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CONTRACT FOR THE DESIGN, CONSTRUCTION, FINANCE, OPERATION AND MAINTENANCE OF
HIGHWAY [] AS A TOLL HIGHWAY, INCLUDING ASSOCIATED DEVELOPMENTS AND
FACILITIES.

ANNEXURE II

ENGINEERING REQUIREMENTS

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SCHEDULE 1 : PERFORMANCE BASED MAINTENANCE REQUIREMENTS

LIST OF TENDER DOCUMENTS

VOLUME	BOOK	DESCRIPTION	ANNEXURE
VOLUME 1		INVITATION TO TENDER AND CONTRACTS	
VOLUME 1	BOOK 1	INVITATION TO TENDER	
VOLUME 1	BOOK 2	CONCESSION CONTRACT	
VOLUME 1	BOOK 3 A	SCOPE OF WORKS AND PROGRAMMES	ANNEXURE I
VOLUME 1	BOOK 3 B	ENGINEERING REQUIREMENTS	ANNEXURE II
VOLUME 1	BOOK 3 C	DESCRIPTION OF SITE	ANNEXURE III
VOLUME 1	BOOK 3 D	ENVIRONMENTAL REQUIREMENTS	ANNEXURE IV
VOLUME 1		SOCIO ECONOMIC REQUIREMENTS AND TRAINING	ANNEXURE V
VOLUME 1		INDEPENDENT ENGINEER AGREEMENT	ANNEXURE VI
VOLUME 1	BOOK 3 E	DESIGN AND CONSTRUCTION CONTRACT	ANNEXURE VII
VOLUME 1		OPERATION AND MAINTENANCE CONTRACT	ANNEXURE VIII
VOLUME 1		FORM OF OPERATIONS AND MAINTENANCE BOND	ANNEXURE IX
VOLUME 1		FORM OF FINAL MAINTENANCE BOND	ANNEXURE X
VOLUME 1		FORM OF RESOLUTIVE CONDITIONS BOND	ANNEXURE XI
VOLUME 1		FORM OF OPERATIONS REPORT	ANNEXURE XII
VOLUME 1		FORM OF CONSTRUCTION PROGRESS REPORT	ANNEXURE XIII
VOLUME 1	BOOK 3 F	FINANCIAL BASE CASE	ANNEXURE XIV
VOLUME 1		TOLL STRATEGY AND TOLL TARIFFS	ANNEXURE XV
VOLUME 1		HIGHWAY USAGE FEE	ANNEXURE XVI
VOLUME 1		EQUITY CONTRIBUTION	ANNEXURE XVII
VOLUME 1		INSURANCE REQUIREMENTS	ANNEXURE XVIII
VOLUME 1	BOOK 3 G	CONCESSIONAIRE DOCUMENTS OF ASSOCIATION	ANNEXURE XIX
VOLUME 1		KEY PERSONNEL POSITIONS	ANNEXURE XX
VOLUME 1		SHAREHOLDERS AGREEMENT	ANNEXURE XXI
VOLUME 1		FORM OF ATTORNEYS AFFIRMATION	ANNEXURE XXII
VOLUME 1		ASSOCIATED AGREEMENTS	ANNEXURE XXIII
VOLUME 1		OVERLOADING	ANNEXURE XXIV
VOLUME 1		DEED OF SURETYSHIP	ANNEXURE XXV

VOLUME 2		STANDARD SPECIFICATIONS
VOLUME 2	BOOK 1	STANDARD SPECIFICATIONS FOR OPERATIONS AND MAINTENANCE: GENERAL
VOLUME 2	BOOK 2	STANDARD SPECIFICATIONS FOR OPERATIONS AND MAINTENANCE: ELECTRICAL AND MECHANICAL EQUIPMENT
VOLUME 2	BOOK 3	STANDARD SPECIFICATIONS FOR OPERATIONS AND MAINTENANCE: TOLL SYSTEM AND EMERGENCY COMMUNICATIONS SYSTEM
VOLUME 2	BOOK 4	STANDARD SPECIFICATIONS FOR OPERATIONS AND MAINTENANCE: ELECTRONIC TOLL COLLECTION
VOLUME 3		INFORMATION DOCUMENTS
VOLUME 3	BOOK 1	HIGHWAY INFORMATION
VOLUME 3	BOOK 2	TRAFFIC INFORMATION
VOLUME 3	BOOK 3	DRAWINGS
VOLUME 3	BOOK 4	ENVIRONMENTAL SCOPING REPORT
VOLUME 3	BOOK 5	ADDENDUM TO ENVIRONMENTAL SCOPING REPORT
VOLUME 3	BOOK 6	MACRO ECONOMIC ASSESSMENT REPORT

ROADS AUTHORITY

CONTRACT NO

FOR

THE DESIGN, CONSTRUCTION, FINANCE, OPERATION AND MAINTENANCE OF HIGHWAY No* AS A TOLL HIGHWAY INCLUDING ASSOCIATED FACILITIES AND DEVELOPMENTS.

