JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)

GOVERNMENT OF SOUTHERN SUDAN

JUBA URBAN TRANSPORT INFRASTRUCTURE AND CAPACITY DEVELOPMENT STUDY IN THE SOUTHERN SUDAN

FINAL REPORT

EXECUTIVE SUMMARY

JULY 2010

CTI ENGINEERING INTERNATIONAL CO., LTD.
YACHIYO ENGINEERING CO., LTD.

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EXCHANGE RATE

June 2010

1 US$ = 2.212 Sudanese Pound (SDG)
1 US$ = 91.100 Japanese Yen (¥)
1 SDG = 41.185 Japanese Yen (¥)

PREFACE

In response to the request from the Government of Southern Sudan (GOSS), the Government of Japan decided to conduct the "Juba Urban Transport Infrastructure and Capacity Development Study" and entrusted the Study to the Japan International Cooperation Agency (JICA).

JICA selected and dispatched the Study Team headed by Mr. Tsuneo Bekki of CTI Engineering International Co., Ltd. in association with Yachiyo Engineering Co., Ltd. from August 2008 to June 2010.

The Study Team held discussions with the officials of the Ministry of Transport and Roads, the Land Commission and other concerned agencies of GOSS as well as the Ministry of Physical Infrastructure of Central Equatoria State (CES), and conducted field surveys, data gathering and analysis, formulation of the Master Plan and Pre-Feasibility Study. In addition, the stakeholders' meetings were conducted nine times in total to solicit opinions from various actors concerning the Study. Upon returning to Japan, the team prepared this Final Report to summarize the results of the Study.

I hope that this report will contribute to the promotion of this project and to the enhancement of friendly relationship between our countries.

Finally, I wish to express my sincere appreciation to the officials concerned of the Government of Southern Sudan and the Central Equatoria State for their close cooperation and help extended to this Study.

July 2010

Kiyohumi KONISHI
Director General
Economic Infrastructure Department
Japan International Cooperation Agency

Mr. Kiyohumi KONISHI
Director General
Economic Infrastructure Department
Japan International Cooperation Agency

Dear Sir,

LETTER OF TRANSMITTAL

We are pleased to submit herewith the Final Report of the "Juba Urban Transport Infrastructure and Capacity Development Study" in Juba urban area in Southern Sudan. The report includes the advice and suggestions of the authorities concerned of the Government of Japan and your Agency, as well as the comments made by the Ministry of Transport and Roads and other concerned agencies of the Government of Southern Sudan (GOSS) and the Ministry of Physical Infrastructure of the Central Equatoria State (CES).

This report analyses the present setting and future conditions and demand of urban transport infrastructure in Juba urban area. It comprehensively covers the issues of transport including road development and policy, urban street improvement, public transport, traffic management, urban street maintenance system, capacity development throughout the pilot project, road institution and urban environment. The report established a Road Network Master Plan for Juba and surrounding areas until the year 2025 and the Capacity Development Plan for the Ministry of Physical Infrastructure of CES. The outcome of the Study concludes that the established plans are technically, economically, environmentally and socially feasible and will contribute to the development of Juba urban area.

In view of urgency of the development of transport infrastructure in Juba urban area and the needs for socio-economic development of Southern Sudan, we recommend that the GOSS implements the projects with utmost urgency.

We wish to take this opportunity to express our sincere gratitude to your Agency, the Ministry of Foreign Affairs and the Ministry of Land, Infrastructure and Transport in the Government of Japan. Further, we wish to express our deep gratitude to the Ministry of Transport and Roads and other agencies concerned in the GOSS, and the Ministry of Physical Infrastructure of CES for their close cooperation and assistance extended to us during the course of the Study.

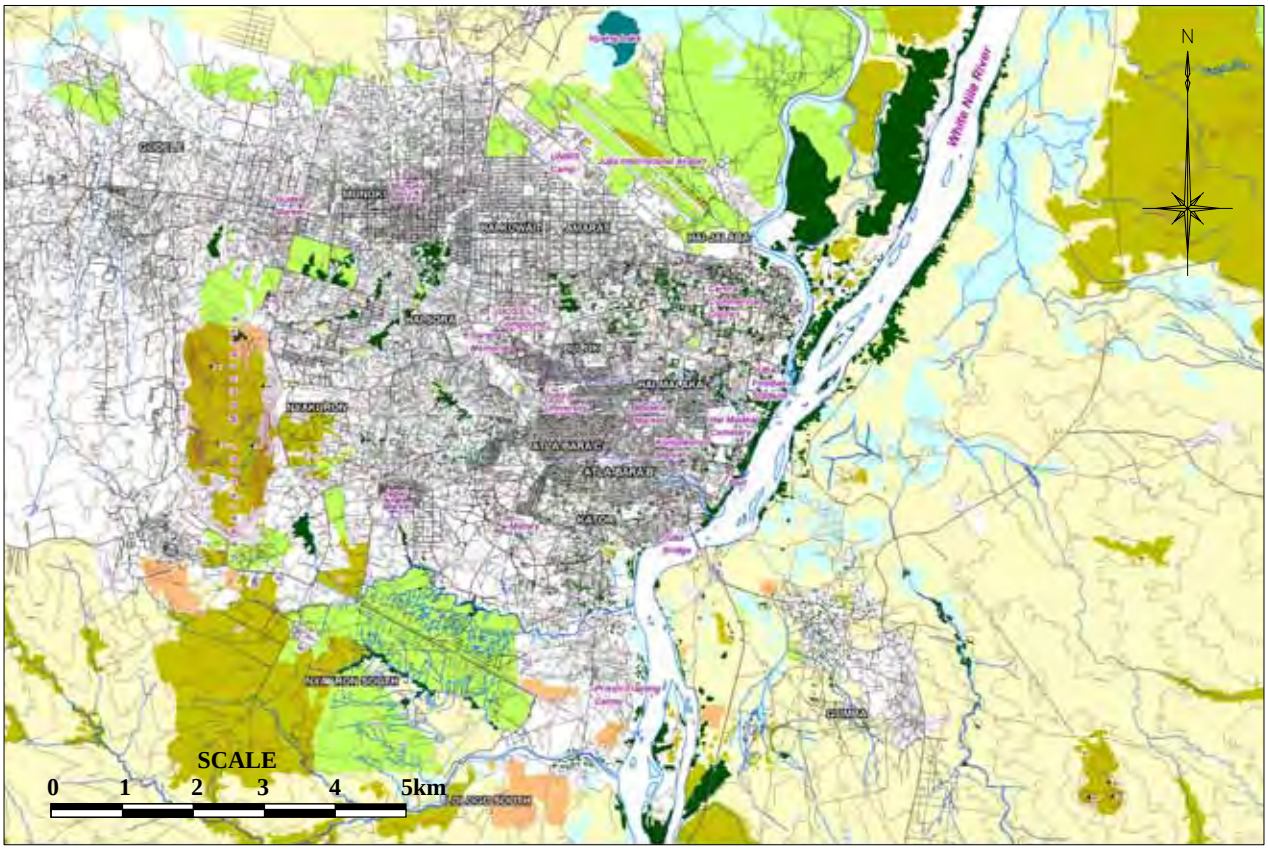
Very truly yours,

Tsuneo BEKKI
Team Leader
Juba Urban Transport Infrastructure
and Capacity Development Study

Sudan International Road Connections

Central Equatoria State with Interstate Road Connections

Juba Urban Area(Study Area)



LOCATION MAP OF THE STUDY AREA

2nd Stakeholders' Meeting

3rd Stakeholders' Meeting

4th Stakeholders' Meeting

5th Stakeholders' Meeting

8th Stakeholders' Meeting

Counterpart Training in Japan

EXECUTIVE SUMMARY

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ACRONYMS AND ABBREVIATIONS

AADT	:	Annual Average Daily Traffic
AASHTO	:	American Association of State Highway and Transportation Officials
AC	:	Asphalt Concrete
BCRP	:	Bridges and Culverts Reconstruction Project
CAI	:	Clean Air Initiative
CBD	:	Central Business District
CBR	:	California Bearing Ratio
CCD	:	Central Commercial District
CD	:	Capacity Development
CES	:	Central Equatoria State
CPA	:	Comprehensive Peace Agreement
DBST	:	Double Bituminous Surface Treatment
DMR	:	Department of Road Maintenance
EIA	:	Environmental Impact Assessment
ERRP	:	Emergency Road Rehabilitation Project
GDP	:	Gross Domestic Product
GNI	:	Gross National Income
GOJ	:	Government of Japan
GOSS	:	Government of Southern Sudan
GRDP	:	Gross Regional Domestic Product
HCM	:	Highway Capacity Manual
HR	:	Human Resources
ICAO	:	International Civil Aviation Organization
IDA	:	International Development Association
IDP	:	Internally Displaced Person
IEE	:	Initial Environmental Examination
IMCT	:	Inter-Ministry Committee for Transport
IOM	:	International Organization for Migration
JAM	:	Joint Assessment Mission
JICA	:	Japan International Cooperation Agency
LOS	:	Level of Service
MAD	:	Mean Absolute Difference
MBA	:	Maintenance by Administration
MBC	:	Maintenance by Contract
MDTF	:	Multi Donor Trust Fund
M&E	:	Monitoring and Evaluation
MEWCT	:	Ministry of Environment, Wildlife, Conservation and Tourism
MFEHR	:	Ministry of Finance, Economy and Human Resources
MFEP	:	Ministry of Finance and Economic Planning
MHPPE	:	Ministry of Housing, Physical Planning and Environment
MHLPU	:	Ministry of Housing, Land and Public Utilities
MOH	:	Ministry of Health
MOPI	:	Ministry of Physical Infrastructure
MSL	:	Mean Sea Level
MTR	:	Ministry of Transport and Roads
MWRI	:	Ministry of Water Resources and Irrigation

NGO	:	Non-Governmental Organization
NMIMT	:	Non-Motorized and Intermediate Means of Transport
NMT	:	Non-Motorized Transport
NSCSE	:	New Sudan Centre for Statistics and Evaluation
OD	:	Origin-Destination
PCM	:	Project Cycle Management
PCU	:	Passenger Car Unit
PDM	:	Project Design Matrix
PMT	:	Project Management Team
QCBS	:	Quality- and Cost-Based Selection
ROW	:	Right of Way
RTC	:	River Transport Corporation
RTSMU	:	Road Traffic and Safety Management Unit
SARPS	:	Standards and Recommendation Practices
SDG	:	Sudani Pounds (Monetary Unit)
SETIDP	:	Sudan Emergency Transport and Infrastructure Development Project
SNAP	:	Sudanese National AIDS Control Programme
SOSUS	:	Southern Sudan SPLM Areas
SPLA	:	Sudan Peoples Liberation Army
SPLM	:	Sudan Peoples Liberation Movement
SRA	:	State Road Agency
SSAC	:	Southern Sudan AIDS Commission
SSCCSE	:	Southern Sudan Commission for Census, Statistics and Evaluation
SSCRA	:	Southern Sudan County Road Agency
SSRA	:	Southern Sudan Road Agency
SSRB	:	Southern Sudan Road Board
SSURA	:	Southern Sudan Urban Road Agency
TA	:	Technical Assistance
TAST	:	Technical Assistance Team
TNA	:	Training Needs Analysis
UN	:	United Nations
UNDP	:	United Nations Development Program
UNICEF	:	United Nations Children's Fund
UNOPS	:	United Nations Office for Project Services
USAID	:	United States Agency for International Development
USD	:	US Dollar
USGS	:	United States Geological Survey
VCR	:	Volume-Capacity Ratio
WB	:	World Bank
WFP	:	World Food Programme
WG	:	Working Group

Summary

1. JUBA URBAN TRANSPORT DEVELOPMENT MASTER PLAN

1.1 Vision and Mission, MTR

- **Vision**

To develop a safe, secure and efficient transport system for the prosperous Sudan.

- **Mission Statement**

The mission is to serve the people of Sudan by ensuring fast, efficient, accessible, convenient and affordable intermodal transport system that meets the vital national interests and enhances the quality of life of the people today and its future.

1.2 Transport Development Policy and Strategy

The following are the transport development policies and strategies proposed based on the analysis of existing issues and future demand in Juba urban area.

a) Road Development

- Administrative Jurisdiction and Functional Classification of Roads
- Development of Hierarchical Road Network System

b) Capacity

- Development of public and private sector capacity for construction, maintenance and operation of urban transport infrastructure

c) Special Policies

- Labor-based system for construction and maintenance works
- Road traffic safety
- Gender Equity
- Environmental and social consideration

1.3 Future Socio-economic Framework

To predict the future activities and demand of the people, the following assumptions are presumed:

		2008	2015	2025
GRDP per Capita (US$)		530	1,030	2,670
Population		260,000	520,000	950,000
GRDP (US$ million)		140	540	2,540
Annual Growth Rate	GRDP per Capita	-	10 %	10 %
	GRDP	-	21 %	17 %

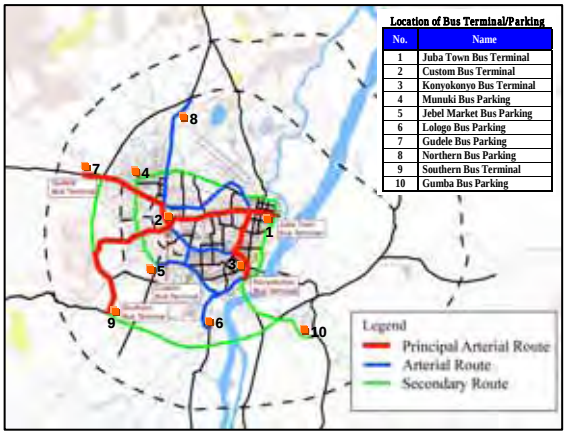
1.4 Road Network Development Plan

- The road network in 2015, 2020, 2025 and beyond 2026 are formulated as shown in the next pages.
- In formulating the plan, special considerations are focused on the following:
  - Standard cross-sections for future traffic demand
  - Multi-purpose lanes
  - Road ancillary, including traffic sign, pavement markings, street lighting
  - Roadside drainage and cross pipes
  - Intersection layout

1.5 Public Transport Development Plan

The vehicle registration and taxi system implementation and bus network and bus terminal improvement are proposed.

Proposed Bus Network



1.6 Traffic Management System Development Plan

Aside from road and intersection layout, the parking control and standardization of traffic control devices are recommended including the following:

- Traffic Safety Education
- Strengthening of Traffic Management and Enforcement

1.7 Environmental and Social Consideration

No major impact was observed during the Initial Environmental Examinations of the proposed road projects.

1.8 Proposed Project Implementation System

Establishment of Inter-Ministry Committee for Transport (IMCT) is proposed for project implementation.

1.9 Proposed Road Maintenance System

The following road jurisdiction is proposed:

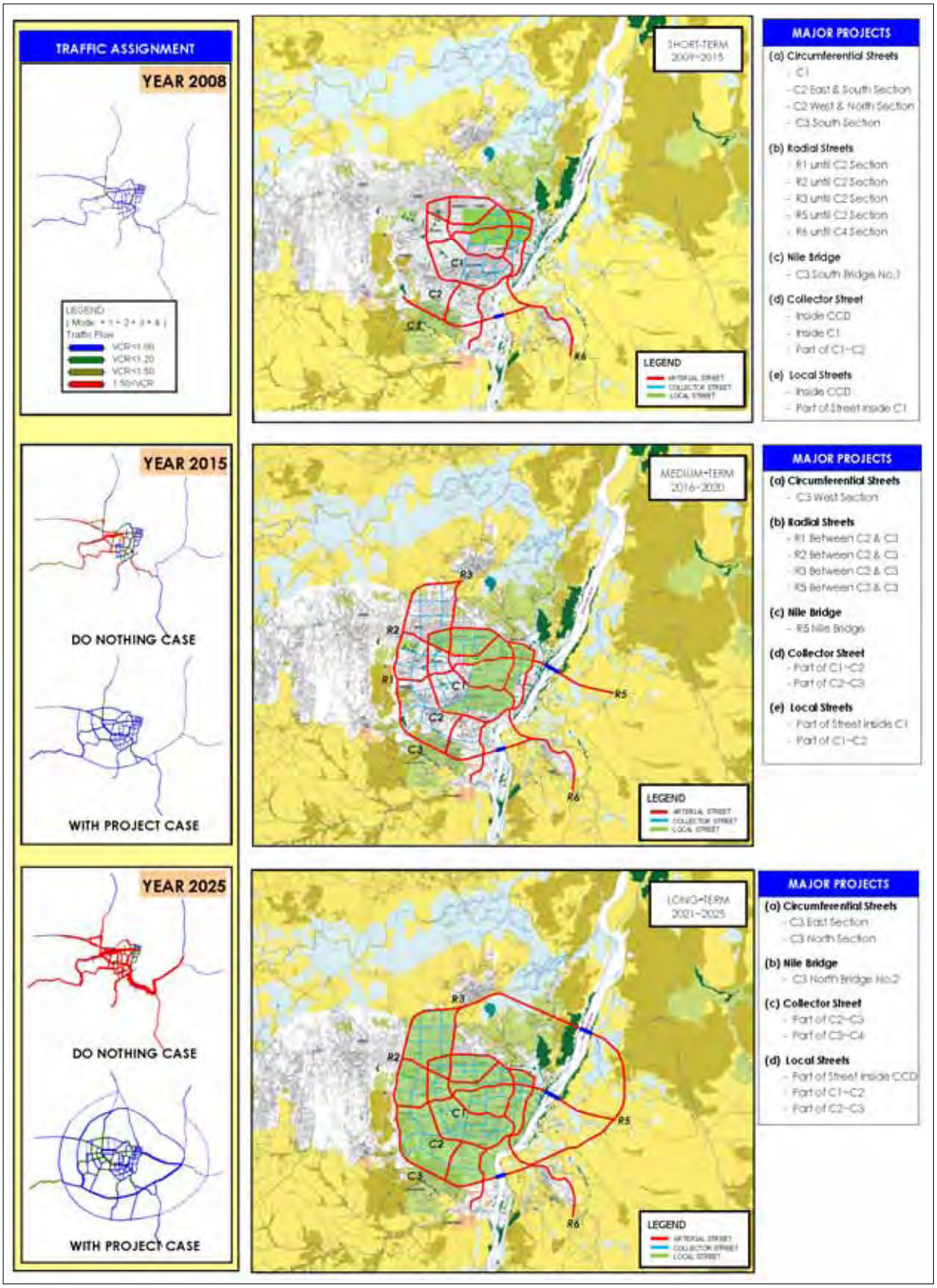
Road Type	Road Construction	Road Maintenance
International/Interstate Road	MTR	MTR
State Road	STATE	STATE
County Road	STATE[1)]	STATE[1)]

Note [1)]: State is responsible for funding and planning, and County is responsible for actual execution of work under the guidance of the State,

1.10 Overall Implementation Schedule

The following development phases for the Juba Urban Transport Master Plan are proposed:

- Short Term : 2009~2015 (7 years)
- Medium Term : 2016~2020 (5 years)
- Long Term : 2021~2025 (5 years)
- Beyond Term : 2026~



2. PRE-FEASIBILITY STUDY ON PRIORITY PROJECTS

2.1 FORMULATION OF URBAN STREET MAINTENANCE SYSTEM

(1) Objectives

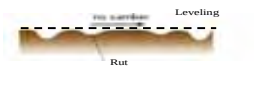
The Study focuses on the maintenance system of the MOPI, covering only collectors and local streets, with the following street improvement and completion scenarios:

- Maintenance Plan for 2012 :
  Completion of Circumferential Road 1 (C-1) and Radial Roads within C-1 by 2011.
- Maintenance Plan for 2016 :
  Completion of C-2 and Radial Roads and Collector Streets within C-2, and Local Streets within C-1 by 2015.
- Maintenance Plan for 2026 :
  Completion of most parts of the master plan by 2025.

(2) Road Improvement Types

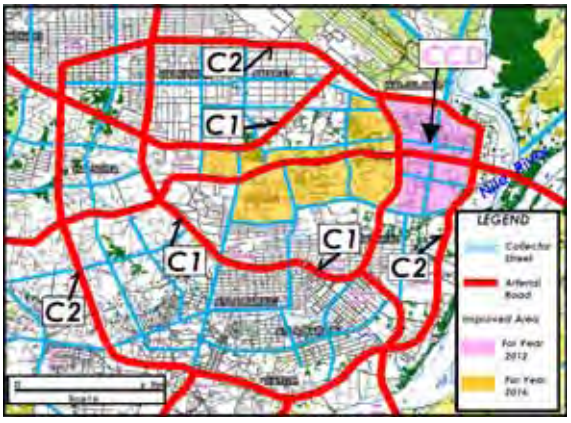
Improvement works are classified into:

(a) Leveling, (b) Re-surfacing, (c) Gravel Pavement, and (d) Asphalt Pavement

Type 0: Leveling To level road surfaces temporally on the corrugation, deep rut, loss of camber, and erosion with minimum materials.	
Type 1: Re-surfacing To secure the smoothness of corrugated road surfaces with suitable material such as a mixture of thin gravel (5cm).	
Type 2: Gravel Pavement To secure the smoothness of corrugated road surfaces with a mix of gravel (15 cm).	
Type 3: Asphalt Pavement To secure the smoothness of corrugated road surfaces with an asphalt concrete pavement (60 cm). Surface course:10 cm, base course:20cm And sub-base course 30cm	

(3) Streets to be Maintained

Target streets to be maintained by the MOPI include collector and local streets as shown below:



(4) Proposed MOPI Annual Maintenance Budget

Based on the case of year 2012 and 2016, the annual maintenance budget required for MOPI shall be:

Unit: Length in km, Cost in US$ x 1,000

Streets	Total Length	2012				2016			
		Improved		Not-Improved		Improved		Not-Improved	
		Length	Cost	Length	Cost	Length	Cost	Length	Cost
Collector	116.04	7.32	35	108.72	-	25.23	120	90.81	-
Local	498.18	13.97	460	484.21	-	70.62	2,400	427.56	-
Total	614.22	21.29	495	592.93	800	95.85	2,520	518.37	800

2.2 URBAN STREET IMPROVEMENT IN CENTRAL COMMERCIAL DISTRICT (CCD)

(1) Objectives

It is of urgent necessity to rehabilitate/improve the roads in CCD in order to improve the traffic flow, the living environment, the urban landscape and preserve the historical nature of the area.

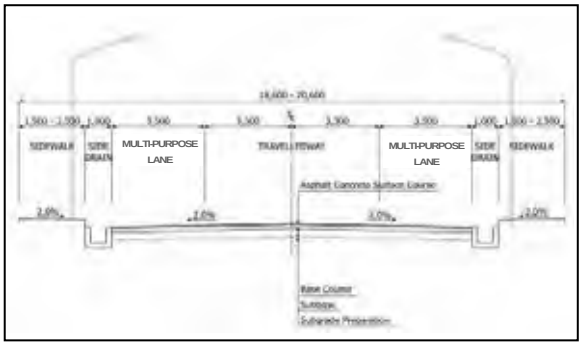
(2) Development Policy

The basic development policies applied in CCD are:

- Accessibility. Includes improvement of road network, development of public transport, and improvement of pedestrian facilities.
- Land Use. Direction for densely developed land use.
- Environment and Amenity. Provision of sidewalk with lighting, parking facilities, drainage facilities, proper garbage treatment, etc.
- Urban Aesthetics. In harmony with culture, climate, economies, etc.

(3) Standard Cross-Section

The proposed major local street section is shown below.

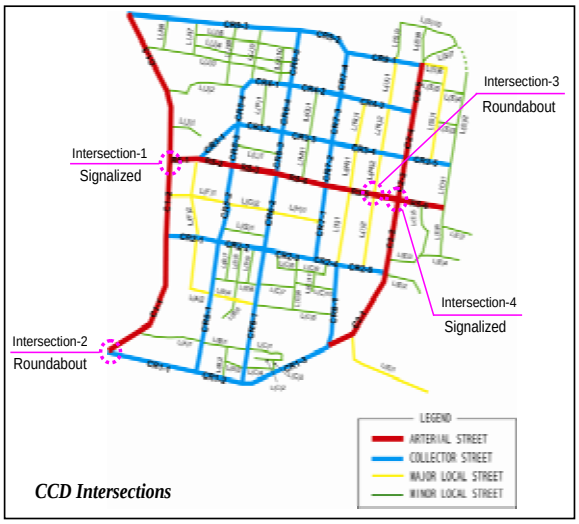


(4) Drainage Design

The drainage design for local streets utilizes an open concrete ditch considering minimal length of discharge points.

(5) Intersection Design

The design of intersection is done considering the projected traffic demand and intersection efficiency for 2015 and 2025 with the proposed type being signalized intersections.



CCD Intersections

2.3 ROUTE LOCATION STUDY OF MAJOR ARTERIALS

(1) Objectives

The basic objective of route location study is to establish the route locations and corridors of arterial streets to guide the development of Juba urban area based on the land use along the route corridors.

(2) Study Routes

The focus of the route location study are circumferential streets C2, C3 and radial street R5, maintaining the existing alignments of other arterial streets to minimize additional right-of-way.

(3) Policy on Route Location Selection

The following policies govern the selection the routes:

- Assure Mobility by maintaining the design speed and functionality
- Minimum Right-of-Way (ROW) Take
- Minimum Adverse Social Impact
- Preservation of the Environment

(4) Standard Cross-Section

The standard road sections require the following ROW:

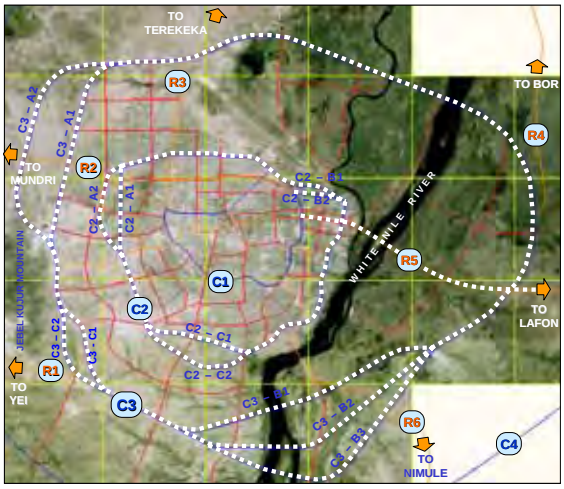
- Arterial 6-Lane Road : 60m
- Arterial 4-Lane Road : 50m

(5) Route Requirements

The following are considered for route requirements:

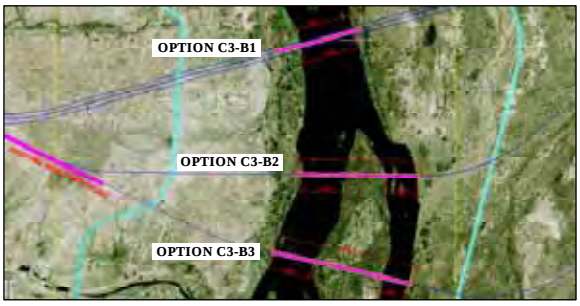
- Land Access
- Engineering
- Environment and Social Considerations

Delineation of Alternative Routes



(6) C-3 Nile River

Three alternatives are considered for the location of Nile River bridge with option C3-B1 recommended.



