



# Federal Republic of Nigeria

Federal Ministry of Works

Highway Manual

Code of Procedure

2013

CODE OF PROCEDURE



## FOREWORD

The vision statement of the Federal Ministry of Works is to elevate Nigerian roads to a standard where they become National economic and socio-political assets, contributing to the Nation's rapid growth and development, and to make Federal roads functional, safe, pleasurable, and an avenue for redeeming Nigerians' trust and confidence in Government. This vision statement is in tune with the Transformation Agenda of the President of the Federal Republic of Nigeria, His Excellency, Dr Goodluck Ebele Jonathan, GCFR. Based on the foregoing, our mission is to use the intellectual, management and material resources available to the Ministry to make Nigerian roads functional all the time. The principal goal of the Ministry is to drive the transformation agenda by improving road transport infrastructure for the overall socio-economic derivable benefits and development of our great country, Nigeria.

In exercising this mission and in discharging its responsibilities, the Ministry identified the need for updated and locally relevant standards for the planning, design, construction, maintenance and operation of our roads, in a sustainable manner. One of the main reference documents for this purpose is the Highway Manual, which previously included Part 1: Design and Part 2: Maintenance. Both current parts of the Highway Manual were first published in 1973 and 1980 respectively and have been subjected to partial updating at various times since then. The passage of time, development in technology, and a need to capture locally relevant experience and information, in the context of global best practices, means that a comprehensive update is now warranted.

The purpose of the Highway Manual is to establish the policy of the Government of the Federal Republic of Nigeria with regard to the development and operation of roads, at the Federal, State and Local Government levels, respectively. In line with this objective, the Manual aims to guide members of staff of the Ministry and engineering practitioners, with regard to standards and procedures that the Government deem acceptable; to direct practitioners to other reference documents of established practice where the scope of the Manual is exceeded; to provide a nationally recognized standard reference document; and to provide a ready source of good practice for the development and operation of roads in a cost effective and environmentally sustainable manner.

The major benefits to be gained in applying the content of the Highway Manual include harmonization of professional practice and ensuring uniform application of appropriate levels of safety, health, economy and sustainability, with due consideration to the objective conditions and needs of our country.

The Manual has been expanded to include an overarching Code of Procedure and a series of Volumes within each Part that cover the various aspects of development and operation of highways. By their very nature, the Manual will require periodic updating from time to time, arising from the dynamic nature of technological development and changes in the field of Highway Engineering.

The Ministry therefore welcomes comments and suggestions from concerned bodies, groups or individuals, on all aspects of the document during the course of its implementation and use. All feedback received will be carefully reviewed by professional experts with a view to possible incorporation of amendments in future editions.



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May, 2013

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## 1 General Information

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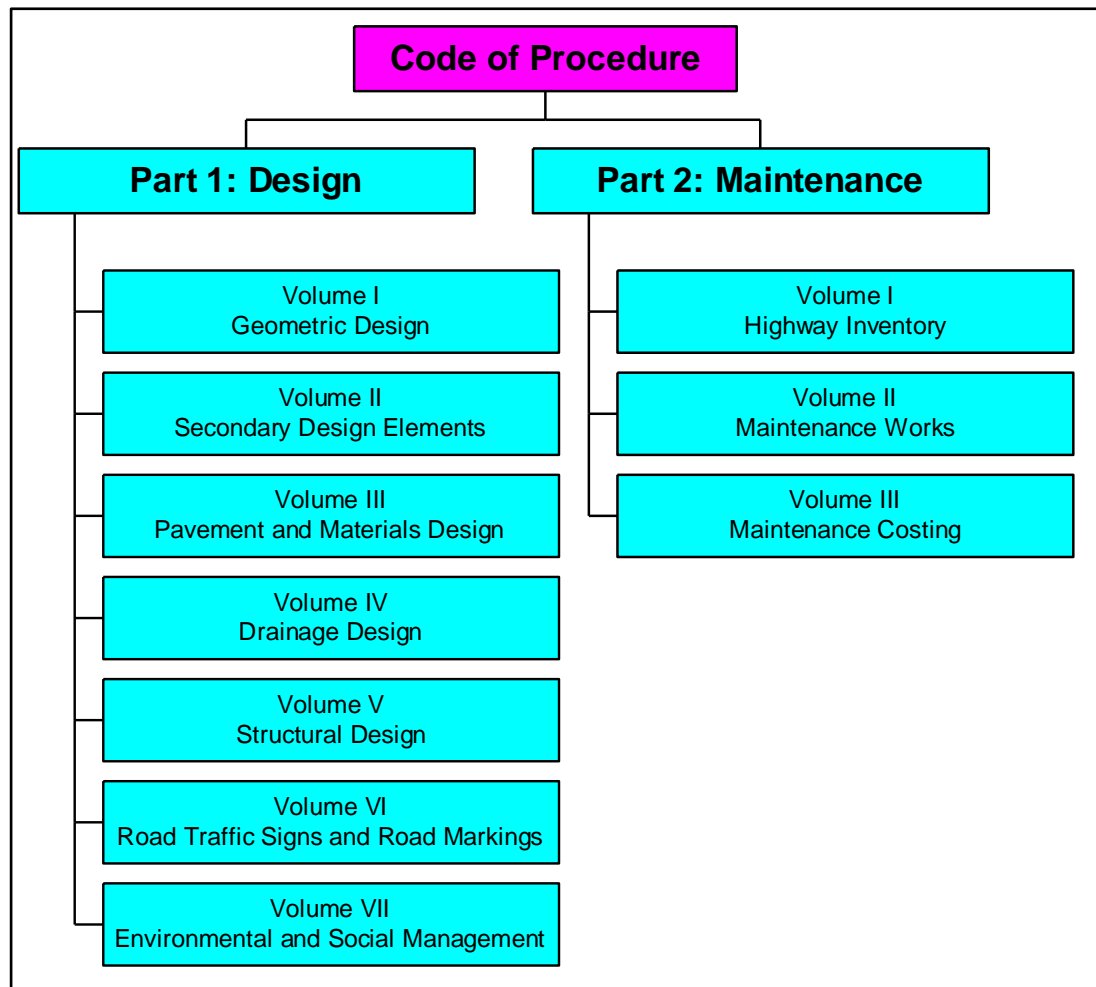
### 1.1 Introduction

Road transportation is the life blood of any country's economy in Africa and the Federal Republic of Nigeria is no exception. Nigeria has a well-defined network of Federal Highways, into which numerous State and Municipal roads interlink to provide a basis for road transportation access throughout the country. Freight and passenger transport is able to move freely to support the growing economy of the country. Future development, maintenance and rehabilitation of roads generally, and the Federal Highway network in particular, are key to unlocking the vast economic potential of the country.

This Code of Procedure is aimed at identifying the key steps in the development and management of roads and highways, to ensure that the system can meet the needs of the country in an economically efficient, effective, safe and sustainable manner. The various phases of a road or highway project are listed and the important elements that need to be taken into account in the process of developing, implementing, operating and maintaining that project in a safe and sustainable manner, to give maximum economic benefit to the country, are indicated.

### 1.2 Code of Procedure to link to Highway Manuals

The Code of Procedure is the initial guide that links the user into the entire set of Volumes of the Highway Manuals, as shown in Figure 1. The Code is highlighted in pink and provides the overarching link to the other volumes of the Manual.



**Figure 1 Organisation of the Highway Manual Showing Context of Code**

### 1.3 Definitions

To assist in the clear understanding of the terminology used in this Code the following terms are defined:

**Agreement:** The Contract Agreement entered into between the responsible Authority and a Consultant.

**Consultant:** A consulting firm or person appointed in terms of an Agreement.

**Design Engineer:** The departmental internal design engineer or a consulting firm or any other body (Consultant) who is appointed to do the design work related to a road project.

**Engineering Representative:** The Engineer appointed by the Road Authority (normally in the employ of such Authority) for the supervision of construction phase of a road project.

**Project Engineer:** The Engineer dealing with a road design project, on behalf of Road Authority (usually an employee of the Road Authority).

**Resident Engineer:** The Engineer appointed by the Road Authority (who can be an employee of the Road Authority or a Consultant), to supervise the construction of the road project concerned.

**Road Authority:** In respect of a section of road, the Authority responsible for such section of road, this will be one of the following:

- For federal highways - Federal Ministry of Works
- For state roads – the Ministry of Works of the State in which the road is situated
- For local roads – the Local Authority in which the road is situated

#### 1.4 Responsibilities for Highway Projects

Public roads in Nigeria are each allocated to one of three levels of Government:

- Federal highways are the responsibility of the Federal Government, are planned and developed by the Federal Ministry of Works, and are maintained by the Federal Road Maintenance Agency.
- Roads, other than federal highways, within individual States and which are not local roads, are referred to as state roads and are the responsibility of the State in which they are located.
- Local roads lie within the local government areas, and fall under the responsibility of the local authority for that area.

Roads built and maintained by private organisations, which are open to public use, must also comply with requirements for public roads and will fall under the State or

Local Government Authority (depending on their location) for the purposes of standards, even though they are privately funded.

The Authority responsible for a road will be generically referred to in this document as the Road Authority or RA for the road concerned and may be any one of the above Authorities.

