CHAPTER 5

BASIC PHYSICAL AND SOCIAL INFRASTRUCTURE DEVELOPMENT PLAN

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5.1 BASIC STRATEGY

5.1.1 Planning Flow

5.1.1.1 Present Situation

The present situation of development plans of basic physical and social infrastructures are summarized below.

- At present, basic and social infrastructure rehabilitation and improvement are urgently being carried out by GOSS (the Government of South Sudanese).
  - The improvement of the main roads, renewal of the electric power facilities, construction of the water purification plant and construction of the waste treatment plant have begun in Juba City.
  - Some basic infrastructures will almost attain the first stage goal for rehabilitation by the urgent reconstruction. (As for road, bidding was already carried out in March 2006, and city road construction started with a period of 13.5 months and, a road maintenance period of 12 months.)
- The urgent rehabilitation and reconstruction of the basic infrastructure for development of urban communities and repatriation of the returnees is required.
- The jurisdiction and responsibility of maintenance and operation of each infrastructure are still unclear between GOS (Sudanese Government) and GOSS, and between GOSS and the State government.
- Administrative organizations are still weak.
- Each donor's approach is to carries out the simultaneous tasks both of an urgent reconstruction and of establishment of the law and regulation, and institutional building.
- Money flow for the tasks of urgent rehabilitation is still little; GOSS started the preparation of 3-year (2007 - 2009) middle budget plan. However, the State Government has insufficient budget for meeting the needs.
- As for a medium to long-range, the referendum of the South Sudanese scheduled in 2011 will be a milestone event; substantial implementation will start in the new era.

5.1.1.2 Planning Flow

In the formulation of infrastructure plan, attention was given to the followings.

- Emergency task is to directly respond to the basic needs of physical and social infrastructure both for the present communities and new settlement of the returnees.
- Needs survey at the community level is a fundamental study for preparation of urgent rehabilitation and development programs for basic physical and social infrastructure.
- The plan is to be prepared as practicable and flexible one by staging the needs and level of services of basic infrastructure.
- Institutional strengthening and capacity building will be carried out through actual planning and construction of the basic infrastructure, at the community, state government and GOSS levels.

A conceptual constitution for infrastructure plan is depicted in Figure 5.1-1.

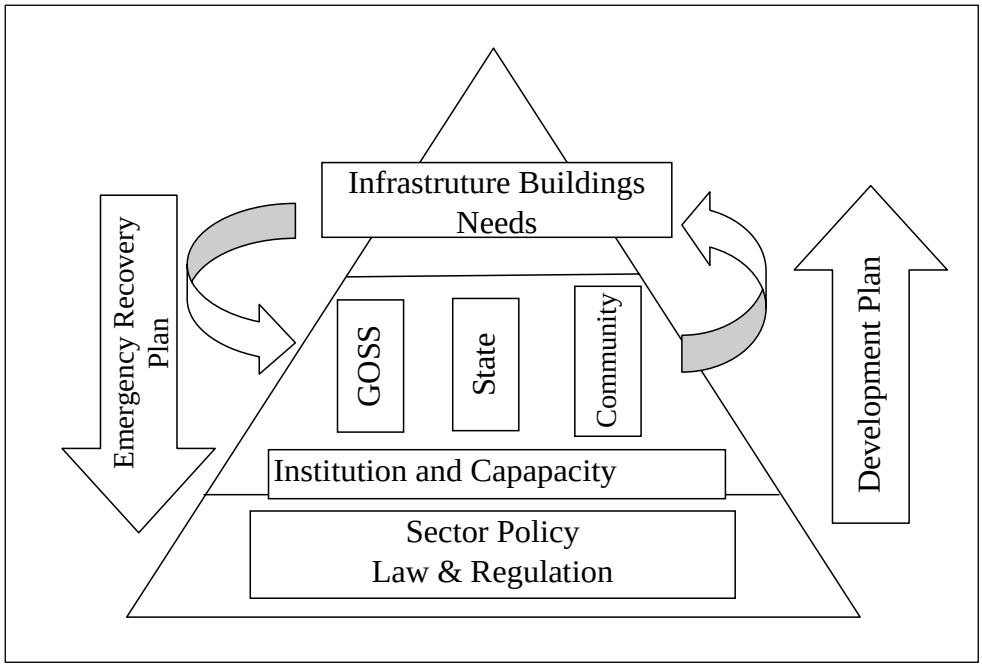


Figure 5.1-1 Conceptual Constitution for Infrastructure Plan

(1) Components of Basic and Social Infrastructure

The infrastructure development plan aims to propose urgent rehabilitation and development programs of basic physical and social infrastructure based on formulation of a development plan for Juba Town with a target year of 2015. For the planning, the basic physical and social infrastructures are defined in Table 5.1-1 for the Study.

Table 5.1-1 Definition of Basic Physical & Social Infrastructures for the Study

Definition	Sector	Basic Infrastructure	Targets Facilities
Economic Infrastructure	Transport	Road	Urban Highway Classified roads NMT Public transport
		River Port	Existing river port New river port
		Air Port	Existing airport New air port
Energy and Utility	Energy	Electricity	Electric facility
	Water Supply	Water Supply	Water facility
Social Infrastructure	Education	School	School facilities
	Health	Hospital	Hospital Health centre
	Business	Market	Markets Shopping centre
Environment Infrastructure	Public Service	Waste Management	Solid waste disposal facility
		Waste Water Management	Treatment facility Sewerage system

(2) Planning Flow

The planning flow is shown in Figure 5.1-2.

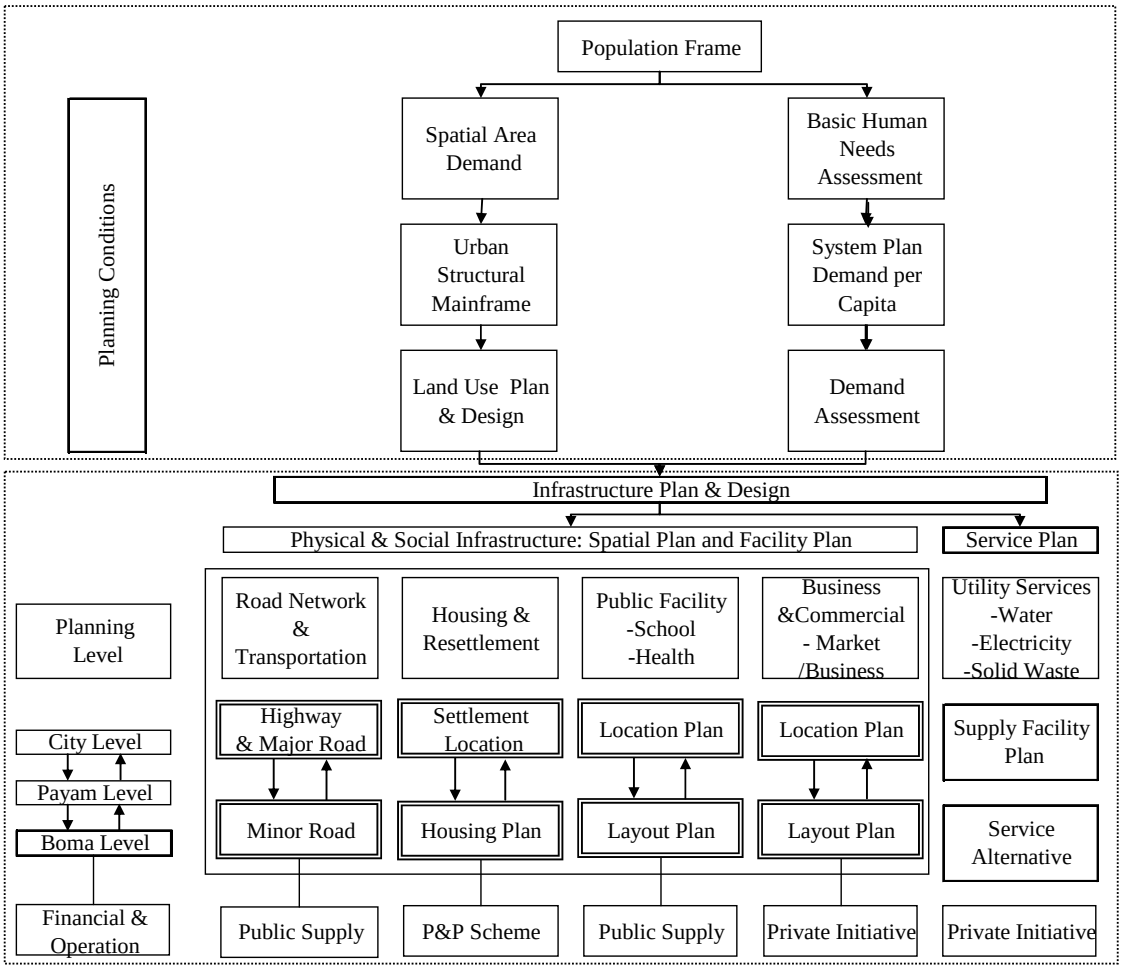


Figure 5.1-2 Planning Flow

5.1.2 Basic Infrastructure Needs

The total basic infrastructure needs are summarized below with per capita demand. The details of basic infrastructure in each sector will be discussed in the relevant chapters.

(1) Road

Table 5.1-2 Total Basic Infrastructure Needs (Road)

Item	2005 (Existing)	2015 (Planned)	Remark
Population	250,000	510,000	
Urban Area (ha)	4,830	7,760	
Urban Road (km)	60*	272	Main & Minor/Local Roads
Urban Road Density (km/sq.km)	1.2	3.5	Main & Minor/Local Roads

*: Roads to be rehabilitated as AC paved road in ERWJ

Figure 5.1-3 Urban Road

(2) Education

Table 5.1-3 Total Basic Infrastructure Needs (Education)

Item	2005 (Existing)	2015 (Planned)	Remark
Population	250,000	510,000	
Primary School Age Population	59,500 (27,452)	121,400	Estimate (Survey by JICA)
Primary School	36	174	36 (exist) + 138 (new)
Total Class Rooms	325	2,428	50/Class
Teachers per Class	1.6	1.6	
Pupil per Class	77	50	
Class per School	9.0	16	
Pupil per School	763	800	
New School Area	-	5,400m^2 (745,200m^2)	60m x 90m (5,400m^2 x 138)
New Building	-	1,200m^2 (208,800m^2)	1.5m^2/pupil (1,200m^2 x 138)

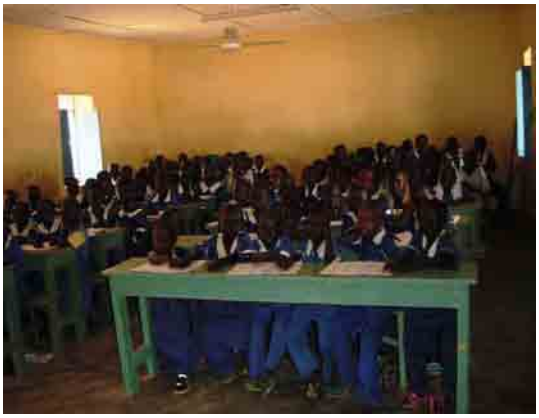



Figure 5.1-4 Elementary School

(3) Health

Table 5.1-4 Total Basic Infrastructure Needs (Health & Medical Services)

Item	2005 (Existing)	2015 (Planned)	Remark
Population	250,000	510,000	
Hospital	4	6	4 (exist) + 3 (new)
Total No. of Bed	769	1,702	3.7bed/1000
Bed per hospital	192	340	
Hospital Area (m^2)	-	6,800m^2/hospital	20m^2/bed
Hospital Building Area	-	4,080m^2	60%
Health Centre	11	46	11 (exist) + 35 (new)
Building Area	-	300m^2	


Figure 5.1-5 Health Facility

(4) Sanitary & Utility

Table 5.1-5 Total Basic Infrastructure Needs (Sanitary & Water Supply)

Item	2005 (Existing)	2015 (Planned)	Remark
Population	250,000	510,000	
Solid Waste Generation			
Generation Ratio per Capita	0.51	1.21	(kg/day/person)
Average Solid Waste Generation	128	619	(ton/day)
Water Supply Demand			
Per Capita Demand	20	100	(litter/day/person)
Water Supply Demand	5,000	51,000	(ton/day)

Figure 5.1-6 Water Facility

5.2 BASIC PHYSICAL AND SOCIAL INFRASTRUCTURE DEVELOPMENT PLAN

5.2.1 Transport

5.2.1.1 Road Network

(1) Present Situation

1) Transportation sector policy study

The policy paper of the transport sector was prepared by the USAID consultant (Louis Berger) in July 2006[1)], and agreed officially by the Transport & Road Ministry of GOSS. The transport sector policy stipulates that the transport infrastructures such as national roads, Juba airport and Juba river port are in the jurisdiction of GOS (Sudanese Government) legally, and GOSS is responsible for improvement, operation and maintenance of these infrastructures.

As for the road development program, following objectives and priorities are stated in the policy paper.

Recommended short and medium term priorities for road network development which have implications for the prioritisation and the character of road sector activities are following.

- Institute and promulgate a clear and detailed set of standards for road design, construction and maintenance for each of the different levels of roads;
- Identify and commence the process of rehabilitating and developing the primary road network;
- Establish mechanisms for adequate and sustained financing for road maintenance; etc.

2) Present Roads and Bridges

Roads

Roads are typically classified into three categories by responsible organization, namely, national road, state road and payam road.

National roads in Juba metropolitan area are following.

① Juba-Rumbek-Wau Road（Road to Yambia is branching off at Mundri.）
② Juba-Yei-Uganda Road
③ Juba-Bor-Malakal-Reng Road
④ Juba-Torit-Kapoeta-Kenya Road
⑤ Juba-Nimule Road

Juba-Kajo Keji Road, and Juba-Terakeka Road fall into state road category.

[1)] Transport Sector Policy for the Ministry of Transport and Roads, Government of Southern Sudan, July 2006.

Road inventory survey was carried out to identify the rehabilitation and development needs by the Engineers of Directorate of Roads and Bridges in the MOPI of CESS and Study Team in June.

All agencies are suffering from insufficient staffing, lack of institutional capacity, and poor and unusable machines for road repair and construction.

Road Type	Responsible Organization		
	Plan	Construction	OM
National Road Those linking South Sudan and neighboring countries	Min. of Roads and Bridges, GOSS	Min of Roads and Bridges, GOSS	State Min. of Physical Infrastructure
State Road Those linking country and state capital	State Min. of Physical Infrastructure	State Min. of Physical Infrastructure	State Min. of Physical Infrastructure
Payam Road	State Min. of Physical Infrastructure	State Min. of Physical Infrastructure	State Min. of Physical Infrastructure

The inventory survey results are summarized below:

Road surface of asphalt paved roads are deteriorated to the extent where immediate rehabilitation/reconstruction is required due to the lack of long-time negligence of maintenance. As for 'murram' roads, severe rutting and outcrop of stones are observed in most road sections reducing travelling speed of vehicles. Generally, vehicles are forced to travel under 40 km/h due to such road surface condition. In the rainy season, some road points crossing the occasional river become impassable after rains causing the detour of vehicles. No attention is now given to pedestrians and Non-Motorized Transport (NMT) judging from the cross sections of urban roads.

Road network of Juba has a deficiency that traffic tend to concentrate on the specific sections (ex. airport access road, May St. and Unity Ave.) due to the insufficient formation of ring road and weak transport corridor.

May St. (AC paved)

Unity Ave.

Table 5.2-1 Local Roads in Juba

	Section	Width	Lenghth**
1	Tombura Street	28.3-35.0m	3,070m
2	Nyigilo St.	15.0-18.0m	2,030m
3	Albino St.	10.0-18.0m	1,580m
4	Kuwait St. -	22.0-35.0m	960m
5	Unity Rd. Junction - Football Stadium (via Salakaua)	9.2-16.0m	1,830m
6	Juba Hospital - Prison	8.0-20.0m	960m
7	Salvation St.	12.0-21.0m	3,200m
8	Freedom Square - Cinema	9.2-21.9m	1,410m
9	Kokora St.	20.0-28.0m	1,680m
10 *	Juba Shopping Center St.	19.8-20.0m (sidewalk	2,390m
11	Nyigilo St. Junction - Army east	6.0-10.2m	1,530m
12	Bus Round Junction of Tombura Rd. - 6km Lologo	7.0-10.0m	2,090m
13 *	Gabad Junction from Airport Road - Custom Office	16.2-20.0m	1,220m
14 *	Youth and Sport Office - World Food Programme strage	10.5-19.0m	1,890m
15 *	Roads in the Ministries Complex and Assembly	14.3-20.0m	2,560m
16	Nile Bridge - Radio Gumba	15.0-18.0m	2,960m
17	Mobile - Mayo St. (via Totochan)	17.0-26.5m	970m
18 *	Road connecting UNDP, Wildlife and UNDP compound - Tomping	16.0-21.2m	410m
19 *	Junction Mayo St. - Unity Avenue (via Luka Badi Bridge)	12.2-17.3m	1,440m
20 *	Basket Ball Studium - University of Juba	20.8-25.7m	870m
21 *	Lazaro St. Tombura St. (via Rujaf Mafi market crossing Lubulyet through Dan As Salam School)	16.0-17.2m	1,210m
22	Junction of Sevendays Adventist - Gudele	8.0-23.0m	2,860m
23	Custom Market - Terekeka Rd. up to 6km Jonglei	15.8-21.5m	5,460m
24	Junction Terekeka Rd. - Suk Malitia Meeting Road	22.8-19.2m	1,700m

* Small Road
** As measured by the JICA Study Team.

Although traffic congestion is not observed as yet, occurrence of congestion is well presumable to become serious traffic problem in near future due to recent rapid increase of vehicles in Juba.

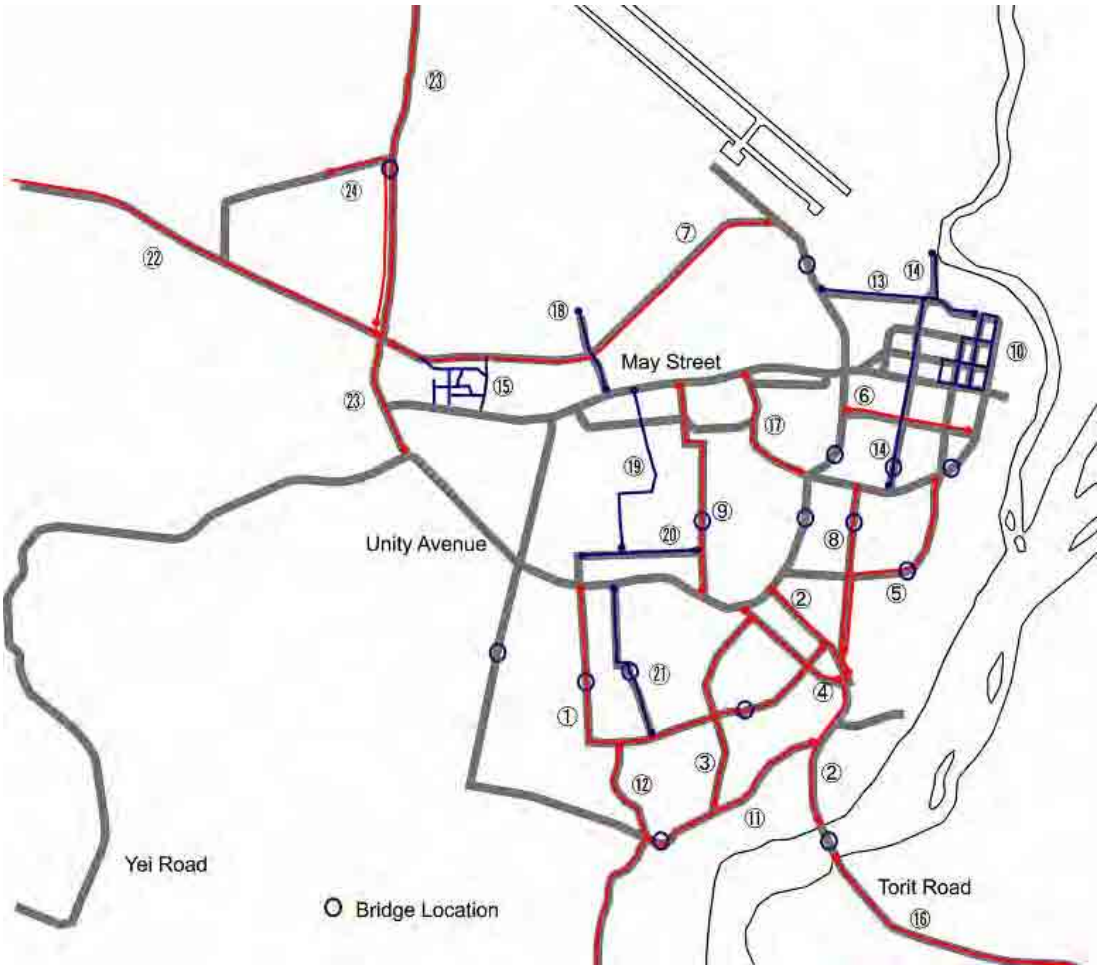


Figure 5.2-1 Location of Local Roads

Bridges

Bridge inventory was carried out by the Engineers of Directorate of Roads and Bridges in the MOPI of CESS and Study Team on 26 July 2006. Location of bridge and pictures of the present bridges are shown in Figure 5.2-2 and Figure 5.2-3, respectively.

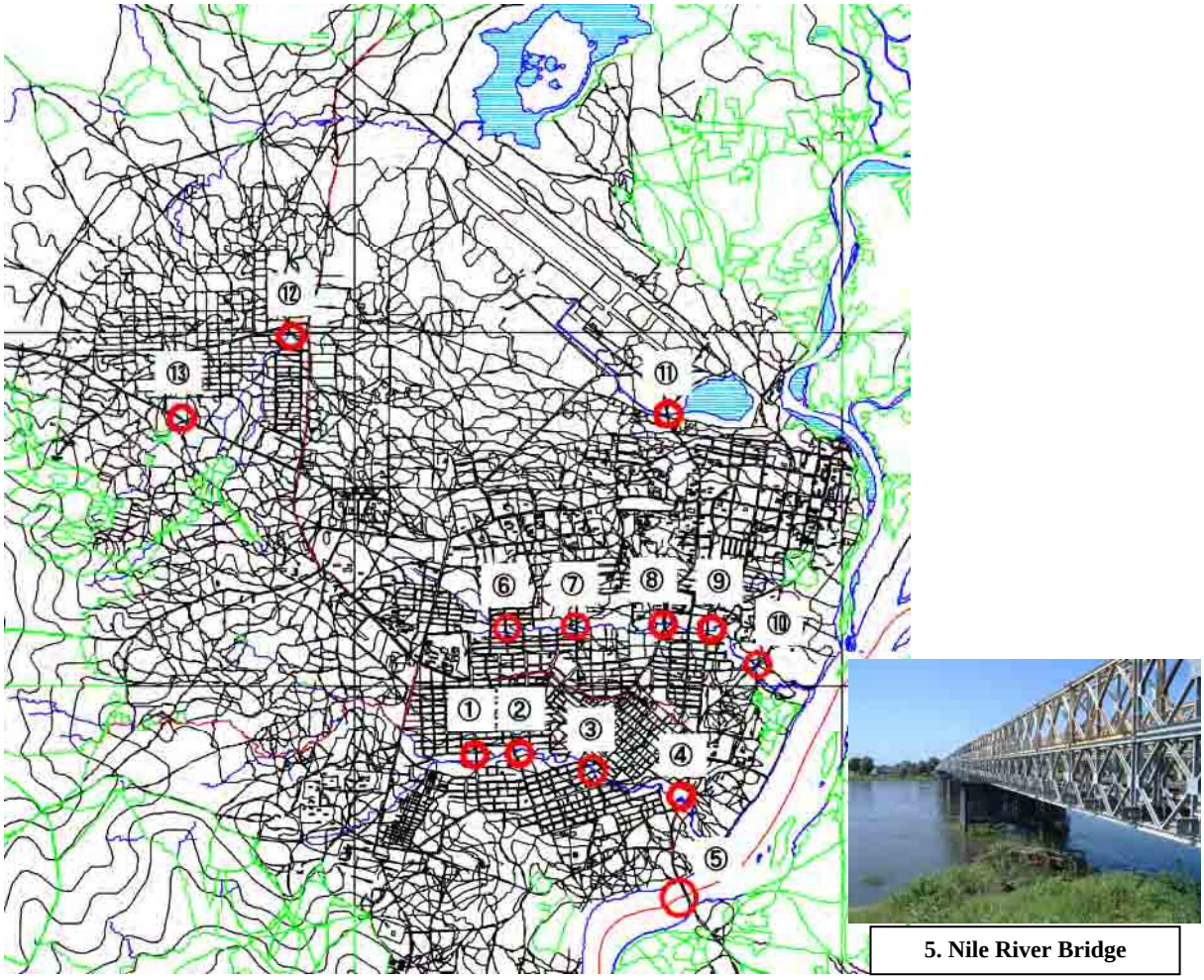


Figure 5.2-2 Location of Bridge Inventory Survey in Juba Town

In total 13 major bridges were surveyed. All bridges are located on the roads to be rehabilitated in the First Stages except the River Nile Bridge (No.5). The present Nile Bridge is a temporary structure having two lanes. Meanwhile locations of No.3 and No.13 have no bridge. Because traffic is cut off in the rainy season, construction of new bridges is required. Moreover cracks of foundation and defects of the slab are seen in number of bridges; an immediate repair is necessary.

The present bridge conditions are shown in the following pictures.