2.4 URBAN STREET NETWORK DEVELOPMENT IN SOUTHERN JUBA

(1) Objectives

Juba urban area is expanding due to the return of refugees/IDPs and migration from rural areas. The direction of growth is towards the east and south of Juba, necessitating improvement of roads in these areas.

(2) Study Roads

Four roads are identified as urgent project in southern Juba – 2 arterial and 2 collector streets as shown.

(3) Design Policy

The necessary ROW shall be reserved for the road corridors. However, considering traffic demand and minimal initial investment, stage construction shall be applied with 2-lane road at the initial stage.

(4) Standard Cross-Section

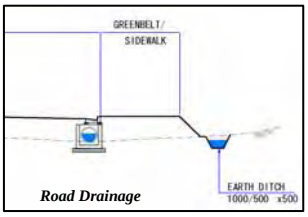
Initial stage construction shall provide 2-carriageways, 2-multipurpose lanes, greenbelts and sidewalks. ROW width shall be 50m for C2, 60m for C3 and 40m for collector roads.

(5) Road Surface and Roadside Drainage

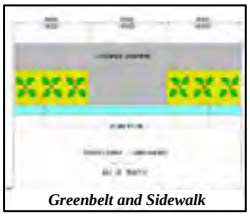
Road surface and roadside drainage shall be provided to protect the road structure as shown below:

(6) Greenbelt and Sidewalk

For a more user friendly road, greenbelts and sidewalks shall be provided.



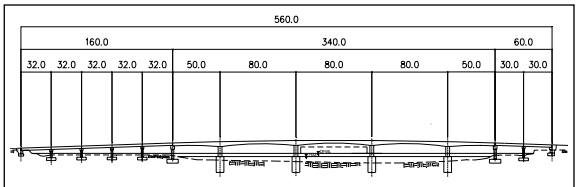
Road Drainage



Greenbelt and Sidewalk

(7) Nile River

Alternatives for Nile River bridge crossing are evaluated with the scheme shown below as recommended.



5-Span Prestressed Concrete Box Girder Bridge

3. BRIDGE AND CULVERT RECONSTRUCTION PROJECT

(1) Objectives

The project is formulated for seventeen bridge locations with the objective of improving mobility and accessibility within Juba by providing fix links in places where roads cross rivers and streams, making the roads accessible throughout the year

(2) Design Policy

Span length - anticipated design flood discharge and flood level supplemented by past experience on flood

Cross-section - bridge deck cross-sections shall be based on the road functional class maintaining the curb-to-curb road width

Bridge Type - local available materials and technology – use of reinforced concrete structure which is easier to construct and requires minimal maintenance

(3) Bridge and Culvert Prioritization

The bridge and culvert construction priority and importance are decided based on:

- Road Functional Class
- Existing Structural Stability
- Traffic Functionality
- Hydraulic Risk
- Environmental/Social Impact
- Harmony with ERRP
- Impact to Society and Economy in Case of Bridge Collapse

(4) Urgent Bridge and Culvert

The Urgent Bridges Reconstruction Project includes Bridges No.6, 9, 12 & Culverts No.13, 14, 15.

Bridge No.6 – Old and narrow bridge

Bridge No.12 – Overflow during heavy rain

Culvert No. 14 – Flooded during heavy rain

The Exchange of Notes between the Government of Japan and the Government of National Unity was signed on November 19, 2009 for the Construction of the above 3 bridges and 3 culverts.

4. CAPACITY DEVELOPMENT THRU PILOT PROJECTS

4.1 1ST & 2ND PILOT PROJECTS IMPLEMENTATION

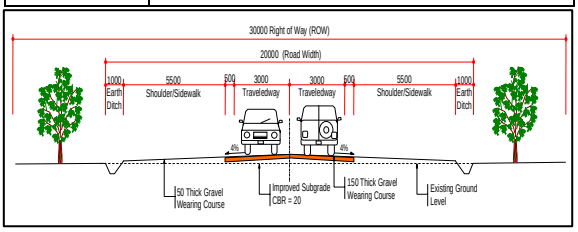
(1) Objectives

The pilot projects aim to develop within the MOPI the series of knowledge and skills in planning, implementation, monitoring, and evaluation of maintenance works for road infrastructures – ***resurfacing*** and ***gravel pavement types***.

(2) Project Components

The pilot projects are undertaken in Munuki with the following components:

1st Pilot Project	• Resurfacing of 770m local street with 7.0m carriageway, 5.5m shoulders and 1.0m ditch in Munuki
2nd Pilot Project	• Gravel pavement for 500m local street with 7.0m carriageway, 5.5m shoulders and 1.0m ditch in Munuki



(3) Working Group/ Implementation Organization

- The Pilot Project was implemented by the Community Construction Group (CCG) consisting of representatives from MTR, Road and Bridges Department of the MOPI and the Munuki Community.
- 20 unskilled labors in the 1st Pilot Project and 28 unskilled labors in the 2nd Pilot Project were recruited from the community.

(4) Project Impact

The impacts of the 1st and 2nd Pilot Projects to the community include:

- Increase in mobility and accessibility
- Improvement in daily life of community
- Increase in business opportunity
- Job creation by hiring unskilled workers from the community

(5) Evaluation

The project identified the need for further improvement of the MOPI skills and knowledge in road maintenance thru technical cooperation type of Capacity Development.

4.2 CAPACITY DEVELOPMENT PLAN

(1) Objectives

To develop the maintenance knowledge, technique and skills, as well as administrative compliance on road maintenance of the MOPI on collectors and local streets in Juba urban area.

(2)Target Group and Technology

Technical Level	Engineering Capacity Development	Construction Capacity Development
Planner	• Planner, Sr. Engineer	• Sr. Administrator
Engineer	• Engineer, Sr. Supervisor	• Administrator, Accountant
Technician	• Technician, Inspector, Supervisor	• Engineer, Technician, Mechanic

(3) Technical Cooperation Project Type Development Method

Technical Cooperation Project Type is recommended with the following methods:

- Seminar / Workshop, Class Room, On-the-job Training
- In-service Training, Training Tour in Foreign Countries

(4) CD Action Plan

The CD action plan covers program for trainings but should also include incentives to participants and strengthening of private sector.

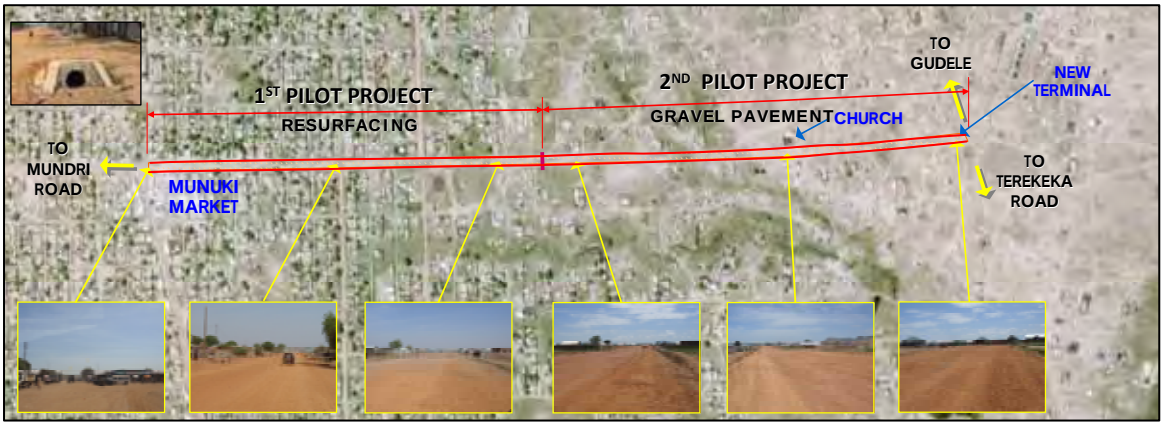
CD Action Plan

Program	Main Subjects	Target Group: Planner Class	Target Group: Engineer Class	Target Group: Technician Class	2010	2011	2012	2013	2014	2015
1. Establishment of Road Maintenance and Management System of the MOPI - Department of Road Maintenance, MOPI	- Recommendation of Road Maintenance System - Preparation of Annual Maintenance plan - Establishment of Force Account / Contract-out System	◎ ◎ ◎	○ ○ ○		▬	▬				
2. Capacity Development of Road Maintenance Technology under Force-Account Scheme **(Pilot Project I)** - Department of Road Maintenance, MOPI - Community	- Design of Gravel Pavement - Organization of Working Group of Community - Execution of Pilot Works		◎ ◎ ◎	○ ○ ○		▬	▬			
3. Capacity Development of Road Maintenance Technology under Contract-out Scheme **(Pilot Project II)** - Department of Road Maintenance, MOPI - Private Sector	- Design of Asphalt Concrete Pavement - Preparation of Tender And Contract Documents - Execution of Pilot Works		◎ ◎ ◎	○ ○ ○			▬	▬		
4. Capacity Development of Equipment Operation and Management for Small-scale Road Maintenance - Department of Road Maintenance, MOPI - Private Sector	- Purchase of Equipment for Road Maintenance - Capacity Development of Equipment Operation and Management		◎ ◎	○ ○	▬					

Note: ◎ Main Target Group ○ Secondary Target Group

Before the Project

Completion of the 1st and 2nd Pilot Projects



5. CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

- The Study proposes a set of measures to solve the present transport issues and formulates a functional transport system for the target year 2025. The output of the Study is expected to contribute to the development of urban transport system and encouragement of socio-economic activities in Juba urban area.
- It is noted that the thoughtful understanding and unprejudiced support of the master plan in policy makers and budgeting agencies of Southern Sudan and the international society are indispensable for the successful implementation of the master plan.

5.2 RECOMMENDATIONS

- **Plan Authorization**

  The authorization of the Master Plan is vital for the systematic implementation of the projects recommended in the Plan.

- **Plan Premise**

  Juba urban area is being widely and drastically developed at present. Therefore, the modification of the Master Plan may be required.

- **Project Arrangement**

  To implement the project as scheduled, such Feasibility Studies and Detailed Engineering Studies should be performed a few years before.

- **Constitution of Inter-Ministry Committee for Transport (IMCT)**

  The Inter-Ministry Committee for Transport (IMCT) is recommended to be organized in order to discuss and enforce such clear and consistent plan.

- **Establishment of a Task Force for Road ROW Reservation**

  A Task Force is recommended to be established to define the road right of way (ROW) in order to reserve the ROW land and minimize encroachment.

- **Adoption of Community Based Local Street Maintenance System**

  Community-based groups are recommended to be organized with the guidance of the Ministry of Physical Infrastructure (MOPI).

- **Community Participation in Project Implementation**

  Public consultation meetings are strongly recommended to be held at the proper timing to build public concerns.

- **Environmental Impact Assessment**

  Initial Environmental Examination (IEE) is a mandatory requirement for every project and Environmental Impact Assessment (EIA) shall be conducted for the project where negative impacts are anticipated.

- **Traffic Safety Education and Enforcement**

  A traffic safety education program should be established involving education in schools and periodic education of drivers.

- **Organization and Human Capacity Development**

  An effective organization for the systematic implementation approach is the vital key to the successful realization of the plan.

PART I

GENERAL

1. INTRODUCTION

(1) Background

- Urban infrastructure such as roads, water supply system, etc. in Southern Sudan, even in the capital Juba is not well provided due to civil wars lasting for more than 20 years.
- With the accelerated increase in returning refugees and internally displaced persons, serious urban problems are expected to arise due to shortage in the capacity of basic infrastructure and utilities, disorderly land use and development without guidance, generation of residential areas in terrible surroundings, and so on.
- The Government of Southern Sudan (GOSS) has identified urgent measures to the growing urban problems – one focus of which is the improvement of the urban transport network, especially the improvement of the urban roads.
- With such conditions, the GOSS requested a technical cooperation from the Government of Japan (GOJ) to conduct the "Juba Urban Transport Infrastructure and Capacity Development Study" (the Study), under the Japan International Cooperation Agency (JICA).

(2) Objectives of the Study

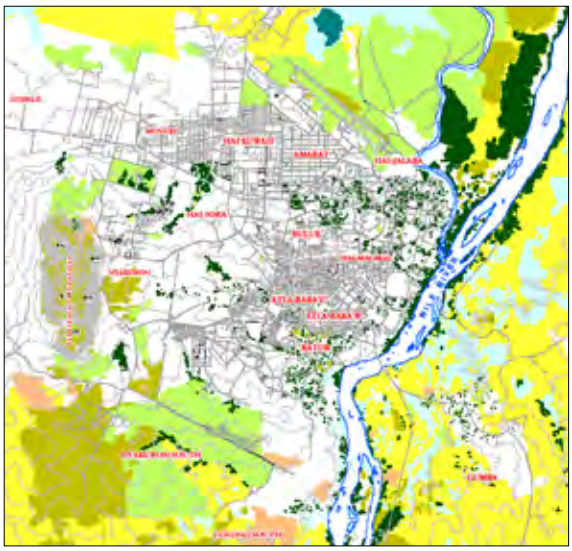
The objectives of the Study are as follows:

1) To formulate a transport network master plan for Juba urban and its surrounding areas with the target year until 2025, based on the review of the transport development plan in the Previous Study,
2) To formulate a project for the reconstruction of bridges/culverts which is not included in the on-going "Juba Immediate Road Rehabilitation Project",
3) To conduct pre-feasibility studies on high priority projects in the transport network master plan,
4) To prepare a capacity development plan for the engineers in-charge of the road improvement and maintenance in the Ministry of Transport and Roads (MTR) of GOSS, the Ministry of Physical Infrastructure (MOPI) of Central Equatoria State (CES) and other organizations related to the Study, and to support in the execution of the capacity development plan, and
5) To support in planning and implementation of pilot projects as an important part of the capacity development.

(3) Study Area

The Study shall cover Juba Urban Area.

Juba Urban Area



(4) Scope of the Study

The Study consists basically of the following main activities:

- Review and analysis of the present condition of the Study area,
- Formulation of Transport Development Master Plan,
- Formulation of Bridges/Culverts Reconstruction Project
- Pre-Feasibility Study on Priority Projects,
- Preparation of Capacity Development Plan for MTR and MOPI, and
- Support in Execution of Capacity Development Plan through Pilot Project.

(5) Stakeholder Meetings

A series of Stakeholders' Meetings were held to discuss the issues and concerns of the Stakeholders and consider such in the Study planning process.

- 1st : Inception Report Presentation
  August 28, 2008
- 2nd : Future Land Use and Road Network
  November 5, 2008
- 3rd : Urban Transport Development Plan
  February 16, 2009
- 4th : JUTI Interim Report
  June 2, 2009
- 5th : Route Location Alternatives for Arterials
  July 1, 2009
- 6th : Environmental and Social Consideration
  August 18, 2009
- 7th : Pilot Project and Capacity Development
  October 30, 2009
- 8th : Draft Final Report Presentation
  December 15, 2009
- 9th : 2nd Pilot Project Presentation
  June 3, 2010

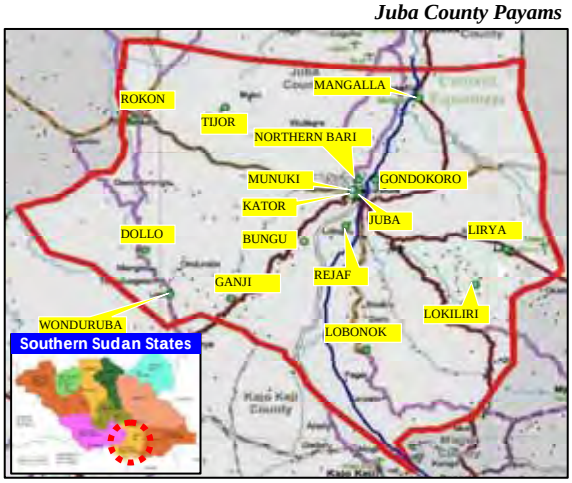
2. ADMINISTRATION AND PHYSICAL PROFILE

(1) Administrative System

1) Administrative Division

The administrative divisions of Southern Sudan consist of the State ➔ County ➔ Payam ➔ Boma. One of the 10 States, Central Equatoria State is composed of 6 Counties while Juba County is composed of 16 Payams and 89 Bomas.

Juba County Payams



2) Organization of GOSS and CES

The Government of the Southern Sudan (GOSS) is administered by 23 Ministries under the President and Vice President.

The Local Government of Central Equatoria State, on the other hand, is headed by the Governor and administered by six (6) Ministries.

3) Transport Administration

The Ministry of Transport and Roads (MTR) of GOSS and the Ministry of Physical Infrastructure (MOPI) of Central Equatoria State are the principal agencies responsible for transport administration.

In both Ministries, the Directorates of Roads and Bridges administer the road sector.

(2) Physical Profile

Juba Town is located at 4°52′ north of the equator and 31°36′ east of eastern longitude, at an altitude of 460m above sea level.

1) Climate

- The monthly average minimum temperatures based on the 1998 to 2004 statistics (excluding 2001) fall in the range of 19.4°C and 23.7°C whereas the monthly average maximum temperatures for the same period were between 31.5°C and 37.9°C.
- The rainy season usually starts in May and lasts to October with an average annual precipitation level of around 1,000mm.
- The prevailing winds are always from the south. Nevertheless, in January and February winds mostly prevail from the north-north-west direction.

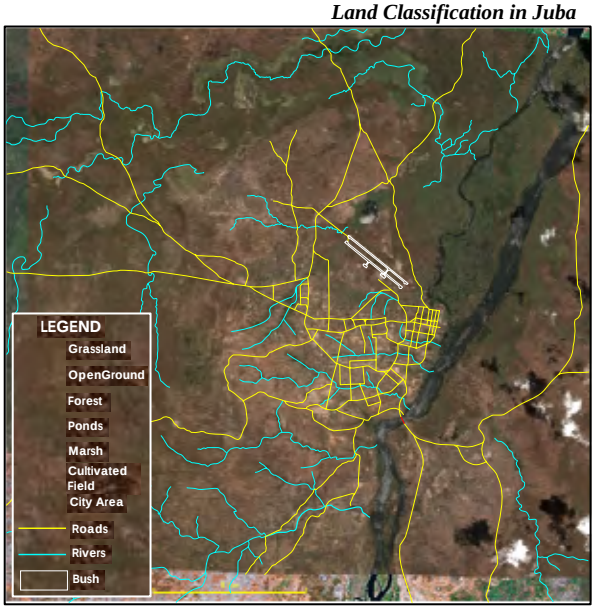
2) Topography and Land Type

Juba Town and the surrounding area are located in the large Bahr al Jebel alluvial plain which inclines from south-southwest to north-northeast direction. A gentle slope generally characterizes the area, where outcrops of hard and firm crystalline rocks are found.

The White Nile River, with an average width between 250m to 600m width, delineates the town boundary in the east. In the rainy season, the flooding water affects an area covering almost 50% of the alluvial plain prompting the emergence of the temporal and seasonal rivers flowing into the White Nile River.

Most of the land around Juba is covered with the bush. Trees abound in both banks of the White Nile River and its tributaries. Woods and cultivated field also abound in the area. A large pond and an open ground are on the north side of the airport, and grasslands and cultivated fields spread out in the northeastern direction.
There are few recorded seismic activities around Juba with epicenters from 16km to 100km away with magnitudes of 5.0 to 7.2.

Land Classification in Juba



3. PRESENT URBAN TRANSPORT INFRASTRUCTURE

(1) Transport System

The transport system in Southern Sudan comprises mainly by four modes:

- Roads – about 12,642km in total
- Railways – no operational railway
- Inland Water Transport – 1,436km stretch
- Air Transport – two 2,500m runways

(2) Road Network

1) Administrative Road Classification and Responsible Organization

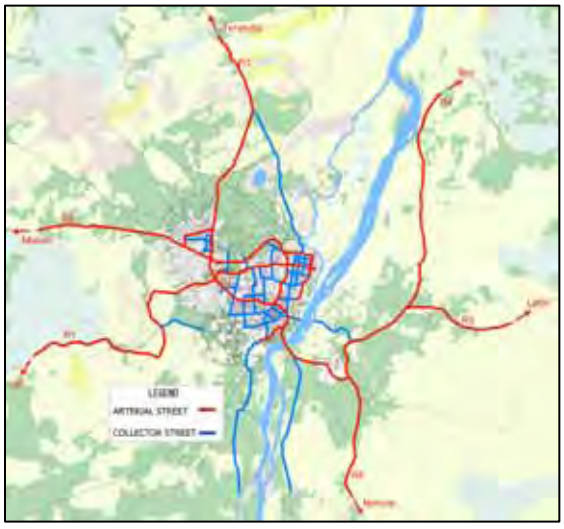
Road Classification	Responsible Organization
International/Interstate Road	GOSS, Ministry of Transport and Roads (MTR)
State Road	State, Ministry of Physical Infrastructure (MOPI)
County Road	County

2) Juba Urban Road Network

The present urban road network in Juba consists of:

- Six radial roads handling interstate and international traffic,
- State roads consisting of one circumferential road (C1) formed by the Old Airport road and the Unity Ave and collector roads connecting different counties, and
- County roads are basically local roads.

Present Road Network in Juba Urban Area



3) Existing Road Condition

- Majority of the roads in Juba urban area are earth roads, with some sections paved with bitumen, in very poor condition,
- The on-going 65km Emergency Road Rehabilitation Project to improve major roads in Juba has so far completed 10kms of asphalt paved roads,
- There is no existing road drainage system,
- About 12 old concrete bridges and culverts cross the streams and rivers within Juba, and
- Only one bridge provides a fix link over the Nile river to connect the east and west sides of Juba.

Traffic Congestion in a Paved Road

4) Vehicle Registration

- There is no standard vehicle registration system in Southern Sudan with vehicle registrations being controlled by different agencies.

5) Traffic Management

- Systematic Traffic Management is not yet established in Juba with intersections, junctions and roundabouts being controlled manually by policemen.

6) Public Transport

- The existing Interstate/International bus transport is being managed by the Department of Road Transport and Safety, MTR.
- Minivans serving short and intermediate transport distances are privately owned and difficult to control.
- Taxis are basically “boda-boda” or bike taxis (which is the dominant mode) and sedan type taxis. There is no registration system and no responsible organization controlling the taxis.
- Buses and taxis are operated arbitrarily since no rules/regulations exists to regulate the public transport.

Bike Taxi or “Boda-boda”

4. TRANSPORT DEVELOPMENT PROJECTS AND PROGRAMS

(1) Main Activities in 2009 Budget

The main activities of transport development for 2009 budget of MTR are summarized in the table below.

2009 Budget Transport Development Activities

Program Area	Main Activities	Description of 2009 Activities.	Cost (Million SDG)
Road Transport Development	1.Policy, Regulation, Strategy Development &Capacity Building	• TA & Policy Studies and Implementation (through MDTF) • PMT support service (through MDTF) • Capacity building of the MTR staff	2.0 M
	2.Feasibility Studies, Technical Assessments and Surveys	• Supervision of construction Nimule-Juba Road	3.1 M
	3.Maintenance of Roads	• Maintenance of Yei-Juba, Rumbek-Tonj, Kapoeta-Juba And Juba-Bor Road by WFP	17.1 M
	4. De-mining, Rehabilitation and Construction of Roads	**Upgrade to All-weather Gravel Standard** • Mvolo-Aluakaluak Road (10.0 M) • Wau-Warrap Road (10.0 M) • Aweil-Mariam Road (90.0 M) • Aweil-Wau Road (23.0 M) • Aweil-Madhol-Abyei-Ameth-Mayen-Abun-Gogrial Road (53.0 M) • Juba-Lobonok-Moli Road (10.0 M) • Hiyala-Ikotos-Tseretenya-Madiope Road (6.0 M) • Wau-Raja, Juba-Terekeka-Ramchiel-Yirol-Leer, Rumbek-Mayandit, and Tambura-Wau Roads (107.0 M) • Faraksika-Chukudum, KajoKeji-Juba, and Narus-Boma Roads (by WFP) • Ayod-Waat-Akobo Road (10.0 M) • Bor-Pibor-Pochalla Road (10.0 M) • Buma-Raad Road (3.0 M) **Upgrade to Bitumen Standard** • Juba Urban Roads LOT-1 (10.0 M) • Juba Urban Roads LOT-2 (10.0 M)	352.6 M
	5. Installation of Inspection Facility	• Purchase and installation of inspection equipment, commissioning and training staff	2.0M
Air, River and Rail Transport Development	1.Air Transport	• Juba Airport apron and car park • 5-Airstrips	18.6 M
	2. River Transport	• Purchase of 2 river barges • Construction of fence around Juba Port	11.4 M
	3. Rail Transport	(none)	-

(2) Development Programs

- **World Bank - MDTF**
  - Sudan Emergency Transport and Infrastructure Development Project (SETIDP)
  - Rapid Impact Emergency Project (Extension) Public Works
  - Rapid Impact Emergency Project (Extension) Commission

- **UN Work Plan**

  The UN and Partners 2006 Work Plan for Sudan includes programs in:
  - Humanitarian assistance in Darfur and other areas of conflict
  - Assistance to recovery and development in Southern Sudan, Abyei, Blue Nile and Southern Kordofan.

- **UNDP**

  The UNDP is implementing the following:
  - Programs by Trust Fund Management on Post Conflict Recovery and Rehabilitation and Prevention of Tuberculosis, HIV/AIDS and control of Malaria
  - Post Conflict Community based Recovery and Rehabilitation Program for water supply

- **World Food Program**
  - Operations to rescue transport routes for food commodities
  - Emergency Road Repair and Mine Clearance of Key Transport Routes

- **USAID**
  - Infrastructure Services Project
  - Humanitarian Assistance Project
  - Rainwater Harvesting

- **JICA**
  - Juba Urban Transport Infrastructure and Capacity Development Study
  - Juba Urban Water Supply and Capacity Development Study

- **Others (UK, Netherlands, UNHabitat, etc.)**
  - Support to States (Infrastructure)
  - Water Sector Capacity Support
  - Technical Assistance

(3) Projects Related to Juba Urban Transport

1) Juba Immediate Infrastructure Rehabilitation

Juba Immediate Infrastructure Rehabilitation is being implemented in Juba urban area as Phase 1 of the SETIDP. This phase consists of the immediate rehabilitation of basic infrastructure including the following:

a) Rehabilitation of priority government and public administration buildings and houses, hospital infrastructures and provision of prefabricated accommodation,
b) Rehabilitation of water supply system of Juba including installation of distribution network and installation of proposed water treatment plants in strategic locations, and
c) Rehabilitation and installation of liquid and solid waste management system including collection and disposal.

