30,600
Maintenance Cost of Dredging	93,000	0.85	79,050
Water Supply			
Extension of water treatment plant modules in Barekese	41,000	0.85	34,850

Source: JICA Study Team

### 5) Result of Economic Analysis

The analysis flow projection based on the above assumptions is presented in Table 23.2.4. The priority project has an EIRR of 15.2%. The NPV of the project is GHC 36 million using a 12% discount rate. The project is economically feasible in the current projection. However, expenses of O & M contained a great deal of uncertain data. Thus, a feasibility study will be required.

**Table 23.2.4 Benefit-Cost Stream Flow of Barekese Water Treatment Plant Project**

Unit: GHc 1,000

Year	Benefit	Cost		Cost Total C	Benefit Total B	B-C	Dis. Cost (12%)	Dis. Benefit (12%)	Dis. B-Dis. C (12%)
		O & M	Investment						
2014	0	17,103	12,070	29,173	0	-29,173	29,173	0	-29,173
2015	0	17,103	12,070	29,173	0	-29,173	26,048	0	-26,048
2016	0	17,103	12,070	29,173	0	-29,173	23,257	0	-23,257
2017	0	17,103	12,070	29,173	0	-29,173	20,765	0	-20,765
2018	0	17,103	12,070	29,173	0	-29,173	18,540	0	-18,540
2019	52,954	18,357	5,100	23,457	52,954	29,498	13,310	30,048	16,738
2020	53,225	19,610		19,610	53,225	33,615	9,935	26,965	17,030
2021	53,495	20,863		20,863	53,495	32,632	9,437	24,198	14,761
2022	53,765	22,116		22,116	53,765	31,649	8,932	21,715	12,782
2023	54,035	23,370		23,370	54,035	30,666	8,427	19,486	11,058
2024	54,306	23,258		23,258	54,306	31,048	7,488	17,485	9,997
2025	53,889	23,146		23,146	53,889	30,744	6,654	15,492	8,838
2026	53,473	23,034		23,034	53,473	30,439	5,912	13,725	7,813
2027	53,057	22,922		22,922	53,057	30,135	5,253	12,159	6,906
2028	52,641	22,810		22,810	52,641	29,831	4,667	10,771	6,104
2029	52,225	22,785		22,785	52,225	29,440	4,163	9,541	5,379
2030	52,133	22,759		22,759	52,133	29,373	3,713	8,504	4,791
2031	52,041	22,734		22,734	52,041	29,307	3,311	7,579	4,268
2032	51,949	22,709		22,709	51,949	29,240	2,953	6,755	3,802
2033	51,857	22,683		22,683	51,857	29,174	2,634	6,021	3,387
2034	51,765	22,658		22,658	51,765	29,107	2,349	5,366	3,017
2035	51,765	22,633		22,633	51,765	29,133	2,095	4,791	2,697
2036	51,765	22,607		22,607	51,765	29,158	1,868	4,278	2,410
2037	51,765	22,582		22,582	51,765	29,183	1,666	3,820	2,153
2038	51,765	22,556		22,556	51,765	29,209	1,486	3,410	1,924
2039	51,765	22,531		22,531	51,765	29,234	1,325	3,045	1,720
2040	51,765	22,506		22,506	51,765	29,259	1,182	2,719	1,537
2041	51,765	22,480		22,480	51,765	29,285	1,054	2,427	1,373
2042	51,765	22,455		22,455	51,765	29,310	940	2,167	1,227
2043	51,765	22,430		22,430	51,765	29,335	838	1,935	1,097
2044	51,765	22,404		22,404	51,765	29,361	748	1,728	980
	1,364,460	666,514	65,450	731,964	1,364,460	632,497	230,126	266,133	36,007

B / C	1.1565
EIRR %	15.20
NPV (GHc)	36,007

## (2) Financial Analysis

“The Dredging of Barekese and Extension of Water Treatment Plant Modules in Barekese” is a high priority to satisfy basic human needs. Financial analysis has therefore been undertaken to determine the financial viability of the project. The following form part of the assumptions:

- An identified possible source of funding is not considered,
- The current tariff structures and levels (both domestic and non-domestic) have been analysed,
- Total water demand will be considered as the consumption amount,
- A detailed financial projection and analysis will be conducted to examine the financial viability of the proposed project; and the Financial Internal Rate of Return (FIRR) will be calculated.