1. Tonbura Bridge

2.Albino Bridge

3.Lobute Bridge (New)

4. Mudarat Bridge

6. Luka Bridge

7. Kokora Bridge

8. Khorbau Bridge

9. Cinema Bridge

10. Salakana Bridge

11. Lodoro Bridge

12. Munuki Bridge

13. Gudele Bridge (new)

Figure 5.2-3 Present Bridge Conditions

Table 5.2-2 Major Bridge Inventory in the Present Road Network

No.	Bridge Name	Location (GPS)		Bridge Width (m)		Bridge Length (m)	Depth below Bridge (m)	Bridge Damage	Road Width (m)	Priority	Remarks
				Carriage -way	Side- way						
1	Tonbura Bridge	N 04°49.826	E 31°35.341	4.90	0.30	5.80	4.20	Width is narrow.	10.00	4	New Bridge
2	Albino Bridge	N 04°49.855	E 31°35.803	6.00	0.30	4.90	3.70	Width is narrow.	6.50	4	New Bridge
3	Lobute Brige (New)	N 04°49.740	E 31°31.956	NA	NA	NA	NA	Nothing Bridge	6.50	2	New Bridge
4	Mudarat Bridge	N 04°49.660	E 31°36.265	4.65	0.25	13.60	2.65	Width is narrow.	6.50	3	New Bridge
5	Nile River Bridge	N 04°49.310	E 31°36.244	3.30x2	—	260.00	NA	Temporary Bridge	11.50	1	New Bridge
6	Luka Bridge	N 04°50.438	E 31°35.469	8.00	1.65	12.00	2.70		10.00	5	New Bridge
7	Kokora Bridge	N 04°50.515	E 31°36.173	8.40	0.40	12.00	3.20	Foundation is damaged	7.80	3	New Bridge
8	Khorbau Bridge	N 04°36.617	E 31°36.433	8.30	0.30	3.60	3.20	Slab is damaged	9.00	3	New Bridge
9	Cinema Bridge	N 04°50.530	E 31°36.189	5.50	0.30	4.30	2.50	Width is narrow.	9.00	4	Box Culvert
10	Salakana Bridge	N 04°50.281	E 31°36.558	7.80	0.50	8.20	3.10		9.00	5	New Bridge
11	Lodoro Bridge	N 04°50.277	E 31°36.665	7.90	0.60	5.20	2.60		7.00	5	Box Culvert
12	Munuki Bridge	N 04°51.839	E 31°34.585	7.00	0.30	3.30	1.40	Flood water pass through Brideg	8.00	2	Box Culvert
13	Gudele Brigde (New)	N 04°51.426	E 31°34.041	NA	NA	NA	NA	Nothing Bridge	8.00	2	Box Culvert

(2) Future Needs

1) Transport Development Policy and Strategy

Figure 5.2-4 shows the planning scheme of transport policy and strategy.

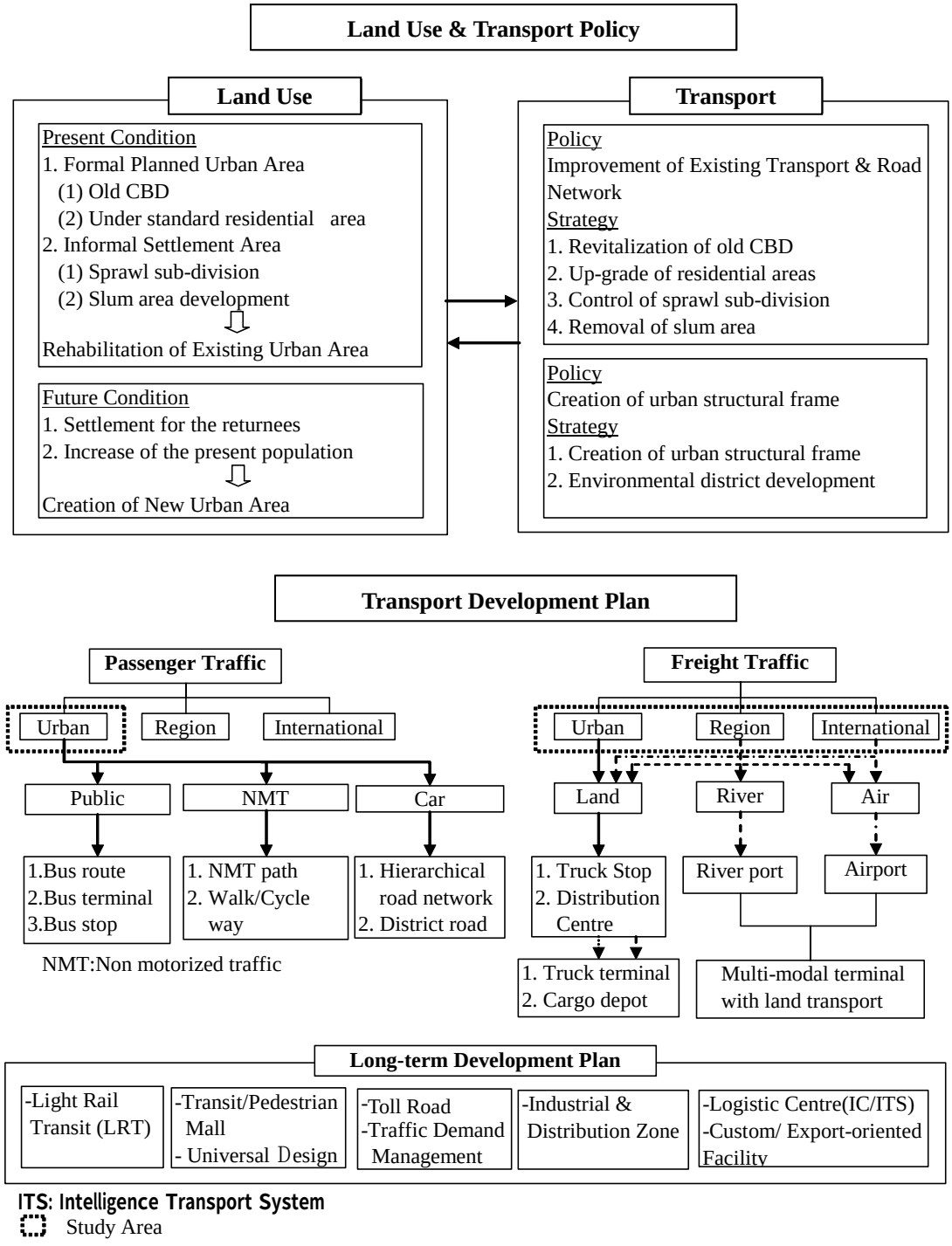


Figure 5.2-4 Planning Scheme of Transport Policy & Strategy

Urban Development Direction and Transport Policy

The land use plan proposes rehabilitation in the existing urban area and creation of a new urban area. The former is divided into a formal planned urbanized zone including CBD (including Old Town and River Port area), an informal sprawl sub-divisions and slum zone, whereas the latter is mostly vacant areas in the suburbs where the settlement for the returnees and the resettlement of increasing population will be located. The new area development is proposed to extend to southern direction and eastern area crossing the River Nile.

The transport policy in the existing urban area is to improve the existing transport and road network and to adopt the strategies of revitalization of CBD, up-grading of residential area, control of sprawl sub-division, and removal of slum area, meanwhile in the suburban area the transport policy is creation of urban structure frame adopting the strategy of establishment of hierarchical urban road network and environmental district development.

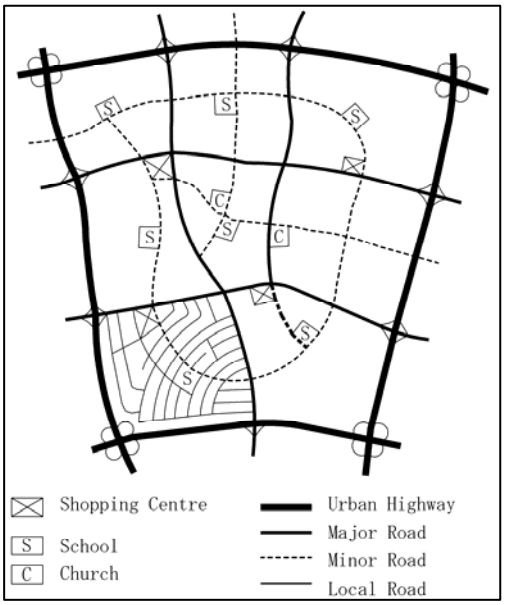


Figure 5.2-5 Hierarchy of Urban Road Network

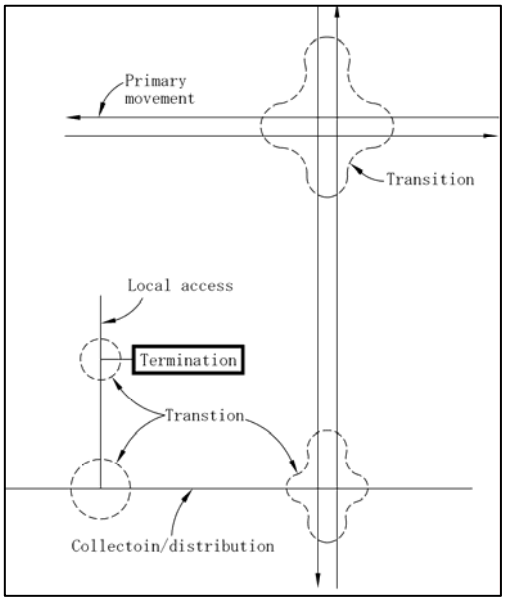


Figure 5.2-6 Hierarchy of Movement in a Functional Circulation System

Transport Infrastructure Development Strategy: Comprehensive Urban Transport Development Plan

To meet the transport policy, a comprehensive urban transport development plan is proposed to aim at dealing with future traffic for both passenger traffic and goods movement that are to be categorised into three areas; intra-urban, inter-city and region, and international transport. For the passenger traffic, the Study will work out only intra urban traffic, but for the freight traffic, intra-urban, inter-city and region, and international transport will be discussed.

Traffic Forecast

For the traffic forecast, characteristics of population increase and land use pattern are preconditions. After the Peace Agreement, the recovery of urban activities initiated by the government, donor-sponsored rehabilitation projects and the induced informal private business have started, and the number of vehicles and traffic volume are increasing day by day. In addition, the population increase depends on the government and donor's repatriation policy and urban planning which is still on-going. Due to these facts, common method of the traffic forecast which use increasing trend of traffic on the base of the present traffic or trip generation survey can not be used at the moment.

Therefore, the Study adopt an approach to deduce from the traffic data in the neighbouring and relevant countries, and estimate the traffic tendency and characteristics for planning transportation infrastructure. Table 5.2-3 shows comparison of forecast of future vehicle ownership estimated from various data sources.

Table 5.2-3 Comparison of Forecast of Future Vehicle Ownership

Year	Juba /South Sudan			Metropolitan[1)] (1985)	Dar es Salam[2)] (2004)	Average	
	Population	GNI /p (USD)	RGNI/p (USD)	Car/1000pop. (Unit)	Car/1000pop. (Unit)	Car /1000 (Unit)	Car (Unit)
2005	200,000	153	229.5	13.1	93.8	53.4	10,691
2011	396,000	267	400.5	31.2	97.1	64.2	25,407
2015	510,000	425	637.5	54.4	99.8	77.1	35,477
2025	750,000	875	1312.5	108.1	104.1	106.1	79,588

Source: Estimated by the equation made of the data in 1) World Bank, 1985. 2) JICA Study, 2004

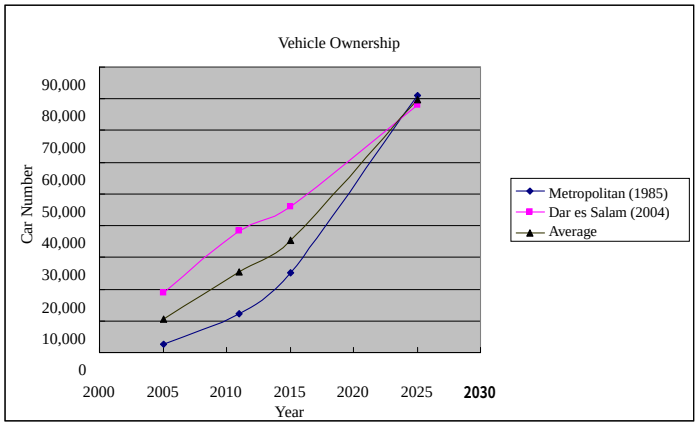


Figure 5.2-7 Future Vehicle Ownership

Attributes of Urban Transport Demand

Table 5.2-4 shows estimation of the attributes of urban transport demand in Juba in 2015.

Table 5.2-4 Estimation of Attributes of Urban Transport Demand (2015)

Attributes	Addis Ababa [1)]	Dar es Salam [2)]	Nairobi [3)]	Juba (2015) [4)]
Average trip rate (per capita per day)	1.9	1.96	2.25	2.5
Estimated daily trips (million)	4.9	4.3	4.8	0.78
Estimated modal split				
- % trips by public transport	26	43	42	20
- % trips by private car	4	6	10	8
- % trips by NMT (including walk)	70	45	48	72
Share of public transport market				
- % trips by big bus	27	2	30	-
- % trips by minibus/shared taxi	72	98	70	-
- % trips by taxi	1	negligible	negligible	-
Average fare paid per journey				
- big bus	US$0.085	-	US$0.26	-
- minibus/shared taxi	US$0.15	US$0.21	US$0.31	-
Average journey distance (km)				
- walk	5	2.2	4	-
- big bus	17	-	12	-
- minibus/shared taxi	7	7	14	-

Source: [1)]-[3)] World Bank, Urban Mobility in Three Cities, October 2002. [4)] The Study Team Estimation

Particular considerations for transport infrastructure development are as follows.

Public Transport

Based on the modal share forecasted above, importance of pubic transport and Non Motorized Transport (NMT) is clear. At present, most predominant means of public transport are minibus, but in the near future larger bus will be required. Therefore fixed route bus system with bus lanes and bus stops, and bus terminals should be introduced with urban road network construction. In the long term, light rail transit (LRT) should be planned for mass transit on the strategic route.

NMT

Non Motorized Transport (NMT) includes walk and bicycles which has the largest share of trips for the population. It is one of the most important transport modes in addressing the mobility needs of the poor as well as development of the healthy town which is independent of the car. NMT paths and pedestrian and bicycle ways beside the carriageways should be integrated into the design of the roads. In long term, transit and pedestrian malls in the CBD revitalization should be planned with universal design for the traffic of the vulnerable people such as the disabled, pregnant women and the aged.

Rehabilitation of Existing Urban Area by Improvement of the Existing Road Network

The following strategies will be considers for improvement of the existing road network

① Improvement of traffic mobility for car, public transport and NMT

- Enhancement of traffic safety for the 'transport vulnerable people': NMT path, universal design, traffic safety measures
- Saving of travel time and cost: increase of road capacity
- Mitigation of traffic congestion: removal of anticipated traffic bottleneck, provision of public transport lane
- Mitigation of transport pollution: road side ecology

② Improvement of accessibility in sprawl developed area: Eliminate/alleviate the following problems.

- Narrow road network in the existing urban area
- Small road space
- Low road pavement ratio
- Deteriorating urban environment
- Worsening security and safety, such as fire risking areas due to a lack of access of fire services
- Lack of public amenity space such as parks and green areas.

③ Revitalization of the old CBD

- Beautification of the streets
- Provision of pedestrian mole
- Rehabilitation of the old port for recreation purposes

④ Re-planning of the CBD streets and readjustment of the residential areas

Creation of a New Road Network as Urban Structural Frame

The following strategies will be applied on the road network as urban frame structure.

① Establishment of a new road network in accordance with land use plan

a) Hierarchical order of network plan: Urban Highway→Major road→Minor road→Local road
b) Local road network for establishment of residential area with good environment (500 x 500)

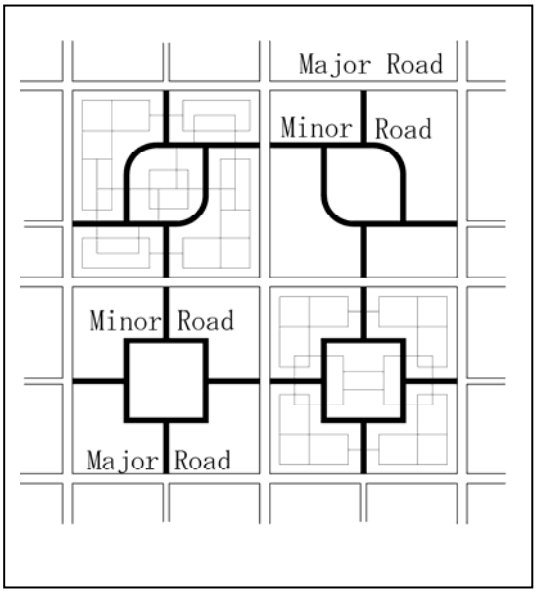


Figure 5.2-8 District Road Network

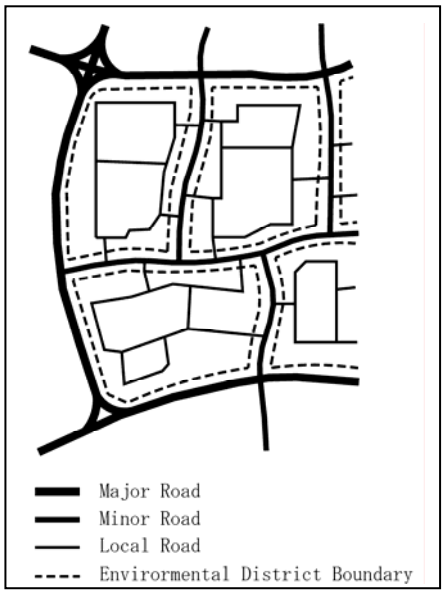


Figure 5.2-9 Environmental District Concept (Example)

② Provision of space for improvement of basic infrastructure
③ Improvement of accessibility to promote efficient land use and environment
④ Provision of space to accommodate public utilities
⑤ Provision of urban structural fame
⑥ Provision of amenities such as green belt, ventilation, and well-lighting
⑦ Provision of space for evacuation route, fire fighting activities, and prevention of spreading of the fire

Establishment of Efficient Public Transport for Promotion of Bus Transport

The following strategies will be considered:

① Introducing efficient bus transport system with bus routes, bus lanes and bus stops
② Providing bus terminals at the strategic points on the public transport routes
③ Shifting to high occupancy vehicles (big bus) from minibus in the future
④ Preparation of right of way for future public transport mode such as LRT

Improvement of Freight Traffic for Facilitation of Goods Movement

The following strategies will be planned for facilitation of goods movement

① Provision of truck terminals and cargo depots at the entrances of the city
② Provision of truck bays and distribution centre inside the urban area
③ Provision of river ports and an airport with multi-modal terminals with land transport for passengers and freight

Long-Term Transportation Development for International Standard Transport Network

The following strategies will be introduced in the long-term development of transport infrastructure

① Light rail transit (LRT) with the future railway stations in view

② Transit mall/pedestrian malls in the business and commercial zones

③ Universal design for mobility improvement for all people (including 'traffic vulnerable people')

④ Toll system and traffic demand management

⑤ Industrial and distribution zone with the truck terminal

⑥ Logistic centre with the multi modal terminal

⑦ Custom depot and export oriented zone for international freight

2) Proposed Transport Infrastructure

Goals of road infrastructure development after the rehabilitation stage is to provide adequate roads and road network system to cope with the expansion of urban area and change in modal split. Development goal of road network by 2015 is shown below.

Table 5.2-5 shows future needs and proposed transport infrastructure.

Table 5.2-5 Future Needs and Proposed Transportation Infrastructure

Development stage	Short (1)	Short (2)	Medium	Long
Year	2006-2009	2009-2011	2011-2015	2016-
Target level of services	Emergency rehabilitation	Adjustment and preparation	Development	
Goal of Institutional development	Law & System establishment	System adjustment	System development	
Transport infrastructure	1. Completion of all weather road networks 2. Solution of foreseeable bottleneck 3. NMT(Pilot base) 4. Promotion of capacity building	1. Paving of the city network 2. Promotion of NMT 3. Promotion of the capacity building 4. Preparation for the full-scale repair business	1. Urban road, traffic network expansion, improvement 2. Public transport enpowerment 3. Promotion of NMT 4. Construction of expressway 5. Road network maintenance	

Table 5.2-6 Development Goal of Urban Roads

Land Use	Road Network Density (km/sq.km)	Network Characteristics
Residential	4.0	Major Road/Minor Road (AC): 2km/sq.km Local Road (AC): 2km/sq.km note: grid pattern at least 500m interval
Commercial and Business	6.0 (5.0~7.0)	Major Road/Minor Road (AC): 4km/sq.km Local Road (AC): 2km/sq.km note: grid pattern at least 300m interval
Industry	1.0~2.0	- Exclusive use area for industry Major/Minor/Local Roads (AC): 2km/sq.km - Ordinary industry area Major/Minor/Local Roads (AC): 1km/sq.km
Average	3.5	

3) Road Classification

The road network is composed of the main roads such as Urban Highways, Major Roads (Class A), Minor Roads (Class B) and Local Roads (Class C). Meanwhile Local Streets (Class E) which make residential units will be considered in the settlement plan. Table 5.2-7 shows the road classification in the road network.

Table 5.2-7 Road Classification in the Road Network

Road Class	Road Category	Road Function	Road Width
Urban Highway	Urban Expressway	Principle Arterial	60m
Class A	Major Road	Primary Distributor	30~40m
Class B	Minor Road	District Distributor	20~30m
Class C	Local Road	Local Distributor	10~20m
Class D	Local Street	Access Road	6~12m
NMT route	Special Road	Walk/Cycle way	3~5m

4) Geometrical Design Criteria

Geometrical design criteria are proposed in Table 5.2-8.

Table 5.2-8 Proposed Geometrical Design Criteria

Item	Expressway	Major Road	Minor/Local Road	Local Street
Design Traffic by lane (ADT)	17~18,000	10~12,000	10~12,000	9,000 for 2-lane
Design Speed (km/h)	100, 80, 60	60, 50	60, 50, 40	50, 40, 30
Target Speed (km/h)	60	40	28	20
Minimum Road Reserve (m)	60	30~40	20~30 (Class B) 10~20 (Class C)	6~10
Applied Road	Urban Highway	Class A (Class B)	Class B Class C	Class D

5) Proposed Cross-Section

① Minimum requirement of design dimensions

Minimum requirement of design dimensions for standard cross section are proposed in Table 5.2-9 and Figure 5.2-10.

Table 5.2-9 Minimum Requirement of Design Dimensions

Road Class	Urban Highway	Class A	Class B/C	Class D	Remarks
Lane Width (m)	3.50 (3.75)	3.50	3.00~3.25	6.00~10.00 for road width	-
Median (m) (Central Reserve)	5.0	1.75~2.25	1.0	-	-
Allowance of Median (m)	0.5	0.25	0.25	-	-
Parking Lane (m)	2.0	1.5~2.5	1.5	-	-
Shoulder (m)	2.5	1.25	1.25	0.5	Paved shoulder is preferable
Service Road for Frontage Area (m)	7.0	4.0	4.0	-	Minimum shoulder width is 0.5m
Walk Way(m)	2.0~3.0	2.0~3.0	2.0~3.0	-	3.5m for high traffic
Bicycle Way (m)	2.0~3.0	2.0~3.0	2.0~3.0	-	
Green Belt (m)	1.0	1.0	1.0	-	3.0m-wide is preferable

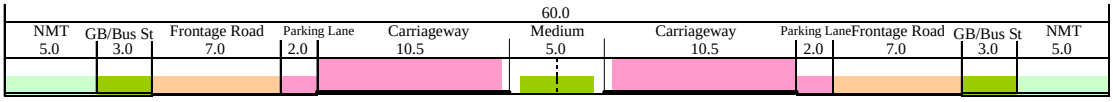
Note: Minimum width of median: 1.5m, desirable 8.0m. Minimum shoulder: 0.6m, 1.5 to 2.5m desirable.
Minimum walk way (footpath): 1.25m, 0.6m for each 20-30 pedestrians per minute plus 0.5m with dead space. Minimum cross fall of 2%. Minimum bicycle way is 2.0m to be separated from trafficking road by a 2.0m wide verge and from pedestrian footpath by 1.0 m.

In order to establish a well-functioning road network, the urban road network is formed by designating the networks of the Urban Highways, the Major Roads (Class A), the Minor Roads (Class B), Local Roads (Class C) and Local Streets (Class D). The order of the connection of the upper class road with the next lower one is an important principle.

② Standard Cross Section

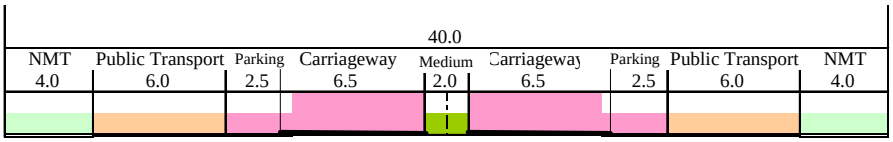
Standard cross sections are proposed as follows.

A: Urban Highway



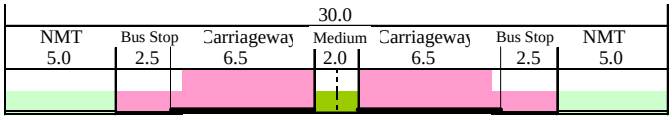
Urban Expressway 6-lane RR=60m (Class UE)

B: Major Road (Class A)



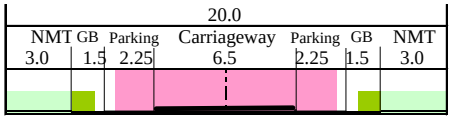
Major Road : Primary Distributor (Public Transport Route) RR=40m (Class A)

C (1) : Minor Road (I) Class B



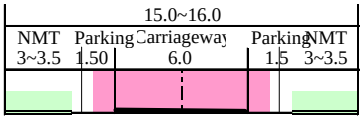
Minor Road: District Distributor (Public Transport Route) (Class B)
or Primary Districutor(Class A)

C (2): Minor Road (II) Class B



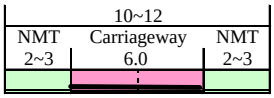
Minor Road: District Distributor RR=20m (Class B)
or Local Districutor(Class C)

D (1): Local Road (Class C)



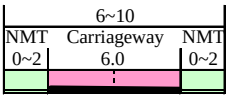
Local Road: Local Distributor RR=16m (Class C)

D (2): Local Road (Class C)



Local Road RR = 10~12m (Class C)

E: Local Street (Class D)



Local Street RR = 6~10m (Class D)

Figure 5.2-10 Standard Cross Section

6) Proposed Design of NMT Facilities

The proposed design concept of NMT facilities are shown in Table 5.2-10. Figure 5.2-11 presents typical NMT design with landscape.