2) Technical Assistance Support

As a technical assistance support to the Project Management Team (PMTs), the consultant's Technical Assistance Team (TAST) was organized and tasked to achieve the following five objectives:

a) To fill and develop the current low technical capacity of the Project Management Team including contract administration and claim resolution, in the central and state offices of the MTR and the MHPPE,
b) To build their capacity in investment planning and programming,
c) To establish and operate the financial management functions in the Ministries,
d) To assist the Ministries in the recruitment and training of technical staff, and
e) To provide support to effectively implement and/or prepare follow up phase of the SETIDP.

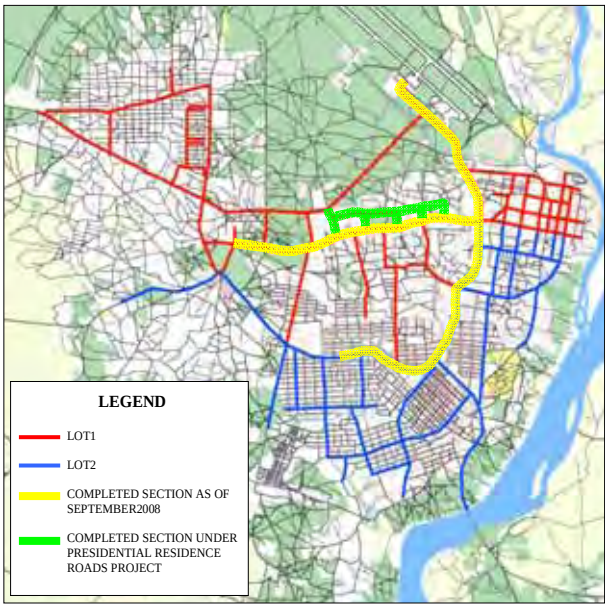
The capacity development required to achieve the above objectives involves the training plans in project and contract management, procurement, financial management, investment planning, information system, road management, materials quality control and testing and environmental issues.

3) Emergency Road Rehabilitation Project

This Project aims to rehabilitate and improve 65km of urban streets in Juba to asphalt standard. Initially, this Project was planned to be implemented using the MDTF as a component of SETIDP but failed which prompted the GOSS to appropriate fund for this Project.

The Project, which started in year 2006 with the MTR as the implementing agency, was originally under one contract but is divided into two segments since September of 2008 - LOT-1 (30km) and LOT-2 (35km). Both LOT-1 and LOT-2 are scheduled to be completed by the end of 2010.

Emergency Road Rehabilitation Project



(4) Six Top Priority for 2008-2011, GOSS

The Governments of Southern Sudan's six top expenditure priorities for 2008- 2011 are:

1. Security
2. Roads
3. Primary Health Care
4. Basic Education
5. Water
6. Production

The GOSS has set the following targets for year 2011 as follows:

- Rehabilitate and upgrade roads to connect all state capitals to one another, to areas of production, Northern Sudan, and to neighboring countries.
- Increase the contracting and procurement capacity of the Ministry of Transport and Roads for both construction and maintenance.
- Develop a rural roads strategy and be ready to start its implementation.

PART II

URBAN TRANSPORT DEVELOPMENT MASTER PLAN

5. TRANSPORT DEVELOPMENT POLICY AND TARGET

(1) Transport Issues

Various transport problems and issues were identified during the course of the Study as follows:

Urban Structure

- No land use plan, physical infrastructure plan and lack of land use control.
- Urban sprawl due to fast and disorganized land development.

Road Network

- Undeveloped or inefficient road network to induce urban development.
- No hierarchy of road network system.
- Substandard international/interstate/arterial road corridor.
- Traffic congestion due to inadequate transport facilities and road network function.
- High vehicle operating and transport cost due to deteriorated road condition.

Typical Traffic Condition in Juba

Public Transport

- Disorganized public transport system such as buses, mini-buses and motorbike taxis.
- Lack of facilities for public transport.

Traffic Management

- Poor enforcement and education on traffic regulations due to lack of traffic management system.
- Increase in traffic accidents with increasing motor vehicles.

Institution

- Lack of institutional structure for GOSS and States.
- Inadequate technical capacity and absence of private sector investment.

Environment

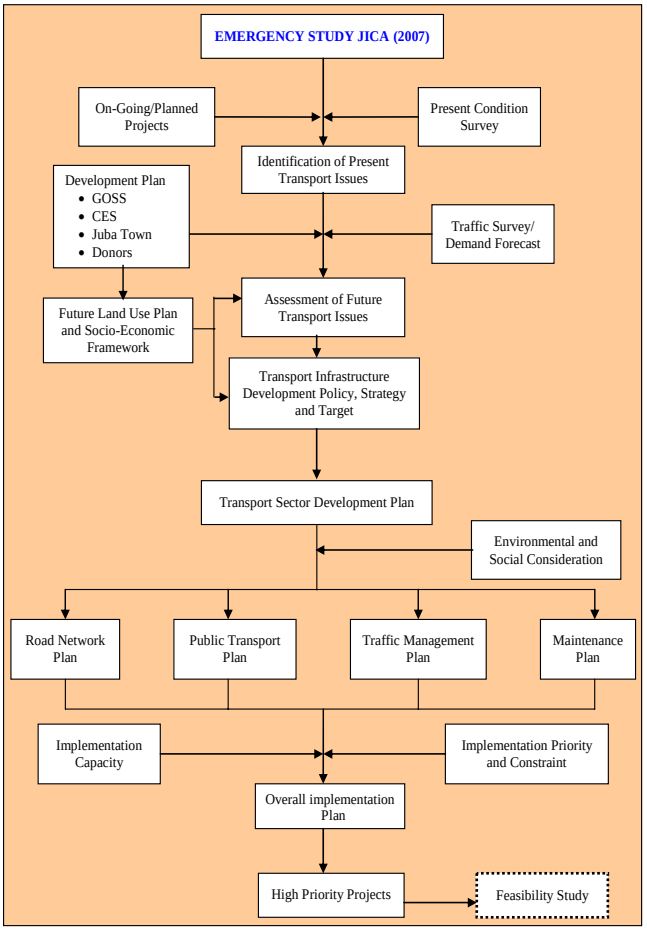
- Poor air quality by exhaust gas due to poor road condition.
- Lack of space for non-motorized transport.
- Poor roadside amenity and city environment due to lack of drainage, sidewalks, etc.

Typical Road Condition During Rain

(2) Planning Approach

A comprehensive road systematic planning approach is adapted to develop the road transport master plan for Juba and surrounding areas.

Procedure for Transport Master Plan Formulation



(3) The Ministry of Transport and Roads (MTR) Vision, Mission and Transport Objectives and Strategy

- Vision

  To develop a safe, secure and efficient transport system for the prosperous Sudan.

- Mission Statement

  The mission is to serve the people of Sudan by ensuring fast, efficient, accessible, convenient and affordable intermodal transport system that meets the vital national interests and enhances the quality of life of the people today and its future.

- Transport Sector Overall Objectives

  The government recognizes the lack of efficient transport system impacts negatively on the performance of the economy and therefore committed to:

  - Improve mobility in rural areas through promotion of appropriate means and modes of transport,
  - Contribute job creation in transport sector,
  - Ensure safety standards in all modes of transport,
  - Provide links with states and neighboring countries, and
  - Recognize and account for environmental concerns.

In the Road Sector, the objectives include:

- To construct modern roads that will connect various parts of Southern Sudan and link them to the outside world,
- To allocate resources, establish adequate legislation and institution, ensure safety and security by law enforcement, and
- To improve mobility in rural areas thru promotion of appropriate motorized and non-motorized means of transport.

(4) MOPI Development Directions

- Vision

  A sector that is efficient, transparent, accountable and capable of delivering services to the people of CES.

- Mission

  To develop human resource and acquire necessary equipment to realize accessible all weather roads, safe and clean drinking water, electricity and affordable housing to the people of CES.

(5) Proposed Urban Development Strategy

In conformity with the policy and strategic plan for urban transport of the MTR, the Juba Urban Transport Development Strategy is proposed below:

Proposed Juba Urban Transport Development Strategy

Existing Issues	Vision	Policy	Strategy
• Lack of Institutional structures • Inadequate technical capacity • High vehicle operating and transport cost due to deteriorated road condition • Ineffective/non-functional road network to induce urban development • Disorganized public transport system • Lack of enforcement and education on traffic regulation • Poor roadside amenity and city environment • Urban sprawl	**Economic Growth** • To provide transport infrastructure to stimulate investment, leading to poverty reduction and enhanced economic growth **Quality of Life** • To develop a safe, secure and efficient transport system, enhancing the quality of life of people **Transport Hub in Region** • To initiate world-class transport system as the hub in the region	**Institution** • To establish appropriate institutional framework for urban transport system **Capacity** • To develop public and private sector capacity for construction, maintenance and operation of urban transport infrastructure **Finance** • To establish sustainable institutional and financial mechanism for development and maintenance of urban transport infrastructure. **Special policies** • Labor-based system for construction and maintenance works • Road traffic safety • Gender Equity • Environmental and social consideration	**Institution** 1. Legal and Regulatory Framework on Urban Infrastructure Development 2. Roles of Public and Private Sectors **Road Development** 3. Immediate Rehabilitation of Existing Roads 4. Administrative and Functional Classification of Roads 5. Development of Hierarchical Road Network System 6. Establishment of Appropriate Standards for Roads Engineering 7. International Level of Improvement **Public Transport** 8. Policy and Regulation of Public Transport Operation 9. Promotion of Bus Transport 10. Provision of Bus Transport Infrastructure **Traffic Management** 11. Development of Traffic Policy and Regulation on Management 12. Enforcement of Traffic Law and Regulation 13. Education of Traffic Rule and Safety Behavior **Specific Issues** 14. Development of Non-motorized Transport Facility 15. Consideration on Environmental and Social Impacts 16. Human Resource Development

(6) Mapping

Since Juba is rapidly growing with new road construction, development of new resettlement areas for returnees and IDPs, business expansion and building construction, it is necessary to update the Juba topographic map prepared by JICA in 2007.

A new topographic map was produced in this Study based on the satellite image of 2009 to guide the preparation of the road network master plan considering recent developments in Juba urban area.

Topographic Map Specifications

Item	Specification
Mapping Area	784 sq.km (28km x 28km)
Application Software	Mapinfo (Mapinfo Corporation)
Layer	1. Road 2. River 3. Building 4. Forest/Grove/Woodland 5. Cultivated Field 6. Grassland 7. Bush 8. Marsh
Vertical Datum	Mean Sea Level (MSL) The contour lines are created using DEM(SPOT-DEM) from "Emergency Study on the Planning and Support for Basic Physical and Social Infrastructure in Juba Town and the Surrounding Areas".

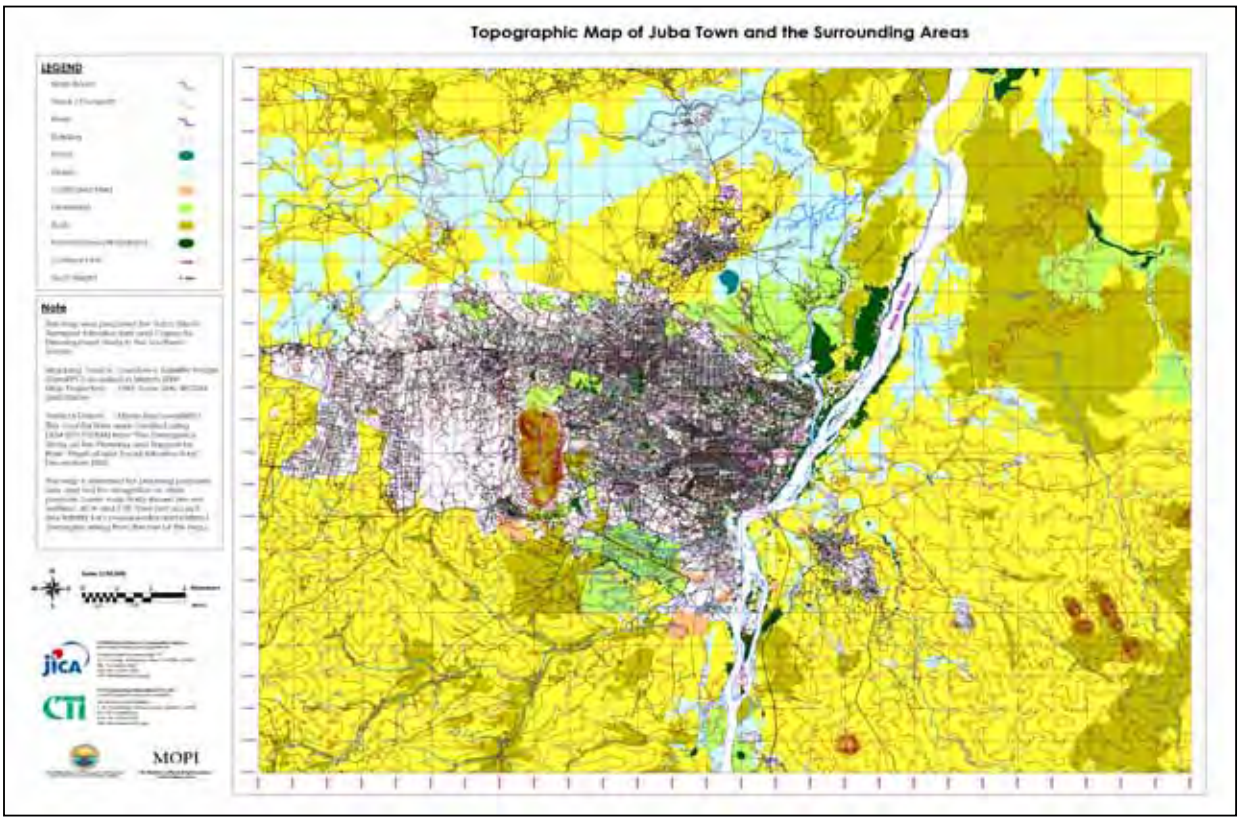
Satellite Image Section of Juba Urban Area

Satellite Image Specifications

Item	Specification
Type of Satellite Image	GeoEye-1 (GeoRPC)
Type of Data File	Geo tiff
Image Resolution	0.5 m
Acquired Date	16 March 2009
Area	784 sq.km (28km x 28km)
Map Projection	UTM (Universal Tranverse Mercator), Zone 36 North
Reference System and Ellipsoid	WGS84 (World Geodetic System 1984)

The topographic map of Juba Urban Area is prepared in scales of 1:10,000 and 1:30,000 as shown below.

Topographic Map of Juba Urban Area



6. TRAFFIC DEMAND FORECAST

Juba, as the center of political, economic, social and cultural activities in Southern Sudan plays the following role:

- An international city to have a hub function international logistics.
- Capital city with central political and administrative function.
- Center of economic activities to promote the development of industries in Southern Sudan.

(1) Land Use

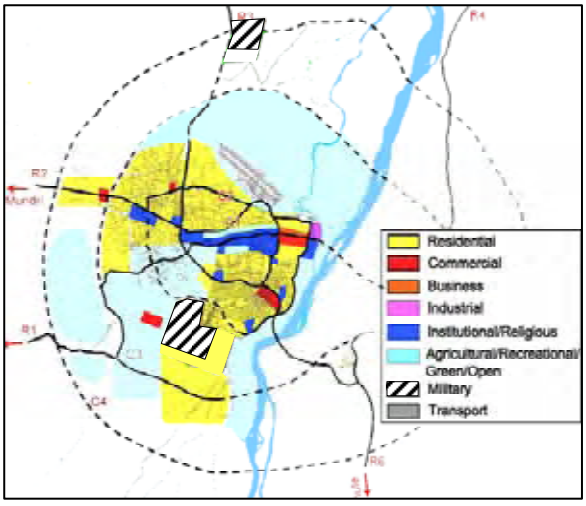
1) Present Land Use

- Juba Payam is characterized by low density urban area where government offices, institutional offices, houses, shops and small business offices intermingle.
- Kator Payam is located south of Juba Payam where markets, old Arab houses and merchant houses intermingle. Informal settlers with "Tukul" style houses are seen in the outskirts.
- Munuki Payam is located west of Juba Payam spreading out in the west of the GOSS Ministry Complex. This is characterized as residential areas for low income families, returnees and IDPs.

Present Land Use by Category

Land Use	Area (ha)				%
	Juba	Kator	Munuki	Total	
Residential	590	460	750	**1,800**	44.2
Commercial	20	10	10	**40**	1.0
Business	30	0	0	**30**	0.7
Industrial	10	0	0	**10**	0.3
Institutional/Religious	150	10	20	**180**	4.4
Military	0	300	0	**300**	7.4
Transport	280	60	40	**380**	9.3
Agricultural/Recreational/ Green/Open	670	400	260	**1,330**	32.7
Total	**1,750**	**1,240**	**1,080**	**4,070**	**100.0**

Present Land Use



2) Future Land Demand

The future land demand is estimated based on the land use demands and working population as indicated in the table below:

Estimated Future Land Demand

		2008	2015		2025	
Basic Multipliers Population Working Population Urban Area Required		1.0 (260,000) 1.0 (42,000) 1.0 (4,070 ha)	2.0 (520,000) 2.5 (106,000) 1.9 (7,700 ha)		3.7 (950,000) 5.7 (240,000) 3.4 (14,000 ha)	
Land Demand (ha)	Residential	**1,800**	(2.0 times)	**3,600**	(3.7 times)	**6,660**
	Commercial	**40**	(2x2.0 times)	**160**	(2x3.7 times)	**300**
	Business	**30**	(2x2.5 times)	**150**	(2x5.7 times)	**340**
	Industrial	**10**	(2x2.5 times)	**50**	(2x5.7 times)	**110**
	Institutional/Religious	**180**	(1.5 times)	**270**	(2.35 times)	**420**
	Military	**300**	(1.0 times)	**300**	(1.0 times)	**300**
	Transport	**380**	(1.9 times)	**720**	(3.4 times)	**1,290**
	Agricultural/Recre-ational/Green/Open	**1,330**	(nearly 1.9 times)	**2,450**	(nearly 3.4 times)	**4,580**
	Total	**4,070**		**7,700**		**14,000**

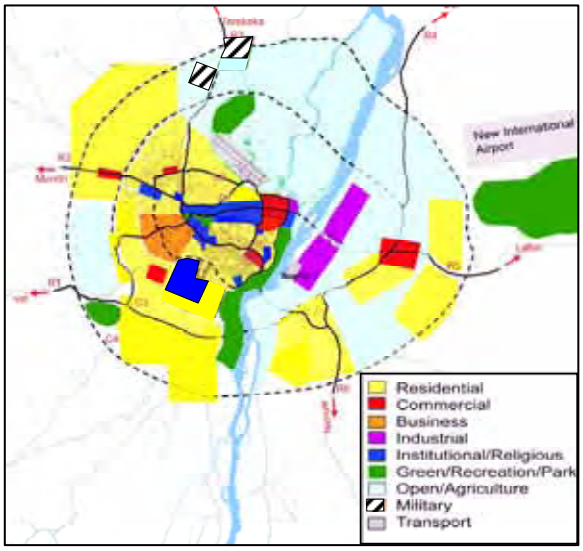
- Circumferential Road C3 covers the 2015 urban area while C4 covers the 2025 urban area.

3) Proposed Land Use Plan

The major points considered in land use planning are as follows:

- Provision of adequate transport facilities as a transport hub of the region, including a network of arterial roads to induce intended land use,
- Appropriate distribution of land for each land use meeting its demand – maintaining existing areas and developing new areas,
- Reservation of enough areas for green and recreation to make Juba a comfortable, pleasant and environmental friendly city, and
- Proper use and development of the areas at the east side of White Nile River

Proposed Land Use for 2025

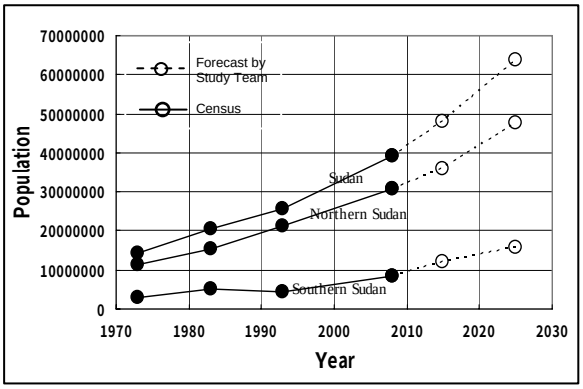


(2) Future Socio-Economic Framework

1) Population of Sudan

- The population of Southern Sudan increased from 1973 to 1983 at a high rate, but decreased during the next decade due to the IDPs. This has since been recovering with the return movements of refugees.
- The population of Northern Sudan showed the opposite movement to the population of Southern Sudan.
- The average annual growth rate of the whole Sudan's population is 2.96% during 1973-2008, and 2.88% from 1993 to 2008.
- The share of the population of Southern Sudan increased from about 20% in 1973 to about 25% in 1983, dropped 17% in 1993 and then recovered to 21% in 2008.
- JAM estimated that approximately 4 million people were displaced from Southern Sudan.
- IOM estimated that the cumulative number of returnees is approximately 1.8 million up to June 2008.

Population of Sudan



2) Population of Juba Urban Area

- The population of Juba urban area in 2008 is about 260,000 including an estimated 160,000 returnees.

Projection of Future Population

Item	Location	2008	2015	2025
Population	Sudan	39,154,490(100%)	47,830,000(100%)	63,660,000(100%)
	Northern Sudan	30,894,000(78.9%)	35,870,000(75.0%)	47,750,000(75.0%)
	Southern Sudan	8,260,490(21.1%)	11,960,000(25.0%)	15,910,000(25.0%)
	Juba Urban Area (Share to Southern Sudan)	260,000 (3.1%)	520,000 (4.3%)	950,000 (6.0%)
Average Annual Growth Rate	Sudan		2.9%	2.9%
	Northern Sudan		2.2%	2.9%
	Southern Sudan		5.4%	2.9%
	Juba Urban Area		10.4%	6.2%

- The 2015 population is estimated as the total of natural increase plus migration of the IDPs/returnees.
- The 2025 population of Juba urban area is estimated to be 6% of the total population in Southern Sudan.

3) Economy

- The major economic indicators for Sudan in the past years are shown below:

Sudan Economic Indicators

	2000	2005	2006	2007
GNI (billion US$)	10.27	22.94	29.25	37.03
GNI per capita (US$)	310	620	780	960
GDP (billion US$)	12.37	27.39	36.40	47.63
GDP Growth Rate (annual %)	8.4	6.3	11.3	10.2
Inflation, GDP deflator (annual %)	8.7	12.2	6.5	7.0
GDP per capita (US$)	371	742	965	1,235
Source : World Development Indicators Database, September 2008, World Bank				

- There is no official information regarding the GDP of Southern Sudan, so that the economic indicators for the Study Area is estimated as:

Study Area Economic Indicators

		2008	2015	2025
GRDP per Capita (US$)		530	1,030	2,670
Population		260,000	520,000	950,000
GRDP (US$ million)		140	540	2,540
Annual Growth Rate	GRDP per Capita	-	10 %	10 %
	GRDP	-	21 %	17 %

- The above table indicates that the GRDP per capita in the Study Area is about 30%, 50% and 90% of the GDP per capita of whole Sudan in 2008, 2015 and 2025, respectively.
- The future socio-economic frame work based on the above estimates is thus summarized in the table below.

Future Socio-Economic Framework

Item		2008	2015	2025
Population		260,000	520,000	950,000
Working Population		42,000	106,000	240,000
GRDP(US$ million)		140	540	2,540
GRDP per Capita(US$)		530	1,030	2,670
Land Demand (ha)	Residential	1,800	3,600	6,660
	Commercial	40	160	300
	Business	30	150	340
	Industrial	10	50	110
	Institutional/ Religious	180	270	420
	Military	300	300	300
	Transport	380	720	1,290
	Agri./Recreational/ Green/ Open	1,330	2,450	4,580
	Total	**4,070**	**7,700**	**14,000**

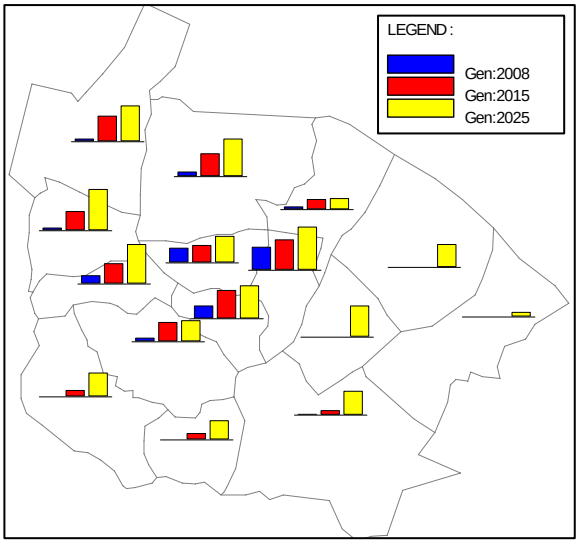
(3) Trip Generation and Attraction

The future total trip generation is forecasted based on the Trip Generation and Attraction Model to be:

Future Trip Generation

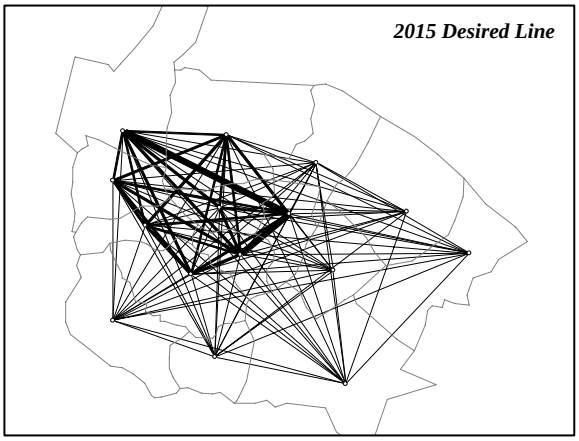
	2008	2015	2025
Total Trips	342,404	960,842	1,806,396
Annual Growth Rate	-	15.9%	6.5%

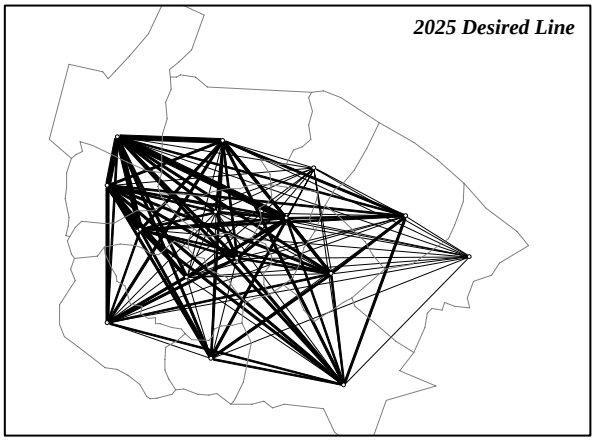
Trip Generation in 2008, 2015 and 2025



(4) Future Trip Distribution

The desired line charts are plotted to clarify the trip distribution and interaction among zone pairs.