### 1) Financial Costs

Financial costs of the project are summarized in Table 23.2.5. Operational cost and maintenance cost were also estimated based on the calculation of economic cost in the above section.

**Table 23.2.5 Financial Costs of Barekese Water Treatment Plant Project**

(GHC Thousand)

Description	Cost	Remarks
Capital Investment Cost	77,000	See Table 23.5.3
Operation and Maintenance cost	93,000	

Source: JICA Study Team

### 2) Result of Financial Analysis

Revenue from households is assumed in accordance with total water demand for the piped water system. The computed Financial Internal Rate of Return (FIRR) for the project is 13.77%. The value of project is financially feasible in current projections. However, the assumptions of revenue and expenses for O & M contain a great deal of uncertain data so that the study team indicated the figure is only preliminary. Thus, a feasibility study will be required.

The cash flow projection based on the above assumptions is presented in Table 23.2.6.

**Table 23.2.6 Financial Flow of Barekese Water Treatment Plant Project**

Unit: GHc 1,000

Year	Revenue	COST		COST TOTAL C	Revenue TOTAL B	B-C	Dis. Cost (12%)	Dis. Benefit (12%)	Dis. B-Dis. C (12%)
		O & M	Investment						
2014	25,942	20,122	14,200	34,322	25,942	-8,380	34,322	25,942	-8,380
2015	25,942	20,122	14,200	34,322	25,942	-8,380	30,644	23,163	-7,482
2016	25,942	20,122	14,200	34,322	25,942	-8,380	27,361	20,681	-6,680
2017	25,942	20,122	14,200	34,322	25,942	-8,380	24,430	18,465	-5,965
2018	25,942	20,122	14,200	34,322	25,942	-8,380	21,812	16,487	-5,325
2019	28,176	21,596	6,000	27,596	28,176	580	15,659	15,988	329
2020	30,410	23,070	0	23,070	30,410	7,339	11,688	15,407	3,718
2021	32,644	24,545	0	24,545	32,644	8,099	11,103	14,766	3,664
2022	34,878	26,019	0	26,019	34,878	8,858	10,509	14,086	3,578
2023	37,111	27,494	0	27,494	37,111	9,618	9,914	13,383	3,468
2024	36,912	27,362	0	27,362	36,912	9,550	8,810	11,885	3,075
2025	36,712	27,230	0	27,230	36,712	9,482	7,828	10,554	2,726
2026	36,513	27,099	0	27,099	36,513	9,414	6,956	9,372	2,416
2027	36,314	26,967	0	26,967	36,314	9,347	6,180	8,322	2,142
2028	36,114	26,835	0	26,835	36,114	9,279	5,491	7,390	1,899
2029	36,069	26,805	0	26,805	36,069	9,263	4,897	6,590	1,692
2030	36,024	26,776	0	26,776	36,024	9,248	4,368	5,876	1,509
2031	35,979	26,746	0	26,746	35,979	9,233	3,895	5,240	1,345
2032	35,933	26,716	0	26,716	35,933	9,217	3,474	4,673	1,199
2033	35,888	26,686	0	26,686	35,888	9,202	3,098	4,167	1,068
2034	35,843	26,656	0	26,656	35,843	9,187	2,763	3,716	952
2035	35,798	26,626	0	26,626	35,798	9,171	2,465	3,313	849
2036	35,753	26,597	0	26,597	35,753	9,156	2,198	2,955	757
2037	35,707	26,567	0	26,567	35,707	9,140	1,960	2,635	674
2038	35,662	26,537	0	26,537	35,662	9,125	1,748	2,349	601
2039	35,617	26,507	0	26,507	35,617	9,110	1,559	2,095	536
2040	35,572	26,477	0	26,477	35,572	9,094	1,391	1,868	478
2041	35,527	26,448	0	26,448	35,527	9,079	1,240	1,666	426
2042	35,481	26,418	0	26,418	35,481	9,064	1,106	1,486	379
2043	35,436	26,388	0	26,388	35,436	9,048	986	1,325	338
2044	35,391	26,358	0	26,358	35,391	9,033	880	1,181	302
	1,047,172	784,134	77,000	861,134	1,047,172	186,039	270,736	277,024	6,288

B / C	1.0232
FIRR %	13.77
NPV (GHc)	6,288

## 23.2.2 Middle Ring Road Improvement Project

### (1) Presumptions of Economic Analysis

The costs and benefits are calculated as the differences between “with” and “without” the Project. The “with” case denotes a situation of how the road conditions could be improved as given in the revised Master Plan Network or Projects. While in the “without” case there is no change in the current situation.