Table 5.2-10 Design Concept of NMT Facilities

Road Class	Urban Highway	Class A	Class B/C	Class D	Remarks
NMT Domain	Service Road(NMT)	Separated	Separated	Mixed	NMT
Walk Way (Pedestrian)	3.5m- wide preferable for the disabled Minimum 2.0m			-	1.5m (Residential Walking Track)
Bicycle Way	2.0m preferable Min. 1.5m			-	
Mixed Walk Way + Cycle Way	-	-	-	4.0m preferable Min. 3.0m	(Single lane road) 3.0m (walk + cycle + MT) with speed hump (Local Road) 5.-6m (walk + cycle + MT) with speed hump

Table 5.2-11 Detailed Design Concept for The Disable

Item		Description
Walk Way (Pedestrian)	Wide	Min. 2m for two wheel chairs to pass each other
	Flatness	Min. 2m wide flat area on ramp
	Kerb	15 cm high
	Mound up	5cm mound-up. green belt, plant, fence, etc. if required.
	Pavement	Flat pavement (AC)
	Slope	Vertical slope: max. 5%, traverse slope: max1%
	Different Level	Different level from carriageway and walkway at crossing pass: 2cm

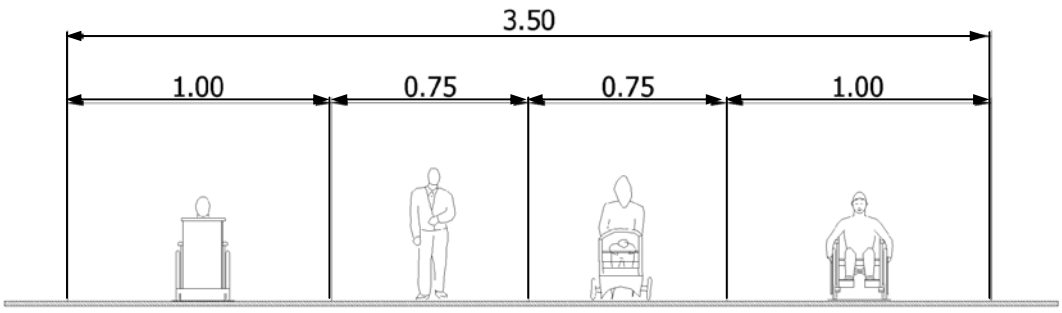


Figure 5.2-11 Example of Walkway for the Disables and the Traffic Vulnerable

(3) Proposed Project

Major aspects in the formation of road sector project are following.

① Relevance with road projects in ERWJ

The road rehabilitation projects presently underway in ERWJ (Emergency Rehabilitation Work in Juba) are those for rehabilitation of main roads to bear traffic in Juba. Accordingly not all roads and bridges to be rehabilitated were listed; rehabilitation of roads and bridges other than those in ERWJ shall be carried out. As the road projects in ERWJ are focusing on rehabilitation, attention was not paid to urbanization, road hierarchy, and NMT. In this regard, improvement of roads in ERWJ is also proposed.

② Roads to correspond to the future urbanization

Road network to correspond to, and induce, future urban structure and land use shall be proposed to correspond to the development directions toward northwest, southwest and south as belt-type urbanization.

③ Reinforcement of present road network deficiencies

Following issues to be solved are observed in the present road network from the viewpoint of efficient road network. Those are;

- Formation of all weather road network to prevent traffic discontinuity in rainy season,
- Reinforcement of May Street is solely accommodating the east-west traffic at present,
- Improvement of routes across the River Nile for the urbanization of eastern bank of the River Nile to correspond to population increasing pressure,
- Route development for airport access road without passing through city center,
- Improvement of accessibility and hierarchical composition of roads in Malakia area,
- Improvement of road network density including main and minor/local roads in the southern part of May Street in the city centre,
- Reinforcement of the function of circumferential road which is currently in complete, and
- Road improvement to establish bypass routes to reduce the concentration of through traffic on Unity Ave.

In this Study, road projects are proposed to cope with the above issues.

④ Trunk road network

Trunk road network with limited access to improve transport mobility within metropolitan area will be proposed. Such trunk road network shall connect with regional artery and shall for the frame of future urban area.

⑤ Public transport and NMT

In many countries of post-motorization, it is pursued to cope with problems including air pollution, accidents and noise originated from vehicles. Emphasis is put on public transport and NMT network as discussed in this Study. NMT network and public transport terminal projects are proposed.

Considering the aspects stated above, as well as constraints in funds and overall schedule as shown in Table 5.2-5, various types of project components are proposed as shown in Table 5.2-12.

Table 5.2-12 Proposed Components of Road Project

Development stage	Short (I)	Short (II)	Medium	Long
Year	2006-2009	2009-2011	2011-2015	2016-
Proposed project Components	Construction 1. Main trunk road paving 2. Community bridge construction 3. NMT facilities construction 4. Community Empowerment (road cluster) 5. Training (GOSS・provincial government)	Construction 1. Paving of the assistant trunk road 2. NMT facilities construction 3. Community empowerment (road cluster) promotion	Construction 1. New Nile bridge construction 2. Trunk road widening, improvement 3. City public transport network maintenance	
	Study Nile bridge FS	Study New Nile bridge construction DD Urban road traffic network maintenance	Study Expressway network construction LRT construction The second Nile bridge construction	

Actual road projects are proposed as explained in the following, in view of the components shown in Table 5.2-12.

1) Road Rehabilitation Project under Emergency Rehabilitation Work in Juba (ERWJ)

(see Chapter 3.)

2) Road Network Development Project, Phase-1

① Background

- The road network in Juba is excessively underdeveloped in terms of both quantity and quality. Due to incomplete formation of the road network, the traffic tends to concentrate on some primary roads causing the traffic congestion, though it is not so severe for the

moment as traffic demand is not fully developed yet. The road conditions, even of the primary roads, are generally poor. The sections of asphalt paved roads such as May Street are deteriorated with many potholes due to neglect of maintenance. Many of previously paved roads have deteriorated so badly that they have reverted to gravel surfaced roads.

- For Juba to fully function as the capital as well as the center of economic activities and to accept the resettlement of returned IDPs and refugees, development of infrastructure as a foundation of sustainable development of Juba, especially road network, is an absolute necessity.
- Following the urgent rehabilitation of roads being implemented by GOSS, this project, combined with the Phase-2, aims to form a complete road network, covering class A to C roads in this Phase-1 and urban highways and interchanges/intersections in Phase-2.

② Objectives

- To build an urban road network as the frame of the urban structure as well as the foundation of the sustainable development of the town.
- To meet the transport demand of people and goods and to activate the social and economic activities.
- To provide with the services for non-motorized traffic.
- To enhance the capacities for road planning, design, construction and maintenance through the implementation of the Project.

③ Location

Whole Juba Town and the surrounding areas

④ Scope of the Project

Construction/improvement of :

- Class A Roads : 85km
- Class B Roads : 69 km
- Class C Roads : 581km
- NMT (Non-motorized transport) Facilities : 60 km

⑤ Responsible Agency (expected)

- Project Implementation: GOSS
- Operation: GOSS / State Government of CES
- Maintenance: GOSS / State Government of CES

⑥ Project Cost

- Detailed Design Cost : USD 7.6mil.

- Construction Cost* : Class A Roads : USD 42.7mil.
  Class B Roads : USD 27.8mil.
  Class C Roads : USD 174.4mil.
  NMT : USD 9.0mil.
- Total Cost : USD 261.5mil.

  * Including construction supervision cost

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population in Juba of 510,000 in year 2015

(b) Effects of the Project :

- Formation/induction of the planned frame of the urban structure
- Transport cost savings and travel time reduction
- Enhancement of social and economic activities

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefits is expected to accrue from transport cost and travel time reduction.

(b) Financial Soundness

No financial problem is anticipated.

(c) Environmental Impacts

- Positive Impacts
  - Betterment of urban environment.
  - Improvement of accessibility to social/public facilities for residents.
  - Decrease of traffic accidents, especially of human related accidents, resulting from provision of pedestrian pathways.
- Negative Impacts
  - Increase in traffic nuisance such as noise and air pollution as a result of growing traffic volume (This can be mitigated by improvement of running condition of roads by the Project).

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Agency responsible for operation and maintenance has sufficient capacity.

(b) Preconditions

- Road right-of way is secured.
- Squatters within the right-of-way remove.
- Necessary fund is prepared.

⑩ Relationship with Other Projects

- This project is one of the preconditions for the following road transport projects, i.e. “Road Network Development Project, Phase-2”, “Nile River Bridge Construction Project” and “Transport Terminal Construction Project”.
- The roads constructed under this Project will provide with the space for laying transmission/distribution pipes in the water supply projects.

3) Road Network Development Project, Phase-2

① Background

- The road network in Juba and regional road network in Southern Sudan are excessively underdeveloped in terms of both quantity and quality. The pimary roads in Juba and regional trunk roads are generally in poor condition. The sections of asphalt paved roads are deteriorated with many potholes due to neglect of maintenance. Many of previously paved roads have deteriorated so badly that they have reverted to gravel surfaced roads.
- Due to incomplete formation of the road network, the traffic tends to concentrate on some primary roads causing the traffic congestion, though it is not so severe for the moment as traffic demand is not fully developed yet. And regional traffic tends to rely on other transport modes such as air transport and river transport resulting in high transport cost or long transport time.
- For Juba to fully function as the capital as well as the center of economic activities and to accept the resettlement of returned IDPs and refugees, development of infrastructure as a foundation of sustainable development of Juba, especially road network, is an absolute necessity.
- Following the urgent rehabilitation of roads being implemented by GOSS and Phase-1 Project, this project, covering urban highways and interchanges/intersections, aims to form a complete road network.

② Objectives

- To build an urban road network as the frame of the urban structure as well as the foundation of the sustainable development of the town.
- To build a regional road network as the foundation of the sustainable development of Southern Sudan.
- To meet the transport demand of people and goods and to activate the social and economic activities.
- To enhance the capacities for road planning, design, construction and maintenance through the implementation of the Project.

③ Location

- Whole Juba Town and the surrounding areas

④ Scope of the Project

Construction/improvement of :

- Urban Highway : 76km
- Interchange/Intersection : 25

⑤ Responsible Agency (expected)

- Project Implementation : GOSS/CES
- Operation : CES
- Maintenance : CES

⑥ Project Cost

- Detailed Design Cost : USD 9.7mil.
- Construction Cost* : Urban Highway : USD 61.1mil.
  Intersection/Interchange : USD 20.0mil.
- Total Cost : USD 90.8mil.

* Including construction supervision cost

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population in Juba of 510,000 in year 2015
- The whole population of Southern Sudan

(b) Effects of the Project

- Formation/induction of the planned frame of the urban structure
- Transport cost savings and travel time reduction
- Enhancement of social and economic activities

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefit is expected to accrue from transport cost and travel time reduction.

(b) Financial Soundness

No financial problem is anticipated.

(c) Environmental Impacts

- Positive Impacts
  - Betterment of urban environment.
  - Improvement of accessibility to social/public facilities for residents.
  - Decrease of traffic accidents, especially of human related accidents, resulting from separation of vehicle and pedestrian traffic.
- Negative Impacts
  - Increase in traffic nuisance such as noise and air pollution as a result of growth in traffic volume (This will be mitigated by improvement of running condition of roads by the Project).

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Agency responsible for operation and maintenance has sufficient capacity.

(b) Preconditions

- Road right-of way is secured.
- Squatters within the right-of-way removed.
- Necessary fund is prepared.

⑩ Relationship with Other Projects

"Road Network Development Project, Phase-1" is the precondition for this Project.

4) Nile River Bridge Construction Project

① Background

- The road network in Juba and regional road network in Southern Sudan are excessively underdeveloped in terms of both quantity and quality.

- The transport across the River Nile is restricted due to the fact that there is only one bridge over the River Nile with loading capacity of 30 tons, resulting in the urbanization limited on the western bank of the River Nile and undeveloped regional economic activities.
- For Juba to fully function as the capital as well as the center of economic activities and to accept the resettlement of returned IDPs and refugees, development of infrastructure as a foundation of sustainable development of Juba, especially road network, is an absolute necessity.
- Following the urgent rehabilitation of roads being implemented by GOSS and Phase-1 Project, this Project aims to form a complete road network to cater both urban and regional transport demand.

② Objectives

- To build an urban road network as the frame of the urban structure as well as the foundation of the sustainable development of the town.
- To build a regional road network as the foundation of the sustainable development of Southern Sudan.
- To meet the transport demand of people and goods and to activate the social and economic activities.
- To enhance the capacities for bridge planning, design, construction and maintenance through the implementation of the Project.

③ Location

Crossing points of both existing and planned roads over the River Nile

④ Scope of the Project

Construction/reconstruction of 6 bridges including approach roads:

- Bridge improvement (B1): replacement of existing bridge L=250m
- Five bridges according to the development of urban road network

  B2: new construction L=600m (to connect Juba to the East Bank)

  B3: new construction L=100m (-ditto-)

  B4: new construction L=250m (Juba north to Northern Sandbank)

  B5: new construction L=750m (Juba south to the East Bank)

  B6: new construction L=750m (Juba far-south to the East Bank)

⑤ Responsible Agency (expected)

- Project Implementation : GOSS/CES
- Operation : CES
- Maintenance : CES

⑥ Project Cost

- Detailed Design Cost : USD 2.5mil.
- Construction Cost* : B1 : USD 17.5mil.
  B2~B6 : USD 66.5mil.
- Total Cost : USD 86.5mil.

  * Iincluding construction supervision cost

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population in Juba of 510,000 in year 2015
- The whole population of Southern Sudan

(b) Effects of the Project

- Formation/induction of the planned frame of the urban structure
- Transport cost savings and travel time reduction
- Enhancement of social and economic activities

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefit is expected to accrue from transport cost and travel time reduction.

(b) Financial Soundness

No financial problem is anticipated.

(c) Environmental Impacts

- Positive Impacts
  - Betterment of urban environment.
  - Improvement of accessibility to social/public facilities for residents.
- Negative Impacts
  - Increase in traffic nuisance such as noise and air pollution as a result of growth in the traffic volume (This can be mitigated by improvement of running condition of roads by the Project).

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Agency responsible for operation and maintenance has sufficient capacity.

(b) Preconditions

- Road right-of way is secured.
- Squatters within the right-of-way removed.
- Necessary fund is prepared.

⑩ Relationship with Other Projects

"Road Network Development Project, Phase-1" is the precondition for this Project.

Overall Road Network Plan

An overall road network plan as an urban structural mainframe is prepared in accordance with land use plan in Figure 5.2-12.

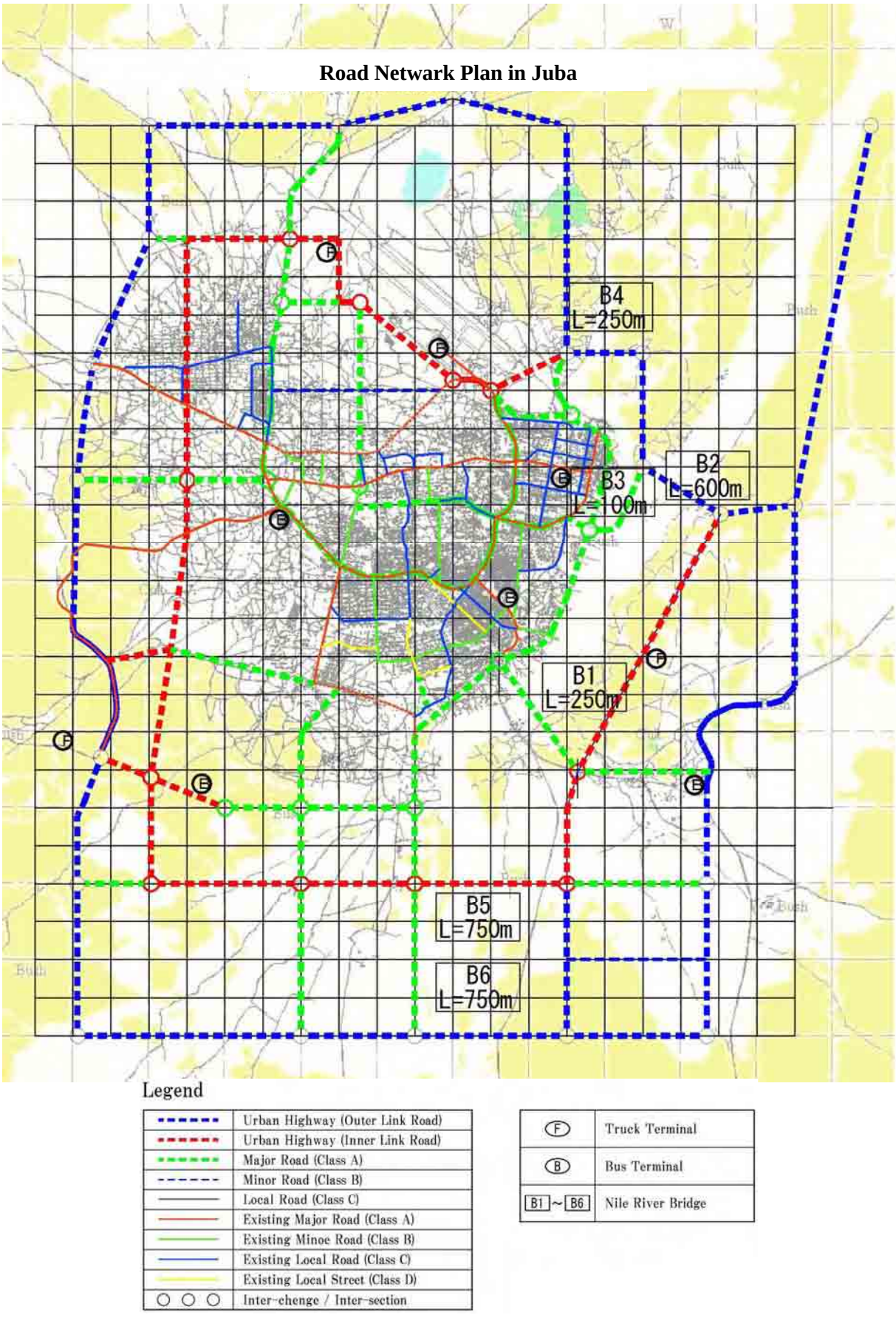


Figure 5.2-12 Proposed Road Network and Terminal (2015)

(4) Implementation Plan

The implementation plan of Urban Road Network Construction, Nile River Bridge Construction and Public Transport & Transport Terminal Improvement Project is shown in Table 5.2-13.

Table 5.2-13 Implementation Schedule of Urban Road Network Construction Plan in Juba

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020-
Road Rehabilitation Project (ERWJ)	■	■													
Road Network Development Project, Phase-1															
Class A		□	□	□	□	□	■	■	■	■					
Class B				■	■	■	■	■	■	■					
Class C				■	■	■	■	■	■	■					
NMT		□	□	□											
					■	■									
Road Network Development Project, Phase-2															
Urban Highway			□	□	□	□	■	■	■	■	■	■	■	■	■
Interchange/Intersection							■	■	■	■	■	■	■		
Nile River Bridge Construction Project															
Nile River Bridge (B1)		□	□			■	■								
Nile River Bridges (B2-B6)					□	□	□								
							■	■	■	■	■				

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

■ Construction/implementation

5.2.1.2 Public Transportation & Transport Terminal

(1) Present Situation

There is no systematic public transportation rules and regulation in Juba Town. The present bus terminals and truck terminals are located at the market places.

Figure 5.2-13 Bus Terminal (at Custom Market) and Bus Station

(2) Future Needs

For the convenience and time saving of public transport passengers, transferring facilities in Juba should be improved together with the rearrangement of public transport routes. Such transferring facility improvement is also expected to reduce the future traffic load on the road. Minibuses are most competitive transporters among public transport means in the developing countries because of their individual passenger-oriented services and low fares. In this regard, minibuses will remain as a major public transport mean and user at transferring facilities in future.

The necessity to move traffic generators as forwarders and warehouses outside of the town can be stressed not only for the development of trucking industry but also for the development/renewal of the town. The increase in urban traffic requires the control of heavy traffic that also reduces the traffic load on the road. In this context, construction plans of bus terminals and truck terminals are studied.

Development goals of public transport terminal and truck terminal are following.

① Public transport terminal

- Improvement of convenience and reliability of public transport
  (Efficiency of public transport is superior to the one by private vehicle)

② Truck terminal

Avoidance of heavy vehicle intrusion to the city centre and reduction of traffic load on the urban road (Composition of heavy vehicles in the total traffic is less than 3%)

Table 5.2-14 Area Requirement for Bus Terminal

		2006	2015	
Population	(pers.)	250,000	510,000	Estimated
Population over 14 years old	(pers.)	152,400	310,700	Calculated
Average person trips	(pers.trips/day)	-	2.5	Estimated
Person trips total	(pers.trips/day)	-	776,750	Calculated
Modal share				
veh. for pax.	(%)	-	8.0	Estimated
public	(%)	-	20.0	Estimated
walk, bicycle, etc.	(%)	-	72.0	Estimated
Modal split				
veh. for pax.	(pers.trips/day)	-	62,140	Calculated
public	(pers.trips/day)	-	155,350	Calculated
walk, bicycle, etc.	(pers.trips/day)	-	559,260	Calculated
Average occupancy of bus	(pers./veh.)	-	15	Surveyed
Bus trips total	(veh.trips/day)	-	10,357	Calculated
Peak hour concentration Rate	(%)	-	10	Surveyed
Peak hour bus operation	(veh./hour)	-	1,036	Calculated
Headway at berth	(min.)	-	6	Estimated
Necessary bus berths	(berths)	-	173	Estimated
Area requirement per berth	(sq.m/berth)	-	150	Estimated
Total planned area	(sq.m)	-	25,000	Calculated

Table 5.2-15 Planning Specifications of Truck Terminal

	unit	2015
Handling capacity per berth	ton/day/berth	20
Planned No. of berths		15
Total handling capacity per berth	ton/day	300
Area requirement per berth	sq.m/berth	350
Total planned area	sq.m	5,250

(3) Proposed Projects

In the planning of public transport terminal, focuses are placed on the following issues:

- To accommodate the passenger movement between industrial zone including market and business district and housing area
- To improve the fluidity of passenger movement among urban functions which are linearly and dispersedly located
- To facilitate coordination between regional public transport terminal and urban public transport terminal

Those public transport terminals are planned at the nodal points between the inner circumferential road and radial trunk road in consideration of covering area of bus service.

In the planning of truck terminal, focuses are placed on the following issues:

- To accommodate the freight movement between regional artery and major industrial areas
- To facilitate inter-modal connection between road and port/airport

Those truck terminals are planned at the nodal points between the outer circumferential road and regional artery, port and airport in consideration of prevention of heavy vehicle intrusion to the city centre.

Truck terminal is one of facilities which constitute the transport system of general cargo. The general cargo handled at truck terminal is relatively small in size but consists of variety of goods.

An overall public transport and terminal construction project is shown below (Table 5.2-16).

1) Terminal Construction Project

① Background

- Currently bus terminals in Juba are formed near the market without specifications as bus terminal facility. Such situation causes traffic congestion near the market and

inconvenience for the passengers. As for the truck terminal, no public truck terminal is provided yet and loading and unloading activities are performed on the road. Such situation also becomes the impediment to road traffic.

- For Juba to fully function as the capital as well as the center of economic activities and to realize future urban structure, development of infrastructure including terminal facilities as a foundation of sustainable development of Juba is an absolute necessity.

② Objectives

- To facilitate public transport and to realize efficient freight transport movement
- To alleviate the traffic congestion on the road and reduce the obstacle for traffic
- To enhance the capacities for road planning, design, construction and maintenance through the implementation of the Project.

③ Location

Juba City and the surrounding area

④ Scope of the Project

- Bus Terminal: Six new bus terminals are proposed at junction points of public transport, market, and major intersections.
- Truck terminal: Three truck terminals are proposed at interchange to control truck traffic to intrude into the town center.

Table 5.2-16 Terminal Projects

Public Transport Terminal			
	No.of berths	Area (sq.m)	Remarks
Juba Town Bus Terminal	50	7,500	Covering city centre, Munuki, Mundri, and Wau
Yei Road Bus Terminal	50	7,500	Covering Yei Rd., Nyakoron, Munuki, and Uganda
Airport Bus Terminal	10	1,500	-
Gumba Bus Terminal	30	4,500	Covering Torit Rd., Gumba, Nimule, Kapoeta, Malakal and Kenya
Malakia Bus Terminal	20	3,000	Covering Lologo, and Gumba
Others (Road side)	10	-	
Truck Terminal			
	No.of berths	Area (sq.m)	Remarks
Airport North Truck Terminal	5	1,750	Inter-modal, covering new industrial area, Wau and Mundri
Rajaf Truck Terminal	5	1,750	Inter-modal, covering new industrial area, Nimule, Kapoeta, Malakal and Kenya
Yei Road Truck Terminal	5	1,750	Covering new industrial area, Yei and Uganda

⑤ Responsible Agency (expected)

- Project Implementation: Government of CES
- Operation: Government of CES
- Maintenance: Government of CES

⑥ Project Cost

- Detailed Design Cost : USD 0.06mil.
- Construction Cost* : Bus terminals : USD 0.96mil.
  Truck terminals : USD 0.22mil.
- Total Cost : USD 1.24mil.