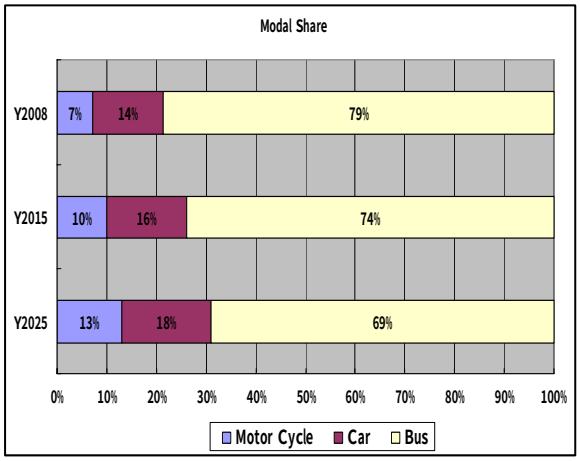




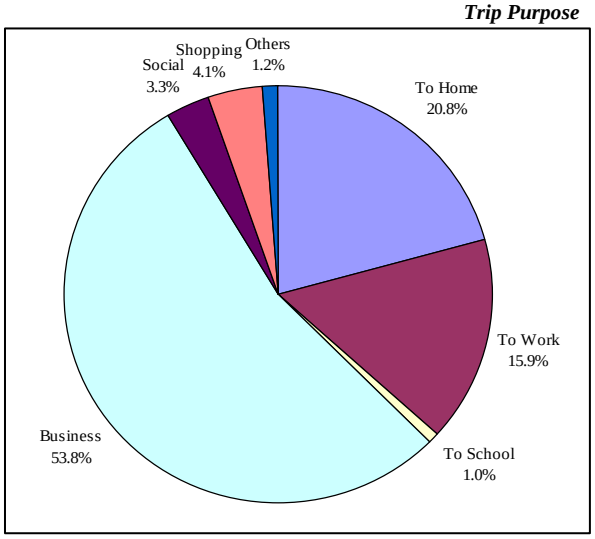
(5) Modal Split

Due to lack of vehicle registration data, the future modal share of person trips is estimated based on the present modal share to predict the choices that individuals or groups of individuals in choosing transportation modes.

Graph of Future Modal Share



Trip Purpose



(6) Evaluation of Present and Proposed Road Network

- The future traffic in Juba urban area is predicted considering the present road network without improvement or the "DO NOTHING" case and the proposed road network master plan or the "WITH PROJECT" case. Drastic improvement is seen when the road network is in place.
- The impact on traffic of the "with project" case is easily realized in terms of ***traffic efficiency*** with improvements in average speed and volume capacity ratio as well as system ***efficiency*** in terms of trip length (pcu-km) and travel time (pcu-hour) reduction.

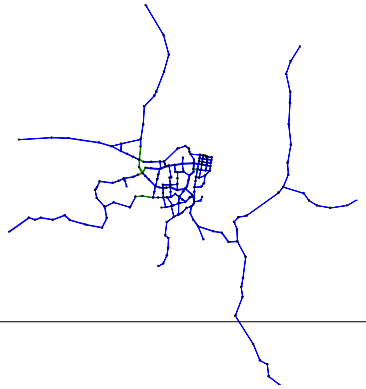
Particular	Year 2008	Year 2015	Year 2025	Ratio 2025/ 2008
Total Vehicle Trips (PCU)	83,895	238,445	500,123	5.96
PCU-km	454,440	1,326,903	3,313,184	7.29
PCU-Hour	23,723	137,729	641,408	27.04
Volume / Capacity	0.38	1.11	2.78	7.31
Average Speed (km/h)	19.2	9.6	5.2	0.27

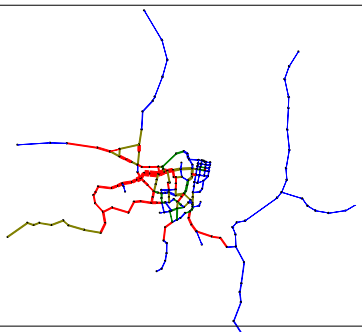
Traffic Assignment for "DO NOTHING" Case

Particular	Year 2008	Year 2015 W/Project	Year 2025 W/Project	Ratio 2025/ 2008
Total Vehicle Trips (PCU)	83,895	238,445	500,123	5.96
PCU-km	454,440	1,296,723	3,430,968	7.55
PCU-Hour	23,723	42,119	113,634	4.79
Volume / Capacity	0.38	0.40	0.49	1.29
Average Speed (km/h)	19.2	30.8	30.2	1.57

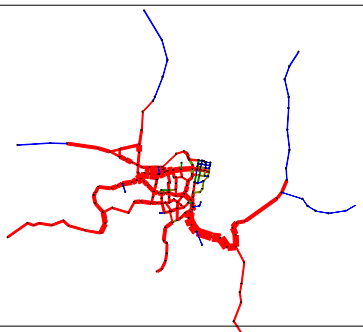
Traffic Assignment for "WITH PROJECT" Case

Existing Traffic Assignment -2008

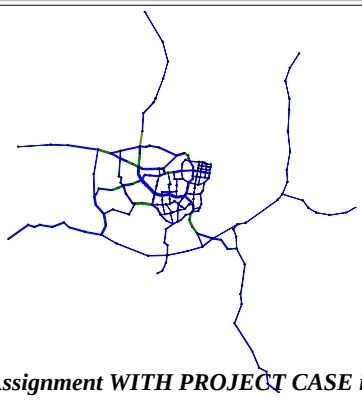




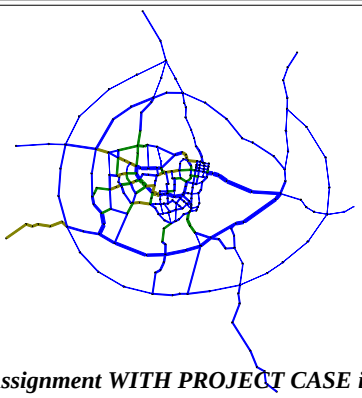
Traffic Assignment in DO-NOTHING CASE in 2015



Traffic Assignment in DO-NOTHING CASE in 2025



Traffic Assignment WITH PROJECT CASE in 2015



Traffic Assignment WITH PROJECT CASE in 2025

7. ROAD NETWORK DEVELOPMENT PLAN

(1) Plan Concept

The road development strategies are as follows:

- Immediate rehabilitation of existing roads
- Administrative and functional road network
- Development of hierarchical road network system
- Establishment of appropriate standards for road engineering
- International level of road improvement

To realize the above strategy, the basic direction of road network development plan is as follows:

1. Introduction of radial and circumferential road network system
2. Hierarchical and functional road network
3. Maximum utilization of existing network
4. Inducement of proper urbanized area expansion
5. Harmonized development with public transport

The Principles for Road Network Improvement Plan shall be:

- To improve a hierarchical and functional road network
- To form a radial and circumferential road system composed of arterial streets.
- To guide and coordinate the future land use plan to avoid sprawling suburban development.
- To utilize existing roads as much as possible.

(2) Road Classification

The administrative classification of the road network in Southern Sudan is as follows:

Road Type and Responsible Organization

Road Type	Responsible Organization
International/ Interstate Road	GOSS, Ministry of Transport and Roads (MTR)
State Road	State, Ministry of Physical Infrastructure (MOPI)
County Road	County

However, at the moment the urban road classification is not clear in Southern Sudan so that the Study proposes the following classification:

Definition of Urban Road Classification in AASHTO

Principal Arterial	Service to the major centers of activity of urbanized areas, the highest volume corridors and the longest trip. The principal arterial should be integrated both internally and between major rural road connections.
Minor Arterial	Trips of moderate length at a somewhat lower level of travel mobility than principal arterial
Collector	Land access service and traffic circulation within residential neighborhood and commercial and industrial areas.
Local	The lowest level of mobility and usually contains no bus routes. Service to though traffic movement usually is deliberately discouraged.

Source: A Policy on Geometric Design of Highways and Streets, 2004, AASHTO

(3) Design Criteria

The design criteria for the streets in the proposed road network are recommended based on the road functional classification.

Proposed Design Criteria Based on Functional Class

	Arterial Streets	Collector Streets	Local Streets
Function	- Intercity trunk road - Primary distributer - District distributor	Access road connecting to local streets and local distributor.	Other minor roads for local access.
Flow Condition	Possibly uninterrupted flow except at intersection	Interrupted flow	Interrupted flow
Design Traffic by lane (ADT)	10,000-12,000	10,000-12,000 (9,000 for 2-lane)	9,000 for 2-lane
Design Speed (km/h)	60, 50	60, 50, 40	50, 40, 30
Target Speed by LOS (km/h)	40	30	20
Level of Service	C	D	D
Lane Width (m)	3.6	3.3	3.0
Median (m)	3.6-5.4	3.0-4.8	-
Multi-purpose Lane (m)	3.5	3.5	3.0
Bicycle Lane (m)	2.0	2.0	If required
Shoulder (m)	1.2	0.6-1.2	0.5
Greenbelt (m)	2.0-4.0	1.0-3.0	If required
Sidewalk (m)	2.0-3.0	2.0-3.0	2.0-3.0

(4) Standard Cross-Sections

The typical cross-sections proposed for each road class – arterial streets, collector streets and local streets, are shown in the Figure below. Service Utilities shall be contained within the limits of the right-of-way.

(5) Multi-Purpose Lanes, Green Belts and Sidewalks

- ***Multi-Purpose Lanes***

  This lane is intended to provide exclusive space for bus bays, on-street parking, use of bike and bicycles and other slow moving vehicles. Parking and loading/unloading zones will have to be limited more than 50m before and after intersections.

- ***Green Belts***

  A 2.0m-4.0m greenbelt space for trees and vegetation is provided between traveledway and sidewalk to secure the safety of pedestrians and enhance the aesthetic value of the road and the environment.

- ***Side Walks***

  Sidewalks with width of 2.5m-3.0m are proposed in the standard cross-sections to accommodate pedestrians and non-motorized transport (NMT) modes. The design of these sidewalks shall consider the requirements of physically challenged people (PCP).

(6) Road Ancillary Facility

The following road ancillary facilities are introduced to improve the road function and convenience of users:

- ***Traffic Signs***

  The following traffic signs to inform, warn and control drivers are recommended:

  - Regulatory Signs – indicate legal requirements of traffic.
  - Warning Signs – indicate conditions that may be hazardous to drivers.
  - Informatory Signs – convey information of use to the driver.

- ***Road Marking***

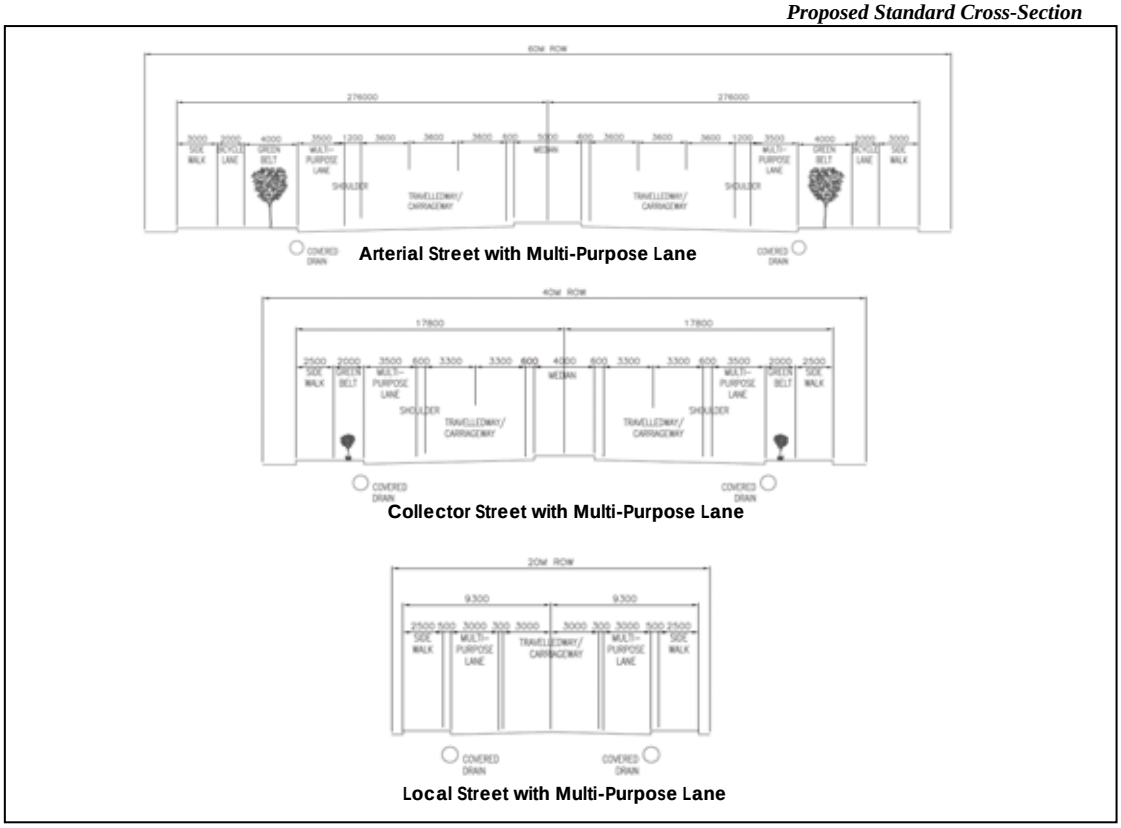
  Road markings, which function to encourage safe operation include:

  - Pavement Markings – centerlines, lane lines, no overtaking line, edge lines, etc.
  - Pedestrian Crossings – markings shall be at intersections, roundabouts, markets, bus bays, public areas, etc.
  - Object markers – used to mark physical obstructions in or near carriageway
  - Road Studs – generally placed at road centerline for added demarcation

- ***Street Lighting***

  Street lighting is recommended in the proposed road network to improve safety and increase driving visibility.

Proposed Standard Cross-Section



(7) Road Surface and Side Drainage and Cross-Pipes

Drainage is one of the most important road facilities to keep the streets in safe condition for traffic and extend the life of road structures, especially pavement.

- To facilitate road surface drainage, gutters with collector pipes are provided at both sides of the street and properly discharge to outlets such as canals, streams or rivers, etc.
- On embankment section, ditches are to be provided at the toe to collect road side drainage.
- Cross-drainage shall also be provided at regular intervals (250m-500m) to allow flow of water from one side of the road to the other side.

(8) Intersection Improvement

Intersection layouts shall be properly done to maintain safe and efficient vehicle and pedestrian operations. Typical applicable intersection types for the road network include:

- Non-signalized Intersections (Stop Sign)
- Signalized Intersections
- Roundabouts
- Signalized Roundabouts

(9) Arterial Street Improvement

- The necessary improvement works for the Arterial Streets in the proposed Juba Urban Road Network Master Plan are outlined in the accompanying table.

- Staging Scheme: Due to high initial investment costs, it is recommended that Staging Improvement Scheme be implemented, depending on the timing of traffic volume demand:

  - Initial Stage:
    2 - lane AC road
  - Second Stage:
    2 → 4 lane AC widening
  - Final Stage:
    4 → 6 lane AC widening

Arterial Street Improvement Works

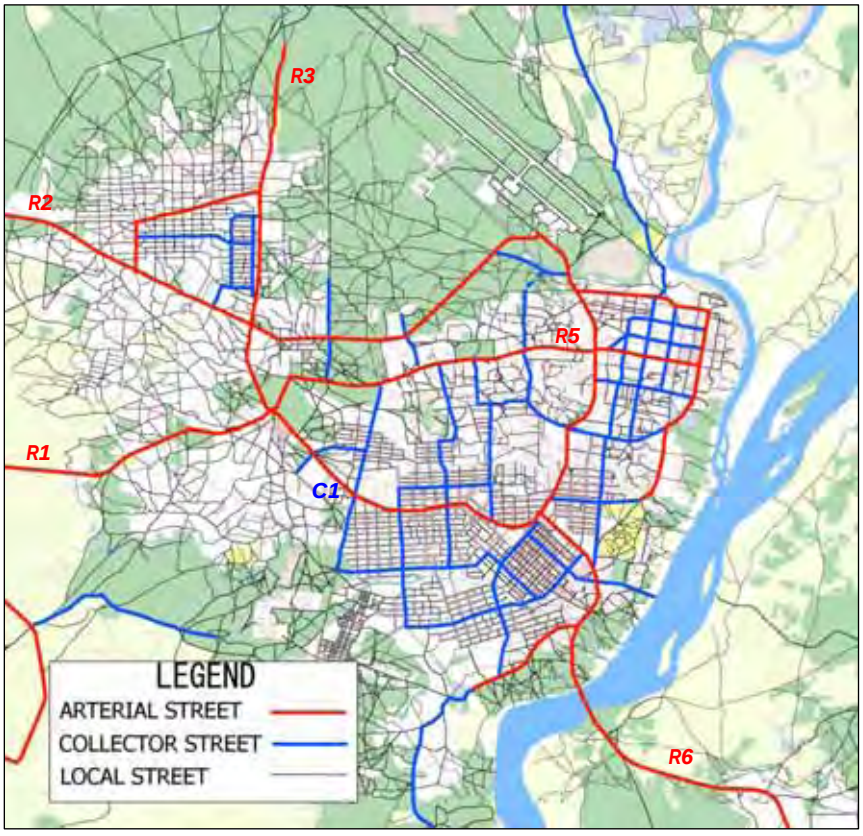
Project Component	Improvement Type	No. of Lanes (Initial Stage)	Project Type	
			Improvement of Existing Road (km)	New Construction (km)
1. Arterial Streets (Circumferential Roads)				
1.1 C-1 (Unity Ave.)	AC	2	10.14	-
1.2 C-2	AC	2	7.01	9.65
1.3 C-3	AC	2	11.62	21.36
1.4 C-4	AC	2	-	52.24
2. Arterial Streets (Radial Roads)				
2.1 R-1 (Juba-Yei Road)	AC	2	6.45	-
2.2 R-2 (Juba-Mundri Road)	AC	2	2.62	3.16
2.3 R-3 (Juba-Terekeka Road)	AC	2	7.73	-
2.4 R-4 (Juba-Bor Road)	AC	2	6.34	-
2.5 R-5 (Juba-Lafon Road)	AC	2	7.46	3.60
2.6 R-6 (Juba-Nimule Road)	AC	2	7.70	-
3. Nile River Bridges				
3.1 C-3 (South)		2	-	0.56
3-2 C-3 (North)		2	-	0.69
3-3 C-4 (South)		2	-	0.70
3-4 C-4 (North)		2	-	0.55
3-5 R-5		2	-	0.92
3-6 R-6		2	-	-

(10) Collector Street Improvement

Similarly, Staging Improvement Scheme is also recommended for Collector Street improvement, depending on the timing of traffic volume demand:

- Initial Stage : 2 - lane AC road
- Final Stage : 2 → 4 lane AC widening

Present Road Network in Juba



Collector Street Improvement Works

Project Component	Improvement Type	No. of Lanes (Initial Stage)	Project Type	
			Improvement of Existing Road (km)	New Construction (km)
1. Collector Streets				
1.1 Central Commercial District (CCD)	AC	2	7.32	-
1.2 Inside C-1	AC	2	10.40	-
1.3 Between C-1 and C-2	AC	2	30.03	-
1.4 Between C-2 and C-3	AC	2	56.65	-
1.5 Between C-3 and C-4	AC	2	11.64	-

Local Street Improvement Works

Project Component	Improvement Type	No. of Lanes (Initial Stage)	Project Type	
			Improvement of Existing Road (km)	New Construction (km)
1. Local Streets				
1.1 Central Commercial District (CCD)	AC GR→AC	2 2	5.60 8.37	- -
1.2 Inside C-1	AC GR→AC RS→AC	2 2 2	14.16 14.16 42.50	- - -
1.3 Between C-1 and C-2 (excluding CCD)	AC GR→AC RS→AC	2 2 2	64.91 64.92 32.46	- - -
1.4 Between C-2 and C-3 (excluding CCD)	AC GR→AC RS→AC RS→GR→AC	2 2 2 2	25.97 60.60 17.32 69.26	- - - -
1.5 Between C-3 and C-4	AC GR→AC RS→AC RS→GR→AC	2 2 2 2	7.80 23.39 15.58 31.18	- - - -

(12) Implementation Priority

The project implementation frame, as presented below, for the proposed road network covers

- Short Term : 2009-2015 (7 years)
- Medium Term : 2016-2020 (5 years)
- Long-Term : 2021-2025 (5 years)

Project Implementation Frame

Road Projects	Short Term (2009-2015)	Medium Term (2016-2020)	Long Term (2021-2025)	Beyond 2025
1.Circumferencial Road Improvement	C-1 (on-going) C-2 C-3 (South)	C-3 (West)	C-3 (East & North)	C-4
2.Radial Road Improvement	R-1 (inside C-2) R-2 (inside C-2) R-3 (inside C-2) R-5 (inside C-2) R-6	R-1 (C-2～C-3) R-2 (C-2～C-3) R-3 (C-2～C-3) R-5 (C-2～C-3)		R-1 (C3～C4) R-2 (C3～C4) R-3 (C3～C4) R-4 R-5 (C3～C4)
3.Collector Street Improvement	Inside CCD Inside C-1 C-1～C-2 (35%)	C-1～C-2 (65%) C-2～C-3 (50%)	C-2～C-3 (50%) C-3～C-4 (70%)	C-3～C-4 (30%)
4.Local Street Improvement (Initial Phase)	Inside CCD Inside C-1 (50%)	Inside C-1 (30%) C-1～C-2 (50%)	Inside C-1 (20%) C-1～C-2 (50%) C-2～C-3 (70%)	C-2～C-3 (30%) C-3～C-4
5.Construction of Nile River Bridge	C-3(South)	R-5	C-3(North)	C-4 (South) C-4 (North)

(11) Local Street Improvement

Local streets shall be improved with asphalt pavement finally. However considering the urgent requirement for making passable with limited available fund, the following four types of improvement are considered including stage improvement schemes depending on the importance of the road, traffic demand and urgency:

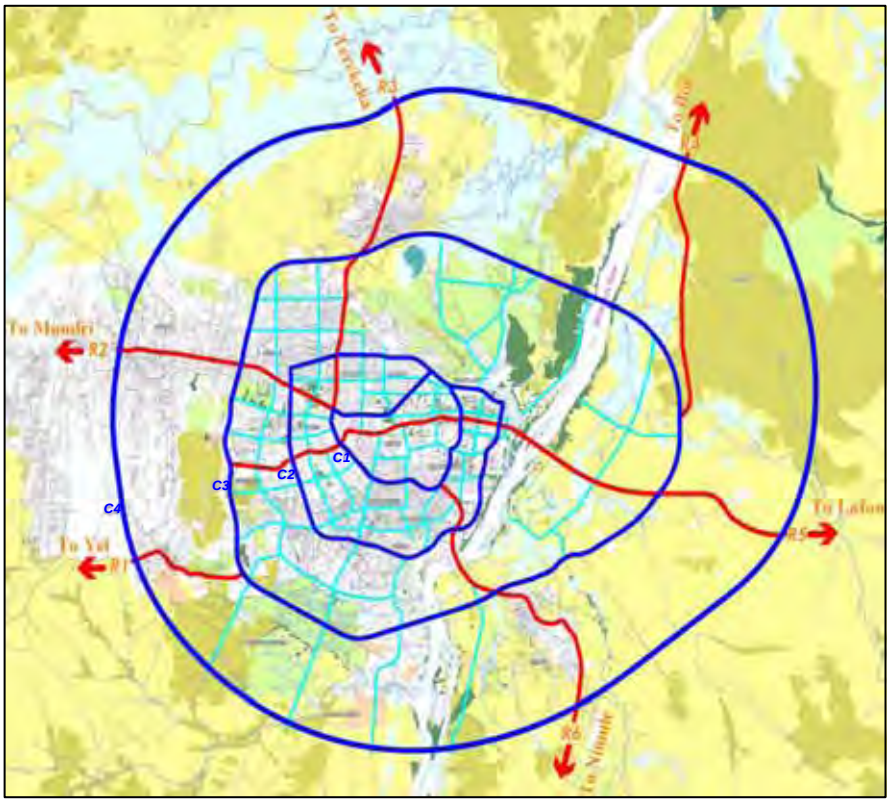
1) <u>AC</u>
Asphalt paved road from the beginning.

2) <u>GR→AC:</u>
Gravel road → upgrade to asphalt paved road.

3) <u>RS→AC:</u>
Resurfaced road → upgrade to asphalt paved road.

4) <u>RS→GR→AC:</u>
Resurfaced road → upgrade to gravel road → asphalt paved road finally.

Proposed Juba Urban Road Network



8. PUBLIC TRANSPORT DEVELOPMENT PLAN

(1) Existing Condition and Problem

- City Bus
  - City buses in Juba are basically private minivans, with about 513 registered to the State Police,
  - At present, there is no control of public bus transport within the state although responsible agency is the Department of Communications and Transport, MOPI under CES,
  - Laws/regulations on licensing for operation of buses are not yet established,
  - Passengers are not satisfied with city bus and request improvement of services and accessibility to bus terminals, and
  - Disorganized minivans occupy road sides causing congestion at intersections.
- Interstate/International Bus
  - Interstate/International buses operate from Juba to Yei, Nimule, Mundri, Aulu and Kampala,
  - The Department of Transport and Safety, MTR is responsible for controlling interstate/ international bus, and
  - Only temporary bus terminals without facilities exist in Juba.
- Taxi
  - Taxi types are basically sedan taxi and bike taxi or "boda-boda" (which is the majority),
  - No responsible organization exist to control taxi operation, as such there is no existing taxi registration system, and
  - Motorbike taxi traffic accident is increasing due to unlicensed drivers and poor road.

(2) Planning Direction

- Administrative and Institutional System

  Strengthening of public transport institution is necessary including:
  - Establishment of the ***Directorate of Public Transport***, ***MTR*** for policy, planning and administration and public transport facilities.
  - Strengthening of the ***Directorate of Communication and Transport, MOPI*** for bus and taxi registration/licensing, route development, zoning and inspection.
- Vehicle Registration

  In order to control the safety and orderly operation of public transport, it is necessary to establish a "vehicle registration system for public transport" and safeguard the interests of the commuting public.
- Designated Bus Route

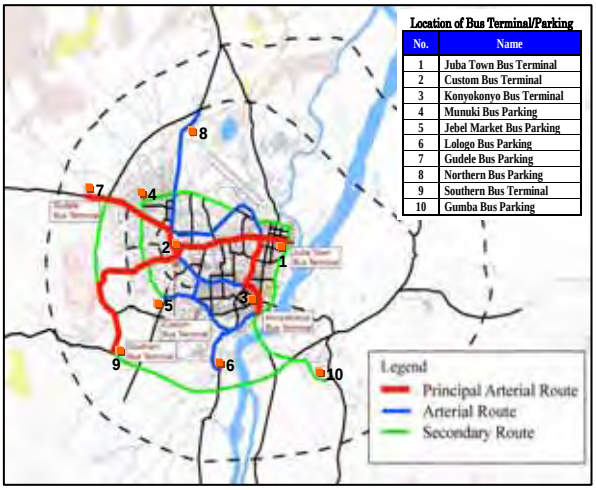
  Establishment of an appropriate bus routes that compliments interstate/international bus, city bus and short-trip taxi system into an efficient public transport system.