#### 1) Evaluation Period

Evaluation period is assumed to be 30 years from 2019 to 2049

The following benefits are estimated:

- Saving in vehicle operation costs (VOC)
- Saving in travel time costs

## 2) Estimation of Economic Cost

The financial cost of the project is estimated at GHC 18.1 million in total. In this study the economic cost was estimated by deducting government taxes and import duty from the financial cost so that a conversion factor of 0.85 was assumed. Hence, the total economic cost is estimated at GHC 15.38 million as shown in Table 23.2.7.

Maintenance cost is also added to economic cost. The study team assumed 5% capital cost every year and 20% rehabilitation cost for each road every ten years.

**Table 23.2.7 Economic Cost of Middle Ring Road Project**

(Unit: GHC Thousand)

Project	Financial Cost	Conversion Factor	Economic Cost
Road Network Scheme	18.100	0.85	15,385
Routine Maintenance Cost (per year)	905	0.85	769
Rehabilitation Cost (in ten years)	3,620	0.85	3,077

Source: JICA Study Team

## (2) Economic Analysis of the Proposed Roads

The economic analysis of the improvement of the Middle Ring Road was made based on the above mentioned benefits and costs estimation. Table 23.2.8 shows the benefit cost stream. The results of the economic analysis show a Net Present Value (NPV) of GHC 276 million and BCR of 17.4 over the 30 year life of the road using a discount rate of 12%. The Economic Internal Rate of Return (EIRR) is calculated at 45.1% which indicates that the high priority project is economically feasible.

The benefits from this project are great and cost can be reduced by upgrading the existing unpaved roads that are in poor condition. Moreover, generated traffic will arise from the saturated condition of the radial roads because this road improvement makes a journey more attractive as a result of travel cost and time reduction.

**Table 23.2.8 Benefit-Cost Stream Flow of Middle Ring Road**

Unit: GHc 1,000

Year	Benefit	Cost		Cost Total C	Benefit Total B	B-C	Dis. Cost (12%)	Dis. Benefit (12%)	Dis. B-Dis. C (12%)
		O & M	Investment						
2019			3,077	3,077	0	-3,077	3,077	0	-3,077
2020			3,077	3,077	0	-3,077	2,747	0	-2,747
2021			3,077	3,077	0	-3,077	2,453	0	-2,453
2022			3,077	3,077	0	-3,077	2,190	0	-2,190
2023			3,077	3,077	0	-3,077	1,955	0	-1,955
2024	4,551	769		769	4,551	3,782	436	2,583	2,146
2025	9,103	769		769	9,103	8,334	390	4,612	4,222
2026	13,655	769		769	13,655	12,885	348	6,177	5,829
2027	18,206	769		769	18,206	17,437	311	7,353	7,042
2028	22,758	769		769	22,758	21,988	277	8,207	7,929
2029	33,037	769		769	33,037	32,268	248	10,637	10,389
2030	43,317	769		769	43,317	42,547	221	12,452	12,231
2031	53,596	769		769	53,596	52,827	197	13,757	13,559
2032	63,876	769		769	63,876	63,106	176	14,639	14,462
2033	74,537	3,077		3,077	74,537	71,460	630	15,252	14,622
2034	84,816	769		769	84,816	84,047	141	15,496	15,355
2035	95,096	769		769	95,096	94,326	125	15,512	15,387
2036	105,375	769		769	105,375	104,606	112	15,347	15,235
2037	115,655	769		769	115,655	114,885	100	15,040	14,940
2038	125,934	769		769	125,934	125,165	89	14,622	14,532
2039	136,214	769		769	136,214	135,444	80	14,121	14,041
2040	146,493	769		769	146,493	145,724	71	13,559	13,488
2041	156,773	769		769	156,773	156,003	64	12,956	12,893
2042	167,052	769		769	167,052	166,283	57	12,326	12,270
2043	177,332	3,077		3,077	177,332	174,255	203	11,683	11,480
2044	187,611	769		769	187,611	186,842	45	11,036	10,991
2045	197,891	769		769	197,891	197,121	40	10,393	10,353
2046	208,170	769		769	208,170	207,401	36	9,762	9,726
2047	218,450	769		769	218,450	217,680	32	9,146	9,114
2048	228,729	769		769	228,729	227,960	29	8,551	8,522
2049	239,009	769		769	239,009	238,239	26	7,978	7,952
	2,927,234	24,616	15,385	40,001	2,927,234	2,887,233	16,907	293,196	276,288