The Road Authority will need to take decisions relating to the various phases of the project and manage the process, but the execution of the various tasks within the process can be done using the Road Authority's own resources, by engaging consulting firms to do planning, design, environmental and social impact assessment and technical management, and engaging contractors to provide specific services, equipment or the construction of facilities.

An outline of the process to engage a consultant is provided in the Annex in Section 7.1. The process of procuring contractors is briefly touched upon in Section 5.1.

### 1.5 Phases of a Highway Project

The following are identified as the phases of a road or highway project:

- Identification phase
- Preparation phase
- Design phase
- Implementation phase
- Maintenance and operation phase

Each of these phases comprises several processes that are illustrated in the flow diagram in Figure 2 and listed in Figure 3. These are briefly elaborated in the following chapters of this Code. The points within these processes at which the various Volumes of the Highway Manuals need to be referenced are identified, to facilitate uniformity of both procedure and technical standards used in developing highway projects.

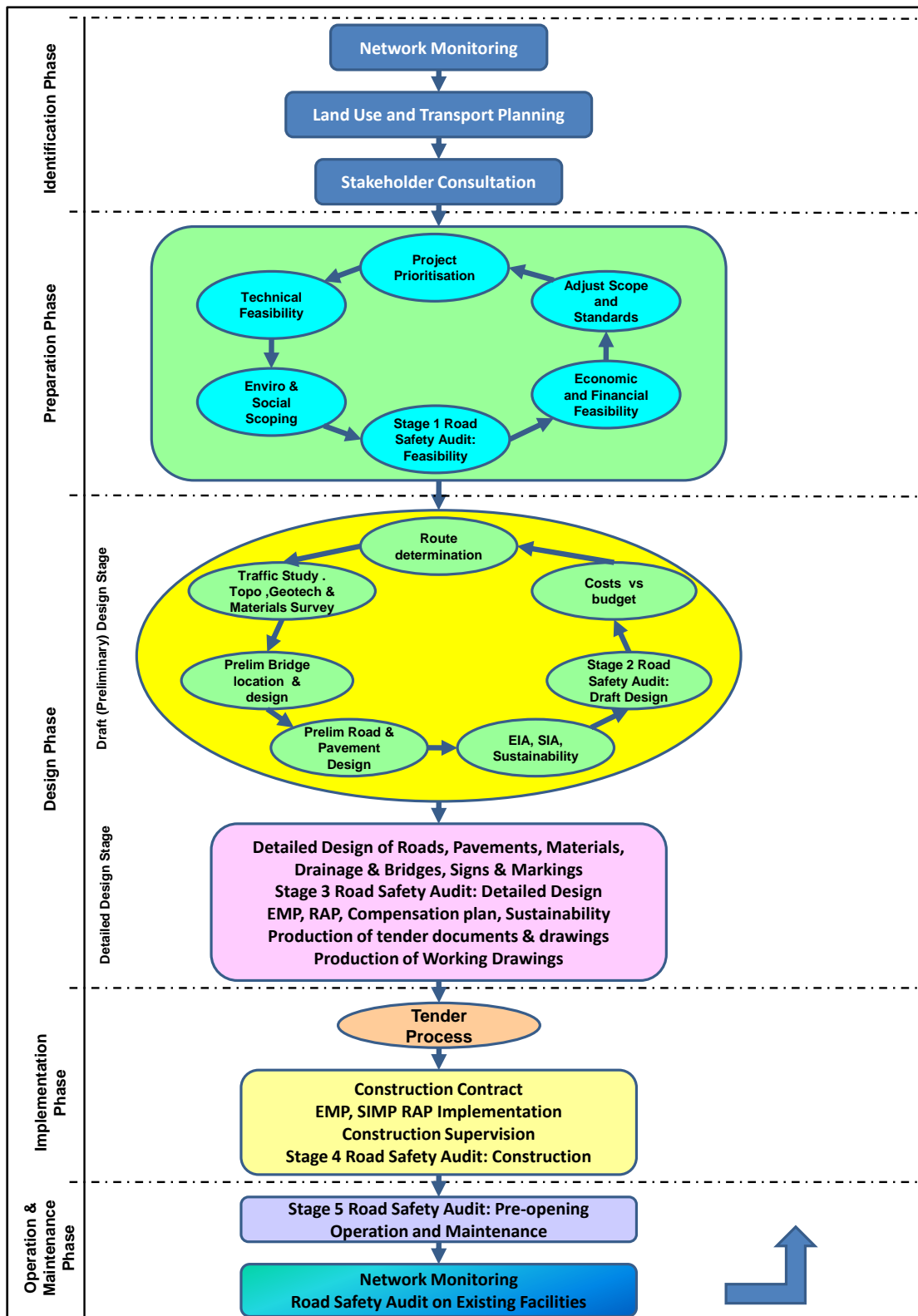


Figure 2 Flow Chart Showing the Phases of a Highway Project

### Identification Phase

- Network Monitoring
- Land Use and Transport Planning
- Stakeholder Consultation
  - This Phase results in a Long List of Projects

### Preparation Phase

- Project Prioritisation
- Technical Feasibility Studies
- Environmental and Social Scoping
- Stage1 Road Safety Audit: Feasibility
- Economic and Financial Feasibility
- Adjustment of Scope and Standards
  - This Phase results in a List of Prioritise Projects with definition of scope

### Design Phase

- Draft (Preliminary) Design (carried out on highest priority project(s))
  - Route Determination
  - Traffic Study, Topographical, Geotechnical and Materials Survey
  - Preliminary Bridge Location and Concepts
  - Preliminary Road, Pavement and Signage Design
  - Environmental and Social Impact Assessment
  - Stage 2 Road Safety Audit: Draft Design
  - Comparison of Costs and Budgets
  - This part of the Design Phase may be iterated to balance costs and budgets and results in finalising the proposed scope and details of the Project
- Detail Design of
  - Roads, Pavements, Materials, Drainage, Bridges, Roads Signs and Road Markings
  - Environmental Management Plan (EMP), Social Impact Management Plan (SIMP), Resettlement Action Plan(Rap) and Sustainability Design
  - Stage 3 Road Safety Audit: Detailed Design
- Tender Document and Working Drawings
  - This Phase results in a full designed and specified Project ready for implementation

### Implementation Phase

- Tender Advertisement, Bid Evaluation, Award, Construction Contract
- Stage 4 Road Safety Audit: Construction
- EMP, SIMP & RAP Implementation
- Construction Supervision and EMP, SIMP and RAP Supervision
- Stage 5 Road Safety Audit: Pre-Opening
  - The completion of this Phase will result in a sustainable, safe facility

### Utilisation and Asset Management Phase

- Operation and Maintenance of Roads, Bridges and Signs
- Network Monitoring
- Road Safety Audit on Existing Facilities
  - This monitoring Phase is an input to the identification of new projects

**Figure 3: List of Processes in Phases**



## 2 Identification Phase

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### 2.1 Project Identification

The project identification phase for roads involves determining from among the following processes or other sources, the need for road development and improvement. This phase is the responsibility of the Road Authority, which should be done within in the context of National, Regional and Local Planning for urban and rural development if such plans are available. Resources, in the form of consultants, can be drawn in by the Road Authority for specific investigations and planning tasks, but the overall vision for the road system remains the responsibility of the Road Authority. The procedure to appoint a consultant, if required, is described in the Annex in section 7.1.

### 2.2 Network Monitoring

Monitoring of the existing network of roads leads to the identification of rehabilitation and maintenance needs, and capacity constraints that are inhibiting efficient transport under present demand. Such monitoring may also in turn entail an analysis of the balance between private and public transport supply and demand on the road network. Road safety issues on the existing network may be identified and road safety audits on existing roads may be carried out to identify necessary road safety improvements. Similarly, environmental and social issues may be identified on existing roads that require specific intervention to improve existing facilities.

### 2.3 Land Use and Transport Planning

National and regional plans guide the future development of the country and therefore provide the basis for the future prediction of transport demand. The land use and transport planning processes are interactive, as providing appropriate transport to and from developments can be a determining factor when the locations of most developments are decided upon. Road transport provision is a substantial aspect of meeting this transport demand to support the economy. Increasingly, environmental issues are being included at the macro-planning level, as an early

warning or fatal flaw identification mechanism, when determining road network links at the regional scale.

## **2.4 Stakeholder Consultation**

Formalised stakeholder consultation is provided for through the parliamentary legislative and budgetary processes established in government, but these can be insensitive to needs in particular areas or under specific authorities. Where possible, consultation with key stakeholders needs to be conducted outside the formalized parliamentary process, to both identify needs and to obtain “grass roots” support for proposed projects.

## **2.5 Long List of Projects**

The above processes lead to a “long list of projects” covering new road provision and specific road upgrading and maintenance needs.

## **3 Preparation Phase**

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### **3.1 Project Preparation**

The Road Authority prepares projects identified in the previous phase to ensure that these are tested for feasibility in all respects; that budgets for the projects are developed; and to determine the benefits of each project to provide a basis for assigning priority among the projects identified. These are tasks which are easily packaged for use by consultants.

### **3.2 Prioritisation of Projects**

The long list of projects must be verified and prioritised on non-technical factors, to provide the indication of which projects should be further investigated first.