(3) Bus Network and Terminal Improvement Plan

Bus network improvement shall consider:

- Restructuring the present bus route,
- Improvement of connection point between the same and different public transport modes, and
- Improvement/construction of bus terminals.

Proposed Bus Network and Bus Terminals



(4) Taxi System Improvement Plan

- Basic Concept
  - Control of Motorbike: Motorbike taxis shall be banned in major arterial streets in Juba urban and shall operate only in their designated zones. Other taxis shall have no restriction on service area.

    Moreover, licensing of motorbike taxi operation shall be strictly enforced.
  - Safety Enhancement: Appropriate provision of necessary facilities and regulations.
- Provision of Facilities

  Transit points between modes shall be improved with facilities for passengers to transfer to next transport mode.
- Establishment of Rules and Regulations

  Rules and regulations to clarify the functional assignment of modes, control of operation, restriction on parking, provision of parking and parking control shall be established.

9. TRAFFIC MANAGEMENT SYSTEM DEVELOPMENT PLAN

(1) Present Problem

1) Traffic Engineering and Technical Perspective
- Disorderly traffic flow due to the mixed traffic
- Inefficient traffic processing capacity at roads and junctions
- Undeveloped traffic facilities at junction
  - Inadequate geometric configuration
  - Insufficient traffic safety facilities
  - Insufficient pedestrian crossing facilities
- Inadequate traffic regulations

2) Traffic Safety Perspective
- Insufficient traffic safety education
- Lack of drivers' discipline to observe traffic regulations
- Inconsistent traffic enforcement

(2) Planning Direction

1) Administrative and Institutional Framework

- Strengthening of the *Directorate of Road Transport and Safety, MTR*
  - Road Transport Policy, Planning and Administration
  - Traffic Management, Installation of Traffic Safety Facilities
- Strengthening of *Directorate of Communication and Transportation, MOPI*
  - Road Safety Planning and Administration
  - Installation of Traffic Safety Facilities
- Reinforcement of Traffic Police
  - Establishment of Education System for Traffic Policemen
  - Traffic Rule Enforcement

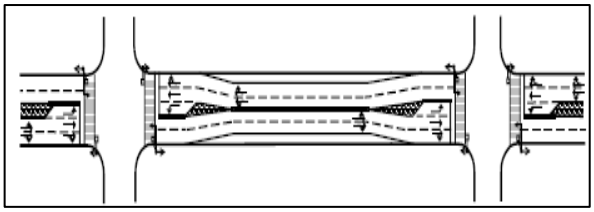
- Establishment of ***Road Traffic and Safety Management Unit (RTSMU)***
  - Coordination and management of road safety activities
  - System for collecting road accident data
  - Programs for controlling traffic offences including overloading vehicles
  - Promotion of roles of traffic officers
  - Police training

2) Traffic Management Measures
- Measures of Traffic Engineering
  - Improvement of Junction and Road Section
  - Installation of Traffic Signal
  - Setting up Traffic Accident Data Management System
- Promotion of Traffic Education
- Strengthening of Traffic Enforcement

(3) Road Improvement

The following measures are proposed: - provision of road facilities including pavement markings, exclusive left turn lane, raised median, sidewalk and crosswalk, treatment at roundabout and prohibition of parking in/near junctions.

Exclusive Left Turn Lane



(4) Intersection Improvement

Improvement Type	Intersection No.
Minor - Pavement Markings, Signs	4,6,7,8,11
R/A to R/A with Traffic Signals	-
R/A to I/S with Traffic Signals	1,2,5,10
I/S to I/S with Traffic Signals	3,9

R/A : Roundabout I/S : Intersection

Intersection Improvement Plan

(5) Traffic Management

- Policy on Parking Control, Enforcement of Parking Control, On/Off-Street Parking
- Standardization of Uniform Traffic Control Device – e.g. traffic signs, markings, etc.
- Cooperative efforts between MTR, Police, Ministry of Education, Social Welfare, private sector, etc.

(6) Traffic Safety Education and Traffic Enforcement

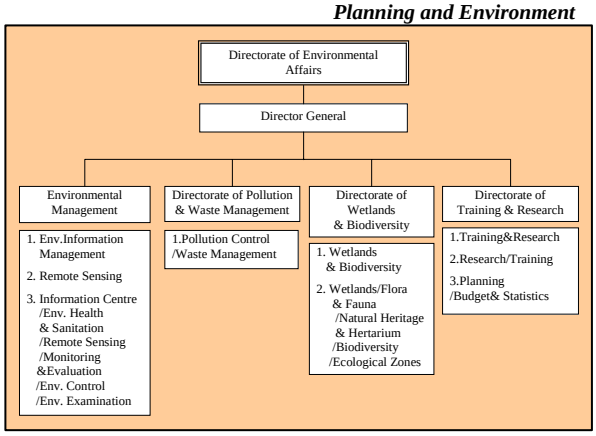
- System for Traffic Accident Data Collection and Analysis
- Periodic Traffic Safety Campaign
- Traffic Safety Education to School Children
- Strengthening Traffic Enforcement by Traffic Police

10. ENVIRONMENTAL AND SOCIAL CONSIDERATION

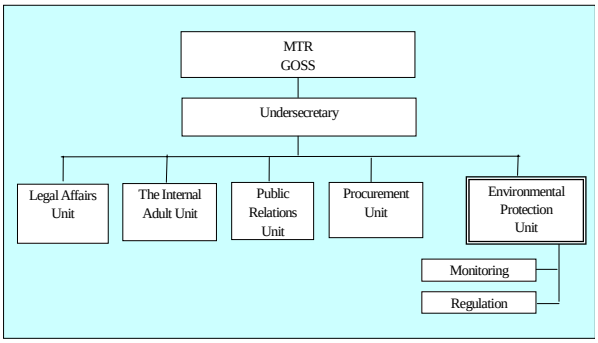
(1) Environmental Institution

There are two Environmental Units responsible for environmental management of projects in Southern Sudan with the following organization:

Environmental Affairs, Ministry of Housing, Physical Planning and Environment



Environmental Protection Unit, MTR-GOSS



(2) Environmental Rules and Regulations

▪ GOSS

The Environment Guidelines of MTR was formulated by USAID in November 2007 and contains practices on: Water Quality, Air Quality, Noise, Land Use, Community Health and Welfare, and Cultural Heritage.

▪ MDTF

The Preliminary Environmental and Social Assessment Framework for MDTF Investments in Southern Sudan (Draft) was formulated in March 2008. This Framework contains: Policy, Legal and Administrative Framework, Anticipated Environment and Social Impacts, Incorporating Environmental and Social Assessment in Project Cycle, Social Safeguards Processes and Policies, Public Participation and Institutional Framework.

▪ JICA

The "JICA Guideline on Environmental and Social Considerations" formulated for JICA projects includes: Impacts on Human Health and Safety, Natural Environment thru Air, Water, Soil, Waste, Accident, Water Usage, Ecosystem and Biota.

(3) Land Acquisition and Resettlement Procedure

▪ Land Ownership

The proposed Land Bill of 2007 states all land in Southern Sudan to belong to the people and can be acquired, held and transacted through these tenure system:

- Customary,
- Freehold, and
- Leasehold.

▪ Land Classification

Land is classified as:

- Public Land owned collectively by the people and held in trust by the government, and
- Community Land held by communities on the basis of ethnicity, residence or community interest.

▪ Registration

Land collectively or individually owned in Southern Sudan shall be registered and given a title in accordance with the law.

The Bill define Cadastral Administration to include: Function of the Cadastral, Land Registry and Documents, the Registrar General, the State Registrar, and Cadastral Title.

▪ Expropriation

Land to be expropriated for public use shall be justly compensated taking into account:

- the purpose for which the land is to be utilized,
- the market value, and
- the value of investment in it by those affected and its interest.

Compensation shall be in cash or in kind as greed upon by both parties and overseen by the Southern Sudan Land Commission.

▪ Present Practice

In Juba, land acquisition for public works by the central and state governments is done as follows:

a. the Land Commission reviews land compensation and scheduling (including costs) at the GOSS level,
b. land surveys related to land acquisition are conducted and relocation destinations reviewed, and
c. stakeholders discuss to make a decision.

The basic land price is 4,000 SDG per square meter. However, in case of a government-led public works project, it is said that this land price is not applicable, particularly for temporary facilities.

The Land Bill does not specify yet the costs in relation to land, compensation, etc.

(4) Initial Environmental Examination (IEE) on Proposed Projects

- **Natural Environment**

Topography. Juba is relatively flat with some rolling terrain. There are at least three mountains in the suburbs of Juba with Mt. Jebel Kujur at 744m high being the nearest.

White Nile River

River System. The major water area is the White Nile River with small tributaries flowing into it from north to south. Groundwater is on average 5-6m below ground.

Flora and Fauna. There used to be savannas and forests around the vicinity of the Study area which was greatly transformed due to civil war and cutting of trees. Only few wood remain along the Nile River. Birds and wildlife living in the forests were affected with the present living condition unknown.

Landscapes. Typical landscapes include urban landscape in the center of Juba, rural landscape with traditional houses or "tukul", riverside landscape along the Nile, flatland in Munuki and Kator, and hilly landscapes in the periphery at the southern and western sections. Monuments, religious structures and sport facilities exist but there is no park found in the city.

National Park. The nearest game reserve to Juba is the Bandingalo Game Reserve and the Juba game reserve which is 20-30km in the northern and southwestern sides of Juba.

Jebel Kujur Mountain

- **Social Environment**

Population. The population in Juba urban area (comprising of Juba, Kator, Munuki, Rejaf and part of North Bari) in 2008 is around 260,000 which is roughly 3% of the population in Southern Sudan. However, the actual number of returnees in Juba displaced by the civil war is not known but estimates indicated a figure of about 160,000.

Livelihood. In the rural areas of CES the main sources of income are trade in livestock, crops, petty trades, milk sales and labor in the farms.

Communities. Many people in Juba and surrounding areas belong to the Bari ethnic group with some areas from different ethnic groups.

Typical "Tukul" Houses

- **IEE for Road Improvement Project**

An IEE for the master plan of major road improvement projects was conducted with the results summarized below.

Evaluation Results for Environmental Elements

Environmental Elements	Evaluation Results
Social Environment	
1. Involuntary resettlement	B
2. Local economy, employment and livelihood	E
3. Land use and local resources utilization	E
4. Existing social infrastructure and services	E
5. Local communities	E
6. Benefit and damage misdistribution	D
7. Gender	E
8. Children's rights	E
9.Cultural heritage	D
10.Local conflicts of interests	D
11.Public sanitation	E
12. Infectious diseases such as HIV/AIDS	D
13. Water usage and right	E
14. Traffic accidents	B
Natural Environment	
15. Biota and ecosystem (Fauna and flora)	D
16. Geographical features	D
17. Soil erosion	D
18. Underground water	D
19. Hydrology situation	D
20. Coastal zone (mangroves etc)	D
21. Landscape	D
22. Climate exchange	D
23.Global warming	D
Pollution	
24. Air pollution	E
25. Water pollution	D
26. Soil contamination	D
27. Bottom sediment in sea and rivers	D
28. Waste	D
29. Noise and vibration	D
30. Ground subsidence	D
31. Offensive odors	D

Note) A: serious impacts, B: some impacts, C: degree of impacts is unknown, D: Few impacts, E: Desirable impact

- **Bus Terminal and Parking Project**

  - In the vicinity of the proposed bus terminals and parking areas, the majority of land use are residential and commercial (shops and markets) with a few government and business facilities.
  - The area may have resettlement problems ("B" evaluation) but the positive effects of improving the transport facilities, local economy, employment and livelihood outweighs the negative impact.

11. PROPOSED PROJECT IMPLEMENTATION SYSTEM

(1) Issues and Measures

- **Institution**
  - No clear rules and regulations for project implementation including duties and responsibilities.
  - Demarcation between MTR and MOPI roles in road project implementation is ambiguous
  - Institutional structure is still immature.
- **Planning**
  - Overall planning for road development is not well undertaken.
  - Feasibility studies are seldom conducted except in some foreign assisted projects.
- **Implementing Capacity**
  - Administrative and technical capacity of implementing agency is weak; lack of personnel.
  - Lack of qualified and experienced local consulting engineers.
- **Funding**
  - Financial gap exists between financing needs for road projects and available funds.
  - Extraordinarily high project cost which is about 3 times as much as neighboring countries.
- **Construction**
  - Capacity in construction management is inadequate due to lack of experienced engineers.
  - Contractor performance is not satisfactory in quality and progress due to lack of resources
  - Only few local contractors have sufficient capability.
  - Experienced local consultants to assist implementing agencies are very few.
  - Land tenure is ambiguous causing disputes in right-of-way acquisition.
- **Operation and Maintenance**
  - Road maintenance works are far from adequate causing rapid deterioration of assets.
  - Non-observance of traffic rules by users causes accidents and damage to road facilities.
  - Vehicle overloading remains uncontrolled causing damages to pavement and bridge structures.

(2) Transport Sector Policy

MTR's policy for delivery of transport sector services includes:

- **System Preservation**

"Maintenance first" commitment guides the management of assets and funding and resources prioritization for preservation and betterment of system and services.

- **Management and Productivity**

Maximizing performance to optimize resources and improve effectiveness and efficiency of products and services.

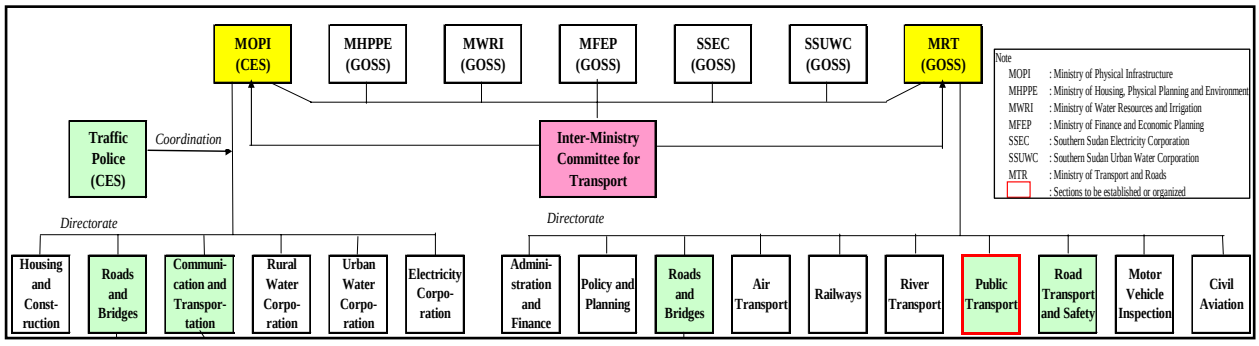
- **Organization Excellence**

Advancement of the ability of the MTR and participating institutions to manage for results and innovation.

(3) Proposed Organizational Structure and Function

- **Establishment of Inter-Ministry Committee for Transport (IMCT)**
  - Members: MTR, MHPPE, MWRI, MFEP, SSEC, SSUWC, MOPI (CES), Traffic Police and other related agencies.
  - Role: formulation of transport development policy, strategy and plan, and coordination between Ministries.
- **Re-organization/Establishment/Strengthening/ Reinforcement**
  - Re-organization of Directorate of Roads and Bridges, MTR.
  - Establishment of Directorate of Public Transport, MTR.
  - Strengthening of Directorate of Road and Transport Safety, MTR.
  - Reinforcement of Directorate of Roads and Bridges, MOPI.
  - Strengthening of Directorate of Communication and Transportation, MOPI.
  - Reinforcement of Traffic Police.

Proposed Overall Organizational Structure



12. PROPOSED ROAD MAINTENANCE SYSTEM

(1) Proposed Jurisdiction

The demarcation of road improvement work between MTR and MOPI is presumed according to administrative road classification.

Proposed Jurisdiction of Road Improvement Work

Road Type	Road Construction	Road Maintenance
International/Interstate Road	MTR	MTR
State Road	STATE	STATE
County Road	STATE[1)]	STATE[1)]

Note [1)]: State is responsible for funding and planning, and County is responsible for actual execution of work under the guidance of the State.

(2) Proposed Development Scenario

- **Force Account vs Contract-Out System**

  Type 01 : Force Account

  - Small scale and labor-based construction (routine maintenance).
  - Rapid responses and emergency actions required (small emergency maintenance).

  Type 02 : Contract-out

  - Large scale and equipment-based construction (periodic maintenance).
  - Large scale and time-consuming restoration work required (large emergency restoration).

- **Traditional vs Performance Based**

  Traditional Input-Based Contract

  - Based on a schedule of unit prices and estimate of quantities causing wrong incentive to maximize work outputs.

  Performance-Based Contract

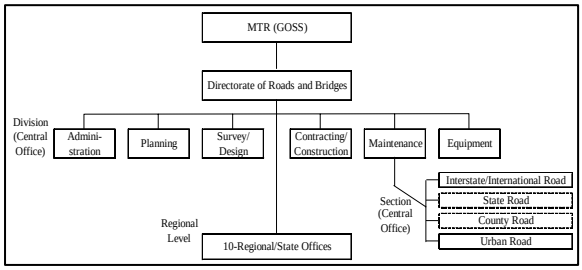
  - Based on minimum condition of roads, bridges and traffic assets complying with defined performance standard.

- **Maintenance Contract Type**
  - **G Type** : Force account by Government
  - **C Type** : Contract-out
  - **P Type** : Privatization with private company

(3) Proposed Organization and Function of the MTR

The Directorate of Roads and Bridges (DRB) is recommended to be reorganized, clearly demarcating the roles of each Division.

Proposed Structure of DRB, MTR



The DRB shall consist of six (6) divisions:

- Administration Division
- Planning Division
- Survey and Design Division
- Contracting and Construction Division
- Maintenance Division
- Equipment Division

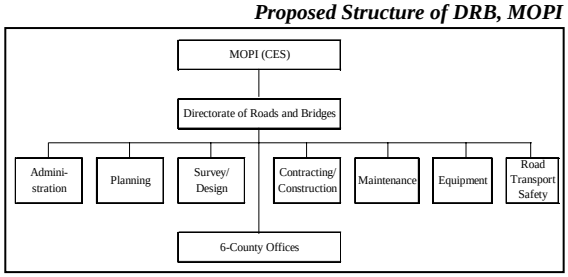
The Maintenance Division is divided into four (4) sections:

- International/Interstate Road Section
- State Road Section
- County Road Section
- Urban Road Section

(4) Proposed Organization and Function of MOPI

The organizational structure and function of MOPI is similar to that of MTR.

Proposed Structure of DRB, MOPI



Proposed Development Scenario of Road Maintenance System

Items			Responsible Agency	Short Term							Medium Term					Long Term				
				2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Policy and Institution	Establishment of Maintenance Policy		MTR																	
	Reorganization of MTR		MTR																	
	Reorganization MOPI		MOPI																	
Maintenance Works	National Roads (International/ Interstate Roads)	Routine	MTR				G Type							C Type (2)						
		Periodic	MTR				C Type (1)							C Type (2)						
		Emergency	MTR								G Type									
	State Roads (Intrastate/ Intercountry Roads)	Routine	MOPI						G Type							C Type (1)				
		Periodic	MOPI				G Type							C Type (1)						
		Emergency	MOPI								G Type									
	Country Roads (Inttracountry/ Minor Roads)	Routine	MOPI								G Type									
		Periodic	MOPI						G Type							C Type (1)				
		Emergency	MOPI								G Type									

13. IMPLEMENTATION PLAN

(1) Implementation Framework

▪ Development Phase

The following development phases for the Juba Urban Transport Master Plan are proposed:

- Short Term : 2009~2015 (7 years)
- Medium Term : 2016~2020 (5 years)
- Long Term : 2021~2025 (5 years)
- Beyond Term : 2026~

▪ Institution and Organization

In order to systematically and effectively implement projects proposed in the Master Plan, appropriate institution and organizations shall be established with clear and streamlined jurisdiction, roles and responsibilities. Sections 11 and 12 discuss the project implementation system and road maintenance system of the Master Plan.

▪ Project Implementation Capacity

- The administrative and technical capacity for implementation shall be developed with efficient deployment of government human resources.
- Experienced engineers shall be employed in consulting services including planning, design, tendering and construction.
- Construction projects shall be executed by professional and reliable contractors appointed through transparent tendering process.
- To create and improve capacities, government personnel shall be deployed in all aspects of project implementation as in-service and on-the-job training program.

(2) Assumption on Funds

▪ The fund available for the transport and road sector was assumed based on the Approved Budget of 2008 and the funding needs in 2011 amounting to US$ 490 million.

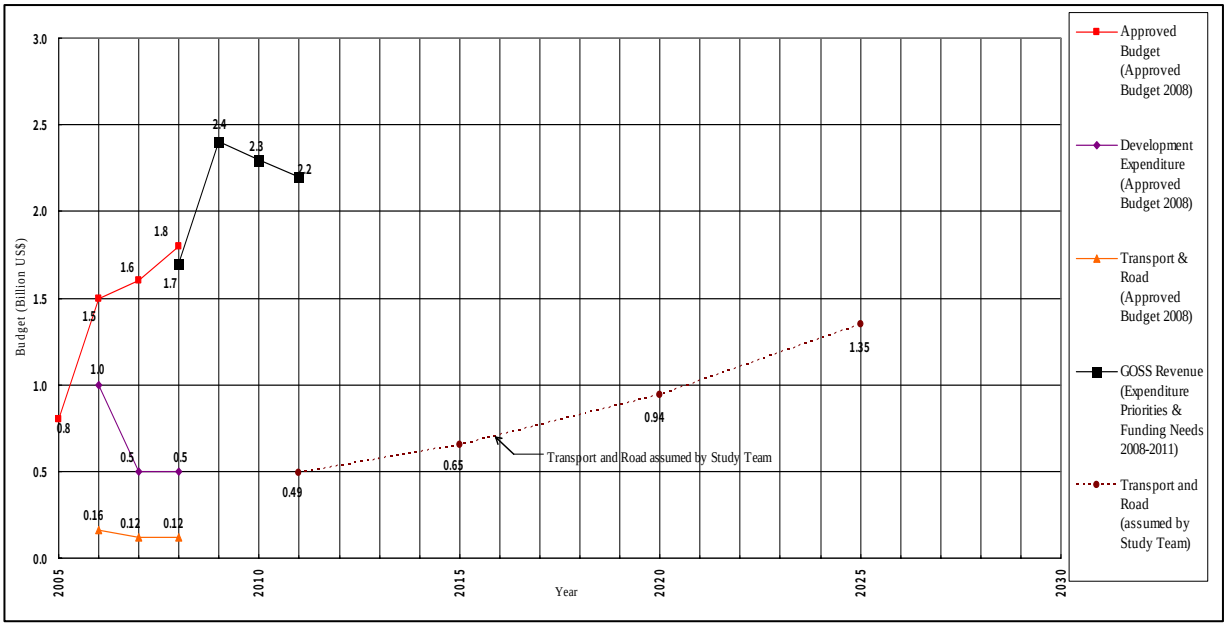
▪ The fund needs of the road sector for the period 2011-2025 are projected assuming a 7.5% annual escalation based on economic growth and population increase.

- 2011-2015 : 3,000 million US$/5years
- 2016-2020 : 4,500 million US$/5years
- 2021-2025 : 6,000 million US$/5years

▪ The funds available for the Road Network Development Master Plan Projects are assumed as percentages of the total transport and road funds.