1. INTRODUCTION

The engineering requirements regarding Construction Works and the Operation and Maintenance of the Highway, including but not limited to the roads, bridges, drainage structures and toll facilities are specified in this document. Also included in this document are the performance criteria, which shall be used to measure the performance of the Concessionaire in terms of the specific criteria.

The highway is divided into [here insert number of sections] highway Sections as shown in Table 1.1 below

TABLE 1.1 Division of Highway Sections

Section	Highway Description	Start (km)	End (km)	Length (km)
1				
2				
3				
4				
5				
6				
7				
			Total Length	

The Preliminary Design for the Initial Construction Works and the Additional Construction Works shall be submitted to the Independent Engineer for review and recommendations and to the Authority for approval in accordance with the provisions of the Concession Contract and within the prescribed periods and subject to the requirements of subclause 2.1 of the Concession Contract.

Each Detailed Design for the Initial Construction Works and Additional Construction Works shall be submitted to the Authority for comment and to the Independent Engineer for approval in accordance with the provisions of the Concession Contract and within the prescribed periods and subject to the requirements of subclause 2.1 of the Concession Contract.

Each completed part of the Construction Works and all services and activities required in terms of an Operation and Maintenance Contract, shall be subject to review by the Independent Engineer for compliance with these Engineering Requirements. Review and/or approval by the Independent Engineer and/or the Authority of the aforementioned or any other aspects of the Project shall not imply that the responsibilities and liabilities of the Concessionaire are in any way reduced or assumed by the Independent Engineer or the Authority.

The Authority reserves the right to request the Concessionaire to provide any data which it has collected and used in determining when Additional Construction Works are to be carried out, and to check such data if deemed necessary.

All Construction Works shall be in accordance with current (at the time of signing of the Concession Contract) standard codes and specifications used by the Authority. Should the use of other codes and specifications be required, such use shall be subject to the approval of the Authority. The current versions and future amendments of the documents, codes and specifications referred to herein, shall become the ruling documents, codes and specifications for the duration of the Concession Contract.

2. ENGINEERING REQUIREMENTS

The requirements stipulated herein are to be used in addition to sound engineering knowledge and good industry practice. A requirement must not be understood as an "instruction" to the Concessionaire, who must at all times use its discretion and engineering expertise to critically evaluate the requirement and, if it decides to deviate from or not to abide by such requirement, the Concessionaire must motivate recommendations to the Authority substantiating the reason for the required deviation. All deviations must be approved by the Authority.

Comment [ID1]: [note-it would be possible to reduce the role of the Independent Engineer by developing a process of certification by or on behalf of the Concessionaire. The Concessionaire could be required to appoint or cause the Contractor to appoint a Designer who would be named as such and the Designer would have to issue a certificate that the design had been properly prepared. In addition and Independent Checker who was not employed by either the Contractor or the Designer could be required to check and certify the design of certain critical structures. Other design of structures of a less critical nature could be checked and certified by a separate team within the Designer. Similar arrangements could exist for construction. The role of the Independent Engineer in those circumstances would be more of an auditor but with the ability to carry out spot checks].

2.1 Preliminary and Detailed Design Procedures and Requirements

2.1.1 Introduction

All the design work undertaken by the Concessionaire in respect of the Concession Contract shall comply with these procedures and requirements as well as with the requirements of Annexure IV : Environmental Approval.

The design requirements are divided into the following two stages:

- Preliminary Design
- Detailed Design

Comment [ID2]: [note-this will depend upon the scope of consents and approvals acquired by the State or the Authority].

2.1.2 Preliminary Design

The Preliminary Design shall, inter alia, include alignment, position of the road within the Road Reserve, proposed road cross-sections, toll plaza location and layout, the influence on land, environment and Utilities, to such detail that a review can be undertaken for compliance with these requirements. The Preliminary Design shall also demonstrate design standards clearly so as to enable the Authority and the Independent Engineer to assess the design.

Due to varying road types and road conditions encountered, the Preliminary Design requirements are categorised as follows:

Preliminary Designs for:

- a. New Construction Works or Upgrade Works
- b. Rehabilitation
- c. Periodic Maintenance
- d. Structures
- e. Toll plazas
- f. Signalisation
- g. Lighting

Comment [ID3]: [note-these will be project specific. In this case the project includes taking over and upgrade of existing roads or highways].

The content of the Preliminary Design submissions shall, inter alia, include the following:

2.1.2.1 New Construction Works or Upgrade Works

Submission of a preliminary design report containing the following:

- a. Description of the works
- b. Traffic analysis and traffic loading
- c. Geometric design
- d. Geotechnical evaluation
- e. Preliminary materials report and pavement design with preliminary materials investigation
- f. Details regarding drainage design including positions and sizes of drainage structures
- g. Information regarding Utilities
- h. Details regarding land and additional Road Reserve requirements according to the procedures as agreed to from time to time.
- i. Traffic accommodation during construction
- j. Details pertaining to the negotiations with landowners, for additional Road Reserve requirements; only where applicable, and according to the procedures as agreed to from time to time.
- k. Consideration of environmental impacts.