### **3.3 Technical Feasibility**

The highest priorities of identified projects are then subjected to technical feasibility studies, to identify the technical parameters that will need to be addressed in undertaking such projects. Concept designs for roads, pavements and concept forms for major structures that will be required are identified, as well as other major cost items that will be encountered in implementing the project. Industry norms to determine costs should be used.

### **3.4 Environmental and Social Scoping**

Environmental scoping of potential impacts relating to identified road projects, including the evaluation of alternatives, needs to be carried out and social and sustainability issues investigated. Opportunity for initial interaction with stakeholder groups and costs relating to the mitigation of these identified impacts should also be estimated.

### 3.5 Stage 1 Road Safety Audit: Feasibility

A Stage 1 Road Safety Audit (Feasibility) should be done by an independent specialist road safety auditor during the Preparation Phase of the Project. A Stage 1 Road Safety Audit has the following objectives:

- To identify the potential safety problems that can influence the:
  - Project scope
  - Choice of route, layout and/or treatment
  - Design standard selection
  - Impact on the adjacent road network
  - Access Control: Provision of accesses/ intersections/ interchanges
  - Continuity of routes
- To consider the design and operating speeds
- To assess the relative safety performance of various alternatives for the road project

Guidance on the execution of a Road Safety Audit is given in Volume II: Secondary Design Aspects of the Highway Manual Part 2: Design.

### 3.6 Economic and Financial Feasibility

Using the costs determined for the project, and traffic estimates, high level economic feasibility studies should then be undertaken to indicate investment needs and likely returns from such investment.

Financial analysis will determine the overall budgets, as well as the timing of the investments that are required for the project. Funding for these projects must then be identified and allocated.

### 3.7 Adjustment of Scope and Standards

Where the cost of a proposed project either exceeds or does not reach the limit of funds available for the project, the scope and standard of the project can be reviewed to create savings or cost increases as appropriate, including considering stage construction of the project.

### 3.8 Confirmation of Priority of Projects

Economic returns (Net Present Value, Internal Rates of Return, Cost/Benefit Ratios) are then used to provide confirmation/adjustment of the priorities among projects identified.

If required, the entire project preparation process can be re-iterated to test alternatives of scope and standard of a particular project, to determine the alternative with the highest benefit cost ratio, or to fit available funding.



## 4 Design Phase

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### 4.1 General

The Design Phase of a road project involves three stages; comprising a Draft (Preliminary) Design Stage, a Detailed Design Stage and a Documentation Stage. These are described in the following subsections.

As indicated in Chapter 1.4, a Road Authority may undertake road design using its own design resources or using a consultant. Where it is decided to use a consultant, the procedural guideline to appoint the consultant is shown in the Annex in Section 7.1 should be adapted to the specific requirements of the project.

The Design Engineer for the road project shall, in the execution of his duties outlined in this Code of Procedure, use the Highway Manuals Part 1: Design and reference the other technical guidelines referred to in those manuals.

### 4.2 Draft (Preliminary) Design Stage

Preliminary design is carried out to provide a technical solution to the design of the project, and to give an estimate of cost that will be within 20 percent of the actual final construction cost. The preliminary design therefore provides a basis for interaction between the Project Engineer and the Design Engineer, to allow the road standards and facilities provided under the project to be adjusted, to best achieve the objectives of the project while remaining within available budgets.

The steps in carrying out the Preliminary Design Stage require the execution of all or a subset of the various tasks that are clarified in the following subsections. It should be noted that although the steps are presented sequentially, there will be a need to iterate between two or more of these steps to determine the optimum arrangement for the project concerned.

#### 4.2.1 Route Determination

##### *a. Purpose of Route Determination*

The route determination is a process that is mainly required for new roads, but can be required for existing roads where realignment is required on some sections. The purpose of the route determination process is to:

- Establish the extent of the area to be covered by topographical survey to produce site plans that will allow the detailed alignment to be selected during the preliminary and final design stages
- Produce a report which provides sufficient detail to form the basis for consultation with authorities and stakeholders.

##### *b. Process for Producing a Route Determination*

The steps to be followed include but not limited to the following:

- The selection of the Class of Road and its function is to be determined from Chapter 2 of the Volume 1 – Geometric Design.
- Determination of target geometric standards for curves and grades, in accordance with the class of the road.
- Visual inspection of the site in order to determine physical controls.
- Identifying preferred bridge sites for bridges across major rivers or for other required structures.
- Acquisition and study of existing plans and aerial photographs.
- Examine the Environmental and Social Impact Assessment Report relating to the project, or if this has not been completed previously, have such a report compiled, taking into account the findings of such report, particularly with regard to possible route alternatives.
- Investigation of land utilization and development potential.
- Liaison with federal, state, local authorities, utilities service providers and other interested parties.



*c. Required outputs of Route Determination*

The Design Engineer shall compile a full report, including a key plan and interpolated longitudinal sections, which shall comprehensively describe the project and its objectives in non-technical terms and include:

- A discussion of feasible or alternative routes.
- A substantiated recommendation regarding the most suitable route, including cost estimates for the construction of alternative routes.
- A listing of any important issues that will need to be investigated or mitigated in the design process going forward.

#### **4.2.2 Traffic Study and Prediction**

*a. General*

Estimates of future traffic to use a road are required to determine the cross sections required along the road, to accommodate the predicted traffic and to determine the strength of pavement of the road to carry the expected numbers of heavy vehicles that are anticipated during the life of the road.

*b. Existing Traffic*

Where the project consists of upgrading of an existing road, an assessment of existing traffic should be made from:

- Any available traffic count data.
- A specific traffic count for the project, taken over as long a period as possible. A minimum of a seven day classified count (classified as a minimum of six classes of vehicle – light vehicle, minibus, bus, heavy vehicle two axle, heavy vehicle three to four axle, heavy vehicle five axles and more) should be required. Where traffic data from a nearby permanent traffic count station is available, the specific seven day traffic count information should be adjusted according to cyclical and seasonal variations shown at the

permanent traffic count station, to better represent the annual average daily traffic AADT on the project.

- Origin – Destination (O-D) surveys should be carried out on existing roads that are currently carrying the traffic that has potential to use the road project under consideration. This is an important input to assessing the amount of traffic that may divert from other routes onto the proposed road project.

*c. Traffic Modelling*

Where the project is a new road, anticipated traffic on completion of the road needs to be determined, based upon a traffic model taking account of diverted traffic and generated traffic. Traffic models can also be used to more accurately predict future traffic on existing roads.

*d. Predicted Traffic*

Prediction of future traffic on the project road should be determined by at least assessing planned future developments in land use, as well as trends in general economic growth in the areas served by the road.

Predictions of traffic (in the classes identified above) at the completion of the improvement project, and at points five, ten, fifteen and twenty years after the completion of the road should be made.

### **4.2.3 Topographical Survey**

The Design Engineer is responsible for all aspects of the topographical survey work, which will usually be undertaken by a specialist survey contractor. The survey should include the basic ground survey, the establishment of permanent survey beacons, and the preparation of a digital terrain model in an appropriate electronic format and the production of plans, including the compilation and plotting of all data according to the relevant specification. This will include detailed site surveys for all major structures. The survey will be conducted in accordance with the Highway Manual Part 1 Design: Volume I Geometric Design.

#### 4.2.4 Geotechnical and Materials Survey

The materials surveys are to be carried out to provide the information required to identify sources and qualities of all materials required for the construction of the road project. This includes identifying the qualities of the in-situ materials that will form the road bed and subgrade, identifying of sources of all material required for the design of road pavements, in accordance with the technical guidance provided in Volume III Pavement and Materials Design of the Highway Manual, Part 1: Design, identifying materials sources for aggregates for road surfacing and for aggregates (sand and stone), for use in concrete for minor structures and for bridge structures, and sources of water for construction.

Bridge site investigations require comprehensive geotechnical foundation investigations, including drilling of cores to establish suitable founding levels for each element of the substructure for each bridge.

Where deep cuts and high fills are required, geotechnical investigations may also require boreholes to be drilled for cores to establish the nature of underlying strata, to assist with estimation of costs of cutting into such deep lying strata, and to assist in the preparation of mitigation measures if such strata indicate a likelihood of cut faces collapsing, or of underlying materials consolidating under high fills.

#### 4.2.5 Preliminary Geometric Design

The preliminary geometric design should include:

- Determining the most suitable horizontal alignment of the centre-line of the road.
- Provision of detailed route alignment for legal proclamation of the road Right of Way (RoW), if this has not been done in the project preparation phase.
- The preparation of a recommended comprehensive vertical alignment design for the roads, including interpolated longitudinal sections, preliminary planning with regard to the placing of road signs, and the preparation of cross-sections from the Digital Terrain Model at intervals not greater than 40 metres apart. Consideration of alternatives that can generate capital cost

savings and the reasons why these are not recommended shall be documented.

#### **4.2.6 Preliminary Pavement and Material Design**

- The estimation of the expected axle loading and the preparation of a preliminary pavement design.
- The investigation of the general geology of the area, the local occurrence of road building materials and possible problem areas, that must be covered in full in the report.