- Fund for 2009-2010 : 90 million US$/2years
- Fund for 2011-2015 : 420 million US$/5years
- Fund for 2016-2020 : 630 million US$/5years
- Fund for 2021-2025 : 720 million US$/5years

Assumed Budget for Transport and Roads



Overall Implementation Schedule

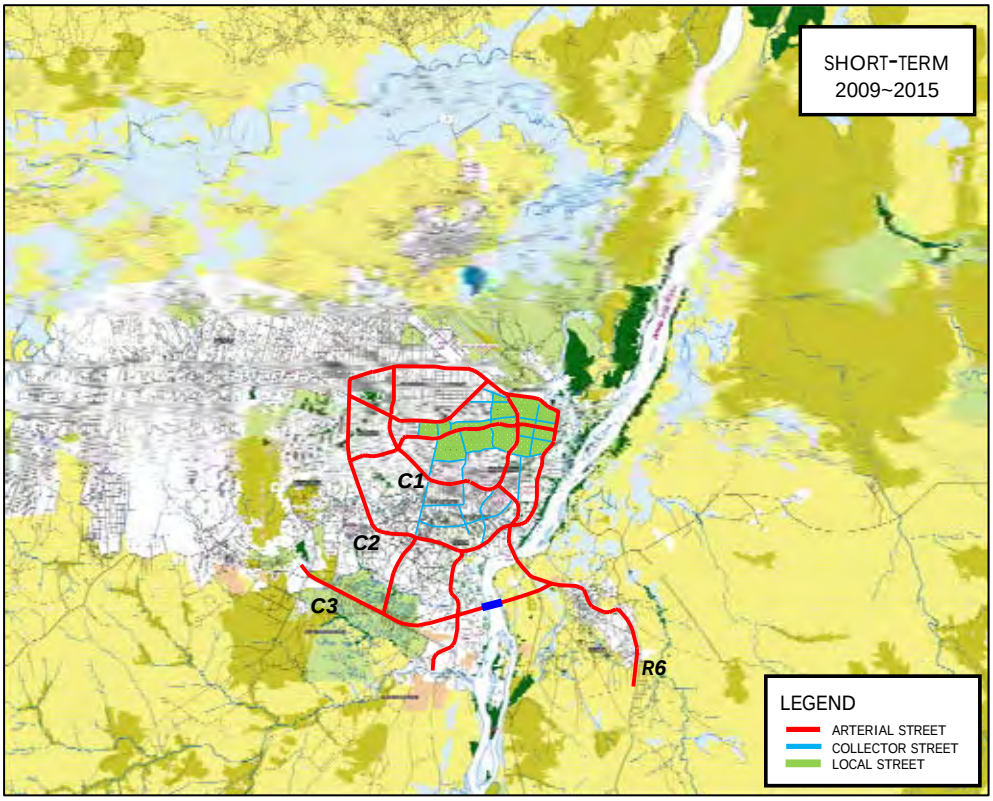
Sector	Project Code	Project Name	Length (km)	Costs (M$)	Plan Term: Short Term 2009	2010	2011	2012	2013	2014	2015	Medium Term 2016	2017	2018	2019	2020	Long Term 2021	2022	2023	2024	2025	Beyond Term 2026	2027	2028	2029	2030
Road Sector		**Emergency Road Rehabolitation Project**																								
	L	**Local Street Rehabilitation**																								
	CCD	C-1 to C-2	13.97	29.6	AC/GR			AC																		
					5.5	5.5	5.5	5.6	3.8	3.7																
	L-C1	Local Street inside C-1	70.82	161.5				AC/GR/RS				AC/GR/RS					AC/GR/RS									
								19.4	19.4	19.4	19.7	9.3	9.3	9.3	9.3	9.5	7.3	7.3	7.3	7.3	7.6					
	L-C2	Local Street C-1 to C-2	162.29	350.6								AC/GR/RS					AC/GR/RS									
												37.0	37.0	37.0	37.0	37.0	33.1	33.1	33.1	33.1	33.14					
	L-C3	Local Street C-2 to C-3	173.15	206.9													AC/GR/RS					AC/GR/RS				
																	41.4	41.4	41.4	41.4	41.3	14.7	14.7	14.7	14.7	14.8
	L-C4	Local Street C-3 to C-4	77.95	0.0																		GR/RS				
																						12.6	12.6	12.6	12.6	12.73
		Sub-total	498.18	748.5	5.5	5.5	5.5	25.0	23.2	23.1	19.7	46.3	46.3	46.3	46.3	46.5	81.8	81.8	81.8	81.8	82.1					
	C	**Circumferential Street Construction**																								
	C-1	C-1 (On-going)	10.14	25.4	AC																					
					8.4	8.5	8.5																			
	C-2 (1)	C-2 (East & South)	7.74	36.4			AC																			
						9	9.0	9.1	9.3																	
	C-2 (2)	C-2 (West & North)	8.92	38.2				AC																		
								9.5	9.5	9.6	9.6															
	C-3 (1)	C-3 (East & South)	13.47	63.3				South (AC)									East (AC)									
								10.2	10.4	10.2							10.8	10.8	10.9							
	C-3 (B1)	C-3 (Nile Bridge No.1)	0.56	61.6				Br. C-3 (1)																		
								15.4	15.4	15.4	15.4															
	C-3 (2)	C-3 (West & North)	19.51	91.7								West (AC)					North (AC)									
												9.3	9.3	9.3	9.3	9.3	9.1	9.1	9.1	9.1	9.1					
	C-3 (B2)	C-3 (Nile Bridge No.2)	0.69	77.3													Br. C-3 (2)									
																	15.5	15.5	15.5	15.5	15.5					
	C-4 (1)	C-4 (South)	24.50	0.0																		AC				
																						23.0	23.0	23.0	23.0	23.2
	C-4 (B1)	C-4 (Nile Bridge No.1)	0.70	0.0																		Br. C-4 (1)				
																						15.6	15.6	15.6	15.6	15.5
	C-4 (2)	C-4 (North)	27.74	0.0																		AC				
																						26.0	26.0	26.0	26.0	26.4
	C-4 (B2)	C-4 (Nile Bridge No.2)	0.55	0.0																		Br. C-4 (2)				
																						12.1	12.1	12.1	12.1	12.3
		Sub-total	114.52	393.9	8.4	17.5	43.1	44.4	44.4	25.0	9.6	9.3	9.3	9.3	9.3	9.3	35.4	35.4	35.5	24.6	24.5					
	R	**Radial Street Construction**																								
	R-1	R-1 (Juba-Yei Road)	6.45	15.1	Inside C1			C1-C2				C2-C3										C3-C4				
					0.5	0.5	2.0	2.3	2.0			2.6	2.6	2.7								4.8	4.8	4.8		
	R-2	R-2 (Juba-Mundri Road)	5.78	9.7		C1-C2						C2-C3										C3-C4				
						1.5	1.5					3.3	3.3									7.4	7.5			
	R-3	R-3 (Juba-Terekeka Road)	7.73	15.1		C1-C2							C2-C3									C3-C4				
						1.5	1.8						5.9	5.9								6.1	6.1	6.2		
	R-4	R-4 (Juba-Bor Road)	6.34	0.0																		C3-C4				
																						5.9	5.9	5.9	5.9	6.2
	R-5	R-5 (Juba-Lafon Road)	11.06	26.9	Until C2								C2-C3									C3-C4				
					3.3	3.3	3.4						5.6	5.6	5.7							5.4	5.4	5.5		
	R-5 (Br)	R-5 (Nile Bridge)	0.92	99.4									Br. R-5													
												19.5	19.5	19.5	19.5	19.82										
	R-6	R-6 (Juba-Nimule Road)	7.70	8.4		Until Nile (AC)		Nile-C4 (DBST)														Improvement to Standard Section				
						2.7	2.6	1.6	1.5																	
		Sub-total	45.98	174.6	3.8	9.5	11.3	3.9	3.5	0.0	0.0	25.8	37.3	34.1	25.6	19.8	0.0	0.0	0.0	0.0	0.0					
	CS	**Collector Street Construction**																								
	CCD	C-1 to C-2	7.32	30.0	AC																					
					10.0	10.0	10.0																			
	CS-1	Inside C-1	10.40	42.6				AC																		
								10.7	10.7	10.7	10.54															
	CS-2	C-1 - C2	30.03	123.1								AC														
									14.1	14.1	14.0	16.2	16.2	16.2	16.2	16.1										
	CS-3	C-2 - C-3	56.65	232.3													AC									
												24.5	24.5	24.5	24.5	24.4	22.0	22.0	22.0	22.0	21.9					
	CS-4	C-3 - C-4	11.64	32.8																		AC				
																			10.9	10.9	11.0	4.9	4.9	5.1		
		Sub-total	116.04	460.9	10.0	10.0	10.0	10.7	24.8	24.8	24.6	40.7	40.7	40.7	40.7	40.5	22.0	22.0	32.9	32.9	32.9					
		Total (Road Sector)	774.72	1,777.9	27.7	42.5	69.9	83.9	95.9	72.9	53.9	122.1	133.6	130.3	121.9	116.1	139.2	139.2	150.2	139.3	139.5					
Public Transport	P	Policy and Regulation on Operation		0.5																						
					0.2	0.2	0.1																			
	RE	Vehicle Registration		0.6																						
						0.3	0.3																			
	BT	Bus Terminal	10 locs	34.0																						
							11.5	11.5	11																	
		Sub-total		35.1	0.2	0.5	11.9	11.5	11.0																	
Traffic Manage-ment	PM	Policy and Regulation on Management		0.5																						
					0.2	0.2	0.1																			
	EN	Enforcement		1.1																						
							0.1	0.1	0.1	0.1	0.1	0.1		0.1		0.1	0.1		0.1		0.1					
	ED	Education		1.5																						
							0.2	0.2	0.2	0.2	0.1	0.1		0.1		0.1	0.1		0.1		0.1					
		Sub-total		3.1	0.2	0.2	0.4	0.3	0.3	0.3	0.2	0.2	0.0	0.2	0.0	0.2	0.2	0.0	0.2	0.0	0.2					
Transport Institu-tion	HD	Human Resource Development		1.4																						
						0.2	0.2	0.2	0.1	0.1	0.1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05					
	ID	Institutional Development		1.2																						
						0.3	0.3	0.3	0.3																	
		Sub-total		2.6		0.5	0.5	0.5	0.4	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1					
Total Fund Requirement (in Million US$)				1,818.7	**28.1**	**43.7**	**82.7**	**96.2**	**107.6**	**73.3**	**54.2**	**122.3**	**133.6**	**130.6**	**121.9**	**116.3**	**139.4**	**139.2**	**150.4**	**139.3**	**139.8**					
Fund Requirement per Plan Term (in Million US$)					485.8							624.8					708.1									

Projected Available Funds (in Million US$)	510.0	630.0	720.0

Notes: 1. The above costs cover Road Construction Costs only, Detailed Design and Construction Supervision are not included.

2. Road Construction Costs cover only the road structure including drainage facilities and exclude the costs of bridges and culverts.

3. The costs of Right-of-Way Acquisition and Compensation are not included in the above costs.



MAJOR PROJECTS

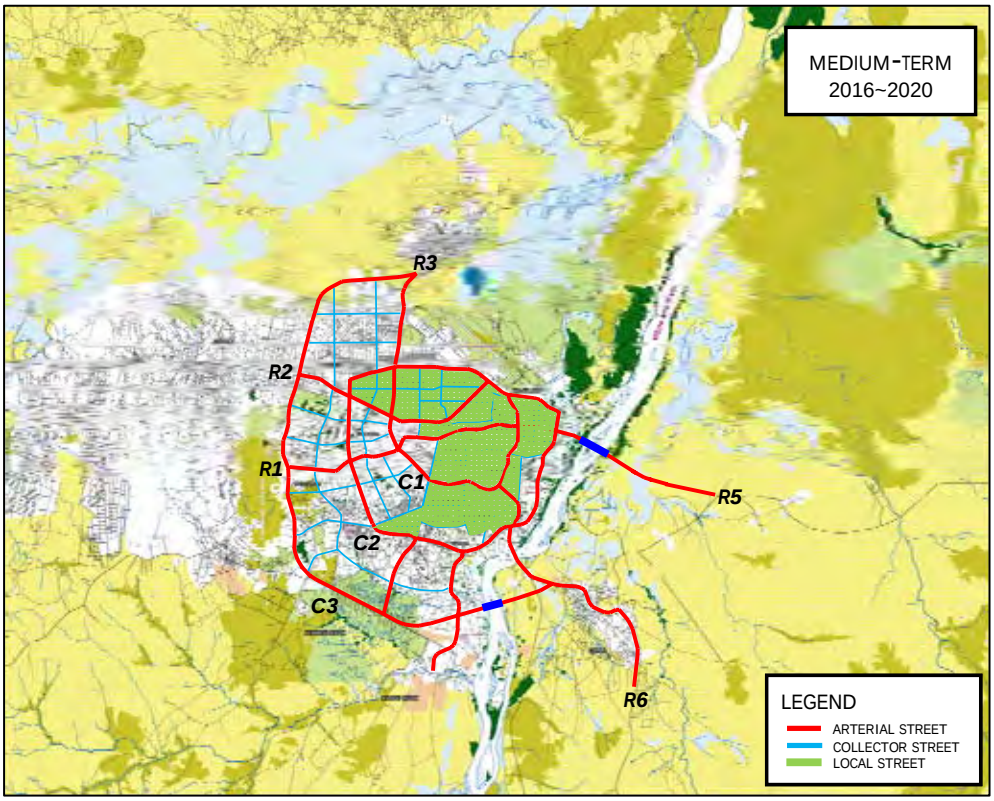
(a) Circumferential Streets
- C1
- C2 East & South Section
- C2 West & North Section
- C3 South Section

(b) Radial Streets
- R1 until C2 Section
- R2 until C2 Section
- R3 until C2 Section
- R5 until C2 Section
- R6 until C4 Section

(c) Nile Bridge
- C3 South Bridge No.1

(d) Collector Street
- Inside CCD
- Inside C1
- Part of C1~C2

(e) Local Streets
- Inside CCD
- Part of Street Inside C1



MAJOR PROJECTS

(a) Circumferential Streets
- C3 West Section

(b) Radial Streets
- R1 Between C2 & C3
- R2 Between C2 & C3
- R3 Between C2 & C3
- R5 Between C2 & C3

(c) Nile Bridge
- R5 Nile Bridge

(d) Collector Street
- Part of C1~C2
- Part of C2~C3

(e) Local Streets
- Part of Street Inside C1
- Part of C1~C2

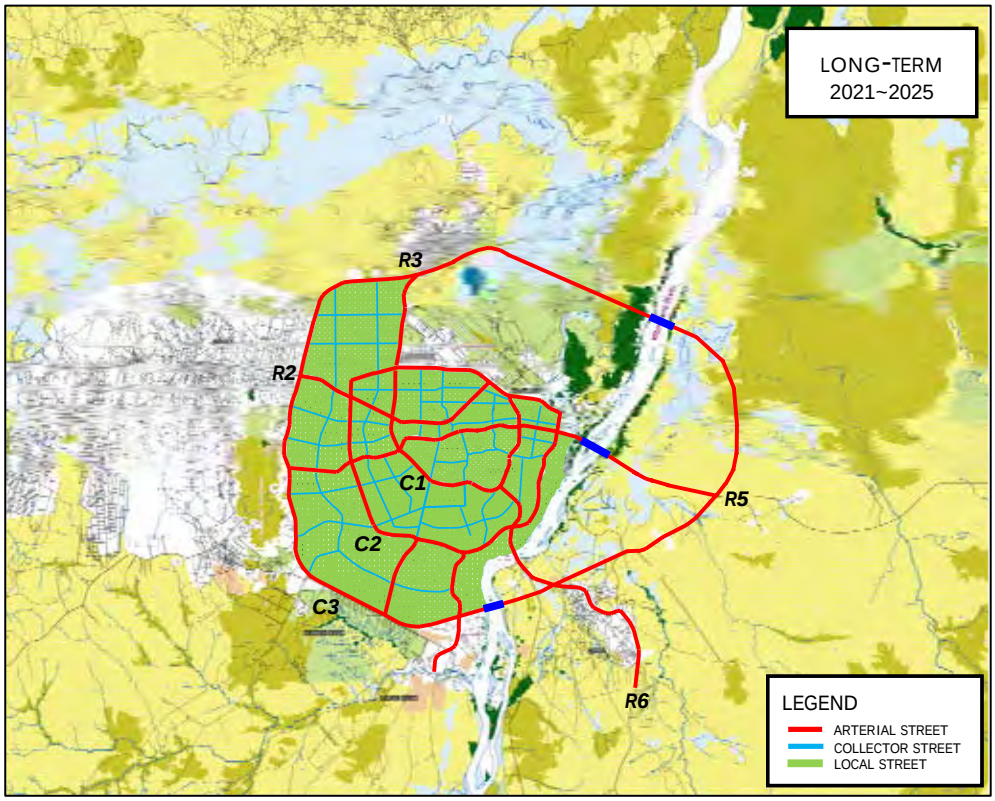
MAJOR PROJECTS

(a) Circumferential Streets
- C3 East Section
- C3 North Section

(b) Nile Bridge
- C3 North Bridge No.2

(c) Collector Street
- Part of C2~C3
- Part of C3~C4

(d) Local Streets
- Part of Street Inside CCD
- Part of C1~C2
- Part of C2~C3



MAJOR PROJECTS

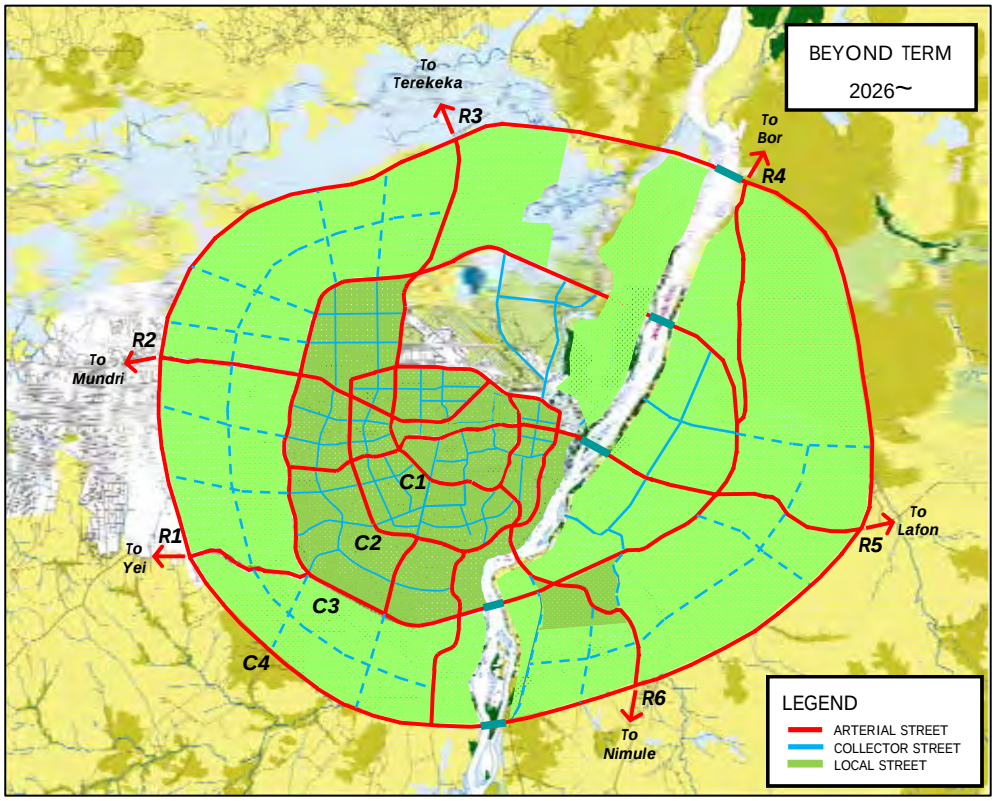
(a) Circumferential Streets
- All of C4

(b) Radial Streets
- R1 Between C3~C4
- R2 Between C3~C4
- R3 Between C3~C4
- R4 Between C3~C4
- R5 Between C3~C4
- R6 Improvement

(c) Nile Bridge
- C4 South Bridge No.1
- C4 North Bridge No.2

(d) Collector Street
- Inside C3~C4

(e) Local Streets
- Inside C2~C3
- Inside C3~C4



Part III

Pre-Feasibility Study

14. FORMULATION OF URBAN STREET MAINTENANCE SYSTEM

(1) Objectives

The objective of the study is to formulate the urban street maintenance system, including:

- estimation of road length to be maintained,
- required maintenance work volume,
- necessary equipment/materials/manpower,
- annual budgeting plan, and
- execution system/organization.

The study focuses the maintenance system of the MOPI, covering only collectors and local streets, with the following scenario:

- Maintenance plan for 2012 : Completion of Circumferential Road 1 (C-1), and Radial Roads and Collector Streets within C-1 by 2011:.
- Maintenance plan for 2016 :Completion of C-2 and Radial Roads and Collector Streets within C-2, and Local Streets within C-1 by 2015.
- Maintenance plan for 2026 : Completion of most parts of the master plan by 2025.

(2) Road Improvement Types

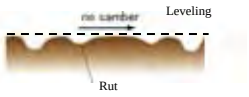
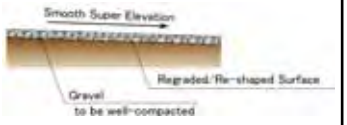
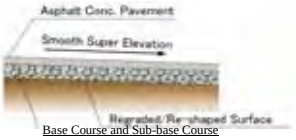
Improvement works for existing earth roads in Juba can be classified into:

- Leveling
- Re-surfacing
- Gravel Pavement
- Asphalt Pavement

(3) Assumed Stage of Road Improvement

Four options of stepwise road improvement are proposed under the condition of limited resources, especially availability of funds.

Road Improvement Types

Type 0: Leveling To level road surfaces temporally on the corrugation, deep rut, loss of camber, and erosion with minimum materials.	
Type 1: Re-surfacing To secure the smoothness of corrugated road surfaces with suitable material such as a mixture of thin gravel (5cm).	
Type 2: Gravel Pavement To secure the smoothness of corrugated road surfaces with a mix of gravel (15 cm).	
Type 3: Asphalt Pavement To secure the smoothness of corrugated road surfaces with an asphalt concrete pavement (60 cm). Surface course:10 cm, base course:20cm And sub-base course 30cm	

Assumed Stages of Road Improvement

Option	Existing Road Condition (EC)	Re-surfacing (RS)	Gravel Road (GR)	Asphalt Pavement (AC)
Option I	EC →			AC
Option II	EC →		GR →	AC
Option III-1	EC →	RS →		AC
Option III-2	EC →	RS →	GR →	AC

(4) Typical Road Maintenance Work

Road maintenance work is required for road structures of Resurfacing (RS), Gravel Pavement (GR) and Asphalt Pavement (AC) after completion of the road improvement.

Typical Required Road Maintenance Work

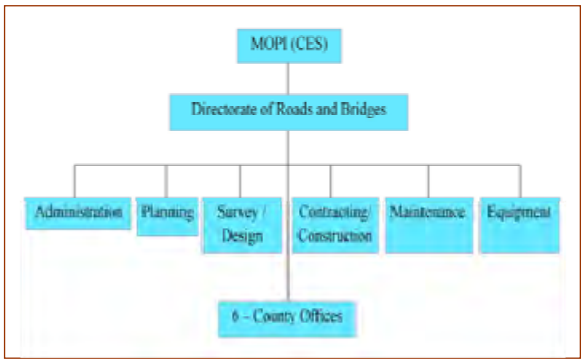
Major Maintenance Works			Estimated Frequency	Resources	
				Equipment and Tools	Materials
Local Street	Re-surfacing (Earth Road)	Cleaning (**LB**)	4 times/year	Pick-up Truck, Shovel, Hoe, Cutlass, Broom, Wheelbarrows, Signs and Safety Equipment, etc.	Fuel
		Re-shaping/Re-grading (**LB**)	2 times/year	Pick-up Truck, Tipper Truck, Hand Ramer, Pick-axe, Shovel, Hoe, Cutlass, Broom, Wheelbarrows, Camber Board, Signs and Safety Equipment, etc.	Fuel, approved soil / gravel
		Re-surfacing（5 cm）(**EB**)	2 times/year	Tipper Truck, Grader, Roller, Wheel Loader, Water Truck, Hand Ramer, Shovel, Camber Board, Signs and Safety Equipment, etc.	Fuel, gravel
	Gravel Pavement	Cleaning (**LB**)	4 times/year	Pick-up Truck, Shovel, Hoe, Cutlass, Broom, Wheelbarrows, Signs and Safety Equipment, etc.	Fuel
		Re-shaping/Re-grading (**EB**)	2 times/year	Tipper Truck, Grader, Roller, Wheel Loader, Water Truck, Hand Ramer, Shovel, Camber Board, Signs and Safety Equipment, etc.	Fuel, approved soil / gravel
		Re-gravelling (15cm) (**EB**)	once/year	Tipper Truck, Grader, Roller, Wheel Loader, Water Truck, Hand Ramer, Shovel, Camber Board, Signs and Safety Equipment, etc.	Fuel, gravel
	Asphalt Pavement	Cleaning (**LB**)	4 times/year	Pick-up Truck, Shovel, Hoe, Cutlass, Broom, Wheelbarrows, Signs and Safety Equipment, etc.	Fuel
		Patching (**EB**)	5 spots /km/year	Pick-up Truck, Hand Ramer, Asphalt Sprayer, Pic-axe, Shovel, Broom, Drum for Water, Signs and Safety Equipment, etc.	Fuel, Gravel, Asphalt Mixture, Emulsion, etc
		Crack Sealing (**EB**)	2 times/year	Pick-up Truck, Asphalt Sprayer, Broom, Signs and Safety Equipment, etc.	Fuel, Emulsion, etc
Collector Street	Asphalt Pavement	Cleaning (**LB**)	once/month	Pick-up Truck, Shovel, Hoe, Cutlass, Broom, Wheelbarrows, Signs and Safety Equipment, etc.	Fuel
		Patching (**EB**)	5 spots /km/year	Pick-up Truck, Hand Ramer, Asphalt Sprayer, Pic-axe, Shovel, Broom, Drum for Water, Signs and Safety Equipment, etc.	Fuel, Gravel, Asphalt Mixture, Emulsion, etc
		Crack Sealing (**EB**)	4 times/year	Pick-up Truck, Asphalt Sprayer, Broom, Signs and Safety Equipment, etc.	Fuel, Emulsion, etc

(5) Urban Street Maintenance System

▪ Proposed MOPI Organization

The proposed organization of MOPI is illustrated below.

Proposed Organizational Set-up of MOPI



- Planning Division evaluates and prioritizes the required maintenance works and conduct budgeting of maintenance works for the succeeding years based on the survey of road and traffic condition.
- The Survey/Design Division conducts the survey of road and traffic as well as the design works, if required.
- The Maintenance Division executes the maintenance works by contract-out and force–account, and shall also undertake the monitoring works of road conditions.
- Contracting/Construction Division shall be responsible for the case of contract-out system.
- The Equipment Division shall maintain the construction equipment and procure spare parts for the maintenance work by force-account.

▪ Function

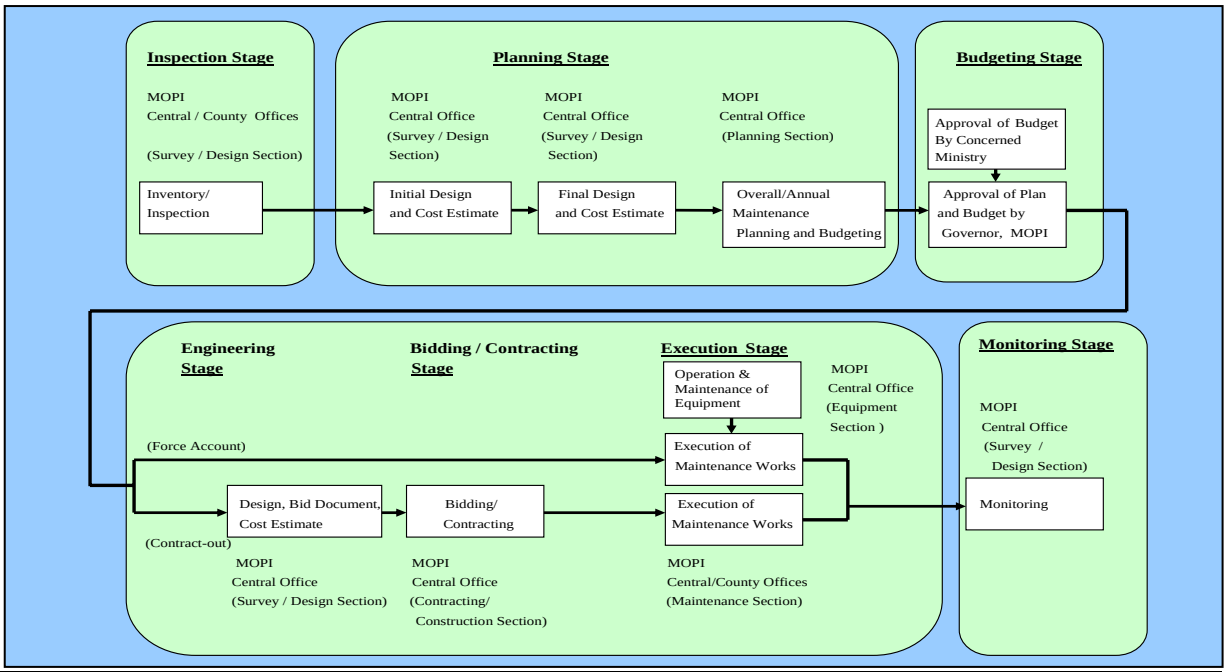
The MOPI should be responsible for the maintenance and operation of the collector and local streets in Juba covering the following stages of maintenance works, as illustrated below:

- Inspection Stage
- Planning Stage
- Budgeting Stage
- Execution Stage
- Monitoring Stage.