- l. Consideration of safety history for Upgrade Works
- m. Drawings consisting of the following:
 - i. Layout drawings, where applicable, indicating horizontal alignment details, intersections and accesses
 - ii. Longitudinal sections indicating proposed vertical alignments, if applicable
 - iii. Typical road cross-sections and pavement details
- n. Road furniture

2.1.2.2 Rehabilitation

Compilation and submission of a preliminary design report containing, inter alia, the following:

- a. Description of the works
- b. Surface drainage on focus areas
- c. History of inadequate drainage
- d. Subsurface drainage (in distressed areas only)
- e. Traffic accommodation during construction
- f. Traffic and traffic loading analysis
- g. Applicable functional performance indices
- h. Consideration of safety history
- i. Drawings consisting of the following:
 - i. Typical road cross-sections with pavement details
 - ii. Summary of pavement condition
 - iii. Summary of pavement rehabilitation measures including intersections and accesses

2.1.2.3 Periodic Maintenance

Compilation and submission of a preliminary design report containing the following:

- a. Description of the works inclusive of a:
 - i. Summary of pavement condition
 - ii. Summary of maintenance measures
- b. Traffic accommodation during construction
- c. Drawings, when applicable, to be included in the design report

2.1.2.4 Structures

Work on structures is divided into:

- New and Upgrade Works
- Repair works

2.1.2.4.1 New and Upgrade Works:

Compilation and submission of a preliminary design report containing inter alia the following:

- a. Description of the works
- b. Traffic analysis if not already covered elsewhere
- c. Preliminary foundation investigation
- d. Hydraulic calculations or confirmation of previous hydraulic calculations in the case of bridge widening
- e. Conceptual design
- f. Accommodation of Utilities where applicable
- g. Requirements for additional Road Reserve and details of

negotiations with land owners if applicable, according to the procedures as agreed to from time to time

- h. Traffic accommodation during construction
- i. Environmental impact details
- j. Diagnostic Survey Report if appropriate.
- k. Bridge schedule [here insert relevant reference document for bridge design]

Waterway structures for which the design flood exceeds [here insert criterion] shall be regarded as bridges.

2.1.2.4.2 Repair works:

Compilation and submission of a preliminary design report containing, inter alia, the following:

- a. Description of the works
- b. Traffic analysis if not already covered elsewhere
- c. Conceptual design
- d. Accommodation of traffic where necessary
- e. Reference to Bridge Management System if it has been inspected
- f. Reference to diagnostic survey reports if appropriate
- g. Drawings consisting of conceptual designs as applicable

2.1.2.5 Toll Plazas

Submission of a preliminary design report containing the following:

- a. Description of the works
- b. Traffic analysis – including peaks in both directions
- c. Land acquisition requirements and negotiation with landowners if applicable according to the procedures as agreed to from time to time.
- d. Conceptual designs for plazas and systems
- e. Preliminary foundation investigation report
- f. Services supply arrangements
- g. Traffic accommodation during construction
- h. Environmental impact details and mitigation measures as required by legislation.
 - i. Preliminary Design drawings including:
 - ii. Plaza layout and lane configuration drawings
 - iii. Longitudinal sections
 - iv. Typical cross sections

2.1.2.6 Signalisation

Submission of a preliminary design report containing, inter alia, the following:

- a. Description of the works
- b. Traffic analysis
- c. Intersection and signal layout
- d. Timing plan

2.1.2.7 Lighting

Submission of a preliminary design report containing, inter alia, the following:

- a. Description of the works
- b. Lighting layout
- c. Equipment details (e.g. poles, luminaries etc.)

2.1.2.8 General

Information about consultation on technical and socio-economic matters with Relevant Authorities and other parties concerned. Details of interviews held with affected land owners including contact information and agreements reached regarding access arrangements, accommodation of services as well as other information pertaining to the Preliminary Design enabling the Independent Engineer to approve such Preliminary Design.

2.1.3 Detailed Design

The Detailed Design is the preparation of detailed working drawings, project specifications and the appropriate documentation for construction purposes. After the Initial Construction Period, the Detailed Design for Additional Construction Works shall also include a schedule of quantities and rates and prices for those Construction Works.

The Detailed Design of the Highway shall include, but will not be limited to, the following:

- a. All working drawings, schedules and designs required for the Construction Works in accordance with the applicable standards and codes of procedure listed herein.
- b. Project specifications and other provisions required for the Construction Works.
- c. Schedule of quantities with rates and prices for Additional Construction Works.
- d. Design changes to the drawings, to comply with the Engineering Requirements or as agreed by the Independent Engineer.
- e. A detailed geotechnical report.
- f. A detailed materials report.
- g. Design drawing(s) for bridges consisting of a general arrangement drawing or drawings as provided for under [here insert relevant reference to appropriate Code of Procedure for the Planning and Design of Structures] shall be submitted for approval prior to the commencement of the Detail Design. All approval requirements of other relevant authorities shall be adhered to.
- h. Requirements for land acquisition related to borrow areas and temporary accommodation of traffic and details of negotiations with land owners if applicable, according to the procedures as agreed to from time to time.
- i. Traffic analysis and traffic loading.
- j. Compliance with environmental requirements.