  * Including construction supervision cost

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population in Juba of 510,000 in year 2015

(b) Effects of the Project

- Formation/induction of the planned frame of the urban structure
- Transport cost savings and travel time reduction
- Enhancement of social and economic activities

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefit is expected to accrue from transport cost and travel time reduction.

(b) Financial Soundness

No financial problem is anticipated.

(c) Environmental Impacts

- Positive Impacts
  - Betterment of urban environment (noise pollution and vibration).
  - Improvement of accessibility to social/public facilities for residents.
  - Improvement of economic activities
  - Decrease of traffic accidents, resulting from vehicle intrusion to town center.
- Negative Impacts
  - None

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Agency responsible for operation and maintenance has sufficient capacity.

(b) Preconditions

- Road right-of way is secured.
- Squatters within the right-of-way removed.
- Necessary fund is prepared.

⑩ Relationship with Other Projects

"Road Network Development Project, Phase-1" is a precondition for this Project.

(4) Implementation Plan

Table 5.2-17 shows an Implementation Plan of Public Transportation & Transport Terminal.

Table 5.2-17 Implementation Plan of Public Transportation & Transport Terminal

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016-
Terminal Construction Project											
Truck Terminal											
Bus Terminal											

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

Construction/implementation

5.2.1.3 River Port

(1) Present Situation

1) Port facilities

In Juba, there are an old port, a new port and a small wharf for small private boats. Among these ports, the old port is located near the old blocks facing the tributary of the River Nile. The River Transport Corporation, under the Ministry of Transport of GOSS, has the ownership of the port facilities, loading machine, and warehouses, while the Central Government has the ownership of land. The old port has not been used due to the heavy sedimentation that has made river navigation impossible. Hence port facilities are unworkable and abandoned. In addition to the old port, there is a small wharf located 200m downstream of the old port on the tributary of the River Nile. The port operation is carried out by River Transport Corporation (RTC) under jurisdiction of GOS.

The new river port is located 2km upstream of the old port on the river bank of the main stream of the River Nile. The site of the new port used to be leased to private sector as an orchard yard before. There is no port facilities, such as loading and unloading machines and warehouses, and a natural riverbank of some 350m in length being used as a mooring or natural wharf; the back yards is still the orchard yard of mango trees. The port is used by the private companies and The River Transport Corporation administrate and operate this port but no users charge is collected.

Present situation of the temporary river port is shown in Figure 5.2-14.


Figure 5.2-14 River Transport and New River Port

2) Movement of Goods and Passengers

The present movement of goods transported from/to Juba is mainly by the following modes:

- Transportation from/to the north mainly depends on the water transportation between Kosti and Juba using the White Nile River, because of no passable and reliable road connecting Juba to other cities in the north.
- Transportation from/to the south mainly depends on the transportation by land through Juba-Yei Road which has been rehabilitated under the "Emergency Road Repair and Mine Clearance in Sudan" by WFP, although it is still gravel-surfaced in poor condition. The Juba-Yei Road is the only reliable inter-city road connected to Juba at present.

In addition to the above means, air transportation is used for urgent transportation, e.g.:

- Transportation of foods by WFP (mainly from Lokichokio in Kenya)
- Transportation of construction materials and equipment by private construction company (from Entebbe in Uganda)

The River Transport Corporation (RTC) runs the transportation by barges between Kosti and Juba new port. Average frequency of services is 16 cargo barges and one passenger barge per

month. Cargo barges run usually in convoy of 4 barges pushed by a push boat. Juba Port is used also by private transporters. The share of RTC is considered to be about 75 %.

Cargo handling volume by RTC is shown in Table 5.2-18 while the number of passengers carried by RTC is about 400 per month according to the information from RTC. About 60 % of cargos carried into Juba are foods and drinks and about 70 % of cargos carried out from Juba are grains.

Table 5.2-18 Cargo Handling Volume at Juba Port by RTC (April to December 2005)

(unit : ton/month)

	To Juba Port				From Juba Port				
	Bulk Cargo	Fuel	Bldg Material	Total	Grain	Various Goods	Scrap	Logs	Total
April 2005	1,050	300	200	1,550	176	23	15	0	214
May	7,150	600	500	8,250	77	0	14	5	96
June	-	-	-	-	-	-	-	-	-
July	2,005	600	300	2,905	159	0	0	9	168
August	1,700	380	100	2,180	45	0	48	0	93
September	4,250 (1,247)	300	100	4,650	-	-	-	-	-
October	4,250 (284)	300	100	4,650	-	-	-	-	-
November	2,950	80	100	3,130	-	37	27	7	71
December	1,450 (1,413)	-	200	1,650	148	-	30	15	193
Average	3,101	320	200	3,621	101	10	22	6	139

Source: River Transport Corporation
Note: ( ) shows food transportation by WFP.

Total transportation volume in 2005 including private transporters is estimated as shown in Table 5.2-19, assuming that the share of RTC is 75 % in both cargoes and passengers.

Table 5.2-19 Average Volume of Cargoes and Passengers at Juba Port

	Carried by RTC		Total including Private Transporters	
	To Juba	From Juba	To Juba	From Juba
Cargoes (ton/month)	3,600	140	4,800	200
Passengers (persons/month)	400	400	530	530

Aside from the transportation of cargoes and passengers, Juba Port is used for the return of IDPs having been evacuated to the southwestern part of Sudan, operated by the International Organization for Migration. They are transported from Juba to Bor by barges.

Modal Split

No data is available on the modal split for transportation of goods. As an example suggesting the modal split, volume of foods carried by WFP in 2005 is shown by modes in Table 5.2-20.

Table 5.2-20 Volume of Foods carried by WFP in 2005

Transport Mode	Volume of Foods and Share
Air	1,382 tons (23.2 %)
River	3,594 tons (60.4 %)
Road	979 tons (16.4 %)
Total	5,955 tons

The food transportation to Juba by WFP relied largely upon the river and air transportations in 2005 since road condition was very poor. However, the share of road transportation is increasing as rehabilitation/improvement of roads is going on.

(2) Future Needs

Many factors affecting the future demand, both plus and minus factors, are considered as follows:

Positive Factors

- Increase in construction materials/equipment and fuel necessary for rehabilitation/ reconstruction of infrastructures damaged during the civil war.
- Increase in transport demand due to increase in population.
- Increase in per-capita transport demand with improvement in living standard.
- Transportation of crude oil delivered in the northern part of the Southern Sudan into Kenya and Uganda.

Negative Factors

- Expansion of road transportation as inter-city trunk roads are rehabilitated/ improved.
- Increase in share of imports from Uganda and Kenya with improvement of international roads connecting thereto.

The above positive factors are those of increase in overall demand of goods transportation while the negative factors are those of increase of the share of road transportation or decrease in the share of river transportation. The positive factors imply that overall demand will increase in the future at higher rate than increase rate of population. On the other hand, it is certain that the share of road transportation will increase as the roads are improved. The following facts are also noted : (1) Since only few passable roads are connected to Juba at present, the river transportation is the only possible way from the north and more reliable way than transportation from the south by land, resulting in its high share: (2) The cost of the products coming from the south carried by land is competitive enough considering that the transshipment at Kosti is costly in case of river transportation while Ugandan products are cheap and their transport distance is short: (3) It is a fact that the share of road transportation is increasing.

Under the above situation, the following assumption is made in estimating the demand for river transportation in short to medium term up to year 2015 :

- The factors to increase the demand than population growth is absorbed by the increase in the share of road transportation.

Finally future demand of river transportation is projected on the following assumption:

- Low Estimate: River transportation demand increases at the same rate as population growth rate. The government of the Republic of the Sudan assumes the population growth rate at 1.5 % p.a. in the Southern Sudan and 4 % in the capital in case the concentration of population thereto continues. Therefore, a growth rate of 4 % p.a. is assumed in estimating the future river transportation demand.
- High Estimate: Taking into account the increase in per-capita transport demand in addition to the above estimate, the growth rate of river transportation demand is assumed to be 6 % p.a.

The projected demand for year 2015 is shown in Table 5.2-21.

Table 5.2-21 Forecast of River Transportation Demand

	Present Demand (2005)		Forecasted Future Demand (2015)	
	Volume	Number of Vessels	Volume	Number of Vessels
Cargo				
To Juba	4,800 tons/month	16 vessels/month	7,100-8,600 tons/month	24-29 vessels/month
From Juba	200 tons/month	-	300-360 tons/month	-
Passenger				
To Juba	530 pass./month	2 vessels/month	780- 950 pass./month	2-3 vessels/month
From Juba	530 pass./month	-	780-950 pass./month	-

Note: Number of vessels is estimated assuming the average load is 300 tons of cargos or 400 passengers.

(3) Proposed Project

After the comparison of candidate sites, port project is proposed at the temporary port site. The existing temporary port is proposed to be rehabilitated so that it can function up to 2015. The outline of the river port improvement project is shown in Table 5.2-22. (See Figure 7.1-3 in Chapter 7 for the layout of the facilities.)

Table 5.2-22 River Port Construction Project

	Stage (Year)	Short (I) (2006-2009)	Short (II) (2010-2011)	Medium (2012-2015)	Long (2016-)
1	Pilot Port (35m)	○			
2	Extension (35m)	○			
3	East River Port (300m)				○
Total (370m)					

1) Juba Port Improvement Project (Pilot Project under This Study)

① Background

- In Juba, there are an old port, a new port and a small wharf for small private boats. Among these ports, the old port has not been used due to the heavy sedimentation that has made the river navigation impossible.
- The new river port is located 2km upstream of the old port on the river bank of the main stream of the River Nile. There is no port facilities, such as loading and unloading equipment and warehouses, and a natural riverbank of some 350m length being used as a mooring or natural wharf.
- The River Nile is used as a low-cost transport mode for cargos and passengers to/from Juba, especially to/from the north because there is no passable and reliable road. Types of commodity by river transport are mainly construction materials/equipment and fuel necessary for rehabilitation/reconstruction of infrastructures damaged during the civil war.
- Transportation of crude oil and oil products to Kenya and Uganda is also expected. Therefore the importance of river transport will remain in future.
- For Juba to fully function as the capital as well as the center of economic activities, development of infrastructure as a foundation of sustainable development of Juba, especially port facility, is an absolute necessity.

② Objectives

- To meet the transport demand of people and goods and to activate the social and economic activities.
- To enhance the capacities for port planning, design, construction and maintenance through the implementation of the Project.

③ Location

Present temporary port

④ Scope of the Project

Construction of:

- A 35-m long pier with loading/unloading equipment
- Some 600m approach road
- Relevant facilities

(see Chapter 7.)

⑤ Responsible Agency (expected)

- Project Implementation: GOSS/Gov. of CES
- Operation: River Transport Cooperation
- Maintenance: River Transport Cooperation

⑥ Project Cost

(see Chapter 7.)

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population in Juba of 510,000 in year 2015
- The whole population of Southern Sudan

(b) Effects of the Project

- Formation/induction of the planned frame of the urban structure
- Transport cost savings
- Enhancement of social and economic activities

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefit is expected to accrue from transport cost and time reduction.

(b) Financial Soundness

No financial problem is anticipated.

(c) Environmental Impacts

- Positive Impacts
  - Improvement of social and economic activities in Juba and surrounding region.
- Negative Impacts
  - Influence on orchard management (This will be compensated.)

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Responsible agency for operation and maintenance has sufficient capacity.

(b) Preconditions

- Land right conversion of the site and road right-of way are secured.
- Squatters within the right-of-way and project site removed.
- Necessary fund is prepared.

⑩ Relationship with Other Projects

- Urban development plan is one of preconditions for this Project.
- "Road Network Development Project, Phase-1", "Nile River Bridge Construction Project" and "Transport Terminal Construction Project" will be the essential conditions for river port to fully function.

2) Juba Port Expansion Project

① Background

- In Juba, there are an old port, a new port and a small wharf for small private boats. Among these ports, the old port has not been used due to the heavy sedimentation that has made the river navigation impossible.
- The Temporary river port is located 2km upstream of the old port on the river bank of the main stream of the River Nile. There is no port facilities, such as loading and unloading equipment and warehouses, and a natural riverbank of some 350m length being used as a mooring or natural wharf.
- The River Nile is used as a low-cost transport mode for cargos and passengers to/from Juba, especially to/from the north because there is no passable and reliable road. Types of commodity by river transport are mainly construction materials/equipment and fuel necessary for rehabilitation/reconstruction of infrastructures damaged during the civil war.
- Transportation of crude oil and oil products to Kenya and Uganda is also expected. Therefore the importance of river transport will remain in future.
- For Juba to fully function as the capital as well as the center of economic activities, development of infrastructure as a foundation of sustainable development of Juba, especially port facility, is an absolute necessity.

② Objectives

- To meet the transport demand of people and goods and to activate the social and economic activities.
- To enhance the capacities for port planning, design, construction and maintenance through the implementation of the Project.

③ Location

Present temporary port

④ Scope of the Project

Construction of:

- An additional 35-m long pier

⑤ Responsible Agency (expected)

- Project Implementation: GOSS/ Gov. of CES
- Operation: River Transport Cooperation
- Maintenance: River Transport Cooperation

⑥ Project Cost

- Detailed Design Cost : USD 0.05mil.
- Construction Cost* : Port expansion : USD 1.80mil.
- Total Cost : USD 1.85mil.

* Including construction supervision cost

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population in Juba of 510,000 in year 2015
- The whole population of Southern Sudan

(b) Effects of the Project

- Formation/induction of the planned frame of the urban structure
- Transport cost savings
- Enhancement of social and economic activities

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefit is expected to accrue from transport cost and time reduction.

(b) Financial Soundness

No financial problem is anticipated.

(c) Environmental Impacts

- Positive Impacts
  - Improvement of social and economic activities in Juba and surrounding region.
- Negative Impacts
  - Influence on orchard management (This will be compensated.)

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Responsible agency for operation and maintenance has sufficient capacity.

(b) Preconditions

- Land right conversion of the site and road right-of way are secured.
- Squatters within the right-of-way and project site removed.
- Necessary fund is prepared.

⑩ Relationship with Other Projects

Urban development plan is one of the preconditions for this Project.

"Road Network Development Project, Phase-1", "Nile River Bridge Construction Project" and "Transport Terminal Construction Project" will be the essential conditions for the river port to fully function.

3) New Port Construction Project

① Background

- In Juba, there are an old port, a new port and a small wharf for small private boats. Among these ports, the old port has not been used due to the heavy sedimentation that has made the river navigation impossible.
- The temporary river port is located 2km upstream stream of the old port on the river bank of the main stream of the River Nile. There is no port facilities, such as loading and unloading equipment and warehouses, and a natural riverbank of some 350m length being used as a mooring or natural wharf.
- The River Nile is used as a low-cost transport mode for cargos and passengers to/from Juba, especially to/from the north because there is no passable and reliable road. Types of commodity by river transport are mainly construction materials/equipment and fuel necessary for rehabilitation/ reconstruction of infrastructures damaged during the civil war.
- Transportation of crude oil and oil products to Kenya and Uganda is also expected.

Therefore the importance of river transport will remain in future.

- For Juba to fully function as the capital as well as the center of economic activities, development of infrastructure as a foundation of sustainable development of Juba, especially port facility, is an absolute necessity together with industrial development.

② Objectives

- To meet the transport demand of people and goods and to activate the social and economic activities.
- To enhance the capacities of port planning, design, construction and maintenance through the implementation of the Project.

③ Location

Eastern bank of the River Nile is presumed. Location of the new port will be studied and determined.

④ Scope of the Project

Construction of:

- A new river port

  * Including a Feasibility Study in which roles of temporary and new port will be examined.

⑤ Responsible Agency (expected)

- Project Implementation: GOSS/CES
- Operation: River Transport Cooperation
- Maintenance: River Transport Cooperation

⑥ Project Cost

- F/S, D/D: USD 0.6mil.
- Construction Cost* : USD 12.3mil.
- Total Cost : USD 12.92mil.

  * Including construction supervision cost

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population in Juba of 510,000 in year 2015
- The whole population of Southern Sudan

(b) Effects of the Project

- Formation/induction of the planned frame of the urban structure
- Transport cost savings
- Enhancement of social and economic activities

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefit is expected to accrue from transport cost and time reduction.

(b) Financial Soundness

No financial problem is anticipated.

(c) Environmental Impacts

- Positive Impacts
  - Improvement of social and economic activities in Juba and surrounding region.
- Negative Impacts
  - Influence on orchard management (This will be compensated.)

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Responsible agency for operation and maintenance has sufficient capacity.

(b) Preconditions

- Land right conversion of the site and road right-of way are secured.
- Squatters within the right-of-way and project site removed.
- Necessary fund is prepared.

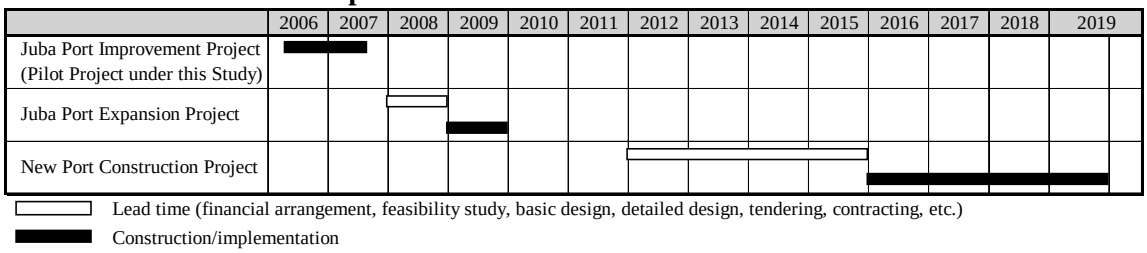
⑩ Relationship with Other Projects

- Urban development plan is one of the preconditions for this Project.
- “Road Network Development Project, Phase-1”, “Nile River Bridge Construction Project” and “Transport Terminal Construction Project” will be the essential conditions for the river port to fully function.
- Improvement of competitive regional road network and Juba International airport will affect on the modal share in regional transport by river.

(4) Implementation Plan

The implementation plan of River Port Construction is shown in Table 5.2-23.

Table 5.2-23 Implementation Plan of River Port Construction in Juba



5.2.1.4 Airport

(1) Present Situation

The existing Juba International Airport is located 2km north of the old district of Juba Metropolitan area. Formerly the Airport was administrated by Civil Aviation Authority (CAA) under the Ministry of Transport, Government of Sudan, and it was transferred to the GOSS in 2006. Two 2,500m runways of concrete pavement are running in parallel in northwest-southeast direction. Open apron transporter parking is adopted.

Although the control tower and the terminal building exist, modernization of the controlling system and improvement of the terminal building as well as the equipment are urgently needed to accommodate the growing transport demand. No X-ray examination security system is provided as yet. As for other facilities, the deterioration of runways is continuing and need for rehabilitation is gradually intensified. Also parking space including a hangar for aircrafts is insufficient and needs to be enlarged. Protective fences are not provided on the rim of airport site as a security measure to mark off.

Table 5.2-24 Passengers and Freight Movement at Juba International Airport in 2006

Month	Air Carrier Movement			Passenger			Freight				Mail		
	Arr.	Dep.	Total	Emb.	Disemb.	Total	Transit	Loaded	Un-loaded	Total	In	Out	Total
Jan.	693	693	1,386	2,835	3,318	6,153	-	903	-	903	81	228	309
Feb.	688	688	1,376	3,110	3,960	7,070	-	1,513	-	1,513	264	155	419
Mar.	726	726	1,452	4,605	4,908	9,513	789	1,554	-	1,554	264	155	419
Total	2,107	2,107	4,214	10,550	12,186	22,736	789	3,970	-	3,970	609	538	1,147

Source: Civil Aviation Authority

Although the airport is used by civil airline companies, WFP and UNMIS for passenger and freight transport services, it still has the characteristics of military airport.

Total number of air carriers to from the Juba International Airport is some 40 to 60 flights a day now, and the affordable capacity of airport to deal with air carriers is becoming meagre.

Air routes to/from Juba International Airport are rather limited: At presen, domestic routes are between Juba and Khartoum and Rumbek, and international routes are between Juba and Nairobi (Kenya), Lokichigio (Kenya), and Entebbe (Uganda).

Following airline companies are in operation at Juba International Airport for passenger and freight transport. Among these passenger airline companies, four are Kenyan or Ugandan companies. Cargo airline companies are all founded by domestic capital, connecting Juba and Khartoum.

Table 5.2-25 Passenger Airline Company

Company Name		Number of flights per Week	Remarks
1	Sudan Air	Khartoum-Juba (3)、Khartoum-Juba-Nairobi (1)	
2	MARSLAND Air	Khartoum-Juba (3)	
3	Air WEST	Khartoum-Juba (1)	
4	EAGLE Air	Entebbe-Juba (3)	
5	DELTA CONECTION	Nairobi-Juba (3)	Foreign company
6	EAST AFRICAN	Nairobi-Juba (3)	Foreign company
7	Jet Link	Nairobi-Juba (3) Code sharing with EAST AFRICAN	Foreign company
8	DAIRO Air	Entebbe-Juba (3)	Foreign company

Table 5.2-26 Cargo Airline Company

Company Name		Route and Number of Flights per Week
1	AZZA Air Cargo	Khartoum-Juba (7)
2	BDRE Air Cargo	Khartoum-Juba (7)
3	Sudan Air Cargo	Khartoum-Juba (1-2)
4	Air West Cargo	Khartoum-Juba (1-2)
5	ABABEEL Air Cargo	Khartoum-Juba (1-2)
6	Juba Air Cargo	Khartoum-Juba (7)
7	BENTUE Air Cargo	Khartoum-Juba (1)
8	TRANS ATICO	Khartoum-Juba (1-2)

WFP operates two flights a week and UNMIS six flight between Juba and Khartoum and both organizations also operate temporary flights.

Total number of arrival and departure passengers a day is about 650 and showing increasing trend. Regarding air cargo volume, no data on the volume by UN operated flights compiled at CAA, and only the statistical data by civil airline companies are available. According to the information available, more than 30 tonnes are loaded at Juba International Airport a day.

Figure 5.2-15 Juba International Airport

(2) Future Needs

As the continuous expansion of the airport transport demand is expected because Juba International Airport is a gateway of Southern Sudan and because economic growth will require more rapid and more voluminous movement of passengers and cargo, elasticity method was applied to roughly estimate the future air transport demand.

Table 5.2-27 Future Air Carrier Movement Demand at Juba International Airport

(unit:plane/day)

		2006	2011	2015	Growth Rate	
					2011/2006	2015/2006
Number of Carriers to/from Juba International Airport (total)	High Estimate	47	127	246	2.70	5.24
	Low Estimate	47	79	112	1.69	2.38

(3) Proposed Projects

It is most expected that air transport will keep growing rapidly because of the current poor conditions of other major transportation means that include road and river between Juba and other region of Southern Sudan and neighboring countries.

For the future demand of air transport at Juba International Airport, it is required to improve the airport facilities such as runway, apron, terminal building and air navigational aid facilities.

Figure 5.2-16 Juba International Airport Development Project (Conceptual)

Present location of Juba International Airport is very close to the old built-up area and it causes the problems of noise and urban development. It is worthwhile to examine possibility to relocate Juba International Airport a little far from the existing built-up area in the long span. However until the year 2015, the present Juba International Airport shall accommodate the future air transport demand through rehabilitation and expansion of facilities. In this context, a feasibility study for new airport construction is required before 2015. In the feasibility study, alternatives including entire relocation of Juba International Airport, and additional construction of new international airport other than present one shall be examined and evaluated.

1) Juba International Airport Rehabilitation Project

① Background

- Juba is the only airport that receives limited international flights.
- The existing Juba International Airport is located 2km north of the old district of Juba Metropolitan area and is administrated by GOSS.
- Although the control tower and the terminal building exist, improvement of the controlling system, terminal building and equipment are severely dilapidated. Deterioration of runways is continuing and need for rehabilitation is gradually intensified. Also parking space including a hangar for aircrafts is insufficient and needs to be enlarged. Protective fences are not provided on the rim of airport site as a security measure to mark off.
- It is urgently required to accommodate the growing air transport demand and to secure safe navigation.
- For Juba to fully function as the capital as well as the center of economic activities, development of infrastructure as a foundation of sustainable development of Juba, especially international airport, is an absolute necessity.

② Objectives

- To meet the domestic and international transport demand of people and goods, and to activate the social and economic activities.
- To enhance the capacities for airport planning, design, construction and maintenance through the implementation of the Project.

③ Location

Existing Juba International Airport

④ Scope of the Project

Outline of the projects are following.

(a) Runway and Apron

- Rehabilitation of existing runways (2500m)

(b) Terminal Building and Control Tower

- Renovation of VIP lounge

(c) Air Navigational Aid Facilities

Upgrading and/or new installation of Air Navigational Aid System

- Doppler VOR (VHF Omni-directional Radio Beacon)
- DME (Distance Measuring Equipment)
- NDB (Non-directional Radio Beacon)

(d) Other Facilities

- Improvement of car parks, electric power generator and fire-fighting vehicles
- Installation of X-ray examination security system
- Placement of ambulances for airport health facility
- Construction of protective fence

⑤ Responsible Agency (expected)

- Project Implementation: GOSS
- Operation: South Sudan Airport Authority
- Maintenance: South Sudan Airport Authority

⑥ Project Cost

- Construction Cost* : USD 1.5mil.
- Total Cost : USD 1.5mil.

* Including construction supervision cost

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population of Southern Sudan

(b) Effects of the Project

- Improvement of air transport safety
- Transport cost savings and travel time reduction
- Enhancement of social and economic activities

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefit is expected to accrue from transport cost and travel time reduction.