Proposed Management and Maintenance Responsibilities of MOPI

Existing Department	Proposed Department	Proposed Responsibility
Planning	Planning	Planning is to be undertaken to evaluate and prioritize the required works and to conduct budgeting for the succeeding year based on the results of road survey, required maintenance works and cost estimation.
Road Survey	Survey/ Design	Survey works shall be conducted to identify the existing condition of roads and to maintain proper records in a database for efficient utilization in planning. Design works shall be undertaken based on adequate knowledge and analysis of existing conditions obtained from the road survey. Cost estimation also shall be conducted for the required works.
Road & Bridges		
Construction	Contracting/ Construction	Improvement, rehabilitation and new construction works shall be executed by the force-account and/or contract-out basis.
Maintenance	Maintenance	Maintenance works shall be executed by the force-account and/or contract-out basis.
Mechanical/ Equipment	Equipment	Equipment shall be allocated to conduct the maintenance works economically, to maintain the equipment in the workshop, and to procure spare parts timely.

Implementation Cycle and Proposed Function of MOPI



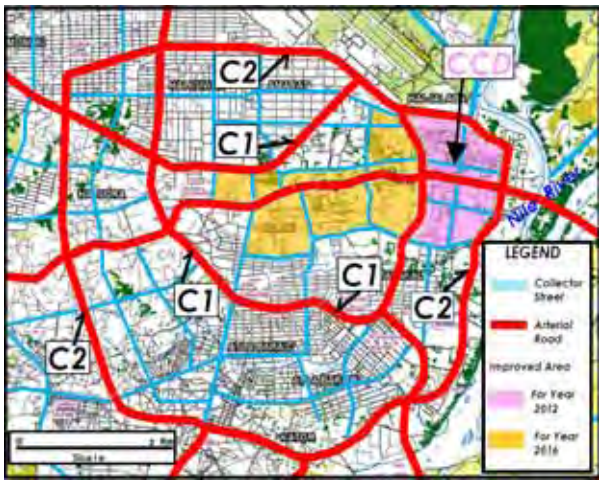
(6) Annual Maintenance for 2012 and 2016 of MOPI

- Streets To Be Maintained

The collector and local streets to be maintained by MOPI as shown in the figure below include:

- Beginning Year 2012: Local and Collector Streets inside CCD
- Beginning Year 2016: Local and Collector Streets inside CCD plus additional streets inside C1.

Streets to be Maintained by MOPI



- Maintenance for Improved Streets

The amount of maintenance work to be handled by MOPI shall follow the assumed progress of road improvement for collector and local streets in Juba urban area. In this case, it is taken that:

- by year 2011, 7.32km of collector streets and 13.97km of local streets or a total of 21.29km have been improved which shall be maintained from year 2012.
- by year 2015, 25.23km of collector streets and 70.62km of local streets or a total of 95.85 have been improved which shall be maintained from year 2016.

This will require an annual maintenance budget equivalent to US$400,000 from year 2012 and US$2.52 million from year 2016.

- Maintenance for Not-Improved Streets

- Due to the limitation in road development fund availability, improvements of collector and local streets have to be done in phases. Under such situation, certain road lengths remain unimproved but needs intervention to make it passable.
- Temporary leveling of unimproved streets that are in very poor condition due to damages caused by neglect, overloading, flood, emergency, etc. will have to be carried-out as a community-based road repair and maintenance.
- For this case of road repair/maintenance, annual fund allocation shall be set aside by MOPI to make these roads passable and support the daily socio-economic activities of the people. A limited budget is assumed for this activity as indicated below.

Assumed Cost for Temporary Leveling

Unit: USD 1,000

Unit Cost Per km	2012		2016	
	Length	Cost	Length	Cost
40	10 km	400	20 km	800

- Major Equipment for Maintenance Work

The following equipment is recommended to be owned by MOPI for:

a. Emergency maintenance works for the collector and local streets, and

b. Capacity development of the MOPI.

List of Equipment Required for Maintenance Work

Major Equipment	2012	2016
1. Pick-up Truck	1	5
2. Tipper Truck	2	10
3. Motor Grader	1	2
4. Roller	1	2
5. Wheel Loader	1	2
6. Water Truck	1	2
7. Hand Ramer	1	4
8. Asphalt Sprayer	1	2

Proposed MOPI Annual Maintenance Budget

Unit: US$ 1,000

Streets	Total Length (km)	2012				2016				2026			
		Improved		Not-Improved		Improved		Not-Improved		Improved		Not-Improved	
		Length	Cost	Length	Cost	Length	Cost	Length	Cost	Length	Cost	Length	Cost
Collector	116.04	7.32	35	108.72	-	25.23	120	90.81	-	110.22	524	5.82	-
Local	498.18	13.97	460	484.21	-	70.62	2,400	427.56	-	402.91	7,749	95.27	-
Total	614.22	21.29	495	592.93	800	95.85	2,520	518.37	800	513.13	8,273	101.09	4,000

15. URBAN STREET IMPROVEMENT IN CENTRAL COMMERCIAL DISTRICT (CCD)

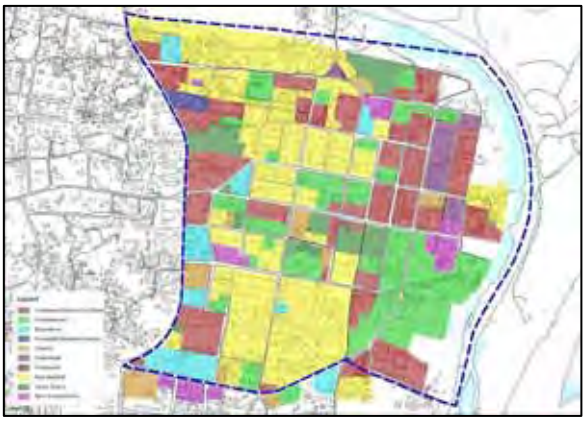
(1) Background and Objectives

- The Central Commercial District (CCD) is a historical block spreading in the north and south of the eastern section of May Road with an area of about 1.4 km in north-south and about 1.0 km in east-west.
- This area has been developed as a center of Juba town in commercial, business and institutional activities, where Juba Town Market and many State Government offices and private business entities are situated.

Location of CCD

- The roads in this area have been heavily deteriorated due to negligence of maintenance work, and the traffic is hindered from moving smoothly by improper layout of intersections and ineffective traffic management.
- The living environment and urban landscape are nasty due to absence of sidewalk and drainage, disposal of wastes on roads, etc.

Existing Land Use



- Under such situation, it is of urgent necessity to rehabilitate/improve the roads, provide sidewalk and drainage, and improve the intersections in order to make the traffic flow smooth and to improve the living environment and urban landscape being given top priority in the urban transport development master plan.
- The objectives of the study are:
  - to prepare a basic plan of the street improvement in CCD, and
  - to conduct a pre-feasibility study thereof as a preparatory work for early implementation of the project.

The study includes road inventory, basic strategies and plan, preliminary design, construction plan and cost estimate, environmental impact assessment, economic evaluation and implementation plan at preliminary levels.

(2) Streets Covered by On-going Project

The on-going Emergency Roads Rehabilitation Project includes trunk roads and semi-trunk roads in CCD but local streets in support of daily life are not covered. Of the 26.7km of streets in CCD, about 14.1km are covered by the on-going project.

Inventory of Streets in CCD

Road Class	Length (km)		
	Total	On-going	Remaining
Arterial Streets	3.91	3.91	0
Collector Streets	8.84	8.34	0.50
Major Local St.	4.24	1.22	3.02
Minor Local St.	9.73	0.64	9.09
Total	26.72	14.11	12.61

Streets in CCD Covered by On-going Project

(3) Improvement Policy

1） Role of CCD

CCD plays and is expected to play the following roles:

- center of economic activities in Juba as commercial and business center.
- center of administrative function as the capital of Central Equatoria State while the capital function of the Southern Sudan is concentrated in the GOSS Compound at the west side of May Road.
- expected to be a model area for urban development.

2） Development Policy

The basic policy is to develop the CCD as an environmentally friendly, comfortable and pleasant hub in an international level that will attract visitors and investors.

For CCD to fully play its role, the following are carefully considered:

- Accessibility. Includes improvement of road network, development of public transport, and improvement of pedestrian facilities.
- Land Use. Direction for densely developed land use.
- Environment and Amenity. Provision of sidewalk with lighting, parking facilities, drainage facilities, proper garbage treatment, etc.
- Urban Aesthetics. In harmony with culture, climate, economies, etc.

(4) Improvement Level

The level of Improvement in CCD is set based on the proposed road sections in the master plan and dependent on the road class.

Improvement Level

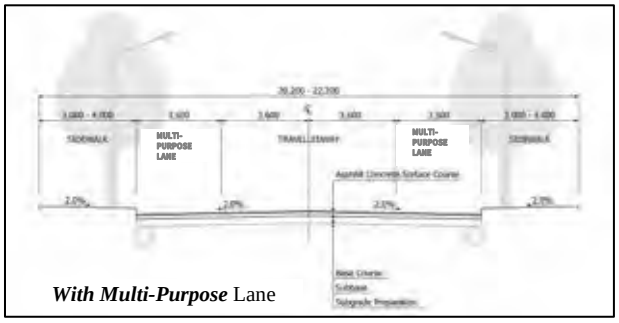
Particular		Road Class							
		Arterial Street		Collector Street		Major Local Street		Minor Local Street	
		A	B	A	B	A	B	A	B
Cross-Sectional Element	Number of Lanes	4 or 6	2	2 or 4	2	2	2	2	2 or 1
	Lane Width (m)	3.6	3.6	3.3	3.3	3.0	3.3	3.0	3.0 (4.0 for 1-lane)
	Median (m)	5.0	None	4.0 or None	None	None	None	None	None
	Multi-purpose Lane (m)	3.5	3.5 or None	3.5	3.5 or None	3.0 or None	3.5 or None	3.0 or None	None
	Sidewalk (m)	2.5-3.0	3.0-4.0	2.5	2.0-4.0	2.5	1.5-2.5	2.5	0-2.5
Road Surface Type		Asphalt	Asphalt	Asphalt	Asphalt	Asphalt	Depends	Depends	Gravel
Roadside Drainage		Pipe	Pipe	Pipe	Pipe	Pipe	Ditch	Depends	Ditch
Road Facilities	Street Lighting	Depends	With	Depends	With	Depends	If possible	Depends	None
	Planting	With	With	With	With	None	None	None	None
	Traffic Signal	As necessary							
	Traffic Sign								
	Pavement Marking	With	With	With	With	Depends	With	Depends	None
	Bus Stop	As necessary							

A : Standard cross-section common to all urban area
B : Adopted cross-section considering peculiar condition of CCD such as many pedestrians, limitation of available space, etc.

(5) Standard Cross-Section

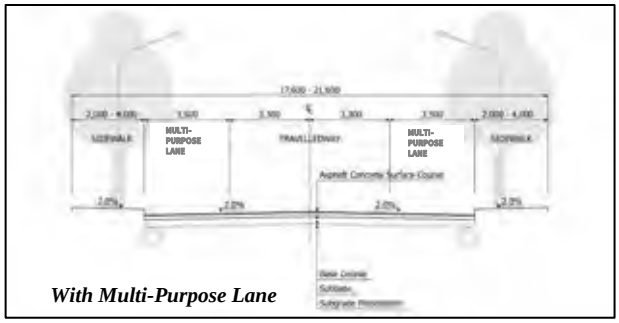
The street cross-sections developed for CCD are classified into arterial, collector, major local and minor local streets. Depending on the right-of-way availability, street sections may or may not include multi-purpose lanes.

- **Arterial Street Section**



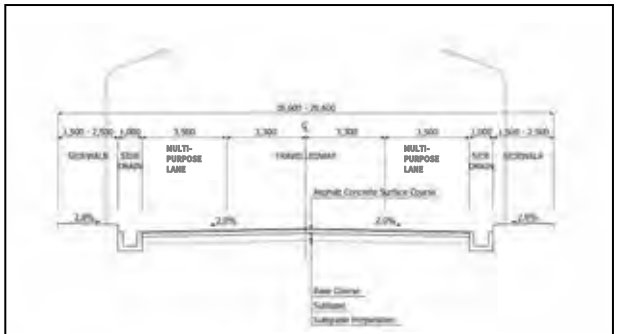
With Multi-Purpose Lane

- **Collector Street Section**

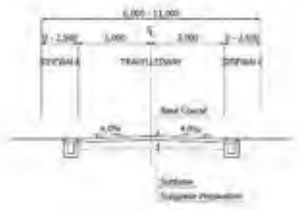


With Multi-Purpose Lane

- **Local Street Section**



Major Local Street (with Multi-Purpose Lane)



Minor Local Street (2-lane)

(6) Preliminary Design

1) Pavement Type

The proposed pavement types are as follows:

Proposed Pavement Types for CCD

Road Class	Pavement Type
Arterial Streets	Asphalt concrete pavement (AC)
Collector Streets	Asphalt concrete pavement (AC)
Major Local Streets	Asphalt concrete pavement (AC)
Minor Local Streets	Gravel surfaced (GR)

2) Road Facilities

The proposed road facilities include Roadside Drainage, Street Lighting, Planting on Sidewalk, Pavement Marking, Traffic Sign, Bus Terminal, Bus Stop and Traffic Signal with layout shown in the figure below.

Layout Plan of Road Facilities

3) Drainage Design

The road drainage layout planning policy shall be:

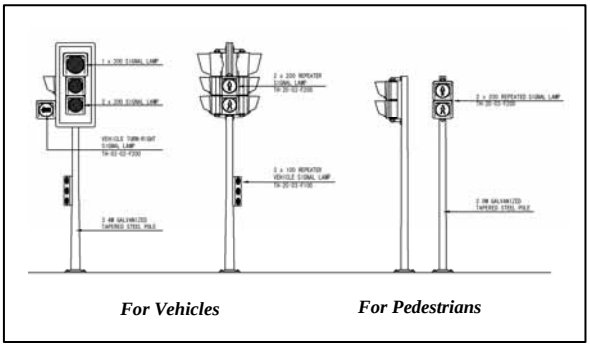
- to utilize pipe culverts on both sides of arterial and collector streets,
- to utilize open concrete ditches on both sides of local streets, and
- to minimize the length of drainage between the start point and the outlet.

4) Traffic Management

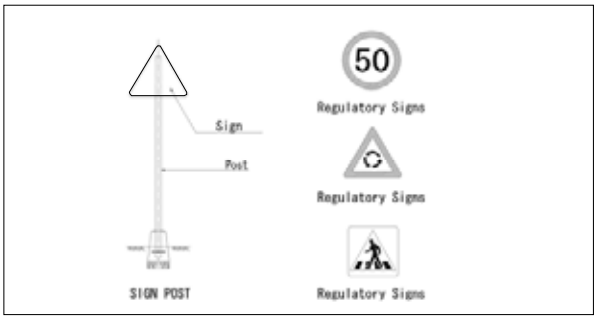
- The choice of roundabout and signalized intersection is examined based on the traffic efficiency performance of both intersections.
- The present condition does not require a traffic circulation plan such as one-way street and left-turn prohibition. This will be considered in the future when traffic volume increases.
- Provision of multi-purpose lanes in arterial, collector and major local streets is considered in the plan. The multi-purpose lane can be used for parking but authorities should strictly control parking within the allocated space.

Drainage Plan Layout in CCD

Proposed Traffic Signals



Proposed Traffic Signs and Sign Post



5) Environment Amenity

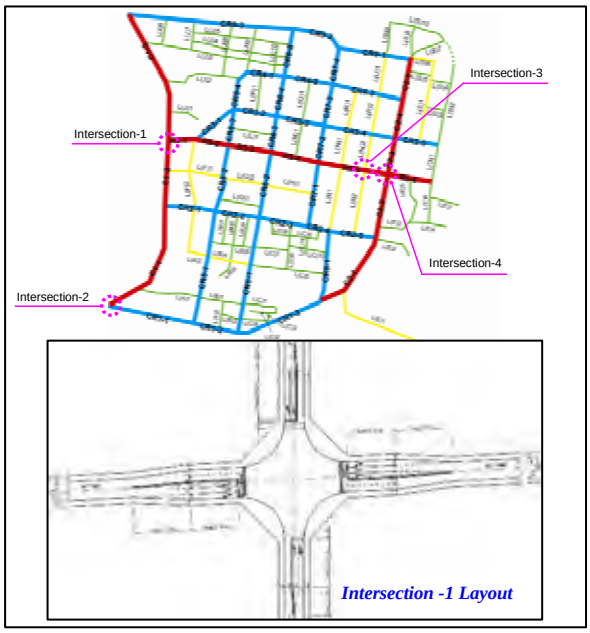
Improvement of the environment is one of the major issues and considerations for CCD development. Some measures to enhance the environment include:

- provision of sidewalk and greenbelt area for the safety of pedestrians and public convenience,
- provision of street lighting for pedestrians and road users,
- proper drainage facilities and waste disposal,
- facilities for handicapped and physically disadvantaged road users,
- facilities for vehicle parking,
- improvement of parks and public places,
- considerations for urban aesthetics thru proper design of buildings and structures, and
- proper arrangement and layout of utilities such as water pipes, electricity, sewerage, etc.

6) Intersection Design

The design of intersection is done considering the projected traffic in year 2015. The existing roundabout type is initially examined based on the traffic demand and if found functional is recommended, otherwise signalized intersection is proposed.

Intersection Design



Summary of Intersection Design

Intersection	Existing Type	Proposed Intersection Type
Intersection-1	Roundabout	Signalized
Intersection-2	Roundabout	Roundabout
Intersection-3	Roundabout	Roundabout
Intersection-4	-	Signalized

(7) Construction Cost

The project cost excluding maintenance cost consists of the following:

- Right-of-way acquisition and compensation cost
- Detailed design cost
- Construction cost
- Construction supervision cost

Summary of Project Cost in (Million US$)

Street Class	Detailed Design Cost	Construction Cost	Construction Supervision Cost	Total
Arterial Streets	283	7,074	566	7,923
Collector Streets	876	21,900	1,752	24,528
Major Local Streets	327	8,168	653	9,148
Minor Local Streets	242	6,049	484	6,775
Total	1,728	43,191	3,455	48,374

Note: Right-of-way and Compensation Costs are not included.

(8) Economic Evaluation

The simplified economic evaluation is done by comparing the project cost with the benefits accruing from the project.

The evaluation results are indicated as following evaluation indicators:

- Net present value (NPV)
- Benefit/cost ratio (B/C)
- Economic internal rate of return (EIRR)

The assumptions for the economic analysis are:

- Costs: Includes construction cost, engineering cost and maintenance cost.
- Benefits: Includes vehicle operating cost savings and travel time savings
- Analysis Period: 20 years after completion of project
- Discount Rate: 8% p.a.

The results of economic analysis indicate the project is feasible.

Economic Indicators

Indicator	Arterial Streets	Collector Streets	Major Local Streets	Minor Local Streets	All Roads
Net Present Value (NPV) (million US$)	17.43	-0.56	-0.25	2.31	18.93
Benefit Cost Ratio (B/C)	3.22	0.98	0.97	1.34	1.39
Economic Internal Rate of Return (EIRR)	28.0 %	7.7 %	7.7 %	11.9 %	12.4 %

16. ROUTE LOCATION STUDY

(1) Objectives

In order to determine a more definitive route alignment considering various existing control points and technical requirements, the route location study aims to:

- establish the route locations and corridors of C2, C3 and R5 (crossing the Nile river and eastward),
- guide the MTR, MOPI and other related agencies in preparing the necessary steps to stake the route alignments on site, in relation to right-of-way acquisition and compensation,
- identify the control points that may influence the choice of the selected routes,
- Determine the most probable location of the C3 White Nile River Crossing. and
- Guide the development of Juba urban area based on the land use along the established route corridors.

(2) Study Routes

The proposed Juba Urban Road Network covers four (4) circumferential and six (6) existing radial streets, namely:

1) Circumferential Streets

- C1 : Circumferential road formed by Unity Ave. and the Old Airport Road surrounding Buluk and Hai Malakal,
- C2 : Covering the area from C1 to Central Commercial District, Atla Bara, Kator, Hai Malakal, Hai Sora, Hai Kuwait and Amarat; C2 overlaps C1 at the airport area,
- C3 : The area from C2 extending to the east of the Nile River, Kator, Lologo, Nyakuron, Munuki, and the large pond north of Juba International Airport, and
- C4 : Area beyond C3.

2) Radial Streets

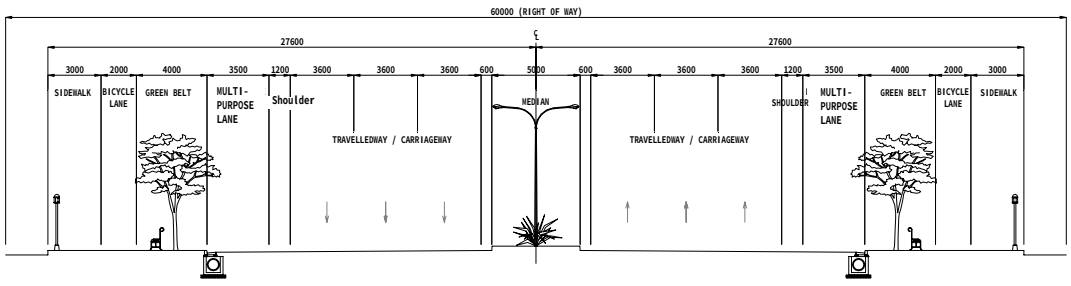
- R1 : Juba-Yei Road
- R2 : Juba-Mundri Road
- R3 : Juba-Terekeka Road
- R4 : Juba-Bor Road
- R5 : Juba-Lafon Road, and
- R6 : Juba-Nimule Road

Among the above arterial streets, C1 and the radial roads R1-R6 have been formed except for the section of R5 crossing the Nile River until C3. So that, the focus of this route location study will be C2, C3 and R5 section from Nile river to R4. C4 route is not to be studied in detail at the moment since it is beyond the long-term plan.

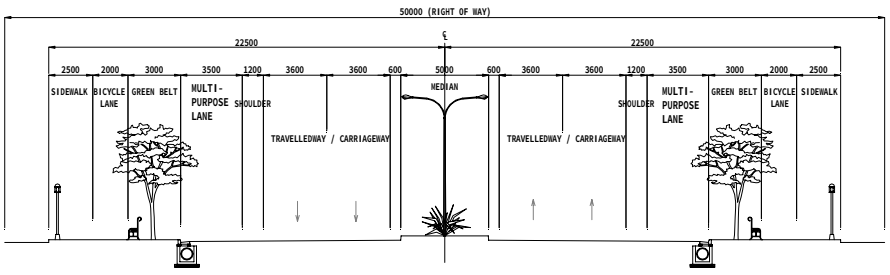
(3) Cross-Section

The objective roads in this study are classified as arterial streets with typical road cross-sections illustrated in the figure below.

Standard Cross-Section for Arterial Streets



(a) 6-Lane Arterial Street Section with 60m ROW



(b) 4-Lane Arterial Street Section with 50m ROW

(4) Policy on Route Location Selection

The proposed arterial street network provides service to major urban centers and functions as primary and district distributor in and around Juba and the surrounding areas. The following policies govern the selection of the proposed routes for the major arterials:

1) Assure Mobility by Maintaining the Design Speed and Functionality

Mobility is the primary objective of the network which requires provision of proper road geometry and efficient connection (by proper intersection layout, etc.) with other arterial and collector streets.

- Design Speed:

  The proper design geometry in the road alignment to attain design speed of 50-60 km/hr.

- Functionality:

  Access shall be controlled by providing efficient intersection layout or avoiding direct access by local traffic (such as provision of frontage roads, etc.).

2) Minimum Right-of-Way Take

In order to minimize additional right-of-way take for the road reserve, the proposed route shall utilize as much as possible, existing road reserves.

3) Minimum Adverse Social Impact

- Minimize the number of affected persons and structures to reduce social impact.
- Route alignment shall be located at the fringes/boundaries of community formations and avoid passing thru the middle of such communities.
- Public sites including churches, cemeteries, institutional areas and historical sites shall be avoided.

4) Preservation of Environment

Preservation of the environment shall be one of the major concerns of the proposed route especially when crossing the Nile River, the alignment near Jebel Kujur mountain and the large pond north of the Juba International Airport.

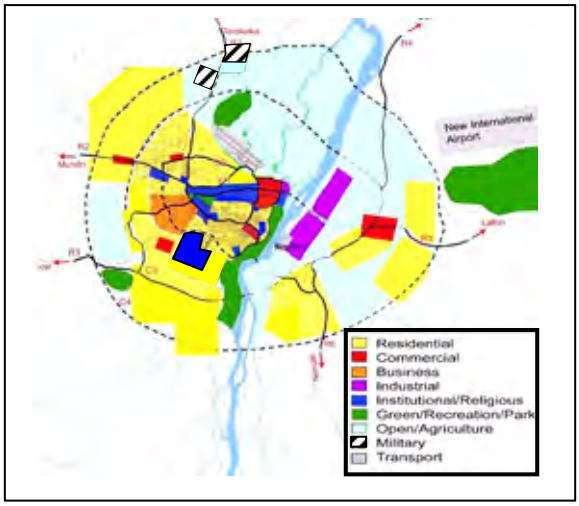
(5) Route Requirements

1) Land Access Requirements

Accessibility of the following are considered:

- Community – route shall not disrupt social links between members of community
- Institutions and Administrative Centers – arterial routes should be near these centers to provide mobility.
- Commercial and Industrial Areas – provide access thru collector and local roads
- Airport, River Ports and Other Transport Modes – arterial routes connects to these roads through collector roads

Proposed Year 2025 Land Use



2) Engineering Requirements

Engineering Requirements for C2, C3 and R5

Functional Classification	Arterial Road/Street	
Function	Circumferential – Primary/District Distributor (C2 and C3)	
	Radial – Interstate/Intercity Trunk Road (R5)	
Access Control	• Possibly uninterrupted except at intersection; • Limited access to next lower class (Collector)	
Design Traffic (ADT)	10,000 – 12,000	
Design Speed	50 – 60 km/hr	
Design Radius	Minimum	150 m (AASHTO)
	Desirable	• C2 : 250 m • C3 & R5 : 500 m
Grade	0.5% – 5%	
Minimum Length of Horizontal Curve	80 m	
ROW/Road Reserve Requirement Based on Cross-Section Elements	4 – Lanes Arterial	50 m
	6 – Lanes Arterial	60 m

3) Environmental and Social Requirements

The following environmental and social issues are taken into considerations:

- Topographic Features
- River System
- Landscapes
- Flora and Fauna
- Vegetation
- Land Use Along the Proposed Routes
- Additional Right-of-way Take
- Number of Affected Structures

(6) Examination of Alternative Routes

The delineation of the proposed routes for C2, C3 and R5 is done using the Geo-Eye Satellite Images acquired in March 2009 with 0.5m resolution.

In sections where there are possible choices of route alignments, the proposed alternatives are examined and compared based on the following criteria:

- Road Alignment/Geometry - smooth alignment meeting minimum geometric requirements will be better alternative,
- Road Length/Cost - shorter route relates to cheaper cost,
- Affected Structure/Houses - less number of affected structures and houses will have less impact problem during implementation, and
- Right-of-Way (ROW) - alternative route with minimum additional right-of-way is recommended.