B / C	17.3415
EIRR %	45.10
NPV (GHc)	276,288

### 23.2.3 Outer Ring Road Improvement Project

#### (1) Presumptions of Economic Analysis

The costs and benefits are calculated as the differences between “with” and “without” the Project. The “with” case denotes the situation of a new ring road being constructed as given in the sub-programmes. While, the “without” case means that there is no change in the current situation.

#### 1) Evaluation Period

The evaluation period is assumed to be 30 years from 2019 to 2049

The following benefits are estimated:

- Saving in vehicle operation costs (VOC)
- Saving in travel time costs

## 2) Estimation of Economic Cost

The financial cost of the project is estimated at GHC 50.55 million in total. In this study the economic cost is estimated by deducting government taxes and import duty from the financial cost so that a conversion factor of 0.85 is assumed. Hence, the total economic cost is estimated at GHC 42.96 million as shown in Table 23.2.9.

Maintenance cost is also added to the economic cost. The study team assumed 5% for capital cost accordingly every year and 20% rehabilitation cost for each road every ten years.

**Table 23.2.9 Economic Cost of Outer Ring Road Project**

(Unit: GHC Thousand)

Project	Financial Cost	Conversion Factor	Economic Cost
Road Network Scheme	50,550	0.85	42,968
Routine Maintenance Cost (per year)	2,528	0.85	2,148
Rehabilitation Cost (in ten years)	10,110	0.85	8,594

Source: Study Team

### (2) Economic Analysis of the Proposed Road

The economic analysis of the improvement of the Middle Ring Road is made based on the above mentioned benefits and costs estimation. Table 23.2.10 shows the benefit cost stream. The results of the economic analysis show the Net Present Value (NPV) of GHC 237 million and BCR of 6.06 over the 30 year life of the road using a discount date of 12%. The Economic Internal Rate of Return (EIRR) is calculated at 32.2% which indicates the high priority project is economically feasible.

The rate of through traffic from outside will be three times that of the existing volume in the period from year 2012 to year 2033. Thus, the improvement to the road may cause existing traffic to divert to another route, this ring road. The benefits arising from such diversion must be included in the benefit calculation and this would indicate that the economic figure is very high in this project.