(b) Financial Soundness

No financial problem is anticipated.

(c) Environmental Impacts

- Positive Impacts
  - Improvement of accessibility to social/public facilities for residents.
  - Decrease of traffic accidents, especially of human related accidents, resulting from facility improvement.
- Negative Impacts
  - Increase in traffic nuisance such as noise and air pollution as a result of growth in traffic volume

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Agency responsible for operation and maintenance has sufficient capacity.

(b) Preconditions

- Necessary fund is prepared.

⑩ Relationship with Other Projects

"Road Rehabilitation Project (ERWJ)" and "Road Network Development Project, Phase-1" are preconditions for this Project.

2) Juba International Airport Development Project

① Background

- Juba is the only airport that receives limited international flights.
- The existing Juba International Airport is located 2km north of old district in Juba Metropolitan area and is administrated by GOSS.
- Although the control tower and the terminal building exist, improvement of controlling system, of terminal building and equipment are urgently dilapidated. Deterioration of runways is continuing and need for rehabilitation is gradually intensified. Also parking

space including a hangar for aircrafts is insufficient and needs to be enlarged. Protective fences are not provided on the rim of airport site as a security measure to mark off.

- It is urgently required to accommodate the growing air transport demand and to secure safe navigation.
- For Juba to fully function as a capital as well as a center of economic activities, development of infrastructure as a foundation of sustainable development of Juba, especially international airport, is an absolute necessity.

② Objectives

- To meet the domestic and international transport demand of people and goods, and to activate the social and economic activities.
- To enhance the capacities for airport planning, design, construction and maintenance through the implementation of the Project.

③ Location

Existing Juba International Airport

④ Scope of the Project

Outline of the projects are following.

(a) Runway and Apron

- Apron expansion for 3 berths
- Extension of existing runway (2,500 m) to 3,350 m (850m extension) with 23 m shoulder

(b) Terminal Building and Control Tower

- Renovation of existing Terminal Building and Control Tower

(c) Air Navigational Aid Facilities

- Aerodrome light
- Equipment in Control Tower

⑤ Responsible Agency (expected)

- Project Implementation: GOSS
- Operation: South Sudan Airport Authority
- Maintenance: South Sudan Airport Authority

⑥ Project Cost

- Detailed Design Cost : USD 0.3mil.
- Construction Cost* : USD 10.0mil.
- Total Cost : USD 10.3mil.

* Including construction supervision cost

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population of Southern Sudan

(b) Effects of the Project

- Improvement of air transport safety
- Transport cost savings and travel time reduction
- Enhancement of social and economic activities

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefit is expected to accrue from transport cost and travel time reduction.

(b) Financial Soundness

No financial problem is anticipated.

(c) Environmental Impacts

- Positive Impacts
  - Improvement of accessibility to social/public facilities for residents.
  - Decrease of traffic accidents, especially of human related accidents, resulting from facility improvement.
- Negative Impacts
  - Increase in traffic nuisance such as noise and air pollution as a result of growth in traffic volume

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Agency responsible for operation and maintenance has sufficient capacity.

(b) Preconditions

- Necessary fund is prepared.

⑩ Relationship with Other Projects

- “Road Rehabilitation Project (ERWJ)” is the precondition for this Project.
- Improvement of other local airports is the precondition for the formation of local air transport network.
- Improvement of regional road network is the precondition for the effective functioning of the airport.

3) New Juba International Airport Construction Project

① Background

- Juba is the only airport that receives limited international flights.
- The existing Juba International Airport is located 2km north of old district in Juba Metropolitan area and is administrated by GOSS.
- Although the control tower and the terminal building exist, improvement of controlling system, of terminal building and equipment are urgently dilapidated. Deterioration of runways is continuing and rehabilitation need is gradually intensified. Also parking space including a hangar for aircrafts is needs for insufficient and to be enlarged. Protective fences are not provided on the rim of airport site as a security measure to mark off.
- It is urgently required to accommodate growing air transport demand and to secure safe navigation.
- For Juba to fully function as the capital as well as the center of economic activities, development of infrastructure as a foundation of sustainable development of Juba, especially international airport, is an absolute necessity.

② Objectives

- To meet the domestic and international transport demand of people and goods, and to activate the social and economic activities.
- To enhance the capacities for airport planning, design, construction and maintenance through the implementation of the Project.

③ Location

Eastern bank of the River Nile is presumed. Location of new airport shall be studied and determined in the feasibility study.

④ Scope of the Project

Construction of:

- A new International Airport

* Including Feasibility Study in which roles of the existing Juba International Airport and the new airport will be examined.

⑤ Responsible Agency (expected)

- Project Implementation: GOSS
- Operation: South Sudan Airport Authority
- Maintenance: South Sudan Airport Authority

⑥ Project Cost

- Detailed Design Cost : USD 1.3mil.
- Construction Cost* : USD 41.8mil.
- Total Cost : USD 43.1mil.

* Including construction supervision cost

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population of Southern Sudan

(b) Effects of the Project

- Improvement of air transport safety
- Transport cost savings and travel time reduction
- Enhancement of social and economic activities

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefit is expected to accrue from transport cost and travel time reduction.

(b) Financial Soundness

No financial problem is anticipated.

(c) Environmental Impacts

- Positive Impacts
  - Improvement of accessibility to social/public facilities for residents.
  - Decrease of traffic accidents, especially of human related accidents, resulting from facility improvement.
- Negative Impacts
  - Increase in traffic nuisance such as noise and air pollution as a result of growing traffic volume

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Agency responsible for operation and maintenance has sufficient capacity.

(b) Preconditions

- Necessary fund is prepared.

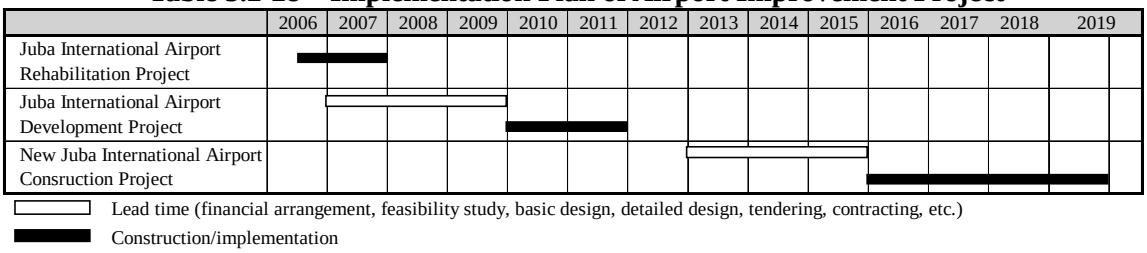
⑩ Relationship with Other Projects

- Improvement of other local airports is the precondition for the formation of local air transport network.
- Improvement of the regional road network is the precondition for the effective functioning of the airport.

(4) Implementation Plan

An implementation plan of airport improvement project is shown in Table 5.2-28.

Table 5.2-28 Implementation Plan of Airport Improvement Project



5.2.2 Utilities

5.2.2.1 Water Supply

(1) Present Situation

The sources of the water supplied to the residents in Juba Town and its surrounding area includes the existing waterworks, deep wells equipped with manual pumps, shallow hand-drilled wells and surface water extracted from the While Nile River.

1) Existing Waterworks

① Current Situation and Problems with Existing Waterworks

The waterworks (public water supply) in Juba Town were constructed in 1937 and have been upgraded twice, in 1957 and 1972 on a large scale. However, the subsequent conditions remain unchanged up to the present time. A layout drawing of the existing water supply facilities is shown in Figure 5.2-17. The existing water works are operated and maintained by the Urban Water Corporation and belong to the Ministry of Physical Infrastructure of the State Government. The service area includes Juba Town core area, part of the Kator District and Kuwait area in Munuki District.

The source of the water services is the White Nile River, from which water is drawn by floating pontoon-type intake pumps and purified by a water treatment plant. Treated water

is transported to a clear water transmission system located in the eastern lowlands including Malakiya and three (3) elevated steel panel water tanks installed in close vicinity to the Teaching Hospital. Treated water is also transported to an elevated water tank at the Jone Garcia Memorial Place via ϕ200mm main steel transmission pipe and distributed to the distribution system installed at higher section including the ministry complex.

The distribution system is composed of 51km distribution pipes, 2,300 household water supply facilities and 40 public water supply facilities (communal standpipes).

The treatment facilities are composed of 4 rapid filter tanks, flocculation and sedimentation tanks (4 concrete tanks and one steel tank) and one treated water tank. The original capacity is 7,200m^3 per day and appears to be able to supply water for 140,000 persons. A water-rate system is applied for water charges of the scope of 600SD per month for 4th Class residents and 1,200SD per month for 1st Class residents. A charge of 3,000SD per zone is imposed for the ministry complex.

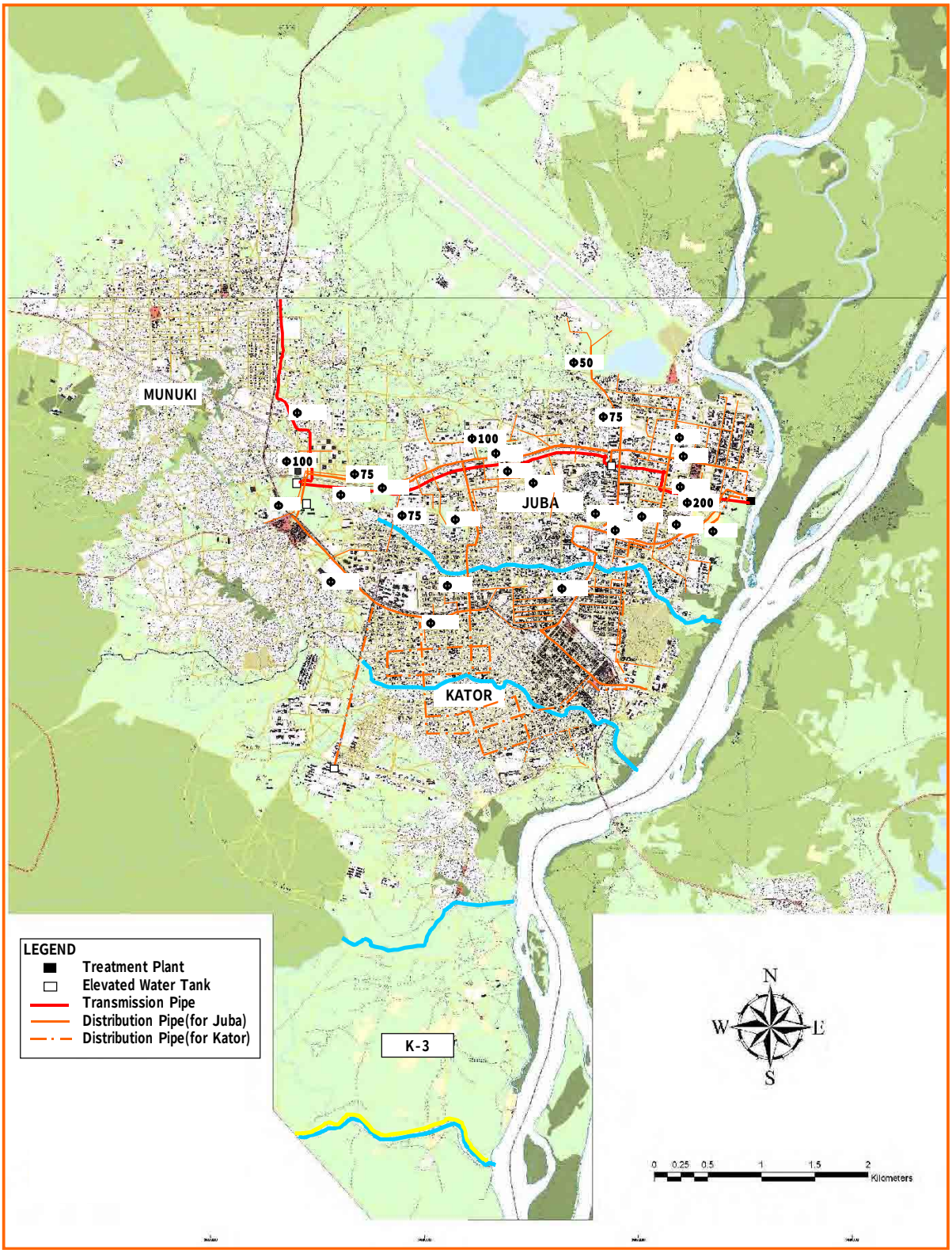


Figure 5.2-17 Layout Plan of Existing Urban Water Supply Facility

The existing water services facilities are extremely old and have not been adequately maintained during two long wars, so the following problems have been identified through the review of the existing data and site reconnaissance:

- Three intake pumps, two transmission pumps and three booster pumps at the hospital have been mismatched, so the required amount of water is not being pumped.
- There are no standby pumps at three pump stations.
- The standby generators need overhauling.
- The flow meters are broken, so the intake amount of raw water and treated water are not measured.
- The treatment plant is old and there is an unbalance in the capacity and scale of the water treatment system: Accordingly, the raw water is not adequately treated.
- The gas chlorinator at the plant is broken, and water is not being disinfected.
- The laboratory at the treatment plant lacks essential equipment, agents and other consumables.
- The galvanized steel transmission pipe is very old and extremely rusty: Its function has deteriorated substantially.
- The elevated steel panel water tanks at the hospital are leaking and can store the water only up to the height of one panel out of three panels.
- The elevated steel panel water tank at the assembly also leaks badly.
- The distribution network functions only for a part of Juba Town core area and does not function for all of Kator District and Kuwait area in Munuki District.
- The distribution pipe is made of asbestos, and has weathered and eroded due to exposure: Accordingly, it has been broken and is leaking at various points.
- The total leakage ratio of the system is reported to be 40-45%.
- Many of the isolating valves in the system are inoperable.
- The Urban Water Corporation lacks skilled labor, vehicles and spare parts and materials for repair: Accordingly, they cannot perform their duty of maintaining the system on time.

② Water Supply Administration Bodies (Responsible Organizations)

Although the Ministry of Water Resources and Irrigation of Government of Southern Sudan (GOSS) is the body in charge of water supply at the national level, the Ministry of Housing, Lands and Utilities (MHLU) is responsible for planning, design and construction of water supply facilities at present. The MHLU performs the duties of the Urgent Rehabilitation Project for water supply facilities in Juba Town and its surrounding area from planning to tender. The Directorate of Drinking Water Corporate, which is a department of the State Ministry of Physical Infrastructure, is responsible for water supply administration at a state level. Operation and maintenance of water services in Juba Town and its surrounding area are taken by the Urban Water Corporation, a sub

organization of the Directorate of Drinking Water Corporation. The organizational chart of the bodies responsible for water supply on a state level is shown in Figure 5.2-18.

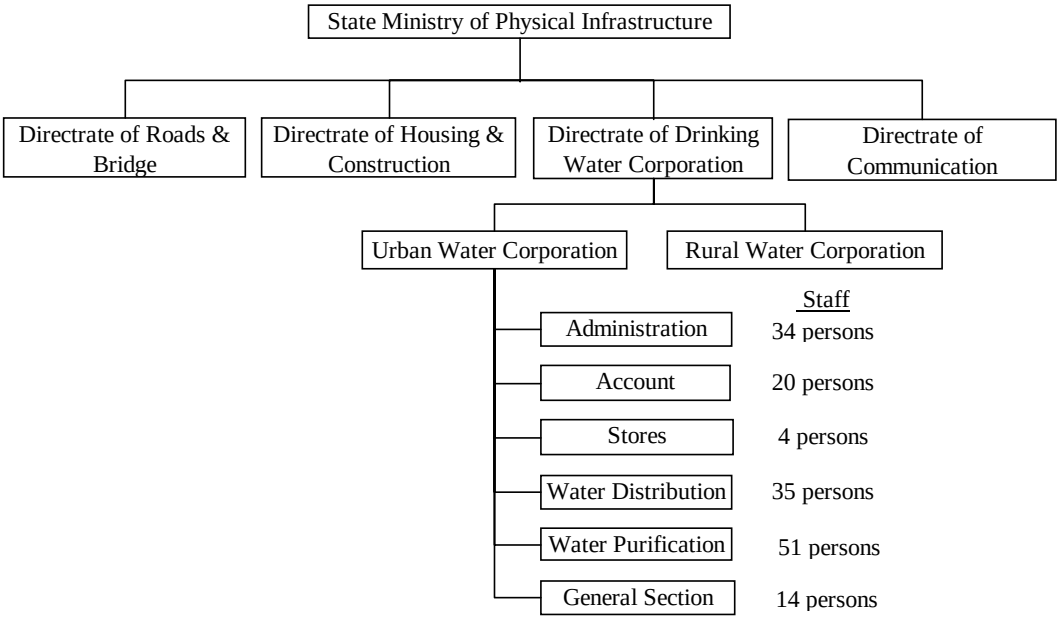


Figure 5.2-18 Organization Chart of Urban Water Corporation

③ On-going Project

The Government of Southern Sudan (GOSS) formulated policies on the remodeling of existing facilities in order to address the above-mentioned existing water supply problems and began implementation of the project in December 2005. Since August 2006, full-scale construction work has been underway. The construction work is outlined in the following:

Emergency Work

- Refurbishment of standby generator sets at the water treatment plant site and at the pumping station adjacent to the Teaching Hospital.
- Replacement of one elevated steel panel water tank at the pump station adjacent to the Teaching Hospital.
- Erection of ten 50m^3/day package water treatment plants with power supplies including 50m^3/day elevated water tank
- Supply and laying of 1,160m of DN110 PVCU distribution pipe work at the Ministry Complex
- Supply and installation of 345m of DN 63 PE service connection with 12 DN 50 water meters at the Ministry Complex

Urgent Work

- Replacement of three intake pumps, two transmission pumps and three booster pumps
- Installation of three standby pumps for three pumping stations.
- Refurbishment of the existing treatment plant to original capacity of 7,200 m^3/day
- Provision of measurement system so that chemicals can be accurately dosed.
- Allowance for the contractor to operate the plant for one year and provide on-the-job training to operators
- Provision of duty and standby mechanical and electrical equipment to improve the reliability of the system
- Provision of flow meters to measure treated water production at the treatment plant
- Provision of adequate laboratory facilities at the treatment plant site
- Replacement of two elevated steel panel water tanks at the pumping station adjacent the Teaching Hospital
- Construction of a 250 m^3 elevated concrete water tank adjacent to the Assembly Hall
- Supplying and laying of 4.7 km of 300 DN transmission main pipe
- Supplying and laying of some 3 km of PVCU distribution pipe work
- Rebuilding 2,045 service connections with flow meter
- Provision of leakage detector and allowance for leakage detection and repair
- Replacement of inoperable valve in the water supply system
- Provision of pipe repair couplings
- Provision of vehicles for operating and maintenance staff

Since emergency work is expected to take two months and urgent construction work to take more than 12 months, completion is scheduled for the end of 2007.

The total cost of construction work is USD19 million.

Of the above-mentioned construction work, the United States Agency for International Development (USAID) will provide financial aid of US$ 311,914 in total for the following construction work.

- Replacement of 11 pumps: USD183,400
- Replacement of elevated water tanks at the hospital: USD50,695
- Rehabilitation of sedimentation tank: USD55,159
- Provision of water leakage detectors: USD22,660

2) Current Situation of Other Water Supply

① Deep Wells (Boreholes)

Current Situation and Problems

At the center and outskirts of Juba City, deep wells equipped with manual pumps have

been developed since the middle of the 1990s to supplement serious shortages of water for domestic use during the war. The number of deep wells has reached 365 at the present time. Of those, 292 wells are in operation. The breakdown is shown in Table 5.2-29.

Table 5.2-29 Numbers of Wells with Manual Pumps by District

Name of District	Numbers of Wells		
	Total	In Operation	Out of Operation
Juba Town	130	104	26
Kator	49	39	10
Munuki	186	149	37
Total	365	292	73

Since the wells are concentrated in a narrow space of 200m to 300m wide and are in built-up residential areas, the ground water level has dropped due to well interference, and there is almost no room for new well development. In addition, the budget of the Rural Water Development Corporation which is responsible for operation and maintenance of wells with manual pumps is small and appropriate maintenance cannot be carried out due to a shortage of maintenance vehicles. Furthermore, beneficiary residents feel that water should be free and show little interest toward assisting well maintenance. Accordingly, the water output per single well is considerably lower than it was at the time of construction, and the local residents have difficulties in securing the required amount of water due to lowering in the ground water level.

Organization Responsible

The Rural Water Development Corporation, a sub organization of the Directorate of Drinking Water Corporation, is in charge of operation and maintenance of deep wells in Juba Town and its surrounding area and well development in rural areas in the State. Its organizational chart is shown in Figure 5.2-19.

Although the Rural Water Corporation has staff of 258 persons, since the drilling rigs owned are old and dilapidated, wells cannot be developed independently and therefore they rely on development by NGOs who own their drilling rigs. Consequently, it is unable to cope with the demand of approximately 1,000 wells which are necessary to satisfy the basic human water supply needs for the entire State and Juba Town and its surrounding area.

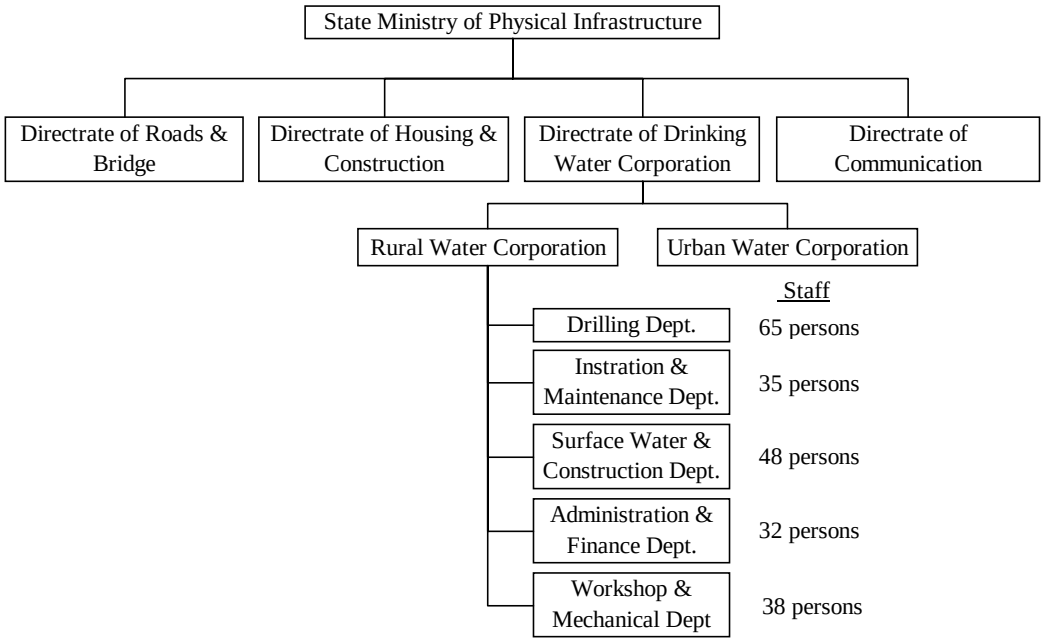


Figure 5.2-19 Organization Chart of Rural Water Corporation

② Others

Many shallow wells have been constructed in the northern Munuki Block as another means of supplying water: The water is utilized for miscellaneous purposes such as for washing clothes, etc.

In addition, residents who cannot obtain sufficient amounts of water from the above-mentioned water supply facilities, particularly many residents of the Kator District where there are few deep wells, utilize surface water of the River Nile for domestic use. Raw surface water is drawn from the River Nile by private water supply companies, sold and then transported to storage tanks at each location by tanker truck at a rate of 50SD/20ℓ.

Although untreated surface water is mainly utilized for miscellaneous purposes, such as washing clothes or bathing, the water is utilized also as drinking water during serious water shortages in the dry season, which is major cause of outbreaks of waterborne contagious diseases.

(2) Future Needs

1) Target Year

Within the development concept of the Study, the period 2006 to 2011 is positioned to be a period of urgent reconstruction and adjustment and preparatory period for full-scale

reconstruction. The period 2012 to 2015, which is the year of the Millennium Development Goals, is regarded to be the period for full-scale reconstruction. The period from 2016 is positioned to be the stage of expansive development. Even in the water supply improvement plan, the existing water supply facilities will be improved through upgrading and short term expansion; whereas, as a medium-term development concept, a full-scale urban water supply improvement plan will be formulated in 2015 which is the target year.

2) Target Areas

The planned areas subject to water supply include all residential areas including commercial and industrial land and public land within Juba Town and districts subject to the development concept which are its surrounding area. The total area is 46.0km^2 including 13.7km^2 in Juba Town District, 15.5km^2 in Kator District and 16.8km^2 in Munuki District.

3) Served Population

① Population

According to the Study, the population of Juba Town and its surrounding area is estimated to be 250,000 in 2006, 366,000 in 2011, and 510,000 in 2015, which consists of 460,000 on the west bank and 50,000 on the east bank of the River Nile. Further breakdown by district is shown in Table 5.2-30.

Table 5.2-30 Population by District

Name of District	2006	2011	2015
Juba	103,000	120,000	134,000
Kator	69,000	90,000	107,000
Munuki	78,000	156,000	219,000
Total	250,000	366,000	460,000
Gumba (East)	0	0	50,000

② Water Supply Ratio

Since there is no established data on the present water supply ratios within the planned service areas, the present water supply ratios have been estimated based on the following assumption.

- Since 20 to 30% of the original capacity (7,200m^3 per day) is estimated to function in the present water supply of the Urban Water Corporation, a minimum ratio of 20% is assumed.