#### **4.2.7 Preliminary Drainage Design**

Preliminary drainage design shall be produced to provide cost estimates within 20 percent of actual final costs. Design in accordance with Volume IV: Drainage Design of the Highway Manual Part 1: Design will be carried out for all watercourses crossed by the road, to determine size and type of structure to be used and to allow the costing of these. In very flat areas, the Design Engineer should check that the preliminary vertical alignment (Section 4.11.1) provides sufficient clearance for freely discharging cross-drainage structures. If not, adjustment of the vertical alignment may be required. Costs for kerbing, channels, flumes, drain lining and road surface drainage can be estimated at a per kilometre rate for the preliminary design stage.

#### **4.2.8 Preliminary Structural Design of Bridges and Culverts**

##### *a. General*

All bridge structures and major culverts (span greater than 6 metres or skew or non standard culvert structures) shall be designed in accordance with the Highway Manual Part 1: Design Volume V Structural Design. The term “bridge” as used in highway design, applies to structures over waterways, grade separation structures, road over rail structures and elevated highways. Each bridge presents its own unique problems. The best type of bridge for grade

separations conforms to the highway alignment, profile, and cross section and gives drivers little sense of restriction. The structure should be pleasing in appearance and properly adapted to the site.

*b. Location of Bridges*

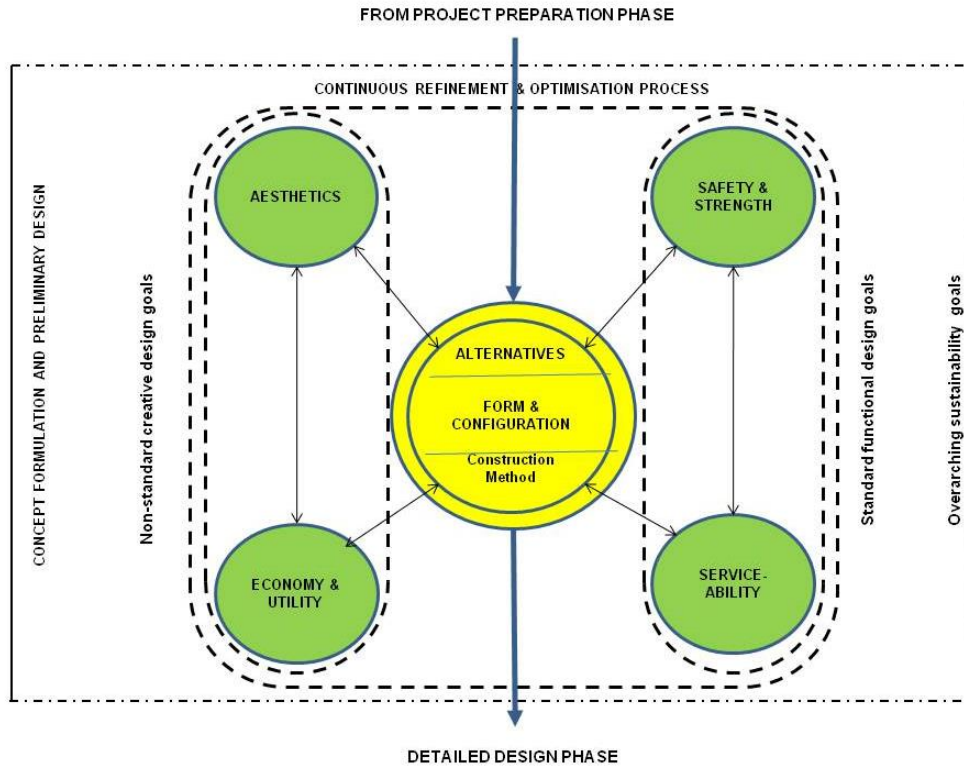
Bridges are located to conform to the general alignment of the highway. The ideal location for a bridge crossing is one where:

- The approach has a reasonable grade
- Soil and foundation conditions are adequate for the installation
- The need for future changes, such as widening, can be accommodated
- Economic considerations with regard to materials and construction methods can be optimised
- Safety of vehicular traffic and other road users is assured

It may not always be possible to satisfy all of the abovementioned conditions, but they should all be carefully considered. When selecting new alignments for the roadway, careful consideration should be given to meeting as many of these conditions as possible. The final decision for location should be based on a complete analysis of the factors involved, including those relating to traffic safety, operating conditions and economics.

*c. Process for Preliminary Bridge Design*

The iterative processes for balancing the various differing requirements for the design of a bridge are shown in Figure 4.



**Figure 4 Process for Structural Design of Bridges**

*d. Requirements at Preliminary Design Stage for Bridges*

For preliminary design, a general arrangement showing the proposed layout and elevation of the structure is required, to allow the assessment of the proposed solution and a preliminary costing of the structure. Locations of all structures are to be shown on the road layout plans. A bridge schedule is to be prepared for all new structures and for widening of existing structures.

#### **4.2.9 Preliminary Design of Road Traffic Signs**

The preliminary design must include the provision of traffic signs, traffic signals, and road markings. These can be a significant cost of the project, particularly for high standard roads where gantries for mounting overhead signs that require lighting for visibility at night are required.

#### **4.2.10 Identification of Affected Services**

- The investigation of services that will be affected by the project, detailing of these on the drawings, and specifics of how these will be dealt with and the estimated costs thereof.
- A schedule together with plans showing all services, such as sewers, pipelines, cables, masts, irrigation canals, local accesses etc., as well as all RoWs, the Design Engineer's proposals as to how they are to be shifted and the estimated cost of relocation, as obtained from the service authorities. This aspect must at least include inspection of properties for services and interaction with local and other authorities and utilities service providers to identify affected services.

#### **4.2.11 Environmental and Social Impact Assessment**

A detailed Environmental and Social Impact Assessment will be required, as set out in the Highway Manual, Part 1 Design - Volume VII Environmental and Social Impact Management. An Environmental Management Plan, identifying impacts and mitigation measures, will be required for inclusion in the construction contract documentation.

#### **4.2.12 Resettlement and Compensation Plan**

The exact areas of land that need to be acquired for the road project must be determined immediately the final alignment is decided upon. Land owners need to be identified, losses assessed and compensation for any land acquired must be determined, including relocation costs where appropriate.

#### **4.2.13 Stage 2 Road Safety Audit: Draft (Preliminary) Design**

The Stage 2 Road Safety Audit is carried out by an independent specialist road safety auditor, as a final task of the preliminary design of the road and has the purpose to review the following items:

- To address the design standards utilised for the draft design
- To consider, among others, the following
  - Alignment (horizontal, vertical)
  - Sight distances
  - Layouts of intersections
  - Widths: Lanes and shoulders
  - Cross sections and super-elevation of pavement
  - Location of accesses
  - Provision for different road user groups - pedestrians, cyclists, heavy vehicles, etc
- To evaluate whether any deviation from guidelines and design standards would impact safety negatively.
- To determine how possible staged implementation of the project could influence road safety; If staging is proposed, then the safety of each stage should be considered, as well as the transition from one stage to the next.
- To consider the issues listed in the Stage 1 Feasibility Road Safety Audit if the Stage 2 Road Safety Audit is the first audit of the road project.

The result of the Stage 2 Road Safety Audit shall be summarised in the Preliminary Design Report. Guidance on the execution of Road Safety Audits is given in Volume II: Secondary Design Aspects of the Highway Manual Part 2: Design.

#### **4.2.14 Preliminary Design Report**

The compilation of a Preliminary Design Report is required, containing detailed contour survey plans showing the proposed design, a summary and recommendations of the Environmental and Social Impact Assessment Report, a summary of the results of the Stage 2 Road Safety Audit, and a critical analysis of the route with clear motivation of proposals, together with data on the standards



which may be attained, as well as cost estimates. Other issues that may be required as part of this report include:

- Any additional investigations, should the route traverse mining land or undermined areas or areas subject to subsidence.
- Investigation and assessment of the impact of high order roads, railways and other important nodes on the project. Existing and future access to railway stations, airports and seaports and similar points of importance must be addressed in all planning and design.

### 4.3 Detailed Design

#### 4.3.1 Preparatory Work

In cases where a route determination report exists, but no approved preliminary design exists, the Design Engineer should undertake the following;

- A visual inspection of the site, with special reference to materials and physical controls which may influence the final alignment and route of the road.
- Study of the existing route determination report, small scale aerial photographs and plans.
- Liaison with public bodies, and other interested parties and investigation of land utilization and development potential.
- Consult with the Project Engineer as to the extent of a preliminary design report.

In cases where an approved preliminary design already exists, the Design Engineer shall review the existing approved preliminary design critically before undertaking detailed design, and should she/he have any comments to make, such comments shall be submitted to the Project Engineer in writing.

### 4.3.2 Detailed Geometric Design

The Design Engineer's normal duties in respect of the Detail Design are as follows:

- The staking of the road, (usually by a survey contractor) together with the taking of cross-sections and the carrying out of any additional site surveys required for the road or structures. Over relatively flat terrain, cross-sections shall be taken at intervals not exceeding 20 metres, and over hilly or mountainous terrain at intervals less than 20 metres as required.
- Preparation for moving of services: The Design Engineer shall liaise at an early stage of detailed design, with all the owners of services affected by the road, arrange for moving and make contractual arrangement therefore.
- Prepare plans and detailed drawings, a full list of which, with recommended scales, is provided in the Annex in Section 7.2

### 4.3.3 Detailed Drainage Design

#### a. General

The technical detail of design of storm water drainage systems is discussed in the Highway Manual Part 1: Design - Volume IV: Drainage Design

Discussion in this Code of Procedure is therefore limited to policy and procedures that the Design Engineer should incorporate in the cross-section to ensure adequate drainage of the road reserve and the adjacent land. A distinction is drawn between rural and urban drainage.