1) Circumferential Road C2 Alignment Alternatives

Three alternative sections are studied for C2 with the following recommended:

- C2-A1: better alignment, shorter length, lesser ROW and affected structures, compared to C2-A2.
- C2-B1: better alignment, shorter length, lesser ROW and affected structures, compared to C2-B2.
- C2-C1: better alignment, shorter length, lesser ROW and affected structures, compared to C2-C2.

2) Circumferential Road C3 Alignment Alternatives

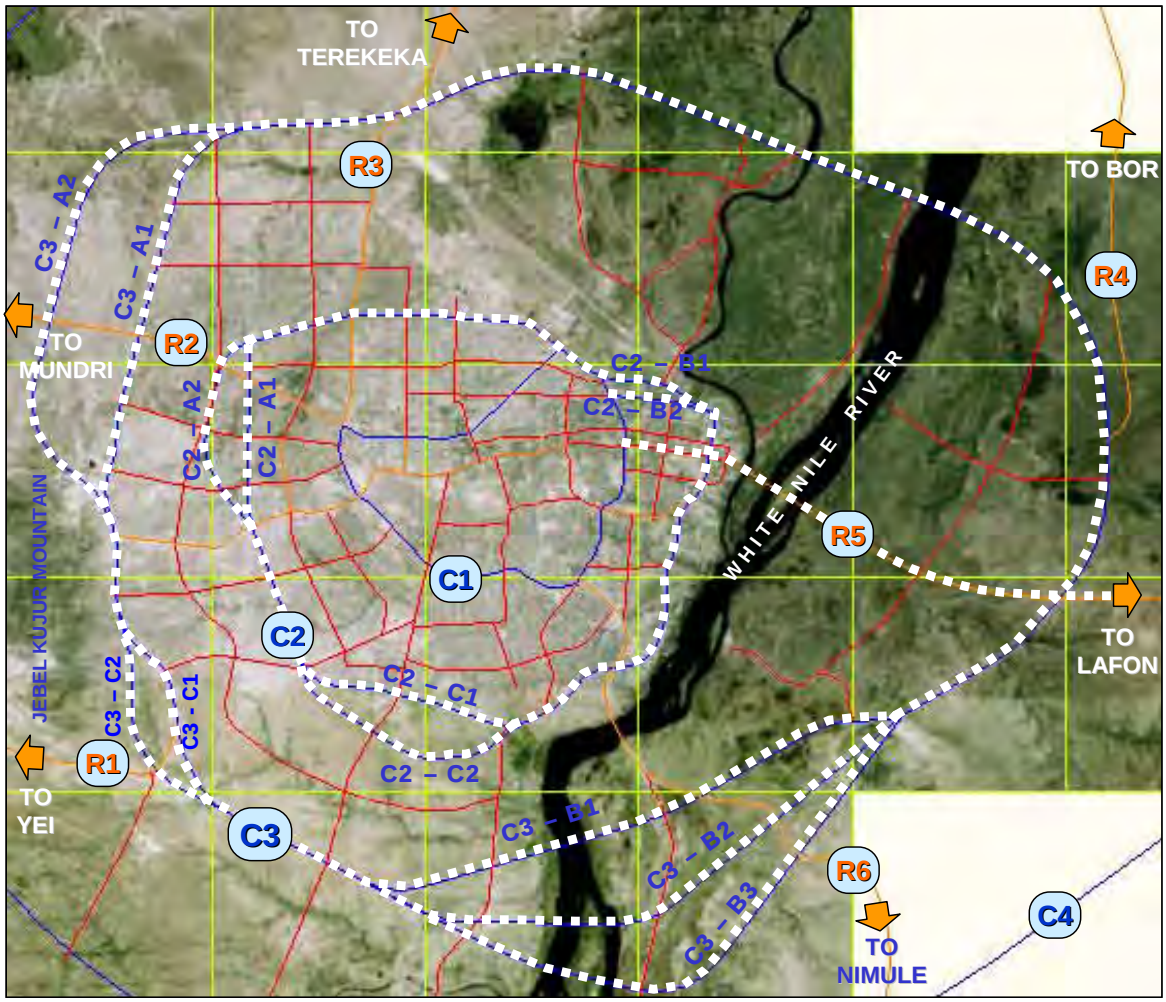
Three alternative sections are studied for C3 with the following recommended:

- C3-A1: cheaper and easier to construct than C3-A2.
- C3-B1: better alignment, shorter road and bridge length, cheaper to construct than C3-B2 and C3-B3.
- C3-C2: better alignment than C3-C1.

3) Nile River Bridges

Two (2) bridges to cross the Nile river are proposed for C3 alignment and one (1) bridge proposed for R5 alignment.

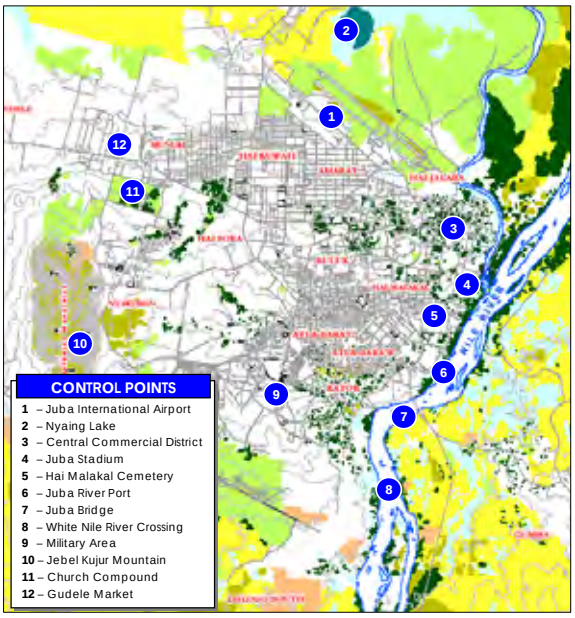
Delineation of Alternative Routes in Satellite Image



(7) Control Point for Route Alternatives

The control points identified in the satellite image and on site are shown in the figure below.

Route Location Control Points for C2, C3 and R5



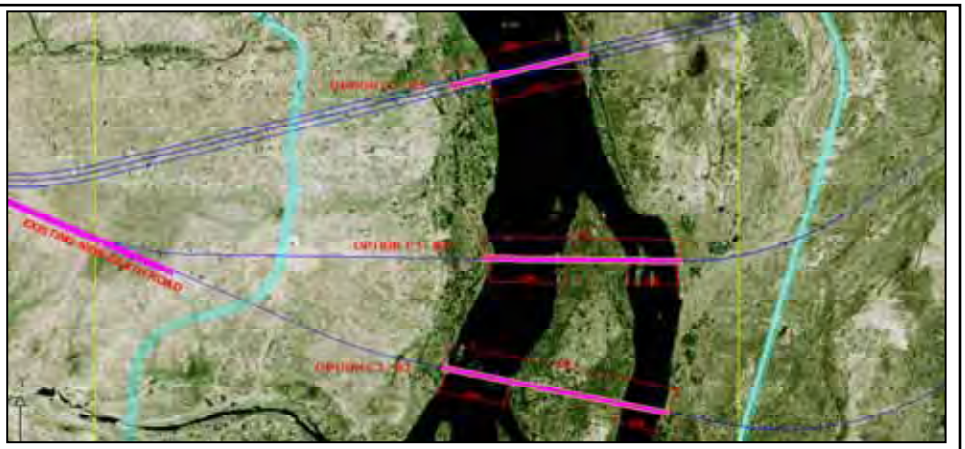
(8) C3 Nile Bridge No.1 – South Section

Three alternatives are considered for the location of C3 Nile Bridge No.1 (South)

- Option C3-B1 – basically located about 1.75 km south of the existing Juba Bridge with the least waterway width among the other options. Bridge length is 560m.
- Option C3-B2 – located at about 1 km south of option C3-B1 and passes over the island towards the eastern side. Bridge length is 770m.
- Option C3-B3 – further 1 km south of option C3-B2 and likewise crosses the island with the longest bridge. Bridge length is 910m.

Option C3-B1 is the recommended route since it has better alignment, shorter bridge and cheaper to construct.

Alternative Locations for C3 Bridge No.1 - South

Plan			
Option	Option C3-B1	Option C3-B2	Option C3-B3
Road Alignment/ Geometry	- road alignment crosses only one channel of the Nile River - alignment pass thru the community boundary on the eastern side - partially utilize the existing new earth road on the west bank	- road alignment crosses the Nile River at two converging channels - alignment cuts through the community on the eastern side - partially utilize the existing new earth road on the west bank	- road alignment crosses the Nile River at two converging channels - alignment cuts through the community on the eastern side - alignment follows the existing new earth road on the west bank
Road Length/ Cost	Road = 5.85 km Nile Bridge = 560m	Road = 6.48 km Nile Bridge = 770 m	Road = 7.02 km Nile Bridge = 910 m
Affected Structures	- affects most number of structures on the western side of Nile River - no structure affected on the eastern side of Nile River	- affects fewer number of structures on the western side of Nile River - most number of structures affected on the eastern side of Nile River	- affects the least number of structures on the western side of Nile River - more structures affected on the eastern side of Nile River
ROW	- shortest length, least additional ROW take	- 10% more ROW take than C3-B1	- longest alignment, greatest ROW take (20% more than C3-B1)
Evaluation	*Recommended* (better alignment, shorter road and bridge and cheaper to construct)	X	X

17. URBAN STREET NETWORK DEVELOPMENT IN SOUTHERN JUBA

(1) Objectives

- Juba urban area is expanding due to the return of refugees/IDPs and migration from rural areas. The direction of growth is towards the south and east of Juba, necessitating improvement of roads in these areas.
- The roads/streets identified of urgent priority to enhance development in these areas are the south and southeast section of Circumferential Streets C2 and C3 and Collector Streets CSA (Lologo Radial Street) and CSB (Nyakuron Radial Street).
- This section of the Study then aims to:
  - prepare a preliminary alignment and basic plan of the road network in the southern area of Juba following the proposed Road Network Master Plan of Juba urban area,
  - establish C3 south and southeast alignment to link R1 (Juba-Yei Road) with R6 (Juba-Nimule Road), and
  - conduct a pre-feasibility study for the preparatory works for the implementation of the road project.

  This includes selection of optimum routes, basic strategies and plan, preliminary design, construction plan and cost estimate, simplified economic evaluation and implementation plan.

(2) Study Roads

The present road network and development trend in Juba, as shown below, indicates the urgent need to develop the south and southeast road links. These roads are expected to promote orderly development as well as catalyze economic and social activities in the area.

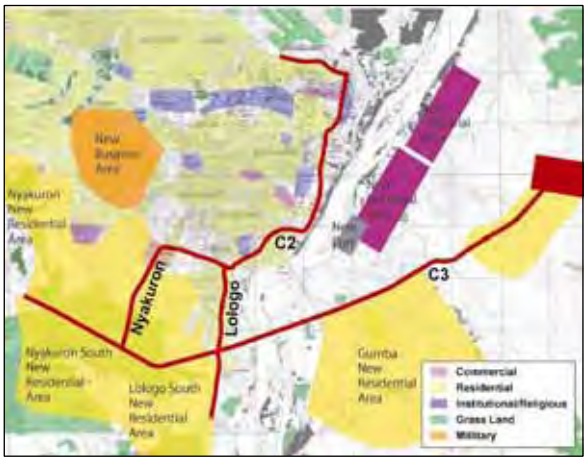
The descriptions and alignment of the study roads are presented in the table below.

Description of Study Roads

Road Name	Section	Road Length	Road Class	Function
C-2	From Near Airport to Military area (Intersection of Nyakuron Rd.)	7.2 km	Arterial	• Circumferential Street • Access to Central Commercial District, present residential area and some major facilities such as football stadium, cemetery, port and military.
C-3	From Intersection of R-5 to Intersection of R-1(Juba-Yei Road)	11.1 km	Arterial	• Circumferential Street • Bypass road for through traffic to Juba Town • Alternative route connection between west side and east side of Nile River • Major road to guide the proper urban development in the southern Juba
Lologo Radial Road (CSA)	From Int. of C-2 to New water treatment plant (passing Lologo residential area)	3.3 km	Collector	• Access road from south section to center of Juba • Access road for Lologo residential area and new water treatment plant. • Link road with C-2 and C-3. • Alternate route to R6 from east side of Nile river to Juba center.
Nyakuron Radial Road (CSB)	From Int. of C-2 Int. of C-3	2.1 km	Collector	• Link road with C-2 and C-3. • Access road for Nyakuron area, which is located at new development area. • Alternate route to R1 from west side of Juba to Juba center.

Location of Pre-Feasibility Study Roads

Land Use Plan in Southern Juba (2025)



(3) Design Policy, Design Specifications and Standards (Pre-Feasibility Study Level)

The design policy adopted for roads and structures are:

- The road corridor shall follow the ROW recommended in the master plan which is 50m for C2, 60m for C3 for arterial.
- Considering traffic demand and minimal initial investment, stage construction shall be applied with 2-lane road at the initial stage. However, the full ROW shall be secured at the initial stage.
- Road design shall provide proper amenities and ancillary facilities including proper drainage.
- Intersection layout shall be carefully planned for efficient traffic mobility.
- Structures shall be planned consistent with road.
- Road planning shall consider minimal environmental impact.

The following design specifications and standards are referred to in the pre-feasibility study of the objectives roads.

1) For roads and highways:

- Geometric Design Manual, Ministry of Transport and Roads, Government of Southern Sudan 2006
- A Policy on Geometric Design of Highways and Streets, the American Association of State Highway and Transport Officials (AASHTO)
- Road Structure Guidelines, Japan Association of Roads, February 2004

2) For bridges and culverts:

- Geometric Design Manual, Ministry of Transport and Roads, GOSS, 2006.
- Bridge Design Manual, Ministry of Transport and Roads, GOSS, 2006.
- Drainage Design Manual, Ministry of Transport and Roads, GOSS, 2006

(4) Standard Cross-Sections

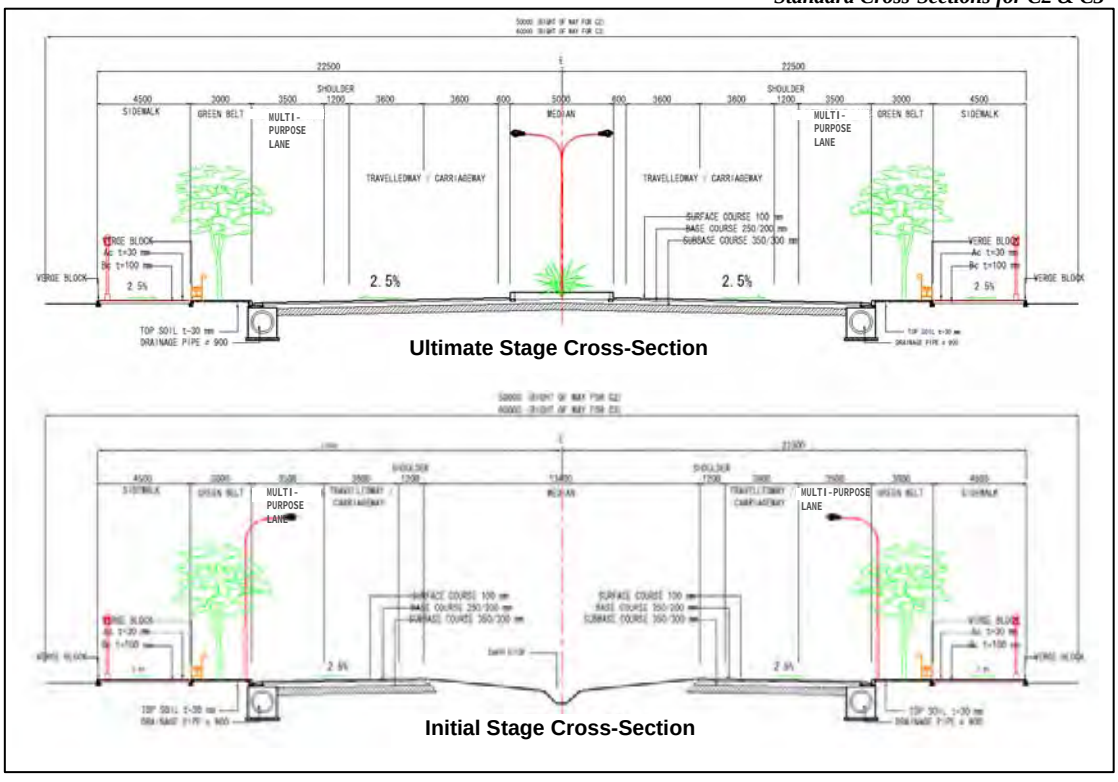
The standard cross-sections for the proposed roads follow those recommended in the master plan with the following cross-sectional elements:

- Carriageway
- Multi-purpose Lane (parking, bus bays, etc.)
- Greenbelt, and
- Sidewalk

1) Stage Construction:

- Since traffic demand does not require a full 4-lane construction for the time being, the initial stage road cross-section is decided to provide only 2-lanes of carriageway which will be expanded to four lanes after year 2015.
- At the initial stage, the 1-lane carriageways shall be constructed on the outer lane sides of the road together with the multi-purpose lane, greenbelt and sidewalks.

Standard Cross-Sections for C2 & C3



Ultimate Stage Cross-Section

Initial Stage Cross-Section

(5) Preliminary Design

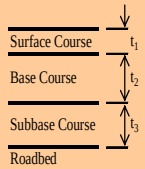
A preliminary design at the pre-feasibility study stage level is carried-out for C2, C3, CSA and CSB road sections with results discussed herein.

▪ Pavement Design

The preliminary pavement design is carried out based on "AASHTO Guide for Design of Pavement Structures 1993" (AASHTO Guide).

Pavement Thickness

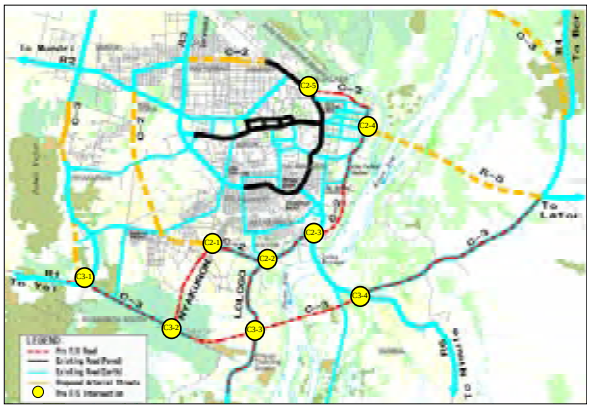
		C-2	C-3	Lologo Radial Road	Naykuron Radial Road
Thickness	Surface Course (t_1)	10 cm	10 cm	10 cm	10 cm
	Base Course (t_2)	20 cm	15 cm	15 cm	20 cm
	Subbase Course (t_3)	35 cm	30 cm	30 cm	35 cm
	Total	65 cm	55 cm	55 cm	65 cm
Structural Number (SN)		3.893	3.442	3.442	3 893
Required Structural Number		3.776	3.381	3.353	3.738



▪ Intersection Design

A study of intersections is carried out to determine the most suitable type (whether non-signalized, signalized, roundabouts and signalized round-abouts) for the identified intersection shown below.

Location of Intersections



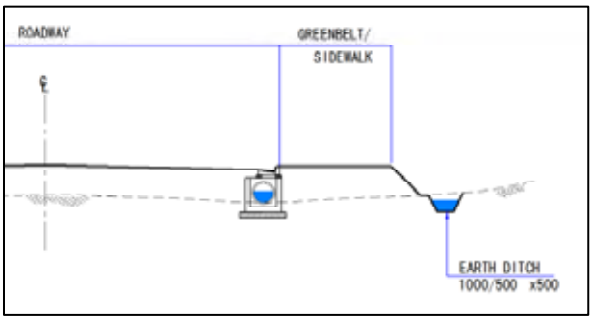
Considering the volume-capacity ratio of intersections for years 2015 and 2025 and the availability of area at the intersections, the ***signalized intersection is recommended*** at all sites.

▪ Drainage Design

For traffic safety and to extend the life of the pavement structure, provisions for drainage facilities cover:

- Road Surface Drainage. Road surface drainage is facilitated by L-shaped gutter with catch basin and 900mmϕ collector pipes. At the initial stage, the middle section is likewise provided with open earth ditch to be discharged to the lateral pipes.
- Road Side Drainage. For embankment sections, earth ditches are provided at the toe of the embankment to protect the road from rainfall, floods, etc.
- Cross-Drainage. Cross-pipes, 1,200mmϕ are provided every 250m to allow flow of water from one side of the road to the other.

Road Surface and Road Side Drainage

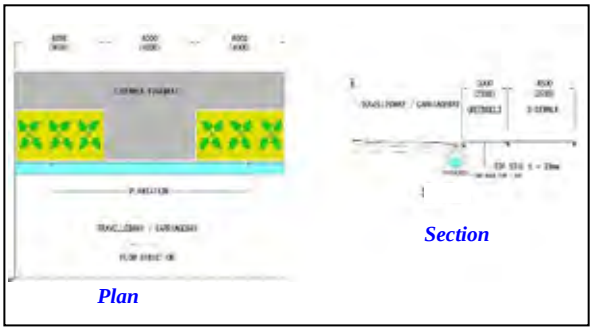


▪ Ancillary Facilities Design

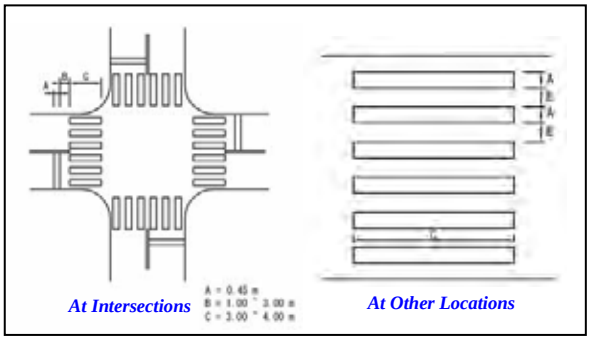
Road ancillary facilities and road furniture considered for the preliminary design include:

- Space for Public Utility Services
- Parking Space
- Sidewalk
- Greenbelt
- Pedestrian Crossing
- Bus Bay
- Road Markings
- Road Signs
- Street Lighting
- Traffic Signals

Greenbelt and Sidewalk



Typical Pedestrian Crossing



(6) Nile River Bridge

Following the alignment recommended in the route location study for C3 Nile River Crossing, a pre-feasibility level study of the Nile river bridge is undertaken including:

- Establishment of the bridge site location,
- Examination of the site condition, river condition, etc.
- Formulation of applicable alternative bridge types and schemes based on engineering requirements,
- Examination of construction methods, available technology and costs.

1) Policy on Bridge Span, Length and Structure Type

The bridge configuration is decided base on:

- pier span arrangement, horizontal and vertical clearance, and bridge length shall not constrict the waterway and should be greater than or equal to the existing Juba Bridge,
- structural system shall be cost-effective, easy to maintain, resistant to loads and aesthetically pleasing, and
- construction method shall consider available technology and materials.

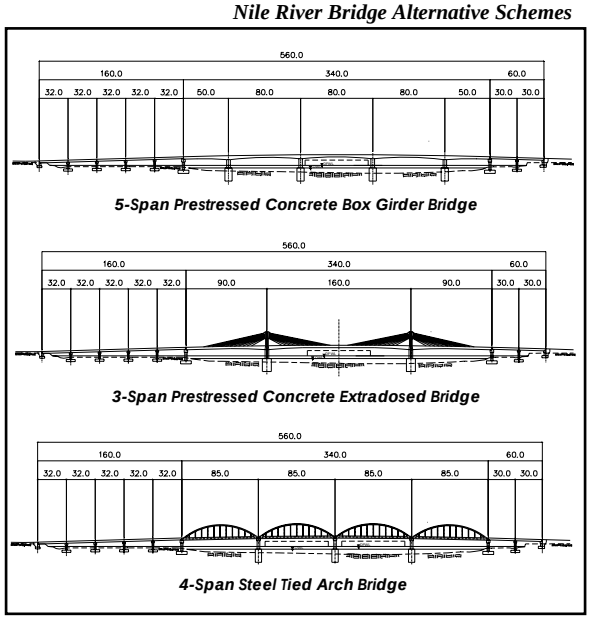
2) Bridge Scheme

Alternative bridge schemes include:

- PC Box Girder,
- PC Extradosed Bridge
- Steel Tied Arch Bridge,
- Steel Truss Bridge, and
- Steel Cable Stayed Bridge.

After evaluating the alternatives, the recommended type for Nile River Bridge is PC box girder.

Nile River Bridge Alternative Schemes



(7) Project Cost

The project cost is determined on the basis of the preliminary engineering design, the scope of work and the quantity of major work items for each project road section.

Project Scope

Road Section	Road Length (km)	No. of Signalized Intersections	No. of Bridges	No. of Culverts
Circumferential Street C2	8.0	5	2 (L=20m & 35m)	7 (1-cell: 3x3 & 4x3; 2-Cells: 4x3)
Circumferential Street C3	12.6	4	6 (L=20m – 35m; 1- Nile Bridge, L=560m)	6 (1-cell: 4x3; 2-Cells: 3x3 & 4x3)
Logogo Radial Street	3.6	-	2 (L=20m & 50m)	3 (1-cell: 3x3 & 4x3; 2-Cells: 4x3)
Nyakuron Radial Street	2.2	-	1 (L=30m)	4 (1-cell: 3x3; 2-Cells: 3x3 & 4x3)

Summary of Project Cost

	C2	C3	Logogo Radial St.	Nyakuron Radial St.	Total
① Construction Cost	52.28	141.56	23.51	14.36	231.71
② Engineering Cost for DD and SV (8% of ①)	4.18	11.32	1.88	1.15	18.54
③ Contractor Overhead (15% of ①)	7.84	21.23	3.53	2.15	34.76
④ Administratio Cost (5% of ①)	2.61	7.08	1.18	0.72	11.59
⑤ Contigency (10% of (①+②+③+④))	6.69	18.12	3.01	1.84	29.66
Total Project	**73.61**	**199.32**	**33.10**	**20.22**	**326.25**

(8) Economic Evaluation

A simplified economic evaluation is carried out to determine the viability of the projects. The following are considered in the evaluation:

- Economic cost as derived from financial cost (construction and maintenance),
- Economic benefit based on savings in vehicle operating and travel time costs,
- Project Life of 20 years,
- Discount rate of 8% p.a.

The results indicate that all projects have EIRR greater than 11%.

Economic Indicators of Benefit Cost Analysis

Economic Indicators	C2	C3	Logogo Radial St.	Nyakuron radial St.
Net Present Value (NPV) in Million US$	19.6	70.2	21.4	11.6
Benefit Cost Ratio (B/C)	1.315	1.438	1.728	1.648
Economic Internal Rate of Return (EIRR)	11.3%	11.4%	15.0%	13.8%