2.1.4 Submission of Preliminary Designs: Format and Procedure

The Concessionaire shall prepare six (6) copies of the Preliminary Design, of which four (4) copies shall be submitted to the Independent Engineer and two (2) copies shall be submitted to the Authority. The number of copies required may be varied as agreed to on a case-by-case basis. These submissions to the Independent Engineer and to the Authority shall be done simultaneously and in accordance with the agreed Preliminary Design procedure. The copies of the document shall comply with the following requirements:

- a. Reports of A4 size, printed on good quality 80 gsm paper and suitably bound in book format.

Comment [ID4]: [note-this again will be project specific. Consideration should be give to allowing the Independent Engineer and Authority to read only access to the hardware on which CAD is run].

- b. Drawings reduced to A2 size and printed on 80 gsm paper, suitably bound in book format.

Covers and titles of documents shall be as agreed upon between the Authority and the Concessionaire.

The procedure for approval of the Preliminary Design shall be as illustrated in Figure 2.1. The Independent Engineer shall review the Preliminary Design and make recommendations to the Authority for amendments or approval. The Authority shall inform the Concessionaire within twenty-one (21) Business Days whether amendments are required or whether the Preliminary Design has been approved.

If the Authority fails to inform the Concessionaire of the approval of the Preliminary Design, or of the amendments required to any part of the Preliminary Design, by the end of twenty-one (21) Business Days of its submission (by hand) to the Authority, the Concessionaire shall give the Authority notice that the Preliminary Design will be deemed to be approved, should no comments be received within three (3) Business Days from the date of delivery by hand of the said notice to the Authority.

Subject to the preceding clause, the programme for submission of the Preliminary Designs must make provision for the submission of a maximum of three (3) submissions per cycle of eight (8) Business Days. Should more than three (3) Preliminary Designs be submitted to the Authority for approval within a single eight (8) Business Day period, then the dates of submission of the submissions in excess of three (3) will be deemed to be submitted in the period following the one in which they were actually submitted.

If the Authority refers the Preliminary Design back to the Concessionaire for amendments, the approval procedure as set out herein shall apply to the amended Preliminary Design.

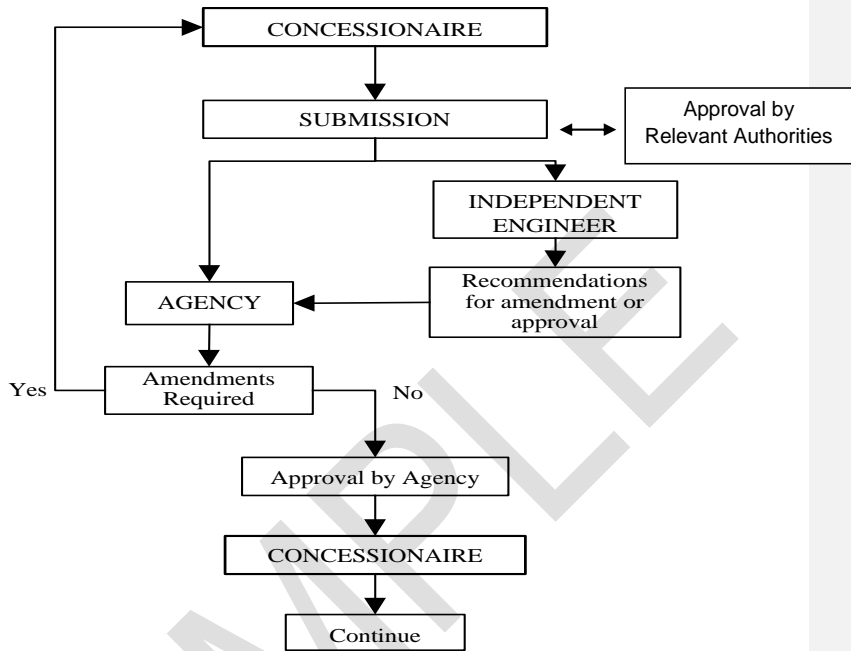
Prior to the submission of the Preliminary Design to the Independent Engineer and the Authority, the Concessionaire shall ensure that the Operations and Maintenance Contractors have been given the opportunity to review the Preliminary Design and give their comments and recommendations.

Approval of the Preliminary Design shall not relieve the Concessionaire of its liabilities and obligations under the Concession Contract, and it shall not relieve the Contractor or the Operator of any of their liabilities and obligations under the Design and Construction Contract and the Operation and Maintenance Contract respectively.

Comment [ID5]: [note-the contractual provisions relating to the approvals process are set out in the Concession Contract. It would be better that contractual terms are dealt with in the body of the Concession Contract and not repeated or added to in the technical annexures].

Figure 2.1: Flow chart: Preliminary Design Approval procedure.