- Although the Urban Water Corporation estimates the leakage rate of the present water supply to be 35% to 40%, the ratio is assumed to be 45% considering the actual situation of leakage of the present facilities.
- Since the practicable output per single well has been estimated to be 20 to 30ℓ /minute through the ground water survey for the pilot project in the Munuki Block, the output per existing single deep well is assumed to be 25ℓ /minute, adopting the mean value.
- The daily consumption per capita is assumed to be 25ℓ/day/person, which is the mean value of the set value for 3rd Class in 2006.
- Water from shallow wells and surface water from the River Nile is not included in the water supply volume in the calculation of water supply ratio.

The present water supply ratios are estimated as shown in Table 5.2-31.

Table 5.2-31 Present Water Supply Ratio

Name of District	Population	Water Supply	Amount of WS* little/day	WSAP**	Ratio %
Juba Town	102,938	Piped W.S.		30,881	66.4
		104 wells	1,123,200	37440	
Kator	69,291	39 wells	421,200	14,040	20.3
Munuki	75,183	149 wells	1,609,200	53,540	71..3
Total	250,000			135.901	54.4

* WS = Water Supply

** WSAP = Water Supply Available Population

Since the supply of water is a basic human need (BHN), the water supply ratio for 2015, which is the target year, is set at 100%.

Assuming that a water supply ratio in 2011 can be obtained through interpolating the figures of 2006 and 2015, the water supply ratio in each year can be obtained as shown in Table 5.2-32.

Table 5.2-32 Water Supply Ratio (%)

Name of District	2006	2011	2015
Juba Town	66.4	83.2	100
Kator	20.3	60.2	100
Munuki	71.3	85.7	100
Average (West)	54.4	77.2	100
Gumba (East)	0	0	100

③ Served Population

The served population can be estimated by multiplying the population in each year by the water supply ratio. The values are shown in Table 5.2-33.

Table 5.2-33 Water Supply Population

(Population unit: 1000 persons)

Name of District	2006			2011			2015
	Population	WSR*	WSP**	Population	WSR*	WSP**	Population/ WSP**
Juba	102,938	66.4	68,321	120,254	83.2	100,051	134,000
Kator	69,291	20.3	14,040	90,004	60.2	54,182	107.000
Mumuki	75,183	71.3	53,540	156,035	85.7	133,722	219,000
Total	250,000	54.4	135.901	366,000	77.2	282,552	460,000
Gumba	0		0	0		0	50,000

* WSR = Water Supply Ratio (%)

** WSP = Water Supply Population

4) Water Consumption

① Daily Consumption per Capita

Present daily per capita consumption

Behaviour toward water utilization varies according to the living standards, customs, etc. of its beneficiaries.

In accordance with the water charge system imposed on local residents by the Urban Water Cooperation, beneficiary residents are classified into the following basic three (3) groups.

Class	Population ratio	Consumption (ℓ/day/capita)
High	10%	100
Middle	20%	60
Low	70%	20

It is difficult to say that the above-mentioned values always reflect the actual conditions of water usage of beneficiaries because the fixed charge system is applied and there are no water meters. Accordingly, no survey on water usage has been carried out.

The JICA Study Team carried out a questionnaire survey for 88 households in Juba Town District, Kator District and Munuki District in order to grasp the actual household situations including water usage. According to the findings of the survey, actual water usage for the entire area is as follows.

Class	Population ratio	Consumption (ℓ/day/capita)
High	2%	70＞
Middle	8%	40 ～ 70
Low	90%	40＜

Judging the above data comprehensively, the present daily per capita consumption in the Project is assumed as shown in Table 5.2-34.

Table 5.2-34 Present Daily Consumption per Capita

Class	Population Ratio (%)	Consumption (ℓ/day/capita)
High	5	100
Middle	10	50
Low	85	20
Average		25

Targeted daily per capita consumption

In due consideration of the targeted daily per capita consumption in 2015 suggested by Gibb Company in Juba Town planning (120lpcd for a house connection, 50lpcd for an yard connection, and 50lpcd for a communal standpipe), the following values are adopted.

Class	Type of connection	Consumption (ℓ/day/capita)
High	House Connection	120
Middle	Yard Connection	60
Low	Communal Standpipe	40

The population ratio by class of beneficiary residents in 2015 is set at 15% for high class, 40% for middle class and 45% for low class, based on the goal of achieving decrease in the ratio of the poor in South Sudan from 90% at present to 45% in the Millennium Development Goals (MDGs).

Maximum daily per capita consumption

The maximum daily per capita consumption will be applied to the targeted average per capita consumption in due consideration of load factor for seasonal changes in water consumption (water supply).

Load factor, which is the ratio of average daily per capita consumption against maximum daily per capita consumption, is set to be 0.75 considering that significant seasonal changes in water consumption is anticipated due to local conditions in Southern Sudan;

the dry season is extremely hot and the rainy season is relatively cool.

The daily average per capita consumption and daily maximum per capita consumption are shown in Table 5.2-35.

Table 5.2-35 Daily Average and Maximum Consumption per Capita

Household Class	Supply Type	2006		2011		2015	
		DACPC	DMCPC	DACPC	DMCPC	DACPC	DMCPC
High Class	House Connection	100	133	111	148	120	160
Middle Class	Yard Connection.	50	67	56	75	60	80
Low Class	Pablic Tap	20	27	31	41	40	53
Average		26	38	46	61	60	80

Note: DACPC = Daily Average Consumption per Capita
DMCPC = Daily Maximum Consumption per Capita

Daily average and maximum per capita consumption for other water supply purposes

Water is also supplied to schools, hospitals and government offices, industrial and commercial districts. The figures of daily per capita consumption, assumed based on the similar values of other countries in Africa, are shown in Table 5.2-36.

Table 5.2-36 Daily Average and Maximum Consumption per Capita for Other Purpose

Purpose of Water Use	2006		2011		2015		Remarks
	DACPC	DMCPC	DACPC	DMCPC	DACPC	DMCPC	
School	15	20	21	28	25	33	
Hospital	90	120	123	164	150	200	per Bed
Govern't Office	30	40	36	48	40	53	
Others	30	40	26	35	40	53	

② Daily Average Consumption and Daily Maximum Consumption

The estimated daily average consumption and daily maximum consumption for domestic use in 2006, 2011 and 2015 are shown in Table 5.2-37 and respectively based on the served population and water consumption per capita in each year.

Table 5.2-37 Total Daily Average Consumption for Domestic Use by Area

District	2006		2011		2015	
	WSP*	Consumption (m^3/day)	WSP*	Consumption (m^3/day)	WSP*	Consumption (m^3/day)
Juba Town	66,000	1,650	108000	4,968	134,000	8,040
Kator	14,000	350	63000	2,898	107000	6,420
Munuki	55,000	1,375	146000	6,716	219,000	13,140
Total (West)	134,000	3,350	313000	14,398	460,000	27,600
Gumba (East)	0	0	0	0	50,000	3,000

* WSP: Water Supply Population

Table 5.2-38 Daily Maximum Consumption for Domestic Use by Area

District	2006		2011		2015	
	WSP*	Consumption (m^3/day)	WSP*	Consumption (m^3/day)	WSP*	Consumption (m^3/day)
Juba Town	66,000	2,508	108000	7,128	134,000	14,606
Kator	14,000	532	63000	4,158	107,000	11,663
Munuki	55,000	2,090	146000	9,636	219,000	23,871
Total (West)	134,000	5,092	313000	20,658	460,000	50,140
Gumba (East)	0	0	0	0	50,000	5,450

* WSP: Water Supply Population

Daily consumptions for other purposes such as schools, hospitals and government offices, industrial and commercial areas are estimated based on the basic values (number of students, number of beds, number of employees) and consumption per capita for other purposes, and shown in Table 5.2-39 and Table 5.2-40, respectively.

Since the ratio of domestic water consumption to other purposes is estimated to be 46% in 2006, 28% in 2011 and 26% in 2015, water consumption for other purposes can be estimated based on this ratio.

Table 5.2-39 Daily Average Consumption for Other Purposes by Area

District	2006		2011		2015	
	WSP*	Consumption (m^3/day)	WSP*	Consumption (m^3/day)	WSP*	Consumption (m^3/day)
School	23,800	357	52,022	1,092	74,600	1,865
Hospital	769	69	1,914	235	2,830	425
Government	15,000	450	15,000	540	15,000	600
Others	22,350	671	71,044	1,847	110,000	4,400
Total		1,547		3,714		7,290
Ratio of Others purposes to Domestic Water Use		46%		29%		26%

* WSP: Water Supply Population

Table 5.2-40 Daily Maximum Consumption for Other Purposes

District	2006		2011		2015	
	WSP*	Consumption (m^3/day)	WSP*	Consumption (m^3/day)	WSP*	Consumption (m^3/day)
School	23,800	476	52,022	1,457	74,600	2,462
Hospital	769	92	1,914	314	2,830	566
Government	15,000	600	15,000	720	15,000	795
Others	22,350	894	71,044	2,487	110,000	5,830

* WSP: Water Supply Population

5) Water Demand Forecast

Water demand in the water supply project can be forecast through the following procedures.

① Leakage Rate

Although the Urban Water Corporation indicates that the leakage rate of the present water

services is 35 to 40%, the actual leakage rate at present is assumed to exceed 45% considering the large quantity of water leakage from elevated tanks, daily leakage in each pipe and large quantity of water dripping from the end of faucets,. However, a rehabilitation project for present water services is currently being implemented. Following its completion, the leakage rate is expected to improve to the level of 35%.

In addition, the leakage rate of planned water services is expected be improved to 30% because of the following.

- Equalization of feed water pressure in blocks through subdivision of water supply blocks and reduction of static water heads working on the end faucets
- Prevention of locally excessive water supply by establishing a water supply control system for impartial water services
- Implementation of an enlightenment and education program to enhance water conservation awareness of benefiting residents

Accordingly, the leakage rate of existing water supply facilities in 2006 and 2011 is respectively set at 45% and 35%. The leakage rate of planned water services in 2015 is set at 30%.

② Demand Forecast

Table 5.2-41 shows the daily average water demand and increased demand in 2011 and 2006 in comparison with 2006 estimated with due consideration of water consumption for domestic use, leakage volume, and the ratio of domestic water consumption used for other purposes.

Table 5.2-41 Daily Average Water Demand

District	Items*	2006	2011		2015	
		Demand	Demand	Increased Demand	Demand	Increased Demand
Juba Town	WD	2,310	6,409	4,099	10,130	7,820
	LW	1,244	2,747	1,503	5,455	4,211
	TWD	3,554	9,156	5,602	15,585	12,031
Kator	WD	490	3,738	3,248	8,089	7,599
	LW	0	0	0	4,356	4,356
	TWD	490	3,738	3,248	12,445	11,955
Munuki	WD	1,925	8,664	6,739	16,556	14,631
	LW	0	0	0	8,915	8,915
	TWD	1,925	8,664	6,739	25,471	23,546
Total(West)	WD	4,725	18,811	14,086	34,775	30,050
	LW	1,244	2,747	1,503	18,726	17,482
	TWD	5,969	21,558	15,589	53,501	47,532
Gumba(East)	WD	0	0	0	3,780	3,780
	LW	0	0	0	2,035	2,035
	TWD	0	0	0	5,815	5,815

* WD: Water Demand LW: Leakage Water TWD: Treated Water Demand

6) Future Need by Phase

Since the water demand in Juba Town and its surrounding area is expected to increase sharply as shown in Table 5.2-41 due to the increase per capita water consumption and the rapid increase in population, economic growth and social development as a result of the influx of returnees. The increase in water demand is expected to be approximately 3.5 times of the present demand (2006) by 2011 and approximately 9 times of the present demand by 2015. Therefore, steps should be taken to meet the increased demand not only from the short-term point of view (target year is 2011), but also from the medium-term point of view (target year is 2015). In such case, it is important not only to improve facilities to the required scale but also to efficiently utilize the existing facilities and the facilities to be newly constructed to the maximum.

① Short Term Needs

The following measures should be taken because, under present conditions, the existing water supply facilities will not be able to cope with the huge increase in water demand in 2011.

- Increase in water supply by urgently rehabilitating existing waterworks:
  Although the rehabilitation of existing waterworks is being implemented through the financing of the GOSS as an urgent rehabilitation project, it only satisfies the current demand and does not address the increased demand since the project aims at recovering the original capacity of relevant waterworks.
- Effective utilization of the existing waterworks through the implementation of training program for staff at the Urban Water Corporation
- Increase in water supply through the rehabilitation of existing deep wells with manual pumps:
  Approximately 20% of the existing deep wells are continuously out of order. These wells can be effectively utilized through rehabilitation.

Accordingly, the following measures for the implementation of the water supply project will be taken.

- Implementation of a pilot project during the Study as a preparatory stage for implementing planned waterworks
- Implementation of the proposed project through the financing of GOSS, USAID and NGOs (such as SFM and ACF)
  - Increase in water supply through the construction of deep wells associated with a piped water supply system

In districts in Juba Town where urbanization is progressing, the existing well layouts are

already saturated and there is little room for development of new wells. Therefore the piped water supply system should be improved using well water mainly in new subdivision districts such as Lologo and Gudele, and then the water supply pipes network can be effectively utilized as part of a distribution pipe network in future planned waterworks projects.

The following measures can be considered for implementation.

- Implementation of a pilot project during the Study as a preparatory stage for implementing the planned waterworks construction
- Implementation of the proposed projects through the financing of GOSS, USAID and NGOs (such as SFM and ACF)
- Construction of wells in the project as training (capacity building) for Rural Water Corporation

- Promotion of well construction by Rural Water Corporation

In order to promote capacity building for Rural Water Corporation, the following support programs should be implemented.

- Provision of equipment for hydrogeological surveys and well drilling
- On-the-job training (OJT) in hydrogeological survey skills
- OJT in boring skills at drilling sites
- Technical guidance including the provision of personal computers for arrangement and preparation of basic data such as well registration, well distribution maps and hydro-geological data

- Sustainable and effective utilization of deep wells with manual pumps through the participation in maintenance by benefiting residents

Education should be provided to the beneficiary residents and their awareness should be improved by letting them participate in the operation and maintenance of deep wells with manual pumps and training program on maintenance skills

② Middle Term Needs

Since the present urban water supply system is old and the functions at various sites have deteriorated, even if the system is improved through the urgent rehabilitation project, the water demand in 2015 may not be fully met. Therefore, the following measures, including the probability of a new urban water supply system, should be taken in order to satisfy water demand in 2015.

- Establishing a new urban water supply system including treatment facilities to corresponding to water demand in 2015:

  An urban water supply system on a scale that will satisfy water demand in 2015 will be

improved.

- Effective utilization of treated water by introducing water wagons:
  The introduction of water wagons to meet the need to eliminate the gap between the completion time of treatment facilities and completion time for water supply facilities should be examined
- Appropriate and rational operation of an urban water supply system by establishing a financial base
- Promote independent implementation of the project by clarifying the authority as an implementing body for an urban water supply system through establishment of a legal system
- Efficient and appropriate utilization of an urban water supply system by supporting the Urban Water Corporation:
  In the case of supporting the Urban Water Corporation, a training program (capacity development) for staff should be implemented.
- Establishment of an efficient and appropriate maintenance system with the collaboration of the Urban Water Corporation and private companies by revising laws which will encourage private companies to participate
- Reduction of local excessive water consumption situations through awareness campaign to promote water conservation. (Awareness campaign for beneficiary residents together with the installation of flow meters)
- Contribution to the development of the regional economy by creating employment opportunities through the implementation of the project and maintenance works

(3) Proposed Project

Although adequate urban water supply is expected to be established in future, it is rather difficult to realize it in the short period. In order to meet the increased water demand in 2011, it is recommended that a development plan for piped water supply system in which groundwater is used as a water resource by rehabilitating existing wells and constructing new wells be implemented. The pilot project proposed in the JICA Study is the preferable solution to cater the imminent water supply demand. Following projects are proposed to be implemented in accordance with the proposed time schedule.

1) Emergency Water Supply Project (Pilot Project under this Study)

(see Chapter 8.)

2) Water Supply Project under Emergency Rehabilitation Work in Juba (ERWJ)

(see Chapter 3.)

3) Urgent Water Supply Project

① Background

- Although the rehabilitation of existing waterworks is being implemented through the financing of the GOSS as an urgent rehabilitation project, it only satisfies the current demand and does not address the increased demand since the project aims at recovering the original capacity of relevant waterworks.
- Under the present conditions, the existing water supply facilities will not be able meet the huge increase in water demand in 2011.
- Approximately 20% of the existing deep wells are continuously out of order, and these wells can be effectively utilized through rehabilitation.
- Effective utilization of the existing waterworks through the implementation of training program for staff of the Urban Water Corporation is required.

② Objectives

Objectives of the Project are as follows.

- To supply safe water before the realization of urban water supply from the River Nile
- To enhance the organization in charge of for operation & maintenance

③ Location

Juba Town and surrounding area where new housing development is taking place and is in short of water supply

④ Scope of the Project

(a) Urgent Water Development

As for rehabilitation of the existing wells, 90% of the wells (24 wells in Juba Town District, 9 wells in Kator District and 33 wells in Mumuki District) that are inoperable are rehabilitated taking into consideration some wells being abandoned due to water quality problems or an abnormal drop in ground water level.

The number of wells to be constructed for a piped water supply system is shown in Table 5.2-42. A total of 129 wells including 8 wells in Juba Town District, 60 wells in Kator District and 60 wells in Munuki District are necessary.

Table 5.2-42 Number of Wells to be Rehabilitated and to be Constructed by 2011

District Name	Water Supply Measure	Number of Wells	Water Supply Amount	Water Demand in 2011	Remarks
Juba Town	Present water suply system	7,200	6,480		(Water supply
	Rehabiritated well	24	324		capacity)
	Constructed wel	18	972		
	Operating well	104	1,404		
	Total		9,180	9,156	OK
Kator	Present water suply system	0	0	3,738	
	Rehabiritated well	9	122		
	Constructed wel	58	3,132		
	Operating well	39	527		
	Total		3,780	3,738	OK
Munuki	Present water suply system	0	0		
	Rehabiritated well	33	446		
	Constructed wel	115	6,210		
	Operating well	149	2,012		
	Total		8,667	8,664	OK
Total	Present water suply system	7,200	6,480		(Water supply
	Rehabiritated well	66	891		capacity)
	Constructed wel	191	10,314		
	Operating well	293	3,956		
	Total		21,641	21,558	OK

(b) Capacity Building

During the whole course of the Project, capacity building and technology transfer shall be performed to the Southern Sudan personnel.

⑤ Responsible Agency (expected)

- Project Implementation: Ministry of Water Resources & Irrigation of GOSS, and State Ministry of Physical Infrastructure
- Operation: Urban Water Corporation
- Maintenance: Urban Water Corporation

⑥ Project Cost

- Implementaion/Construction Cost* :

  Urban Water Development : USD 25.8mil.

  Capacity building : USD 0.9mil.

- Total Cost : USD 26.7mil.

  * Including construction supervision cost

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population in Juba of 510,000 in year 2015

(b) Effects of the Project :

- Formation/induction of the planned frame of the urban structure (promotion of settlement of IDPs and other refugees)
- Reduction of water-bone disease and infant mortality rates
- Improvement of the quality of life

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefit is expected to accrue from safe water supply.

(b) Financial Soundness

Revenue from the safe water supply can be expected, however, some subsidy by the State Government will be necessary.

(c) Environmental Impacts

- Positive Impacts
  - Betterment of urban environment.
  - Improvement of sanitary/health condition.
- Negative Impacts

  None

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Agency responsible for operation and maintenance has sufficient capacity.

(b) Preconditions

- Beneficiary-pay principle is accepted.
- Necessary fund is prepared.

⑩ Relationship with Other Projects

- The GOSS is implementing the Urgent Rehabilitation Project for the present urban water supply system.
- Road project, i.e. “Road Network Development Project, Phase-1”, will provide the space for laying transmission/distribution pipes in the water supply projects.

4) Urban Water Supply Project

① Background

Since the present urban water supply system is old and the functions at various sites have deteriorated, even if the system is improved through the urgent rehabilitation project, the water demand in 2015 may not be fully met. Therefore, the following measures, including the probability of a new urban water supply system, should be taken in order to satisfy water demand in 2015.

② Objectives

Objectives of the Project are as follows:

- To supply safe water
- To establish a reliable water supply system
- To enhance responsible organization for operation & maintenance
- To reduce water supply cost

③ Location

Whole Juba Town and the surrounding areas

④ Scope of the Project

Scope of the Project is following:

- Preparation of detailed design documents
- Implementation of bidding
- Construction of intake facility and water treatment plant
- Construction of transmission facility
- Construction of distribution facility
- Implementation of training program for operating and maintenance staffs of the Urban Water Corporation

The study result of this Project is shown below.

(a) Water Supply Block

As shown in Figure 5.2-20, to equalize feed water pressure at the water supply point and fair water supply control, water supply areas will be subdivided into 10 blocks: lower Juba, lower Kator, higher Juba, higher Juba and Kator, the Lologo extension area, Military area, Nyakoron 3rd/Mauna area, higher Jebel cujuru, Munuki eastern block, Munuki western block and Gudele area.

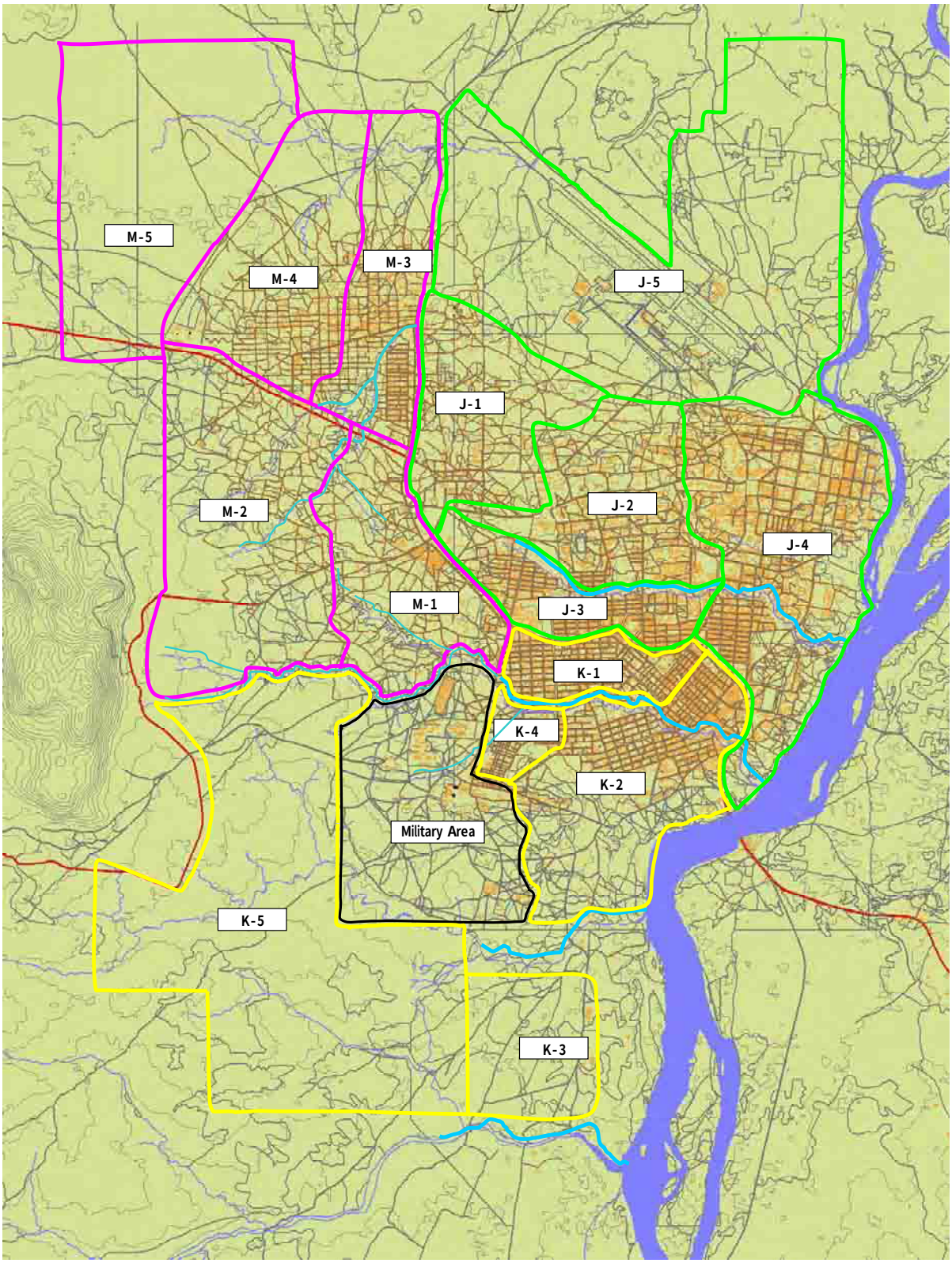


Figure 5.2-20 Water Supply Block

(b) Water Resource

The water resource of the project is the surface water from the White Nile River. Flow volume of the River is abundant. Because there are not observation data, the flow volume is not clear, but judging from the width, water depth and velocity of the River, it is estimated to be more than 1,000m^3. At present, there are no regulations or legislation concerning the intake of surface water from the White Nile River, and, hence, no special problem exists in utilizing surface water of the White Nile River as a water resource under the project.

The difference between the high and low water levels of the White Nile River as they pertain to the intake facilities plan had reached 4m to 5m by the latter half of the 1960s. Consequently, overflowing often occurred in low-lying areas along the river at the time of high water levels. However, the water level appears to have stabilized at the approximately 1.5m due to control of the outflow rate of a dam constructed on the debouchment (water outlet) of Victoria Lake in Uganda. The water level of the White Nile River at the site of intake facilities of existing waterworks is monitored and the data is collectively controlled by the Government of Sudan. Since the data could not been obtained as a matter of procedure in the Study, low and high water levels could not been fully grasped. However, based on the findings of the survey for the design of port facilities under a pilot project implemented in February which is a low water period, the low water and the high water levels are presumed to be EL451m and EL452.5m respectively.