**Table 23.2.10 Benefit-Cost Stream Flow of Outer Ring Road**

Unit: GHc 1,000

Year	Benefit	Cost		Cost Total C	Benefit Total B	B-C	Dis. Cost (12%)	Dis. Benefit (12%)	Dis. B-Dis. C (12%)
		O & M	Investment						
2019			8,594	8,594	0	-8,594	8,594	0	-8,594
2020			8,594	8,594	0	-8,594	7,673	0	-7,673
2021			8,594	8,594	0	-8,594	6,851	0	-6,851
2022			8,594	8,594	0	-8,594	6,117	0	-6,117
2023			8,594	8,594	0	-8,594	5,461	0	-5,461
2024	5,808	2,148		2,148	5,808	3,660	1,219	3,296	2,077
2025	13,044	2,148		2,148	13,044	10,896	1,088	6,609	5,520
2026	20,280	2,148		2,148	20,280	18,131	972	9,174	8,202
2027	27,515	2,148		2,148	27,515	25,367	868	11,113	10,245
2028	36,178	2,149		2,149	36,178	34,029	775	13,046	12,271
2029	43,414	2,148		2,148	43,414	41,266	692	13,978	13,287
2030	50,651	2,148		2,148	50,651	48,502	618	14,561	13,943
2031	57,887	2,148		2,148	57,887	55,739	551	14,858	14,307
2032	65,124	2,148		2,148	65,124	62,975	492	14,925	14,432
2033	72,773	8,594		8,594	72,773	64,180	1,758	14,891	13,132
2034	80,010	2,148		2,148	80,010	77,862	393	14,618	14,225
2035	87,246	2,148		2,148	87,246	85,098	350	14,232	13,881
2036	94,483	2,148		2,148	94,483	92,335	313	13,761	13,448
2037	101,719	2,148		2,148	101,719	99,571	279	13,228	12,948
2038	108,956	2,149		2,149	108,956	106,807	249	12,651	12,401
2039	116,192	2,148		2,148	116,192	114,044	223	12,045	11,823
2040	123,429	2,148		2,148	123,429	121,281	199	11,425	11,226
2041	130,665	2,148		2,148	130,665	128,517	178	10,799	10,621
2042	137,902	2,148		2,148	137,902	135,754	159	10,176	10,017
2043	145,138	8,594		8,594	145,138	136,545	566	9,562	8,996
2044	152,375	2,148		2,148	152,375	150,227	126	8,963	8,837
2045	159,612	2,148		2,148	159,612	157,463	113	8,383	8,270
2046	166,848	2,148		2,148	166,848	164,700	101	7,824	7,723
2047	174,085	2,148		2,148	174,085	171,936	90	7,289	7,199
2048	181,321	2,149		2,149	181,321	179,172	80	6,778	6,698
2049	188,558	2,148		2,148	188,558	186,409	72	6,294	6,222
	2,541,214	68,749	42,968	111,717	2,541,214	2,429,498	47,219	284,475	237,256

B / C	6.0246
EIRR %	32.32
NPV (GHc)	237,256

## **Chapter 24    Monitoring and Evaluation Plan**

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### **24.1    Objectives of Monitoring and Evaluation**

Monitoring and evaluation during implementation of the formulated SDF and SP are essential parts of the implementation plan and activities for promoting execution of the formulated SDF and SP. As proposed in Chapter 20, the Regional Platform's major activities are monitoring and evaluation for promoting implementation of the SDF and SP.

The monitoring and evaluation plan has two major elements. One is monitoring of the activities of efforts aimed towards implementing the SDF and SP. The other is the evaluation of major aspects of implementation of the SDF and SP.

The objectives of the monitoring and evaluation plan for implementation of SDF and SP are also two-fold, including objectives for both monitoring and evaluation.

The objectives of monitoring of the plan are as follows:

- To encourage key stakeholders to continue conducting activities for implementation of the SDF and SP, as well as infrastructure programmes.
- To collect and share information on actualization and difficulties of implementation of the plan.
- To make minor modifications to efforts made for implementing the SDF and SP using the collected information.

The objectives of evaluation of the plan are as follows:

- To analyze collected information on actualization and difficulties of implementation of the plan.
- To measure impacts or outputs from the implementation of the plan.
- To make recommendations for changing methods of implementation of the SDF and SP
- To make recommendations for revising proposed strategies in the SDF and SP, as well as the infrastructure plans themselves.

### **24.2    Five Components of Monitoring and Evaluation of Implementation Activities**

To implement the Greater Kumasi Sub-Regional SDF and Greater Kumasi Conurbation SP, the following five key types of activities are required:

- (A) Official approval of the SDF for Greater Kumasi Sub-Region and the SP for Greater Kumasi Conurbation
- (B) Institutional preparation for activities for implementation of the SDF and SP
- (C) Implementation of sector programmes for sub-regional infrastructures
- (D) Integrated implementation of various priority strategic projects for urban and industrial development
- (E) Preparation and utilization of district-level SDFs and SPs for designating and enforcing land use regulations.

Therefore, monitoring and evaluation also should cover these five types of actions.

#### **24.2.1 Monitoring and Evaluation Activities for (A) on Official Approval of the Plan**

The agency in charge of the monitoring and evaluation for (A) on official approval of the plan is TCPD. TCPD should report the monitoring and evaluation results to RCC.