Comment [ID6]: [note-the whole interface with Relevant Authorities is not fully addressed under the Concession Agreement and should be. This will depend upon the role of the Relevant Authority].



2.1.5 Submission of Detailed Designs: Format and Procedure

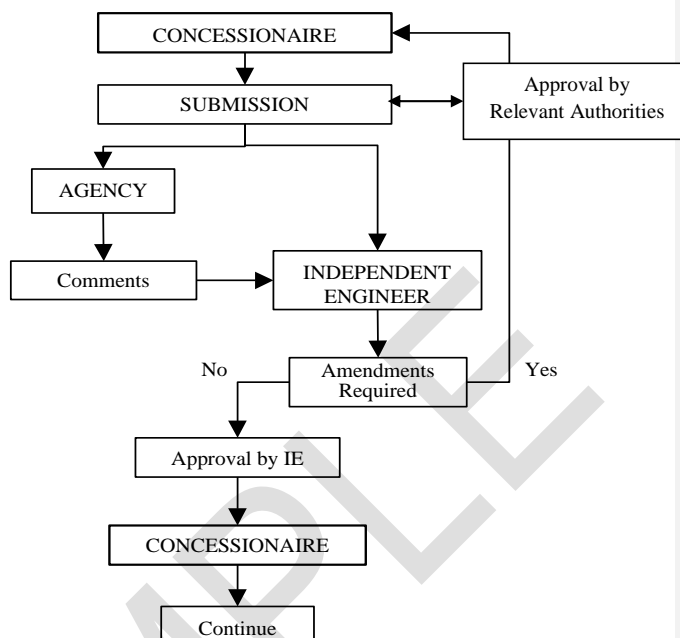
The Concessionaire shall prepare six (6) copies of the Detailed Design, of which four (4) copies shall be submitted to the Independent Engineer and two (2) copies shall be submitted to the Authority. The number of copies may be varied as agreed to on a case-by-case basis. These submissions to the Independent Engineer and to the Authority shall be done simultaneously and in accordance with the agreed Detailed Design procedure. The copies of the document shall comply with the following requirements:

- a. Contract specifications and other documents printed on A4 size, 80 gsm paper suitably bound in book format.
- b. Drawings reduced to A2 size and printed on 80 gsm paper, suitably bound in book format.

The Authority shall be provided with a set of drawings, in the agreed electronic format and as amended from time to time, within two (2) weeks after approval of the Detailed Design drawings.

The Authority shall also be provided with a set of A0 size transparent polyester prints of 0,050mm thickness of all the approved Detailed Design drawings. The procedure for approval of the Detailed Design shall be as illustrated in Figure 2.2: Flow chart: Detailed Design approval procedure.

Figure 2.2 Flow Chart: Detailed Design Approval procedure



The programme for submission of the Detailed Designs must make provision for the submission of a maximum of three (3) submissions per cycle of eight (8) Business Days. Should more than three (3) Detailed Designs be submitted to the Authority for approval within one (1) eight (8) Business Day period, then the dates of submission of submissions in excess of three (3) will be deemed to be submitted in the period following the one in which they were actually submitted.

Prior to the submission of the Detailed Design to the Independent Engineer and the Authority, the Concessionaire shall ensure that the Operations and Maintenance Contractors have been given the opportunity to review the Detailed Design in accordance with the Operation and Maintenance Contracts.

The comments made by the Operator shall be incorporated in the Detailed Design to be submitted to the Independent Engineer and to the Authority insofar as they are compatible with these Engineering Requirements and enhance the Construction Works, but without materially affecting the Contract Price.

The Authority shall inform the Independent Engineer of its comments on the submitted Detailed Design. The Independent Engineer shall review the Detailed Design and inform the Concessionaire within twenty-one (21) Business Days whether amendments are required or whether the Detailed Design has been approved.

If the Independent Engineer fails to inform the Concessionaire of the approval of the Detailed Design, or of the amendments required to any part of it, by the end of twenty-one (21) Business Days of its submission by hand to the Independent Engineer, the Concessionaire shall give the Independent Engineer notice that the Detailed Design will be deemed to be approved, should no comments be received within three (3) Business Days from the date of the delivery (by hand) of the said notice to the Independent Engineer. If the Independent Engineer refers the Detailed Design back to the Concessionaire for

amendments, the approval procedure as set out above shall apply to the amended Detailed Design.

Approval of the Detailed Design shall not relieve the Concessionaire of its liabilities and obligations under the Concession Contract and it shall not relieve the Contractor or the Operator of any of their obligations and liabilities under the Design and Construction Contract and the Operation and Maintenance Contract respectively.

The Highway Sections (or portions or combinations thereof) or Toll Plaza(s), which are to be the subject of a particular Detailed Design, shall be realistic portions of work appropriate to a single Detailed Design, and shall be agreed with the Independent Engineer.