- Rural drainage focuses on the safe removal of storm water from the travelled way onto the verge and on its movement to a point where it can be taken from the upstream to the downstream side of the road, ultimately discharging into a defined natural water course.
- In an urban environment, the road reserve serves as the principal conduit of storm water from surrounding properties and its conveyance to a point where it can be discharged into natural watercourses.

- In both rural and urban environments, storm water drainage is aimed at both the safety of the road user and the protection of the integrity of the designed pavement layers of the road. The safety of the road user dictates that a maximum depth of an open drain be specified and the recommended maximum depth is 500 mm. The volume of water to be conducted by a drain thus indicates the required width of the drain rather than its depth, since the need to protect the design layers from saturation by both storm water and subsurface water remains unchanged.

*b. Drainage Design Procedures*

The fundamental principles of the procedure to be used in designing highway drainage are as follows:

- Where natural water-courses and drainage channels exist, the highway shall be provided with appropriate cross drainage across these channels or water courses, and the roadways and verge shall be drained directly into them.
- Where conditions necessitate drainage beyond the limits of normal acquisition, more land shall be acquired for the necessary drainage channels.
- In urban areas where drainage channels have been provided by other authorities, a formal agreement relating to the extent of the amount of discharge from the highway shall be negotiated and entered into by the Road Authority.
- The Road Authority may participate in flood control projects in the interest of the highway. The amount of participation shall be based on the legal premise that aid must be restricted to the amount of benefit accruing to the Federal Government by reason of the improvement. Such projects shall be covered by a formal agreement.

Design of cross drainage structures shall comprise the following steps:

- Determination of a design flood by assessing catchment areas, rainfall intensity duration frequency, and selecting an acceptable return period for floods that will exceed the capacity of the proposed structure.
- Selection of a structure providing capacity to accommodate the design flood.

A cross drainage schedule shall be compiled and included in the Design Report, which provides a list of catchment areas, return period selected, calculated design flood and capacity of structure provided.

Longitudinal drainage structures shall be designed to ensure flood waters are safely carried to the point of natural discharge without excessive erosion or stagnation.

Road surface drainage should be designed to prevent unsafe flow depths (due to the danger of aquaplaning) on the travelled lanes under design storm conditions, and adequate provision should be made to carry the accumulation of this water safely into the main drainage structures along and across the road.

#### **4.3.4 Detailed Structural Design**

##### *a. General*

Technical guidelines relating to the structural design of bridges and non-standard culverts is provided in Volume V: Structural Design of the Highway Manual Part 1: Design.

##### *b. Bridge Site Data*

It is important to collect all the bridge site data, as it will have a major influence on the ease of construction and construction costs. A list of typical information required at a bridge site is shown in the Annex in Section 7.3.

### *c. Detailed Design of Bridges*

The detailed design of the structures required for the road involves more rigorous application of the optimisation process illustrated in the section on preliminary design of structures, Figure 4, to obtain the most efficient and effective structure, and to ensure that all loads are adequately resisted. The design shall result in detailed drawings and schedules, a typical list of which is given in the Annex in Section 7.2.2.

#### **4.3.5 Detailed Design of Road Traffic Signs**

Detailed designs for all road traffic signs, road markings, as well as full provision for traffic lights, variable message signs, gantry mountings for overhead signs and the lighting thereof, must be detailed in both design drawings and in tender documentation in the Bill of Engineering Measurements & Estimates (BEME).

#### **4.3.6 Environmental Management Plan**

The Environmental Management Plan (EMP) that is derived from the EIA must be fully detailed and mitigation measures required must be specified in detail and included in the Bill of Engineering Measurements and Estimates, to ensure the provision of these measures is priced in the bids offered by the contractors.

#### **4.3.7 Resettlement and Compensation Plan**

Normally the Resettlement and Compensation Plan for a project needs to be prepared in advance of the final tender documentation, because the need to finalise land acquisition and compensation for affected persons has to be complete prior to the commencement of construction.

#### 4.3.8 Stage 3 Road Safety Audit: Detailed Design

The Detailed Design Road Safety Audit normally takes place after completion of the detailed design, but before the contract documents are prepared. This stage is the last opportunity to influence the design before construction commences, and is a review of those drawings that are put forward as those on which the project will be constructed.

This audit is focused on aspects of detail of the road layout, traffic arrangements and information transfer to the proposed road user groups. It is also important that any issues that have not been satisfactorily resolved from earlier audits, be reiterated in this stage audit. It may well happen that the proposed remedial measures for such an outstanding issue be different in this stage than an earlier stage, because the flexibility to influence the design is less.

The purposes of the Stage 3 Road safety Audit are:

- To consider, among others, the following:
  - Any changes since the Stage 2 Audit
  - Road traffic signs and markings
  - Road lighting
  - Intersection detail
  - Roadside hazard management issues (clear zones, traffic barriers, fixed objects etc.)
  - Needs and requirements for Special Road Users (pedestrians, cyclists, individuals with disabilities, heavy vehicles, buses etc.)
  - Traffic management and control drawings for the proposed accommodation of traffic during construction
  - Drainage
  - Landscaping
  - Cross section and side slopes, etc.
- To review those findings of earlier stages and the implementation of mitigating measures;
- To consider the issues listed in the Stage 1 and Stage 2 Road Safety Audit if the Stage 3 Road Safety Audit is the first audit of the road project.

Copies of the report on the Stage 3 Road Safety Audit shall be provided to the Project Engineer and the Design Engineer, as well as to the Road Authority.

Guidance on the execution of Road Safety Audits is given in Volume II: Secondary Design Aspects of the Highway Manual Part 2: Design.

#### 4.3.9 Detailed Design Report

The detailed design report shall contain all details of investigations and results of all calculations carried out for the design of the road project, with special reference to the following:

- Scope of Report.
- Detailed description of the route.
- The Class of Road and the Standards selected for the road.
- Traffic patterns (existing traffic counts, expected growth rate projections) and level of service to determine the number of lanes required or the necessity of climbing lanes, as well as any other special characteristic regarding traffic.
- Regional and urban development.
- Climate, geology and geography of the area traversed.
- Vertical and horizontal standards of alignment that are attained and factors affecting this.
- Details of materials quality and sources, and of the pavement design.
- Existing services and improvements affected.
- Detail of the structures designed.
- Detail of the drainage provided.
- Results of design calculations.
- A summary of environmental and social impacts and the environmental management and resettlement and compensation plans related to the project, as well as any sustainability issues.

- Detail of design of road signs and road marking.
- A summary of the results of the Stage 3 Road Safety Audit and any special measures taken to address safety issues.
- Traffic Accommodation.
- An estimate of construction costs and cash flow for the construction of the road.

#### **4.4 Tender Documentation and Working Drawings**

##### **4.4.1 Preparation of Engineering Plans and Drawings**

A full set of design/construction plans is to be generated providing sufficient information for prospective contractors to bid/tender and subsequently construct the Works, should the bid be successful.

##### **4.4.2 Bill of Engineering Measurements and Estimates (BEME) and Preambles**

The BEME shall be compiled and sequentially refined/amended consistent with the engineering designs and construction plans prepared. The schedule of quantities shall be priced by the Design Engineer, to produce an accurate cost estimate that shall be maintained as strictly confidential. The cost estimate will be reviewed/revised in light of the general state of the local road construction industry.

##### **4.4.3 Works Specifications**

The specification of the Works shall refer to the General Specification (Road and Bridges) of the Federal Ministry of Works <sup>iii</sup>. Specifications of particular application must be compiled where the general specifications do not adequately cover the work to be carried out on any part of the project.



#### 4.4.4 Tender Documents

Draft tender/bidding documents are to be compiled and shall contain the following:

- Form of Tender and concise instructions to tenderers on preparation of tenders
- The General Conditions of Contract used by the Road Authority
- Special Conditions applying to the project
- Specifications of particular application to supplement the Standard Specifications for Road and Bridge Works generally used by the Road Authority
- Specifications of particular application to cover the requirements of the Environmental Mitigation Plan
- Specifications of particular application to cover the requirements of the HIV/AIDs awareness and prevention campaigns
- Specifications of particular application to cover local labour and sub-contracting requirements
- Description of the project including overall objectives and summary of works
- Details of materials and geotechnical information
- Full set of construction plans
- Schedules of quantities

Where prepared by consultants, draft tender/bidding documents together with the detailed design report shall be submitted/presented to the Road Authority for review and comment.



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## 5 Implementation Phase

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### 5.1 Tender Process

#### 5.1.1 Public Procurement Act, 2007

The Public Procurement Act 2007 (2007 Act No.14), governs all procurement by Federal Government and all procurement entities, and by entities deriving more than 35 percent of their revenue from the Federation share of the Consolidated Revenue Fund. The general procurement of goods and services is governed by sections 25 to 38 of the Act, while sections 39 to 43 cover special applications, such as two stage or restricted tendering.