The monitoring and evaluation activities for (A) on official approval of the plan are as follows:

- Monitoring of the process for official approval of the SDF and SP every two months at regular Regional Platform meetings.
  - Have any actions been taken for official approval?
  - Which organization or who should take action to obtain the official approval?
  - Are there any conditions to be satisfied to get official approval?
  - What kinds of actions are required to satisfy the conditions?
- Evaluation of the process and progress for official approval of the SDF and SP at the end of calendar year 2013.
  - Has the official approval been completed?
  - If no, why not?
  - What kinds of actions should be taken to solve the difficulties toward obtaining official approval?
- Monitoring of the announcement after receiving official approval of the SDF and SP
  - Has the official approval of the SDF and SP been announced to the public?
  - Have the official plan documents for SDF and SP been opened to the public for utilization?

#### **24.2.2 Monitoring and Evaluation Activities (B) on Institutional Frameworks for Implementation**

The agency in charge of the monitoring and evaluation for (B) on institutional frameworks for implementation is TCPD. TCPD should report the monitoring and evaluation results to RCC.

The monitoring and evaluation activities for (B) on institutional preparation for implementation are as follows:

- Monitoring of establishment of a regional platform for implementation of the SDF and SP, as well as sub-regional infrastructure programmes at the end of calendar year 2013 and in June 2014.
- Monitoring of establishment of any national-level mechanism for implementation of the SDF and SP, as well as sub-regional infrastructure programmes at the end of calendar year 2013 and in June 2014.
- Monitoring of operation of the established regional platform for implementation of the SDF/SP and sub-regional infrastructure programmes in June 2014 and December 2014.
- Monitoring of operation of the established national-level mechanism for supporting the implementation of the SDF/SP and sub-regional infrastructure programmes in June 2014 and December 2014.
- Evaluation of establishment of the regional platform and national level mechanism for supporting the implementation of SDF/SP and sub-regional infrastructures

#### **24.2.3 Monitoring and Evaluation Activities for (C) on Sub-Regional Infrastructures**

The agencies in charge of the monitoring and evaluation for (C) on sub-regional infrastructures are regional departments or KMA departments, which should report monitoring and evaluation results to the RCC.

The implementation component (C) should focus on the following priority projects:

- Outer Ring Road Project
- Middle Ring Road Project
- Project for Introduction of Type B Bus and Establishment of BRT System
- Feasibility Study on Water Resources Development for Greater Kumasi Sub-Region
- Project for Expansion of Water Supply Capacity of Barekese Water Treatment Plant
- Project for Effective Use of Existing Distribution Pipes
- Project for Development of Septage Treatment Ponds in Adjoining Districts/Municipalities within Greater Kumasi Sub-Region
- Expansion of Asafo Simplified Sewerage System for CBD Area
- Project for Solid Waste Management Improvement in MDAs Adjoining KMA within Greater Kumasi Sub-Region
- Project for Replacement of Small-Sized Wires and Deteriorated Equipment, and Realignment of Distribution Lines

Monitoring of implementation of each priority project should take the following aspects into account:

- Incorporation of the priority project by the national-level sector plan or programme

- Efforts made towards appealing to the national agency for implementation of the priority project
- Completion of feasibility study of the priority project
- Commitment of development partners to the priority project
- Acquisition of land required for implementing the priority project

#### **24.2.4 Monitoring and Evaluation Activities for (D) on Priority Strategic Programmes for Urban and Industrial Development**

The agencies in charge of the monitoring and evaluation for (D) on priority strategic programmes for urban and industrial development are various executive agencies responsible for different programmes as explained in Chapter 21. The proposed executive agencies for the priority strategic programmes are as follows:

- Programme for Investment Promotion for Greater Kumasi (Executive Agency: Ghana Investment Promotion Centre)
- Programme for Revitalization of Kaase Industrial Area (Executive Agency: KMA)
- Programme for Development of Boankra Industrial-Logistics Centre (Executive Agency: Ghana Free Zones Board)
- Programme for Development of Kumasi–Ejisu Urban Corridor (Executive Agencies: KMA, Ejisu-Juaben Municipality, KNUST and CSIR)
- Programme for Redevelopment of Kumasi City Centre (Executive Agency: KMA)
- Programme for Development of New Towns (Executive Agency: Ghana Real Estate Developers Association)
- Programme for Modernization of Informal Sectors (Executive Agency: Regional Office for Ministry of Trade and Industry and KMA)

Monitoring for each of these priority strategic programmes should focus on the proposed actions (See Chapter 21) for the priority strategic programme, whether proposed actions have been conducted or not.