A Detailed Design for roadworks may be submitted for approval with the Detailed Design of some or all of the bridges and structures being excluded. The Independent Engineer may approve such a Detailed Design subject to the express provisions that no work may commence on any structure until the Detailed Design of that structure has been approved in accordance with the procedures outlined herein and that any changes which may be required to the approved Detailed Design of roadworks or completed construction works related to the approved Detailed Design for the roadworks shall be entirely for the account of the Concessionaire. The Concessionaire shall in such cases agree with the Independent Engineer a programme for submission of the outstanding Detailed Designs for bridges and structures.

2.1.6 As-built drawings and construction report

Within three (3) months after the completion of each phase of the Construction Works on a portion of work which is the subject of a single Detailed Design, the Concessionaire shall provide the Independent Engineer, copy to the Authority, with a Construction Completion Report, a schedule of fixed assets and as-built drawings, in hard copy as well as in the agreed electronic format, and as amended from time to time and all such other records as may be required and agreed upon. Material as-built records shall be submitted in the same manner as the as-built drawings within six weeks of each section being completed.

2.2 Geometric Design Requirements

2.2.1 Standard Procedures, Design Manuals and Standard Drawings.

The requirements set forth in the latest version of the documents listed below, or any new document that may be adopted by the Authority, shall apply where applicable:

- a. A Code on Geometric Design of Highways and Streets
- b. Highway Capacity Manual .
- c. Transportation and Land Development Engineering;
- d. Basic Planning of Roads and Bridges.
- e. Manual for the Preparation of Detailed Geometric Design Plans for National Highways.
- f. Manual for Final Design Drawings for National Highways
- g. Drainage Manual,
- h. Geometric Design of non National Highways.
- i. Road Traffic Signs Manual.

Comment [ID7]: [note-the relevant manuals ,policies or codes should be inserted in place of the list in 2.2.1].

- j. Standard and typical plans of the Authority as revised from time to time.
- k. Urban Transport Guidelines

- l. Code of practice for the lighting of National Highways

2.2.2 Requirements

2.2.2.1 General Principles

The engineering design of the project shall be based on the application of the requirements herein as well as good industry practice. Any variation from the requirements specified herein shall be subject to the approval of the Authority and the Concessionaire and must be motivated in detail to the Authority by the Concessionaire. The requirements specified herein may be altered as agreed upon in writing between the Authority and the Concessionaire, dependent on future technological advances in the field of road engineering.

The geometric development of the Highway is to be based on the following:

- The requirements specified in this Annexure
- Standards of the existing roads
- Rural conditions and classification
- Urban conditions and classification

2.2.2.2 Geometry

The geometry of the Highway shall be upgraded for the following reasons:

- Safety of road users
- Capacity improvements
- Elimination of unacceptable operational characteristics
- Non-conformance with minimum geometric standards.

The design shall be in accordance with the documents specified herein or as specified in this Volume. Wherever discrepancies arise, this Volume shall take precedence.

a. Classification of Highway Sections

The following general road classification shall apply to Highway Sections:

TABLE 2.1: Classification of Highway Sections

ROAD CLASSIFICATION	HIGHWAY SECTIONS

Comment [ID8]: [note-complete in accordance with project requirements].

b. New Rural Highways

The Geometric design requirements for new portions of rural Highway resulting from re-alignment of the existing Highway and or portions of provincial road constructed as Associated Facilities, for Initial Construction Works, as well as Additional Construction Works, are to conform to the requirements of Table 2.2

TABLE 2.2: Geometric Design Requirements for Existing and New Rural Highways

NO	DESCRIPTION	REQUIREMENTS
1.	GENERAL 1.1 Design speed minimum 1.2 Spacing between Intersections Minimum	- km/h - m
2.	HORIZONTAL ALIGNMENT 2.1 Minimum radius 2.2 Desirable minimum radius 2.2 Crossfall • For vertical grade > 1,0% • For vertical grade ≤ 1,0% 2.3 Maximum superelevation	- m -m - % - % - %
3.	VERTICAL ALIGNMENT 3.1 Maximum Vertical Grade 3.2 Minimum Vertical Grade 3.3 Minimum K-value • For crest curves • For sag curves 3.4 Minimum length of vertical Curve 3.5 Critical length of grade for the Provision of auxiliary lanes	- % - % - - - m - m

Note: The requirements stipulated in Table 2.2 indicate the absolute minimum or maximum acceptable values applicable in extreme cases only. Good industry practice requires the designer to refer to the relevant standard specifications and codes for desirable standards.

c. Special Considerations for Existing and New Rural Highways

Geometric design requirements to be applied to Highway Sections [here insert relevant sections] are to conform to the requirements of Table 2.2

All existing Highway Sections which are found not to conform to the requirements of Table 2.2, must be improved to the requirements of Table 2.2, during the Initial Construction Works.