#### 5.1.2 Prequalification

A pre-qualification process may be required to select competent tenderers. Clauses shall be compiled and inserted in the bidding data section of the bid/tender documents to cover the qualification requirements for bidding.

The pre-qualification dossier or bidding document shall give a description of the scope of the envisaged project and request prospective contractors to present details regarding:

- Eligibility to Bid
- Experience in similar “Works” contracts regionally
- Specific work experience in country
- Work commitments at time of pre-qualification submission
- Availability and ownership of basic construction equipment
- Financial standing and results of the past five (5) years
- Contact details of Clients and financial references

- Joint Venture arrangements, if any
- Extent of “local” involvement in project
- Anticipated scope of subcontracting
- Policy procedures and statement regarding health and safety.

In the case of a proposed joint venture, each party shall provide separate information and the submission will need to also provide details of the anticipated level of involvement of each party.

### **5.1.3 Invitation and Submission of Tenders**

#### *a. Tender Invitation including Administration Duties*

The tender invitation process shall be conducted by the Road Authority, or shall be carried out by the consultant appointed for the project, in close consultation with the Road Authority at all stages, and shall include the following:

- Compile list of approved contractors
- Advertise in selected publications
- Invite tenderers to collect documents
- Keep audit record of tender deposits and a list of organisations collecting documents
- Organise the pre-bid meeting and site inspection, if required
- Arrange clarification meetings, if required
- Prepare replies to queries
- Prepare addenda to tender documents
- Ensure that all potential bidders receive all tender information issued

*b. Site Visit and Pre-bid Meeting, Minutes and Report*

Where required a site visit and pre-bid meeting shall be arranged for all tenderers, to ensure that they acquaint themselves with the local conditions, environment and type of materials available, thereby eliminating some of the risks and consequent inflated cost. It shall also enable contractors to assess the availability of aggregates.

Any queries related to designs, documentation and drawings shall be clarified during the site visit and meeting, in the presence of all potential tenderers, the Design Engineer and Roads Authority representatives.

The site visit and meeting shall be recorded and issued as minutes. Responses to queries and clarifications, supplemented by the Design Engineer's comments, and decisions by the Road Authority, will be issued as an addendum, to become part of the Contract.

*c. Tender Clarifications, Addendums, Closing Date*

On a day to day basis throughout the tender period, queries from tenderers' may be received. These shall be monitored by the Design Engineer and clarified in close consultation with Roads Authority.

If necessary, an agenda shall be prepared and issued by following the prescribed procedure, ensuring receipt and acknowledgement by each tenderer prior to the closing date.

#### **5.1.4 Adjudication and Award**

Computer aided evaluation of tenders shall be based on the following principle steps:

- Technical matters
  - Conformity with specification and drawings
  - Conformity to time constraints, if applicable

- Identification of alternatives
- Methods of construction and temporary work
- Preliminary programme
- Work to be sub-contracted
- Adequacy of proposed construction plan and equipment
- Adequacy of management structure
- Financial matters
- Arithmetical accuracy
- Reasonableness/conformity to limited establishment cost
- Reasonableness of unit rates
- Reasonableness of time related costs
- Reasonableness of lump sums
- Reasonableness of profit margins on labour and plant
- Reasonableness of transportation and fuel costs
- Scheduling of payments (cash flow versus progress)
- Discounted cash flow and net present worth
- Currency payment requirements
- Contract price adjustment
- Conformity of bonds and guarantees
- General contractual obligations
- Conformity with instructions to tenderers
- Completeness of tenders

- Validity of tenders
- Exclusions and qualifications, whether stated or implied
- Adequacy of insurances
- Working hour/public holiday
- Labour resources
- Administration expertise

The benefits to the Road Authority resulting from alternative designs shall be evaluated and the practicality of alternatives shall be investigated.

Proposed design alternatives shall be checked from an engineering point of view and cost of design changes shall be extracted if applicable.

An evaluation system for alternative designs by various tenderers shall be developed if necessary to apply fair and professional criteria to the overall evaluation of tenders submitted.

The evaluation process shall also include a sensitivity/risk analysis of key aspects of the tenders, including the following:

- Variance of main quantities and their effect on the overall tender price
- Optimistic production rates
- Failure to meet programme completion dates.

The evaluation results shall be presented in the draft Tender Evaluation Report. All priced items, mark-ups and alternatives shall be tabulated to become comparable with the original Design Engineer's estimate.

The objective of this final task in the evaluation process is to arrive at a fair evaluation of all tenders received, including any alternative offers.

Fully motivated, definite recommendations for the award of tenders shall be included in the draft Tender Evaluation Report. This will include recommendations for any conditions, which may need to be imposed on the preferred bidder.

The draft Tender Evaluation Report shall be considered by the Road Authority, and following receipt of comments and after due consultation, the final tender evaluation report will be prepared and submitted for approval by the authorised member of the Road Authority.

Once the Tender Evaluation Report is approved, the preferred bidder will be awarded the Contract.

## **5.2 Construction Contract**

The Road Authority shall then enter into the contract with the preferred bidder to carry out the works according to the contract document.

## **5.3 Construction Supervision**

The Road Authority will appoint a suitably qualified person as “the Engineer” for the project, who may be a staff member or a consultant. Normally a “Resident Engineer” is also appointed for supervision of the works on site during construction of the project, and to monitor the defects liability maintenance period.

The Resident Engineer shall be responsible for proper supervision of the execution, of the work, including the checking and approval of any later alternative designs, designs for temporary works, construction details (such as pre-stressing details) submitted by the Contractor, and of workshop details in the case of the structural steelwork according to the Contractor's working drawings and construction methods.

If deemed necessary, an environmental specialist shall be appointed for the construction phase, to monitor the implementation of the Environmental Management Plan. This should preferably be from an independent environmental firm.



Typical supervisory staff shall be provided in the categories below in respect of each contract for which a tender is accepted:

- a. The Resident Engineer shall be properly qualified and experienced in the type of work to be supervised, and must be a Registered Professional Engineer in terms of the Council for Regulation of Engineering in Nigeria (COREN) requirements.
- b. Approval for the appointment of the Resident Engineer shall be obtained from the Roads Authority. A properly trained Materials Engineer or Technician who can perform and interpret all material tests as stipulated in the specifications, to exercise control over material quality, compacting and finishing. The Engineer or Technician must be registered. The appointment of the Materials Engineer or Technician shall be approved by the relevant Roads Authority.
- c. A properly trained surveyor who can interpret all survey and setting-out plans, survey manuals, cadastral data, quantities, etc. The surveyor must be registered as a surveyor. The Engineer shall, in accordance with the Highway Design Manuals, liaise with the relevant Road Authority and authorize all design changes.
- d. All design changes must be finalized by the Resident Engineer and the Engineer Representative of the relevant Roads Authority.

The Resident Engineer and his representatives on site during the construction phase are responsible to the Roads Authority to “administer the contract” as stipulated in the General Conditions of Contract.

Under no circumstances are changes in the design to be authorized on site without consultation with the Resident Engineer and the Engineer Representative of the Road Authority.

The Resident Engineer shall make recommendations to the Road Authority regarding the number of supervisory staff required, taking into account the extent of the contract and the Contractor's rate of progress. .

The Resident Engineer is responsible for the administration of the contract, including the certification of all payments, the provision of monthly progress reports and a list of work rejected, as well as a three monthly report reflecting the financial state of the contract, which takes into account the incomplete work and negotiations with the Contractor in connection with matters arising from the contract.

The Resident Engineer is responsible for the execution of any duties assigned to him or her in terms of the general and special contract conditions applicable to the project.

The Resident Engineer is responsible for regular site visits to ensure the proper execution of the contract.

After completion of the contract, the Resident Engineer shall submit to the Roads Authority all construction details, "As Built" completion plans and materials test results.

Any changes/omissions/issues relating to environmental matters shall only be addressed as stipulated in the Environmental Management Plan and Environmental and Social Impact Assessment Report, and only after advice from the appointed environmental specialist and consultation with and approval from the Roads and Environmental Authorities.

In the case of archaeological or paleontological findings during construction, the construction work in the area of the findings shall be stopped and the Roads Authority and other applicable heritage authorities shall be notified immediately.

#### **5.4 Stage 4 Road Safety Audit: Construction**

The Construction Stage Road Safety Audit is undertaken to review the traffic management proposed by the Contractor. It is distinguished from the Stage 5 Road Safety Audit in that it is concerned with the temporary measures that are used to protect safety, while the construction operations are in progress. The fact that the Contractor is required to have his own Safety Management Plan, and that this is monitored by the Engineer must be taken into account. The purposes of this Audit are to assess:

- Appropriateness of the proposed traffic management scheme, especially conditions in transition areas
- Adequacy of advance warning
- Proposed and actual speed limits
- Conflicts between permanent and temporary features
- Any aspects of the layout that could be misread by road users or aspects that violate driver expectancy
- Likelihood of mud or dust obscuring devices
- Appropriateness of vehicle restraint systems/ barriers and the correct installation and the safety of the terminals
- Adequate provision for pedestrians and public transport vehicles like minibus taxis
- Conflict points between site traffic and the general public
- The effect of congestion during peak periods
- The effect of an incident within the detour/ deviation areas

The Stage 4 Road Safety Audit Report must be provided to the Engineer with a copy to the Resident Engineer. Guidance on the execution of Road Safety Audits is given in Volume II: Secondary Design Aspects of the Highway Manual Part 2: Design.