(c) Formulation of water supply development plan

The urban water supply system facilities include an intake facility, treatment plant, transmission and booster pumps, power station, transmission pipe, water tank, distribution pipe and water connection facility as shown Figure 5.2-21.

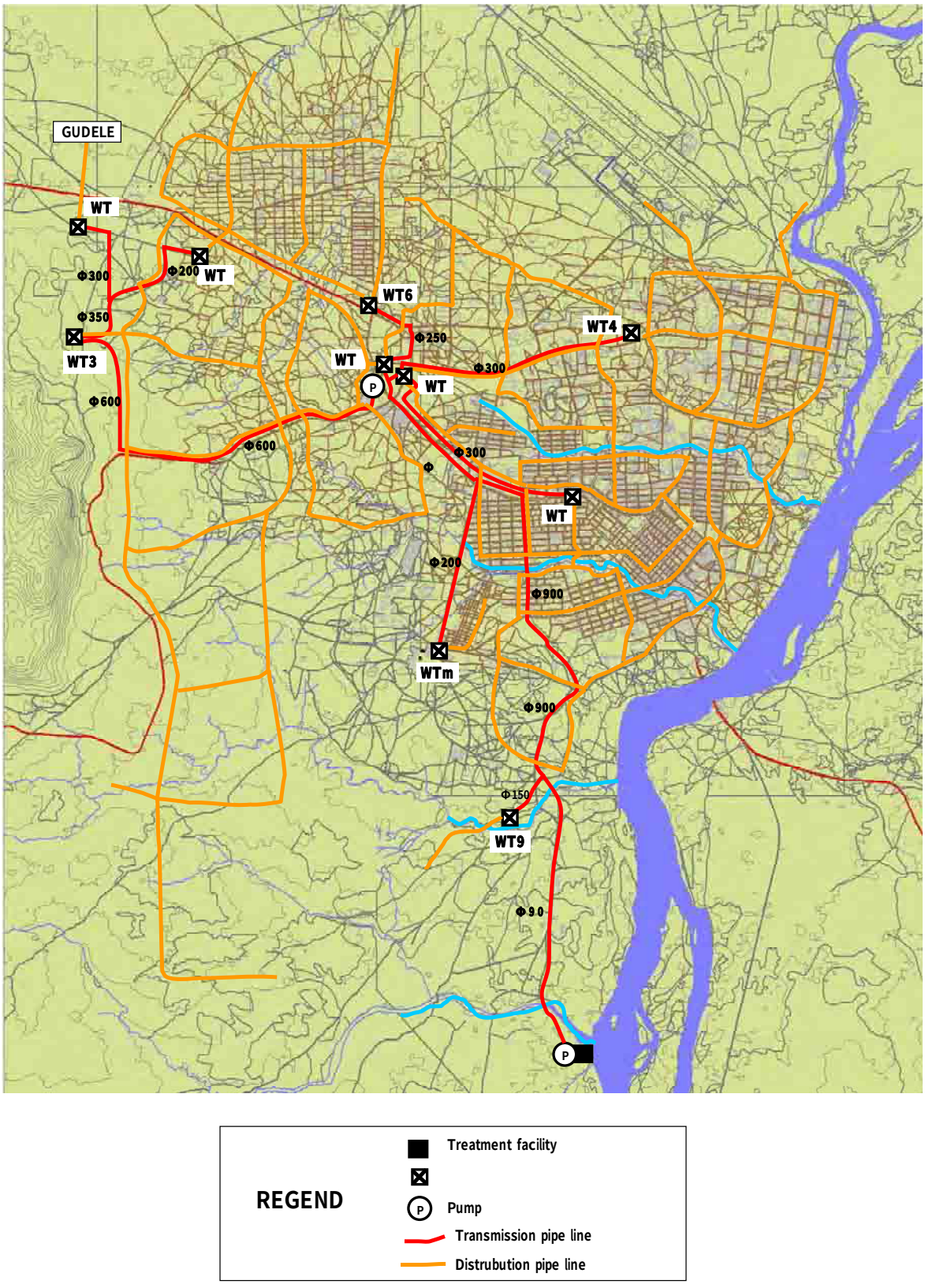


Figure 5.2-21 Layout Plan of Proposed Water Supply Facility

The water supply facility is designed to provide the proper capacity based on design parameters as shown in Table 5.2-43.

Table 5.2-43 Design Parameter by Facility

Facility	Parameter
Intake Facility	Daily Maximum Demand with Leakage and Treatment Loss
Water Treatment Plant	Daily Maximum Demand with Leakage and Treatment Loss
Transmission Pump	Daily Maximum Demand with Leakage
Transmission pipe	Daily Maximum Demand with Leakage
Water Tank	Daily Maximum Demand with Leakage
Distribution Networks	Hourly Maximum Demand with Leakage

The daily maximum demand at each point of the water supply system is shown in Table 5.2-44.

Table 5.2-44 Daily Maximum Water Supply Amount

Section	Water Supply Population	Max.Water Supply Amount (m^3/day)
Intake-Division poin to Rologo	460,000	66,240
Division point to Rologo-Division point to Military Camp	446,740	64,331
Division point to Military camp -WTm	441,181	63,530
WT2-WT3	172,235	24,802
WT3-Jubel Division Point	82,058	11,816
Jubel Division Point-WT7	34,153	4,918
Jubel Division Point-WT8	47,905	6,898
WT2-WT6	32,307	4,652
WT1-WT4	47,369	6,821
WT1-WT5	49,236	7,090
Division point to Rologo-WT9	13,260	1,909
Division point to Military camp -WTm	5,559	800
Intake/Treatment Plant-WTgumba (Eastern)	50,000	7,200

(d) Intake facilities and treatment facilities

The site of intake facility and treatment plant is selected on the left bank of the white Nail River at Lologo extension area. The site is located at 7 km upstream of the existing intake facility in order to avoid water contamination from the urban development and domestic sewage water.

The capacity of the intake facility and treatment facility shall be 70,000m^3 per day taking into consideration 5% of loss during the water treatment process.

Intake Facility

An intake facility will combine an intake and an intake pipe for economical construction and easy maintenance. The surface water will be taken through orifice of the intake and run by gravity to the ponds of the treatment facility.

Water Treatment Facility

Original water quality of the Nail River was analyzed at a laboratory in Nairobi. The water quality was found within the admissive values of WHO guidelines except for turbidity degree and silica contain.

For water treatment, a rapid-sand filter is applied, taken the following into account.

- Future high demand of water (70,000 m^3/day)
- High turbidity degree
- Economical construction
- Easy maintenance and operation (The existing water treatment uses rapid-sand filter.)

Basic flow of water treatment process is as follows. (See Figures 5.2-22 and 5.2-23.)
Original Water → Raw Water Tank → Dosing Device → Rapid-aeration Filter → Flocculation Basin → Coagulation Basin → Rapid-sand Filter → Chlorination → Clear Water Reservoir

By the target year of 2015, the facility should be constructed with two divided units. One has a capacity of 35,000 m^3/day (See Figure 5.2-22.)

(e) Electric Facility and Instrument Facility

The standards of electric and design shall follow the JIS (Japanese Industry Standards) or equivalents. But the specification shall be in accordance with the local environment. It is recommended that simple system will be applied because of easy maintenance and long-term operation.

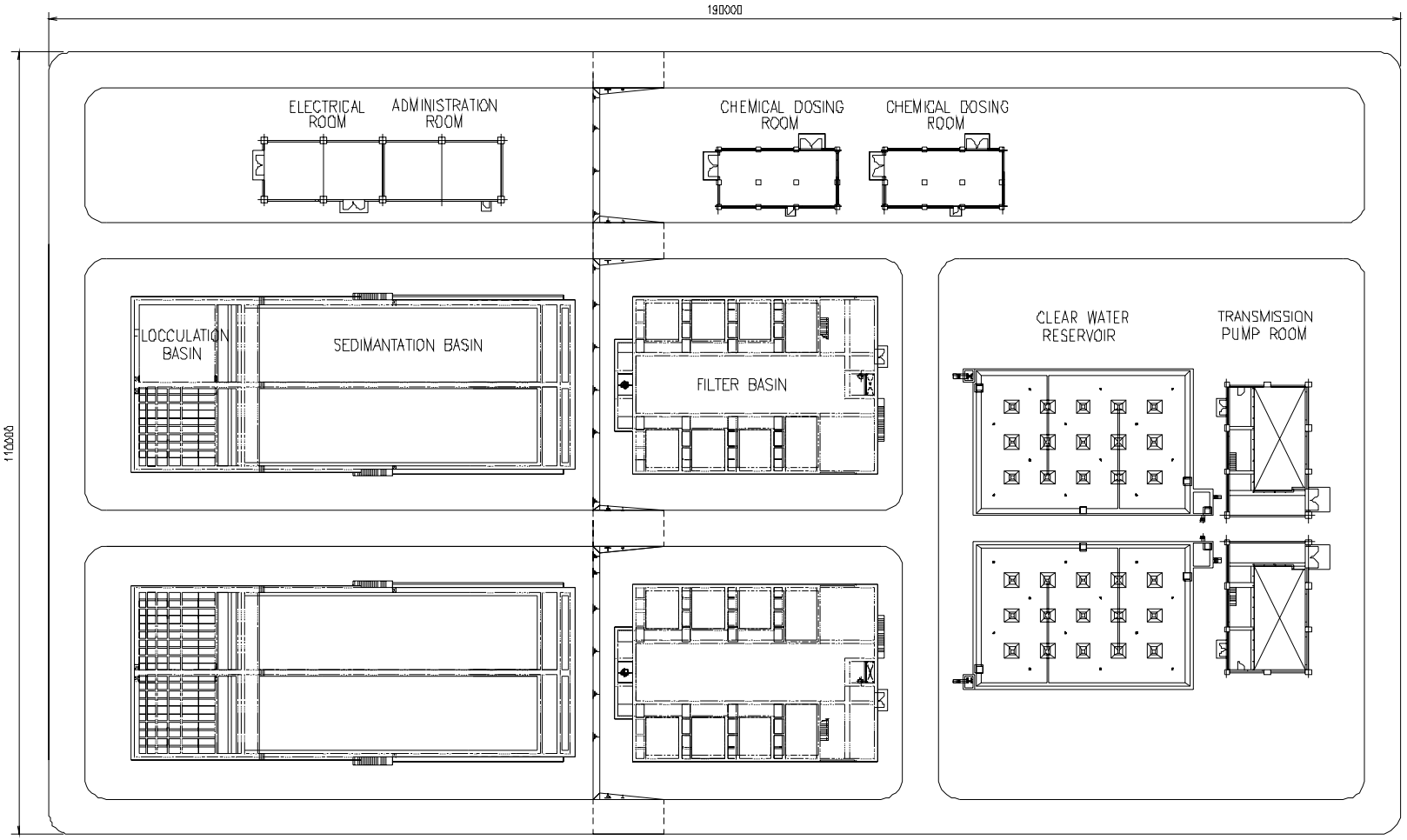


Figure 5.2-22 Layout Plan of Water Treatment Facility

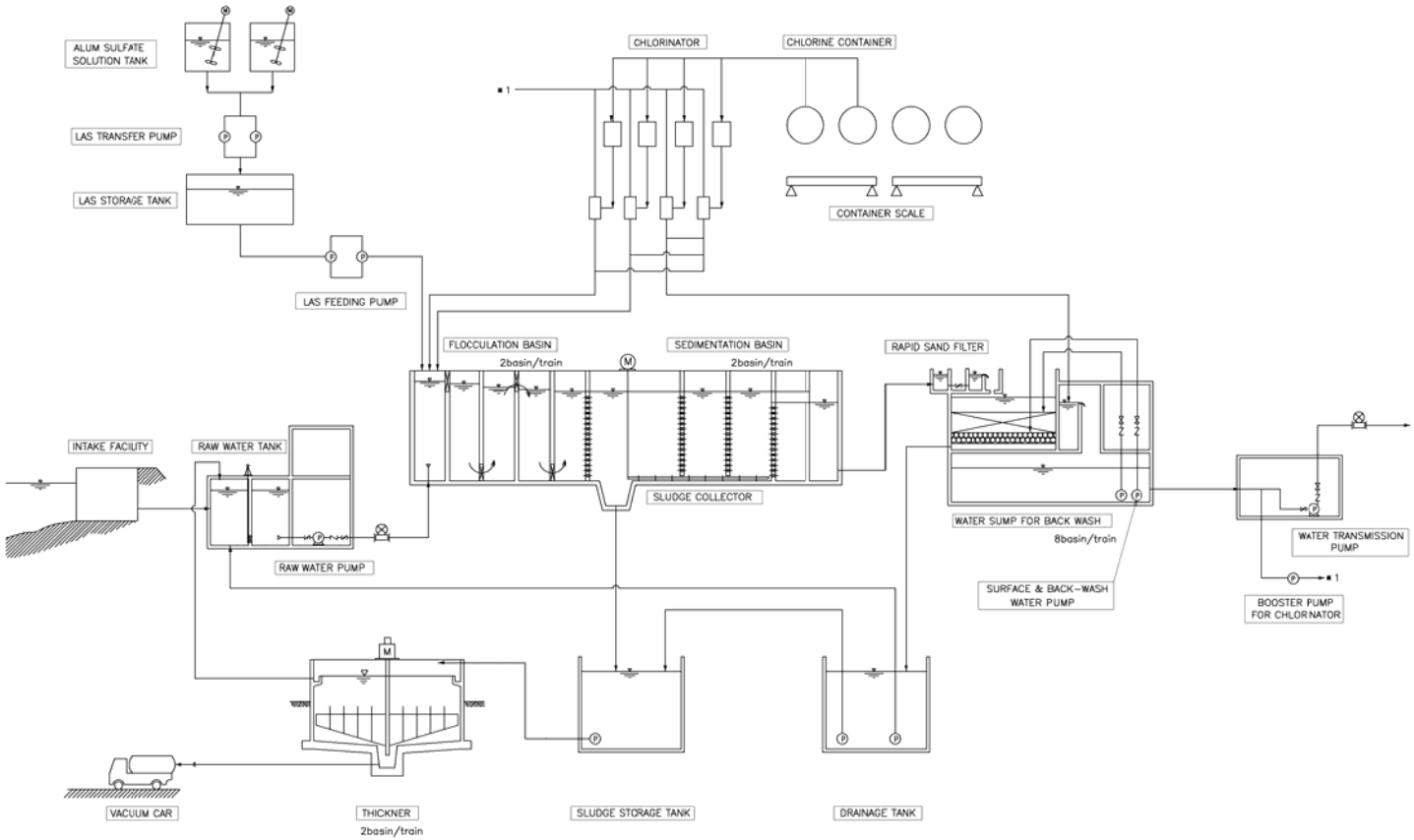


Figure 5.2-23　Water Treatment System（35,000m^3/day）

(f) Scheme of water transmission system (See Figure 5.2-24)

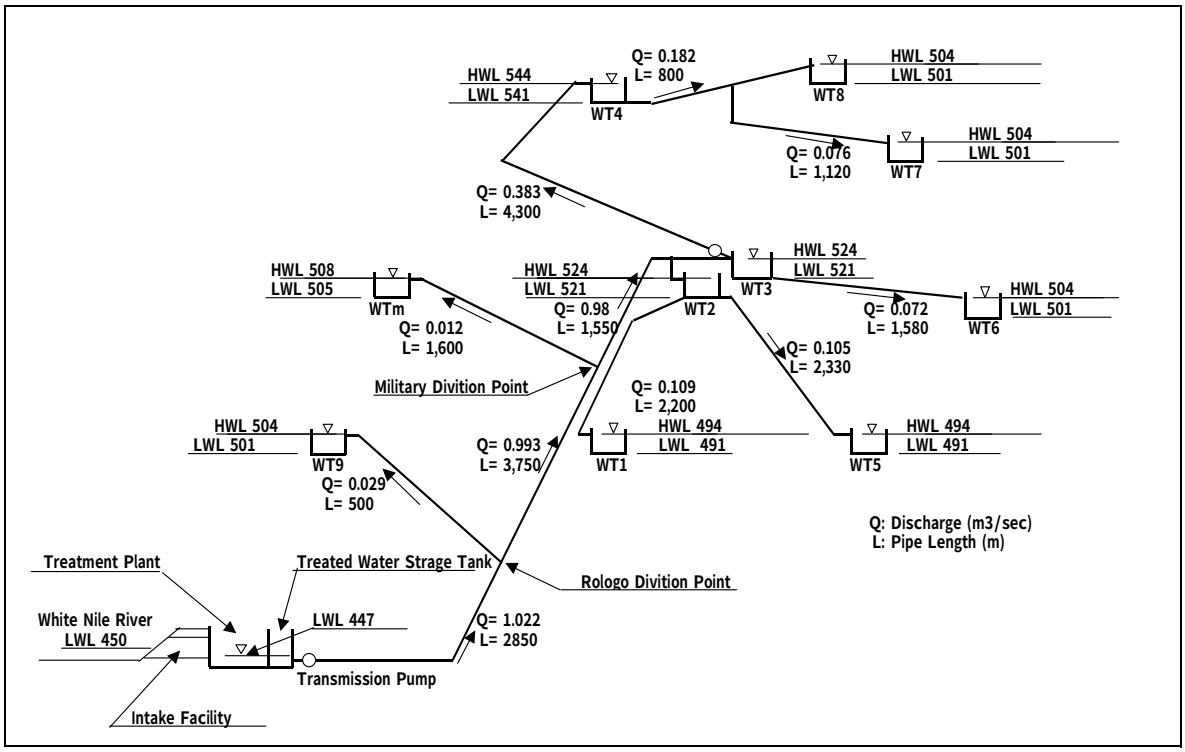


Figure 5.2-24 Schematic Map of Transmission System

a) The following two (2) alternatives can be considered for the water transmission system to transmit water from the treatment site to the water tank located at John Garang Memorial Site.

Alternative 1: Treated water will be transferred directly to the elevated distribution tank located at John Garang Memorial place via a transmission pump at the treatment site.

Alternative 2: Treated water will be transferred in two stages via a transmission pump and booster pump installed halfway along the transmission pipe.

The results of a comparison and examination of the alternatives, as shown in Table 5.2-45, show that alternative 1 is advantageous from the viewpoint of economical efficiency, workability and maintenance.

Table 5.2-45 Comparison Study for Transmission System

Items		Aiternative 1		Alternative 2	
Transmission Pump Volute		ϕ300x101mx400KWx5nos		ϕ300x62mx250KWx5Nos	
Booster Pump				ϕ300x40mx132KWx5Nos	
Generator 1		500KVAx4Nos		500KVAx3Nos	
Generator 2				350KVAx2Nos	
Transmission Pipe Steal Pipe		ϕ900, ϕ250 10,100m		ϕ900, ϕ800, ϕ300 10,100m	
Construction Cost	USD	10,005,000	○	10,444,000	X
Annual Expensese	Deoreciation USD	1,051,000		1,097,000	
	Operating USD	909,000	○	868,000	△
	Total USD	1,960,000		1,965,000	
Workability and Maintenance		Advantageous for 1 pump sration	○	Disadvantageous for two pump stations	△

b) The following two (2) alternatives can be considered as a transmission route from the John Garang Memorial place to Gudele:

Alternative 1: Route reaching Gudele by passing through Yei Road to the foot of the mountain Jebel Kujur. In this case, the water transferred to Gudele will be forwarded by loading on top of the water transferred to the foot of the mountain Jubel Kujur, so installation of a booster pump station is planned near No. 2 elevated water tank.

Alternative 2: Route reaching Gudele by passing by Munuki Block on the Mardi Road. In this case, water transferred to Gudele and transferred to the foot of the mountain Jubel Kujur will be forwarded separately by route, so installation of a booster pump station is planned at one location for the former near No.2 elevated water tank and two locations for the latter near No. 6 elevated water tank.

The results of a comparison and examination of the alternatives, as shown in Table 5.2-46, show that alternative 1 is advantageous from the viewpoint of economical efficiency, workability and maintenance.

Table 5.2-46 Comparison Study for Transmission Pipe Route

Items		Aiternative 1		Alternative 2	
Booster Pump 1 Volute Type		ϕ250x4Nosx39mx110kw		ϕ250x3Nosx42mx110kw	
Booster Pump 2 Volute Type				ϕ200x3Nosx43mx45kw	
Generator 1		200KVAx3Nos.		200KVAx2Nos	
Generator 2				100KVAx2Nos	
Transmission Pipe Steal pipe		ϕ600-250 7,230m		ϕ400-200 10,080m	
Construction Cost	USD	3,259,000	○	3,953,000	X
Annual Expensese	Deoreciation USD	342,000		415,000	
	Operating USD	375,000		348,000	
	Total USD	717,000	○	763,000	X
Workability and Maintenannce		Advantageous for 1 pump sration	○	Disadvantageous for two pump stations	△

(g) Pumping Station and Electric Power Station

a) Transmission pump

The construction of a pump station equipped with 5 transmission pumps is planned at a corner of the John Garang Memorial Place. The design specifications are as follows.

-Designed water discharge: 61.32m^3/min

-Type of Pump: Horizontal shaft type, double suction, volute pump

-Number of Pumps: 5 (One is used as a reserve.)

-Diameter of suction pipe: ϕ300mm

-Lift head: 101m

-Motor output 400kw

Layout plan of transmission pump station is shown in Figure 5.2-25.

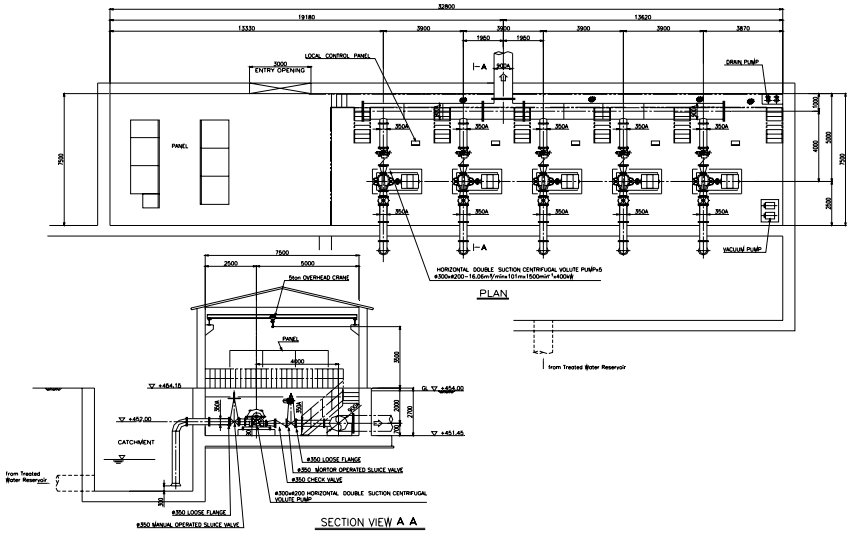


Figure 5.2-25 Layout Plan of Transmission Pump Station

b) Booster pump

The construction of a pump station equipped 4 booster pumps in close vicinity to an elevated water tank planned at the John Garang Memorial Place so that water can be re-pumped to the elevated water tank to be installed at a higher site located in the foot of the mountain Juber Kujur. The design specifications are as follows.

-Designed water discharge: 22.98 m^3/min.

-Type of Pump: Horizontal shaft type, both suction, volute pump

-Number of Pumps: 4 (One is used as a reserve.)

-Diameter of suction pipe: ϕ250mm

-Lift head: 39m

-Motor output 110kw

Layout plan of booster pump station is shown in Figure 5.2-26.

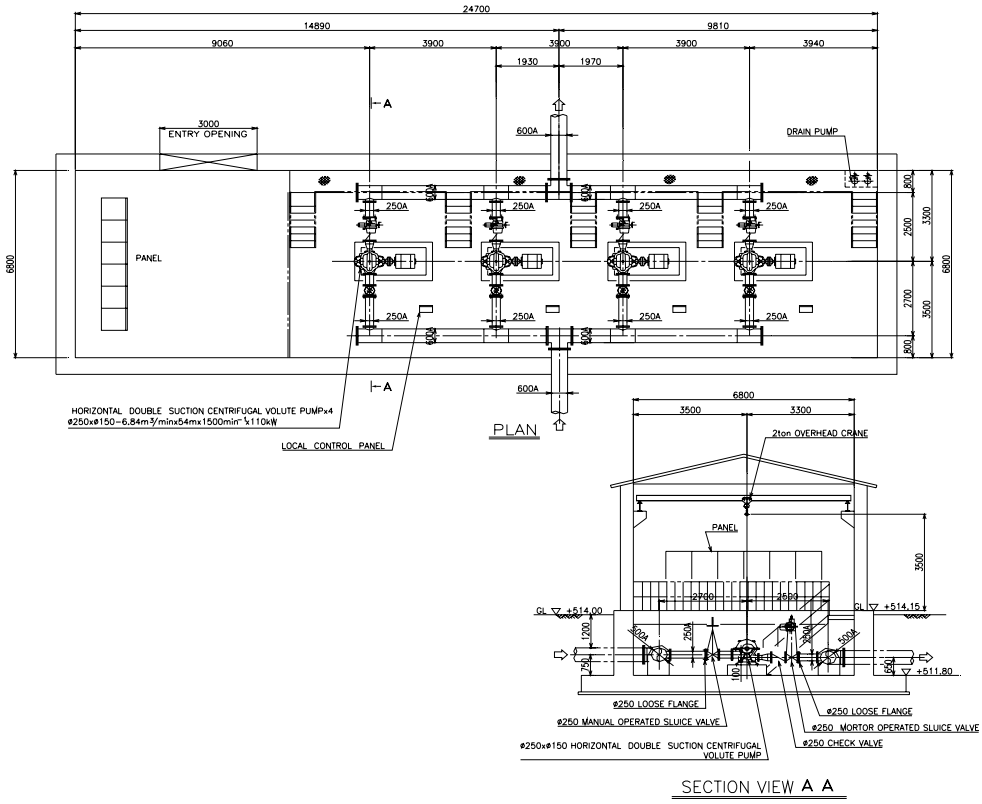


Figure 5.2-26 Layout Plan of Booster Pump Station

c) Electric power station

Electric power station for treatment facility and transmission pump station

Since the treatment facility and the transmission pump station are planned to be constructed at the site 7km away from the city center, obtaining electric power from a commercial power source cannot be expected at present. Therefore a power generator facility is planned. Electric power required for the treatment facility and transmission pump will be 2,000KVA. To supply the power, three 700KVA diesel engine generators shall be installed.