The requirements listed in Table 2.2 may not always be achievable on all portions of the Highway. In such cases some relaxation of requirements may be allowed, but subject to prior approval by the Authority.

d. Urban Arterials

The Geometric design requirements for urban arterials which form part of the Highway resulting from re-alignment of the existing Highway and or portions of provincial road constructed as Associated Facilities, for Initial Construction Works,

as well as Additional Construction Works, are to conform to the requirements of Table 2.3

TABLE 2.3: Geometric Design Requirement for Urban Arterials

NO	DESCRIPTION	REQUIREMENTS
1.	GENERAL 1.1 Design speed minimum 1.2 Spacing between Intersections minimum	- km/h - m
2.	HORIZONTAL ALIGNMENT 2.3 Minimum radius 2.4 Desirable minimum radius 2.3 Crossfall • For vertical grade > 1,0% • For vertical grade ≤1,0% 2.3 Maximum superelevation	- m - m - % - % - %
3.	VERTICAL ALIGNMENT 3.1 Maximum Vertical Grade 3.2 Minimum Vertical Grade 3.3 Minimum K-value • For crest curves • For sag curves 3.4 Minimum length of vertical curve 3.5 Critical length of grade for the provision of auxiliary lanes	- % - % - - - m - %

Note: The requirements stipulated in table 2.3 indicate the absolute minimum or maximum acceptable values applicable in extreme cases only. Good industry practice requires the designer to refer to the relevant standard specifications and codes for desirable standards.

2.2.2.3 Geometric Requirements for Intersection Development

- a. The design of at-grade intersections shall be in accordance with the applicable standards and all documents herein prescribed.
- b. With the upgrading of intersections, existing road lane widths and the cross-sectional development strategy as well as safety will be taken into account to determine the minimum required design standards.
- c. Intersection upgrading will consist of dedicated turning lanes and passing lanes as well as divided lane channelisation, unless otherwise agreed to by the Authority. When required due to intersection capacity or safety requirements, grade- separated interchanges shall be provided.
- d. To determine the upgrading requirements of intersections, traffic surveys and analysis for a specific intersection or group of intersections will be undertaken to evaluate them in terms of level of service requirements.
- e. Traffic capacity (volume) requirements shall be in accordance with sub clause 4.2.4.
- f. An intersection may be identified in terms of safety for the introduction of speed restrictions, subject to the approval of the Authority.

- g. Minimum spacing between intersections will also depend on terrain and sight distance. Sight distance calculations at intersections shall be in accordance with the G2 Manual requirements for "stopping" sight distance.
- h. The minimum curve radius for intersections on curves shall be $R =$ [here insert relevant distance]. Intersections on curves with radius less than R must be well motivated, and each case will be judged on its own merits by the Authority. Care must be exercised not to exceed a [here insert relevant percentage]% superelevation of the main road at any intersection.
- i. In special cases, if well motivated by the Concessionaire and accepted by the Authority, the improvement of existing intersections to comply with the requirements, could be postponed from the Initial Construction period to a later date in the Concession Period, provided that the said improvement shall take place during the first rehabilitation activity that includes the reconstruction of the base course of the existing road and the safety of the intersection is monitored continuously.
- j. Should the intersection prove to be unsafe, immediate remedial action shall be taken to improve the intersection to the required standards.
- k. Where dual carriageways or multi-lane facilities have to be established in an urban environment without grade-separated interchanges, signalised intersections shall be suitably spaced in terms of applicable design standards or traffic capacity requirements. In such cases property access will have to be reduced by the construction of Associated Facilities such as service roads or collector roads parallel to the Highway. This is to be agreed upon with Relevant Authorities where applicable.
- l. The upgrading of intersections in an urban environment on the Highway (primary or secondary arterial) will be by lane addition in terms of the strategy described below:
 - i. The spacing of intersections (or accesses) shall be suitable for co-ordination of signalised intersections when required for capacity reasons.
 - ii. Where required, the crossing of the median on a four or more lane road shall be limited to identified positions on the Highway approved by the Authority.
 - iii. Existing access points may be closed and diverted via parallel service and/or collector roads.
- m. The signal timing of the signalised intersections will be agreed with the local authority. The Concessionaire will be responsible for operating and maintaining the traffic signals
- n. All intersections will be provided with lighting as specified in the latest version of [here insert relevant Code of Practice for the Lighting of National Highways]. The Concessionaire will be responsible for operating and maintaining the lighting.

Comment [ID9]: [note-see previous comment as to issue of Relevant Authorities].

2.2.2.4 Geometric Requirements for Interchange Development

Interchanges shall be upgraded to ensure compliance with the relevant clauses in the Concession Contract.

The design of interchanges shall be in accordance with the applicable standards and all documents herein prescribed.

Geometric standards for interchanges will also be determined by the applicable Relevant Authority's classification of the crossroad subject to the Authority's approval.

2.2.2.5 Cross-Sections and Cross-Section Development Strategy

The cross section of the Highway shall be upgraded to ensure compliance with the relevant clauses in the Concession Contract. The existing and proposed cross-sections as well as the development strategy required are given in Annexure I : Scope of Works and Programmes as well as in the G2 Manual and may be revised after consultation between the Authority and the Concessionaire if so warranted in special cases such as Road Reserve restrictions, alternative upgrading requirements, etc.