### 5.5 Stage 5 Road Safety Audit: Pre-opening <sup>i</sup>

The Pre-opening Road Safety Audit should be conducted before the opening of a road scheme to traffic, but not before substantial completion of the project; enabling the audit team to review conditions as it would be experienced by different road user groups. The purposes of this Stage Audit are to assess that:

- Sufficient provision has been made for the different road users of the road project, in accordance with the design
- There is adequate protection at roadside hazards
- Variations between actual construction and detail design have not had a negative influence on road safety
- Road signs and markings, lighting and other night-time related issues are adequately installed and operational

- All issues listed in the Stages 1, 2 and 3 Road Safety Audits have been properly addressed, or if the Stage 5 Road Safety Audit is the first audit of the road project, to assess all the matters that would have been assessed in those Stage Audits.

The potential for making significant changes to the road safety situation onsite during a pre-opening stage audit is rather limited, and the audit team may have to accept that the mitigating measures that may be recommended at this stage would similarly be limited in scope. The Stage 5 Road Safety Audit Report should be provided to the Engineer and to the Road Authority.

Guidance on the execution of Road Safety Audits is given in Volume II: Secondary Design Aspects of the Highway Manual Part 2: Design.

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## 6 Utilisation and Asset Management Phase

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### 6.1 Introduction

Road construction projects that are completed will be subject to final scrutiny of all technical and performance aspects prior to their being opened to traffic. The project will then be opened to traffic and taken into use.

### 6.2 Maintenance

To extend the lifespan of roads within Nigeria and to provide and retain the road network to an acceptable standard, and thereby contain travel time and vehicle operating costs within reasonable limits, it is imperative that appropriate maintenance procedures be adopted.

#### 6.2.1 Highway Manual Part 2: Maintenance

Maintenance methods are detailed in Highway Manual Part 2, which provides maintenance personnel information in making logical decisions for application of acceptable maintenance methods for maintenance of over 34,000 kilometres of road network within Nigeria. The guidelines provide an easy procedural reference book on all aspects of work required in the maintenance and repair of roads, be it by direct labour or by contract.

In addition to maintenance methods and procedures, this manual also covers the following:

- Pavement distress identification,
- Pavement management information,
- Road user and worker safety procedures.

## 6.2.2 Regular Maintenance of all Road Facilities

Carrying out of regular maintenance on all aspects is of utmost importance to adequate operation of the road network. These aspects include:

- Road ways
- Bridges
- Road side facilities and intersections
- Traffic signs and road markings
- Safety facilities
- Pro-active protection of the right of way

## 6.3 Road Operation

For the smooth operation of the road system, provision must be made to deal with the occurrence of incidents (such as vehicle failure or breakdown, accidents, unforeseen flooding, etc). Planning for the management of such incidents, for the management of the incident scene and for the control and facilitation of traffic around the incident greatly reduce the disruption of normal traffic flow, which can amount to large costs to the economy if these incidents are poorly managed or left unmanaged. For general roads, incident management is left to the police, but for more major roads specific provision for incident management should be made. An incident management plan for each road should be developed and discussed with the relevant authorities who will be involved in the response to such incidents.

## 6.4 Road Network Management

To manage a road network, information is required on the condition and usage of the roads in the network. This information is obtained from gathered data and it is essential that a Pavement Management System (PMS) is available to record the data, store and present this data as usable format.

At network level, information related to the condition and use of the entire network is required for policy and programming decisions. Network level pavement management data is extracted from PMS information and used to derive the following information:

- Identify and prioritise projects
- Establish rehabilitation programmes
- Estimate overall short- and long-term needs
- Establish budgetary requirements for major and maintenance works

Pavement management at project level provides detailed and technical information related to a specific road section or sections.

Project-level pavement management data is extracted from PMS information and used to derive the following information:

- Details of the road pavement structure
- Condition of the road section
- Determine repair or maintenance requirements for the specific road section or sections
- Cost estimates and planning
- Feedback and the documenting of actions taken

Additional information to be collected and documented to form part of the PMS data base, includes the following:

- Geometric data of the pavement such as length, width
- . Pavement structures and layer thickness
- Present Serviceability Index (PSI) of the pavement

- International Roughness Index (IRI) of the pavement
- Road skid resistance
- Accident records
- Maintenance and construction data
- Weather data

### 6.5 Network Monitoring

Road network monitoring needs to be systematically implemented to provide the basic data required to manage the road network effectively. This requires regular data collection for traffic usage, operating speeds, levels of service, ride quality, safety, environment and sustainability. Data collection systems need to be set up and maintained to collect basic data on at least an annual basis, from each section of road. The Pavement Management System can be expanded to form a Road Management System that captures all aspects of the performance of the road network. This will allow the planning of future road development projects on a rational basis.

### 6.6 Road Safety Audit or Appraisal of an Existing Road

The Road Safety Audit of existing facilities provides a mechanism whereby roads constructed previously and not subjected to the Road Safety Auditing processes in the planning and design stages of their development, may be assessed. Obviously priority for this stage of auditing should be placed on roads where safety records show problems, but this process can also be applied pro-actively without the need to have crash data available.

The Road Safety Audit or Appraisal of existing facilities is a systematic examination of an existing road location, in which an independent and qualified team reviews on-site conditions and historical evidence to identify existing or potential road safety problems and suggest measures to mitigate those problems.



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The objectives of the Road Safety Audits on existing roads are as follows:

- To ensure compatibility between the safety features of a road and the functional classification of the road
- To identify any feature that can, with time, create a safety problem – for example vegetation blocking a sign
- To identify all features in the road environment that pose a safety hazard to any of the road users

The report on the Road Safety Audit of any existing road shall be submitted to Road Authority responsible for that road. Guidance on the execution of a Road Safety Audit is given in Volume II: Secondary Design Aspects of the Highway Manual Part 2: Design.



## 7 Annexes

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### 7.1 Annex – Process to Appoint a Consultant

#### 7.1.1 Public Procurement Act 2007

Procurement of Consultancy Services is governed under the Public Procurement Act, 2007 (2007 Act No. 14) <sup>ii</sup> where sections 44 to 52 prescribe the processes to be followed. The essential processes involved are described in this Annex.

#### 7.1.2 Consultancy Agreement required

Where a consultant is required to assist with technical aspects of developing a project, a written agreement between the Road Authority and the consultant will be entered into, comprising a minimum of a detailed terms of reference defining clearly the deliverables to be produced and a schedule of payments for the services, tied to specific milestones and production of the deliverables identified.

#### 7.1.3 Procurement processes

To identify suitable consultants, and to ensure optimal use of the Road Authority's funds, public procurement processes as defined either by the Federal or State Government will be followed. These processes will consist of some or all of the following steps:

- Advertising for suitably qualified consultants to express interest in providing service required. This advert must describe the services required as fully as possible, and indicate the basis upon which a short list of candidates will be compiled, preferably giving guidance on information to be submitted for assessment. A deadline for submission of expressions of interest must be stated.
- After the closing date, submitted expressions of interest shall be assessed on the basis of the suitability of experience of the firm, together with the qualifications of the staff that are available within the firm. Formal scoring of each submission to provide a record of the reasons for the selection of certain bids to be short listed is required, as there will usually be queries as to why one firm of consultants is short listed while another is not. A formal scoring system dispels arguments during this phase.

- The Road Authority will then prepare a Request for Proposals (RFP), which contains instructions to the bidders, a detailed terms of reference providing back ground to the project, detailed requirements, a clear definition of the deliverables required, and the programme for the services, as well as the format for the submission of bids (which is designed to make comparison of submissions easier to carry out). The terms of reference later form part of the agreement as mentioned above. The RFP may require submission of technical and financial proposals, or in specific circumstances only technical or only financial proposals may be required. Where technical and financial proposals are requested, the mechanism whereby the two proposals will be assessed must be specified in the RFP. This could be as a “hurdle system” all bidders that pass a threshold of technical scores will have their financial bids opened – and then the lowest price will be awarded the project, or by a “weighting system” where the relative weights of technical and financial proposals are set out (often 80 technical and 20 financial) and then the scores for both technical and financial are calculated, weighted and added together. The highest combined score is then awarded the project.
- Shortlisted consultants will then be issued with the RFP document and are invited to submit bids by a specific date.
- Consultants can then prepare bids based on the RFP and submit these by the specified date. Late submissions are usually disqualified, to prevent any undermining of the system.
- Adjudication of bids submitted is then carried out. Again formal recorded scoring is recommended, usually using the members of a procurement or tender committee to each score the proposals submitted, to obtain an average balanced assessment of the bids. All submissions that obtain better than a minimum score (usually 70 percent minimum), are then eligible to be considered for appointment.
- If technical and financial bids were requested, the consultants who submitted technical bids passing the minimum technical score will be invited to a public opening of financial bids. The technical scores of each bid, together with amount of their financial bid is then read out at the meeting. Financial bids and technical scores are then both taken into account to identify the preferred bidder. If the RFP requested technical bids, without financial

considerations, then the consultant offering the bid with the highest technical score is identified as the preferred bidder.