Electric power station for booster pump station

Although it is possible to utilize a commercial power source because the booster pump station will be constructed at the city center, where the current electric power situation is based, there is no guarantee that the required power can be obtained continuously for 24 hours a day. An electric power station is, therefore, planned to be built as a reserve power source.

(h) Transmission network

A suitable transmission network is planned that will effectively transfer treated water from treated water tanks to each service water tank at 10 subdivided water supply blocks. The diameter of pipe to be used for transmission networks has been selected so that the velocity of water flow in each pipe will be set at approximate 1.5m/sec as an economical flow velocity. From hydraulic calculations, the diameter of pipe will be in a range of 900mm to 250mm. The entire length of the transmission network is approximate 23km. Steel pipes will be used.

(i) Service (elevated) water tanks

Elevated water tanks are planned to respond to hourly changes in the amount of water distributed and to maintain a predetermined amount and pressure in the event of an accident occurring upstream of the service water tanks at each higher portion of the 10 subdivided water supply blocks. The capacity of service water tanks is determined to be the 6-hour amount of maximum daily demand to provide the above mentioned function as shown in Table 5.2-47. A typical scheme of elevated service water tank is shown in Figure 5.2-27.

Table 5.2-47 Capacity of Water Tank

Name of Tank	Water Supply Population	Daily Muximum Water Supply Amount (m^3/day)	Capacity of Water Tank (m^3)
WT 1	102,302	14,731	3,700
WT 2	36,793	5,298	1,300
WT 3	91,338	13,153	3,300
WT 4	47,369	6,821	1,700
WT 5	49,236	7,090	1,800
WT 6	32,307	4,652	1,200
WT 7	34,153	4,918	1,200
WT 8	47,905	6,898	1,700
WT 9	13,260	1,909	500
WTm	5,559	800	200
WTgumba	50,000	7,200	1,800

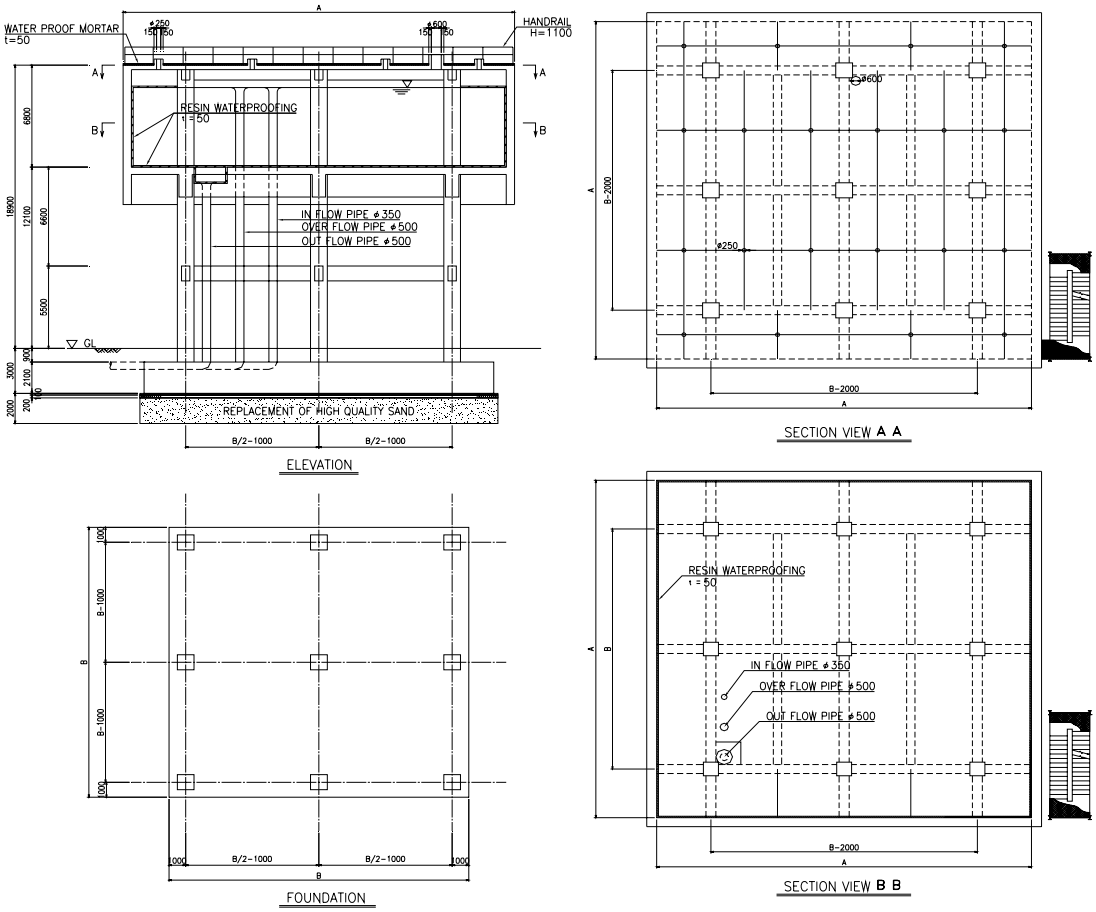


Figure 5.2-27 Typical Elevated Service Water Tank

(j) Water distribution network

The water distribution network is to provide the required water supply pressure at each water connection point. The diameter of pipe to be used for the distribution network is in the range of ϕ200mm to 25mm. The materials used for distribution pipe are steel pipe, PVC and PE pipe. The total length of the distribution network is approximately 353km. (This figure has been quoted from the GIBB consultant's study.)

(k) Water connection facility

Domestic water is provided through three types of connection facilities in Juba Town according to the living standards of beneficiary residents. The water will be supplied through house connections for high class residents, yard connections for middle class residents and communal standpipes for low class residents. Yard connections are scheduled to be installed at a corner of each plot and a communal standpipe are scheduled to be installed for 24 plots. Water flow meters will be installed at each house and yard connection in order to record the water supply situation, to collect water charges, and to promote better awareness of water conservation to beneficiary residents.

⑤ Responsible Agency (expected)

- Project Implementation: Ministry of Water Resources & Irrigation of GOSS, and State Ministry of Physical Infrastructure
- Operation: Urban Water Corporation
- Maintenance: Urban Water Corporation

⑥ Project Cost

- Feasibility Study/Detailed design: USD 2.5mil.
- Implementaion/Construction Cost* :
  Urban Water Development : USD 50.6mil.
- Total Cost : USD 53.1mil.

  * Including construction supervision cost

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population in Juba of 510,000 in year 2015

(b) Effects of the Project :

- Formation/induction of the planned frame of the urban structure (promotion of settlement of IDPs and other refugees)
- Reduction of water-bone disease and infant mortality rates
- Improvement of the quality of life

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefit is expected to accrue from safe water supply.

(b) Financial Soundness

Revenue from the safe water supply can be expected, however, some subsidy by the State Government will be necessary.

(c) Environmental Impacts

- Positive Impacts
  - Betterment of urban environment.
  - Improvement of sanitary/health condition.
- Negative Impacts

  None

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Agency responsible for operation and maintenance has sufficient capacity.

(b) Preconditions

- Beneficiary-pay principle is accepted.
- Necessary fund is prepared.

⑩ Relationship with Other Projects

- The GOSS is implementing the Urgent Rehabilitation Project for the present urban water supply system.
- Road project, i.e. “Road Network Development Project, Phase-1”, will provide the space for laying transmission/distribution pipes in the water supply projects.

(4) Implementation Schedule

It is proposed that the water supply development will be implemented between 2007 and 2015 in order to meet the increasing water demand.

Urgent Water Supply Development Project

The upgrading of 66 existing wells and construction of 197 new wells will be implemented between 2007 and 2011 under the Urgent Water Supply Project.

It is recommended that this project will be implemented through funding from GOSS and other donors such as USAID and NGOs, etc. Part of this project could be implemented as the Pilot Project of this Study during the Feasibility Study Stage for the Urban Water Supply Development Project. In addition, in order to enhance the implementing capacity of the Rural Water Corporation, which is responsible for water supply using wells, and to encourage the independent development of wells, capacity building of the Rural Water Corporation by providing drilling machines and transfer of technique on hydrogeological survey or drilling is recommended.

Urban Water Supply Development Project

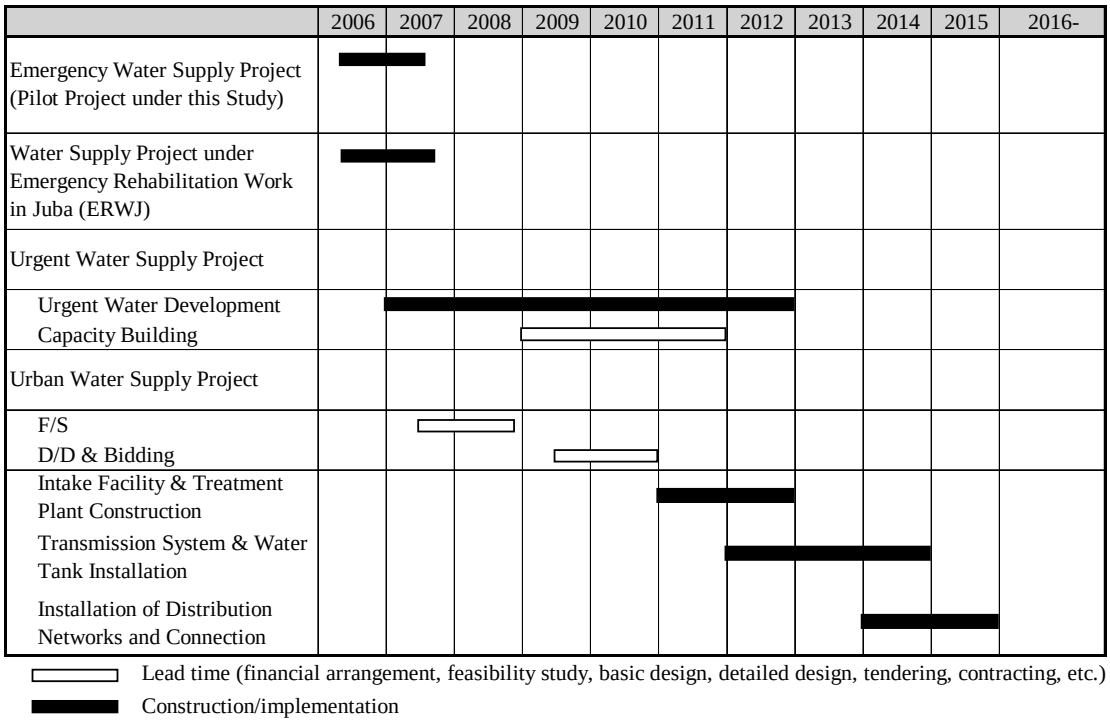
Since the period between 2007 and 2010 is regarded to be the preparatory period for the implementation of the urban water supply development project, a development study, basic design study, a detailed design and bidding, etc. are scheduled for the project.

In order to accomplish the goals by 2015, the construction of an intake facility and treatment

facility will be commenced in 2011 and will be completed so as to ensure a safe water supply. A water transmission facility and water supply facilities will be subsequently built and the project will be completed in 2015.

The implementation schedule is shown in Table 5.2-48.

Table 5.2-48 Implementation Schedule



5.2.2.2 Power Supply

(1) Present Situation

1) Present Situation and On-going Study

The present Juba Power Station was established in 1983. Five (5) MAN diesel engines were supposed to have been installed with one megawatt (MW) capacity each. But due to the war in the country, only three (3) engines were installed and after that, the team of engineers and technicians from German Company could not come back to install the other two engines. Instead, two (2) additional Chinese diesel engines were installed. They were of one MW capacity each. This brought up the total capacity of the power situation to five (5) MW.[1]

[1] The Republic of the Sudan, Euqatoria States Post War Programmes, Greater Equatoria Axis Conference on Development and Services, 10 June 2004

Figure 5.2-28 Present Generators

At present an electric system in Juba is administrated by the National Electrification Corporation under GOS, and consists of an isolated power plant servicing an 11kV distribution system with about 5,000 consumers[2] representing roughly 15% of the town's household population[3]. At present, the power plant is equipped with five 1.1 MW, slow speed thermal power generators by heavy oil, occasionally installed in the period from 1976 to 1996. All generators are broken down except that only one unit (Chinese) is workable with a total effective capacity being less than 1MW and this was installed in 2003. Therefore troubles occur almost every day and the supply of the electric power is unstable. Because of this, supply of electricity is given only to the Public Water Corporation and the main hospital. Other important offices and facilities are obliged to have own generators individually.

The distribution system, though not in very poor overall condition, has very limited capacity to serve additional consumers and suffers from some specific maintenance needs, such as replacement of burned out transformers and damaged poles. Of greater concern is the capability, or lack thereof, of the commercial system. Bills have been issued by the existing system for only three out of the last eight months.

[2] Quoted from the report of NRECA International Ltd., Economic Recovery through Rehabilitation of Electric Service in Juba, South Sudan: An Unsolicited Proposal, 5 November 2005.

[3] 5,000 consumer family x 8 members = 40,000 habitants (15%) out of approx.250,000.

On June 28, 2005 USAID/Sudan contracted a cooperative agreement with NRECA International, USA, to implement the Southern Sudan Rural Electrification Program. Under this program, NRECA will evaluate the needs of the electric system in Juba and prepare a proposal for sustainable development of the system, and in addition make assessment of the potential for a small hydroelectric facility. Therefore this Study preliminarily estimates electricity demand and proposes the conceptual electrification plan for Juba according to our site investigation and available resources.

2) On-going Project

The following projects under ERWJ are on-going in Juba.

1. Juba Emergency Power Project
2. Rehabilitation in Medium and Low Voltage Electricity Networks in Juba

Table 5.2-49 shows the outline of these projects.

Table 5.2-49 On-going Electricity Projects in Juba

	1. Juba Emergency Power Project	2. Rehabilitation in Medium and Low Voltage Electricity Networks in Juba
1. Client	Government of Southern Sudan	
2. Consultant	Kwezi V3 Engineers/ Gibb Africa Ltd	
3. Executing Agency	Ministry of Housing, Land and Utilities	
4. Contractor	Electro Watts Ltd	MEHTA ELECTRICALS LTD
5. Notice to Proceed	Dec. 1 2005	January 16, 2006
6. Scope of Work	Supply and installation of 5x 1 MW generators for Juba Powers Station	Rehabilitation of medium and low voltage electricity network in Juba
7. Contract Price (USD)	4,739,025	6,877,417.84
8. Source of Fund	GOSS	GOSS
9. Contract Period	One year	One year

For the rehabilitation of the present power supply, GOSS contracts provision of five new generators (5MW) with Electro Watts Limited (EWL). EWL installed five generators and oil tanks (in September 2006). This will rehabilitate a present supply capacity to 5MW. However, according to EPPC approximately five times of power supply (25MW) is necessary to satisfy the electric power demand of future Juba within three years.

Figure 5.2-29 On-going Projects

(2) Future Needs

1) Increasing Demand by Development

Figure 5.2-30 shows Unit Consumption of Electricity with GNI per Capita in Africa 2002[4]. The increasing demand of electricity is estimated in Table 5.2-50.

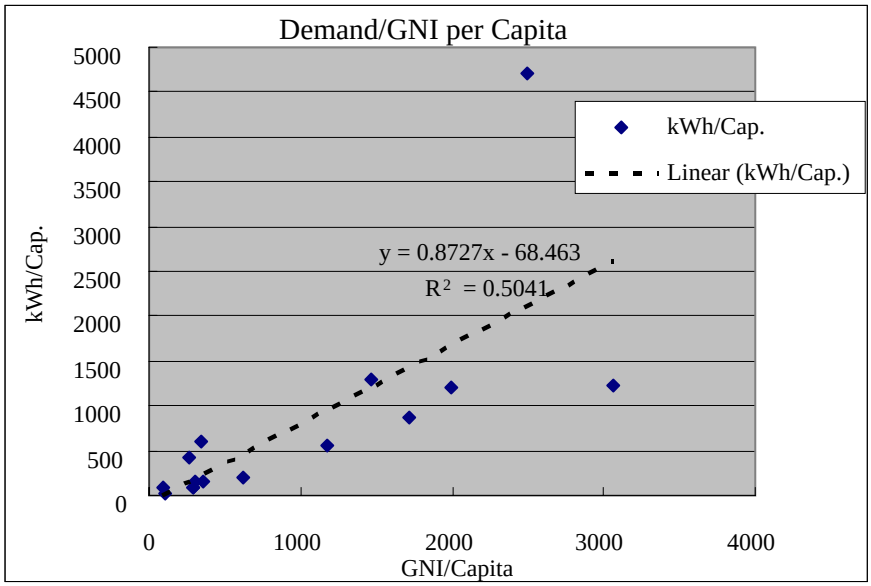


Figure 5.2-30 Unit Consumption of Electricity and GNI per Capita in Africa (2002)

Table 5.2-50 Unit Demand of Electricity and GNI per Capita in Juba

Year	GNI /p	RGNI/p	kWh/p
2005	153	229.5	121
2011	267	400.5	263
2015	425	637.5	459
2025	875	1312.5	1017

Note: RGNI: Regional GNI per capita in Juba

[4] Electric Consumption: Japan Electric Power Information Center, Inc., Statistics 2002, DNI per capita: MOFA Japan, ODA White Books, 2004.

2) Future Needs

The power demand is calculated based on the residence demand and the demand for public and other facilities assumed as 50% of total residence demand. Table 5.2-51 shows future needs of electricity with minimum unit electricity.

Table 5.2-51 Future Needs of Electricity

		Year	2006~	~2011	~2015	2016-
	Item	Unit	Short (I)	Short (II)	Medium	Long
1	Population	Hab.	250,000	394,000	510,000	750,000
2	Unit Demand Per Person	kWh/p	121	263	459	1017
3	General Residence	MWh	24,267	103,622	234,090	762,731
4	Others	MWh	12,133	51,811	117,045	381,365
	Total Needs	MWh	36,400	155,433	351,135	1,144,096
5	Power Demand	MW	4.2	17.7	40.0	130.6

Note: W=Wh / (365 x 24)

For the period between 2006 and 2015, diesel generators will be installed in accordance with the increase in population. For long-term solution, the following hydroelectric projects are proposed by GOSS to replace thermal power with hydroelectric one.

① Beden Falls Hydroelectric Power Project: A potential dam site is located at ten (10) km south of Juba Town.
② Kinati River Hydroelectric Power Project: A potential dam site is located at Kinati River in Torit.
③ Katire Hydroelectric Power: Kitani River in Katire
④ Nimule Hydroelectric Power Project: A potential dam site is at Nimule.

(3) Proposed Project

1) Power Supply Project under Emergency Rehabilitation Work in Juba (ERWJ)

(See Chapter 3.)

2) Power Supply Development Project

① Background

- The Juba generation plant is old. Except the five new generators, generators are more than 20 years old and have been poorly maintained. The generation capacity is far below the demand. The transmission network does not cover present whole town area. Some of the transformers are experiencing serious oil leaks. In addition, maintenance works are hampered by shortage of skilled manpower, tools and spare parts.

- Some governmental facilities, hospital, hotels and major facilities are forced to install diesel generators by themselves to supply their own equipments with electricity.
- For Juba to fully function as the capital as well as the center of economic activities and to accept the resettlement of returned IDPs and refugees, development of infrastructure as a foundation of sustainable development of Juba, especially power supply, is an absolute necessity.
- Following the urgent rehabilitation of power supply implemented by GOSS, this project aims to supply necessary power in future before the realization of nationwide hydroelectric power supply system together with capacity development.

② Objectives

- To enhance the electric power capacity to meet future demand

③ Location

- Whole Juba Town and the surrounding areas

④ Scope of the Project

- Extension (1): additional 8 MW of thermal power generators and its distribution facilities by 2011
- Extension: additional 23 MW of thermal power generators and its distribution facilities by 2015

Table 5.2-52 Proposed Power Supply Frame

		2006-2009	2010-2011	2012-2015	2016~2025
		Short (I)	Short (II)	Medium	Long
Power Demand MW		4.2	17.7	40.0	130.6
Target Power Supply (MW)	-	5	18	40	130
Rehabilitation (ERWJ)	-	5			
Power Supply Development Project	13		13		
	22			22	
Hydroelectric Power	130				130

Small-scale thermal generators with capacity of 1 MW will be distributed to several sites in a group for the efficient operation and maintenance. Fare collection to be entrusted to the community will be the one of the way for job creation.

⑤ Responsible Agency (expected)

- Project Implementation : GOSS/Gov. of CES
- Operation : National Electrification Corporation
- Maintenance : National Electrification Corporation

⑥ Project Cost

- Detailed Design Cost : USD 0.87mil.
- Construction Cost* : 35 x 1MW generators : USD 29.1mil.
- Total Cost : USD 30.0mil.

  * Including construction supervision cost

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population in Juba of 510,000 in year 2015

(b) Effects of the Project

- Formation/induction of the planned frame of the urban structure
- Improvement of living conditions
- Enhancement of urban security
- Enhancement of social and economic activities including private investment

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefit and revenue is expected to accrue from economic activity efficiency.

(b) Financial Soundness

Revenue from the electricity supply can be expected, therefore the Project can be viable.

(c) Environmental Impacts

- Positive Impacts
  - Betterment of urban environment.
  - Improvement of living condition.
- Negative Impacts
  - Air pollution by thermal generators

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Responsible agency for operation and maintenance has sufficient capacity.

(b) Preconditions

- Power plant sites are secured.
- Beneficiary pay principle is accepted.
- Urban road network for providing utility spaces is constructed .
- Necessary fund is prepared.

⑩ Relationship with Other Projects

- Urban road network construction project for providing utility spaces is required.
- This Project is to cater power demand before the following hydroelectric projects proposed by GOSS to replace thermal power with hydroelectric one.

3) Hydroelectric Power Generation Project

① Background

- The Juba generation plant is old. Except the five new generators, generators are more than 20 years old and have been poorly maintained. The generation capacity is far below the demand. The transmission network does not cover present whole town area. Some of the transformes are experiencing serious oil leaks. In addition, maintenance works are hampered by shortage of skilled manpower, tools and spare parts.
- Some governmental facilities, hospital, hotels and major facilities are forced to install diesel generators by themselves to supply their own equipments with electricity.
- For Juba to fully function as a capital as well as a center of economic activities and to accept the resettlement of returned IDPs and refugees, development of infrastructure as a foundation of sustainable development of Juba, especially power supply, is an absolute necessity.
- Following the urgent rehabilitation of power supply implemented by GOSS, and “Power Supply Development Project” this project aims to supply necessary power in future by hydroelectric power supply system instead of thermal power generation system to reduce environmental influence, especially greenhouse effect.

② Objectives

- To enhance the electric power capacity to meet future demand
- To reduce the environmental effect by thermal power generation

③ Location

- Power transmission network is to cover whole Juba Town and the surrounding areas
- Hydropower plants are expected to locate in the River Nile and its tributary

④ Scope of the Project

Construction of hydroelectric dams and its distribution facilities to supply whole Southern Sudan with electricity. Out of the total power generated by the Project, 130MW will be allocated to Juba and surrounding area to replace all thermal generators after 2016. F/S is required

⑤ Responsible Agency (expected)

- Project Implementation : GOSS/CES
- Operation : National Electrification Corporation
- Maintenance : National Electrification Corporation

⑥ Project Cost

- Detailed Design Cost : USD 14.7mil.
- Construction Cost* : Not confirmed

  * Including construction supervision cost

⑦ Beneficiaries

(a) Target Beneficiaries :

- The whole population of Southern Sudan

(b) Effects of the Project

- Improvement of living conditions
- Enhancement of social and economic activities including private investment

⑧ Project Evaluation

(a) Economic Viability

Although no economic analysis is done, it is expected that the Project is economically viable because large amount of benefit and revenue is expected to accrue from economic activity efficiency.

(b) Financial Soundness

Revenue from the electricity supply can be expected, therefore the Project can be viable.

(c) Environmental Impacts

- Positive Impacts
  - Improvement of living condition.
  - Betterment of environment especially in term of CO_2 emission.
- Negative Impacts
  - Some ecological influence presumed

⑨ Conditions Required

(a) External Condition

- A good peace and order situation is maintained.
- Agency responsible for operation and maintenance has sufficient capacity.
- Utilization of international river is agreed upon among the relevant countries.

(b) Preconditions

- Power plant sites are secured.
- Beneficiary pay principle is accepted.
- Necessary fund is prepared.

⑩ Relationship with Other Projects

This Project is to cater for power demand after "Power Supply Development Project" to replace thermal power with hydroelectric one.

(4) Stage Implementation Plan

The implementation plan of Electricity Project is shown in Table 5.2-53.

Table 5.2-53 Implementation Schedule of Electricity Project in Juba

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016-
Power Supply Project under Emergency Rehabilitation Work in Juba (ERWJ)	■	■									
Power Supply Development Project		□	■	■	■	■	■	■	■	■	
Hydroelectric Power Generation Project				□	□	□	□	■	■	■	

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

■ Construction/implementation