#### **24.2.5 Monitoring and Evaluation Activities for (E) District-Level SDFs and SPs**

The agency in charge of the monitoring and evaluation for (E) on district-level SDFs and SPs is the TCPD Regional Office of Ashanti Region.

The monitoring for Implementation Component (E) should take the following points into account:

- Whether the district has a planning officer or not.
- Whether the planning officer and technical officers of the district have participated in training courses for preparing district-level SDFs and SPs.
- Whether the planning officer and technical officers of the district have the ability to use GIS for preparing district-level SDFs and SPS.

### **24.3 Evaluation of Outputs of Implementation of the Greater Kumasi Sub-Regional SDF/SP and Sub-Regional Infrastructures**

The evaluation of the outputs of implementation of the Greater Kumasi Sub-Regional SDF/SP and Sub-Regional Infrastructures is useful and important for revising the formulated Sub-Regional SDF/SP.

#### **24.3.1 Evaluation of Outputs of Enforcement of Sub-Regional SDF/SP and District SDFs/SPs**

The proper utilization and enforcement of the Greater Kumasi Sub-Regional SDF/SP and district-level SDFs/SPs can have a positive effect on preventing overly expansive urban sprawl, while at the same time, promoting urbanization outside KMA within the Greater Kumasi Conurbation boundary.

The output or impact of the utilization or enforcement of Greater Kumasi Sub-Regional SDF/SP and district-level SDFs/SPs can be measured by the following indicators:

- The number of layout plans or local plans prepared and approved outside the Urban Growth Boundary or Greater Kumasi Conurbation boundary.
- The population within the Urban Growth Boundary or Greater Kumasi Conurbation boundary increased at higher rates than KMA.

This evaluation becomes possible when population census data is available. Therefore, this kind of evaluation should be done in years 2022 and 2032. Based on this kind of evaluation, the Sub-Regional SDF/SP should be revised or modified.

#### **24.3.2 Evaluation of Outputs of Implementation of Housing Strategies of Sub-Regional SDF/SP**

The outputs of effective implementation of proposed housing strategies can be measured by the following indicators:

- The percentage of separate houses will increase.
- The percentage of multi-storey apartments will increase.
- The percentage of compound houses will decrease.
- The number of multi-storey apartments within Kumasi City Centre will increase.

Data on the first three indicators can be obtained by studying the population and housing census. Therefore, this kind of evaluation should be done in years 2022 and 2032.

#### **24.3.3 Evaluation of Outputs of Implementation of Industrial Development Strategies of Sub-Regional SDF/SP**

The outputs of implementation of proposed industrial development strategies can be measured by the following indicators:

- The number of economically active population of the manufacturing sector within KMA.

- The number of economically active population of the manufacturing sector in adjoining districts.

These indicators can be measured by population and housing censuses. Such data will be available in 2022 and 2032.

#### **24.3.4 Evaluation of Outputs of Implementing of Strategies for Open Space and Sports Facilities**

The strategies for open space and sports facilities should be evaluated by measuring the following:

- Areas of primary and secondary school grounds that could be opened for the public
- Areas of parks constructed and utilized by the public
- Number of parks constructed and utilized by the public
- Areas of buffer zones designated along rivers and prepared for the public

In addition, a questionnaire survey on demand for utilization of open space and/or sports facilities should be conducted to understand real demand for open space and sports facilities.

#### **24.4 Evaluation of Impacts of Implementation of the Greater Kumasi Sub-Regional SDF/SP and Sub-Regional Infrastructures from SEA Perspectives**

The negative impact of implementation of the Greater Kumasi Sub-Regional SDF/SP and Sub-Regional Infrastructures should be evaluated from SEA perspectives. The indicators proposed in Section 26.7 should be used.

The years 2022 and 2032 are times when population and housing census data will become available.