- The preferred bidder is then invited to negotiate the contract at which meeting any clarification and confirmation of information in the bid. is obtained. This will include the confirmation that the staff listed in the proposal are available and ready to carry out the project as proposed. The programme for the project is also confirmed.
- A formal consultancy contract is then signed to get the project underway.

## 7.2 List of Drawings for a Typical Design

### 7.2.1 Highway Design

Main list of road plans:

- Key plan (1:5,000 or 1:10,000)
- Layout plans (1:1 000)
- Setting out plans (1:200 or 1:500 or 1:1,000)
- Longitudinal sections (1:1,000H, 1:100V)
- Typical cross-sections (1:100H and 1:50V)
- Detail cross-sections (Every 20 m) (1:200)
- Relocation of service plans (1:1,000)
- Shifting of services schedule
- Contour plans of intersections and interchanges (1:200 to 1:500)
- Road signs and markings (1:200 to 1:500)
- All necessary typical plans

Key plans to a scale of 1:5,000 or 1:10,000 to show the following details:

- Centre line for dual carriageways and freeways
- Road reserve
- Bridges and interchanges
- Road numbers and/or street names
- Destinations
- Existing roads and public or access roads
- Roads to be closed or deviated
- Kilometre distances (km)
- Subdivision of properties and farm names
- Cadastral boundaries
- Rivers and their names
- Railway lines
- Radii of horizontal curves (m)
- Limits of construction
- Borrow areas, materials sources and quarries, water abstraction points and possible access roads to these
- Position of layout plans with their numbers.
- Complete list of the detailed design plans with the number of each plan (Plan No. followed by description). If the plan index is compiled on a separate plan, this plan must be allocated a separate key plan number.
- North point
- Drawing scale, bar scale with legend and units

- Locality sketch to a suitable scale (1:250,000) to indicate the road being planned in relation to towns, well known places, and other roads, and must indicate town or place names.

Layout plans of the road and all cross-roads on detailed contour surveys to a scale of 1:1 000, showing the following details:

- Proposed route
- Bridges and interchanges
- Road numbers and/or street names
- Destinations
- Existing roads, streets and service roads
- Roads to be closed or deviated
- Kilometre distances (km)(every 200 m)
- Radii of horizontal curves (m)
- Tabulated values of horizontal curves : Radius, length, deflection angle, tangent length, transition lengths
- Positions of points of intersection and coordinate values (PI's).
- Beginnings and ends of horizontal curves and co-ordinate values
- Distance between carriageways (for dual carriageways and freeways)
- Travelled way and shoulder widths (shaded on tarred portions only)
- Road reserve widths
- Road reserve boundaries
- Directions of traffic movement

- Extent of cuts and fills (unless this is indicated on separate plans)
- Guardrails
- Culverts with sizes, skew + km distance, drainpipes, mitre banks, catch water berms and flow directions with a suitable legend of symbols used
- Catch pits
- Intersections and accesses
- Angles of intersections
- Existing bridges and their numbers
- New bridge numbers
- Co-ordinates of reference points to the nearest 0,01 m (single carriageways only) (BC, EC, PI)
- Limits of construction
- North point
- Drawing scale and bar scale with legend and units
- Sheet No. of total number of sheets (sheet no 1 of 3)
- Plan numbers of adjacent sheets

Longitudinal sections to a horizontal scale of 1:1,000 and vertical scale of 1:100 of the road, cross-roads, access roads and ramps shall show the following details:

- Positions of pegs and reference pegs with their elevations
- Elevation of staked ground line (for dual carriageways and freeways)
- Bridge and interchange positions and their numbers
- Destinations



- Kilometre distances (km)
- Datum level
- Gradients (%)
- Lengths of vertical curves
- K-values
- Vertical points of intersection and their elevations (PI's)
- Beginnings and ends of vertical curves
- Beginnings, ends and other details of horizontal curves
- Details of super-elevation (e-value and edge levels)
- Reduced ground levels on the road centreline to the nearest 0,001 m
- Reduced ground levels on the staked line to the nearest 0,001 metre (dual carriageways and freeways)
- Road levels on the centre line to the nearest 0,001 metre (for single carriageways)
- Road levels on the left and right edges and the centre of the travelled way to the nearest 0,001m (for dual carriageways and freeways)
- Setting-out details (at the top of the longitudinal section for single carriageways)
- Design speed of all roads; positions of intersecting roads and other reference points
- Positions of interchanges, ramp noses, intersections and access points (includes farm accesses), with the actual sight distances in all directions up to 500 metres. Thereafter, only indicate "exceeds 500m" or > 500m. (In the case of ramp noses, the sight distance, is measured to a point on the road surface at the ramp nose).

- Culverts and drainpipes; km distance, sizes and skew
- Guardrail
- Surfaced shoulders
- Barrier lines (for single carriageways)
- Kerbing
- Earthworks quantities for each section of cut and fill for single carriageways
- Drawing scale and bar scale (horizontal and vertical)

Typical cross-sections to a suitable scale that show the following information:

- Centre line of the road
- Distance between carriageways (dual carriageways and freeways)
- Median widths (dual carriageways and freeways)
- Side slopes
- Side drains
- Reserve width
- Formation width
- Lane and shoulder widths
- Kerb widths
- All dimensions
- Clearances
- Crossfall (%) of roadway and shoulders
- Subsurface drains
- Drawing scale and bar scale with units and legend

- Any other details as on the departmental type plans

### 7.2.2 Typical List of Drawings for Bridges

Main list of drawings required:

- Site Plan:
  - Key plan
  - Locality plan
  - List of drawings

Is a separate site plan required for another Authority (for example the Railway Authority)? Has such site plan been submitted to this Authority for approval?

- General arrangement drawing containing:
  - General notes
  - Elevation of the bridge
  - Longitudinal section through the bridge
  - Plan of the bridge
  - Cross-section of deck
- Foundation plan(s)
- Working drawings including
  - Concrete drawings
  - Reinforcing drawings
  - Pre-stressing detail (where appropriate)
  - Balustrade detail

- Miscellaneous drawings
- Steel bending schedules
- Standard plans numbered with the bridge number and sheet number
- Confirm that the latest drawing sheet template is being used

### 7.3 Annex – List of Typical Data Required for a Bridge Site

#### 7.3.1 All Bridge Sites

The following field data should be collected for all structures:

- Location of any sewers, telephone and telegraph lines, water lines, gas lines, masts, culverts and location of other existing structures.
- Alignment of the proposed improvement and any traffic canalisation or separations in the vicinity that would affect the structure.
- Location of existing right of way lines and any intersecting highway or railway, and the position of the proposed right of way lines.
- Distance and direction to the nearest town.
- Location of all roads, streets, and detours.
- Geotechnical investigations for the foundation design including the location of soundings, and test holes with logs showing the elevations at which the various types of materials are encountered and the water table level.
- Location of existing and proposed drainage.
- A longitudinal section showing the existing ground levels on the roadway centre line, proposed grade line, and high, normal and low water elevations where applicable, to natural scale.
- Horizontal and vertical curve data.
- River flow direction (for a river bridge).

- Direction of True North.

### 7.3.2 Additional Data for Grade Separations (Highway/Rail)

A plan of all rail tracks located within 150 metres of the centreline of the proposed highway should be compiled and should include the following data:

- Destinations of the railway lines.
- Radius of curvature, if any
- The position of the beginnings and ends of transition and circular curves.
- Distance from centre to centre of tracks and distance from track centreline to right of way line.
- Angle between centreline of highway and centreline of each track.
- Rail distance of the established railway centreline and the crossing angle at the point of intersection.
- Distance from the crossing point to the nearest rail kilometre post.
- Position of switch points, frogs and other track appurtenances.
- Position of future tracks, if known.
- Cross sections accurate to 3.0 mm taken along railway for 150 metres on each side of the intersection (take elevations on top of each rail).
- The difference in level between the railroad datum and the highway datum, if any.
- Distance to the nearest station and signals.

### 7.3.3 Additional Data for Grade Separations (Highway/Highway)

Prepare a locality plan of the proposed structure and include the following data regarding the existing highway:

- Destinations of roads
- Alignment (horizontal and vertical)
- Degree of radius of curvature
- The position of the beginnings and ends of transition and circular curves
- Width of travelled roadway and of the roadbed from shoulder to shoulder.
- Kilometre distance of the point of intersection on both roads and the angle of intersection.
- Cross sections taken along roadway for a distance of 150 metres on each side of the intersection

### 7.3.4 Additional Data for Waterway Crossings

Where a proposed structure crosses a waterway, the following supplementary data is required:

- A contour plan, stream cross sections and aerial photographs
- Complete data on existing bridges upstream and downstream, including dates of construction and performance during past floods
- Available high water marks with dates of occurrence
- Information on debris and channel stability
- Factors affecting water stages such as high water from other streams, reservoirs, flood control projects and tides
- The existence of any dams upstream or downstream

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## 8 References

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- i. The South African Road Safety Audit Manual (2<sup>nd</sup> Edition), Road Traffic Management Corporation, Department of Transport, South Africa, May 2012
- ii. Public Procurement Act, 2007 (2007 Act No. 14), National Assembly of the Federal Republic of Nigeria, June 2007
- iii. Government of the Federal Republic of Nigeria, *General Specification (Roads and Bridges)*, Revised 1997