2.2.2.6 Geometric Requirements for Toll Plazas

Suitable transition between the road cross-section and toll plaza cross section shall be established in the vicinity of the toll plaza, all subject to the approval of the Authority. Details for the design of the Toll Plazas are specified under Item 2.5.

Geometric Requirements for Associated Facilities and Developments

Standards shall comply with the design codes specified herein, and with the requirements of the Relevant Authorities, unless otherwise agreed.

2.3 Design Requirements for Bridges and Drainage Structures

The Concessionaire shall take into account the following requirements regarding the design of bridges and drainage structures.

2.3.1 Bridges

2.3.1.1 Standard Procedures and Design Manuals

[Here insert details of relevant codes or manuals].

It is incumbent on the Concessionaire to provide the Authority with an aesthetically pleasing and effective practical solution by taking cognisance of all factors, including environmental factors and other factors not directly connected to the structural integrity, such as concrete durability, that may have an influence on the design of the structure.

2.3.1.2 Requirements

a. Width of bridges

The width of bridges as measured between the inside edges of the balustrades shall be as follows:

- i. For multi-lanes, [here insert details].
- ii. For over passing crossroads [here insert details].
- iii. For agricultural overpasses [here insert details].
- iv. For agricultural underpasses [here insert details].
- v. For ramps and loops [here insert details].
- vi. For under passing crossroads minimum clear shoulder widths [here insert details].

vii. For pedestrian bridges a minimum clear width of [here insert details].

b. Clearance

i Vertical clearance

Minimum vertical clearances for road over rail bridges shall be :

[here insert details]

The minimum vertical clearance for new structures shall be [here insert details].

The minimum vertical clearance on all agricultural underpasses used by heavy vehicles shall be [here insert details].

ii Horizontal clearance

The horizontal clearances for road over rail bridges shall be as follows:[here insert details]

c. Width of Sidewalks

[here insert details]

2.3.2 Drainage structures

2.3.2.1 Standard Procedures and Design Manuals

The requirements set forth in the documents listed below shall apply:
[here insert details]

2.3.2.2 Requirements

The requirements shall be those specified in the applicable manuals and codes of the [host country] as well as the following:

[here insert details]

a. Design Flood Return Periods

b. In urban areas the road cross-section may be used as a part of the drainage discharge system for higher flood frequencies.

c. The drainage design criteria shall always be tested in terms of risk of adjoining property damage and be accordingly adjusted where required.

d. If existing property is damaged repeatedly by the assumption of short design flood return periods, these shall be increased by period commensurate with the damage that could ensue.

e. In urban areas the use of large open channel drainage systems are discouraged. In special cases the Concessionaire may motivate the use of such systems to the Authority. Special attention shall be given to safety and security aspects of the design.

f. In the case of a bridge which is designed to pass the design flood below the soffit of the super-structure its stability shall also be checked to be safe when subjected to the regional maximum flood (RMF).

2.3.3 Livestock Crossings

2.3.3.1 Scope

At grade crossing of livestock is not permitted.

Design Requirements for Livestock Culverts /Agricultural Underpasses

a. General Requirements

Since these structures pass under the road foundation, they must be structurally capable of carrying the imposed live and dead loads, and steep enough so that drainage is not impeded. They must be easily usable by the type of livestock and agricultural equipment for which they are provided.

b. Design Requirements

The design of livestock culverts and agricultural underpasses shall be in accordance with the applicable standards and all documents herein prescribed.

i. Structural Design

[here insert details]

ii. Drainage Design

[here insert details]

iii. Culvert size

[here insert details]

iv. Finishing of culvert floors

[here insert details]

v. Finishing of culvert approaches

[here insert details].

2.3.4 Requirements for Concrete Durability in Structures

Additional to the normal concrete tests, concrete durability tests for all drainage structures, livestock culverts and bridges will be done to establish base factors for the concrete.

Before the construction starts, the Concessionaire will provide a testing program for approval. As a guide it will be expected that for a typical road-over-road bridge, one test will be done on the deck soffit, at least one test on the columns and one on each abutment. Each test will consist of 3 cores taken at random positions. Results have to be handed over to the Authority in a prescribed format directly after completion of the specific structures on a Highway Section. Cover meter tests should cover at least *m² for every **m² exposed.

To ensure that the concrete has been placed, compacted and cured correctly, a nominated laboratory shall carry out the following tests after 28 days in terms of the latest specifications of [here insert details]:

- a. Water sorptivity
- b. Oxygen Permeability
- c. Rapid chloride conductivity (only to be applied in an environment subjected to a salt laden atmosphere)
- d. Measure the depth of concrete cover

Results obtained in accordance with the specified test methods, shall be assessed in terms of the ranges specified by [here insert details]. These values are guideline values, which will be refined and agreed during the Concession Period.

The Concessionaire will indicate the positions at which the cores shall be extracted on site.

2.4 Pavement and Geotechnical Design Requirements

2.4.1 Scope

The requirements contained in this clause cover road pavement design, cut and fill stabilities and road building materials for new works, upgrades and rehabilitation. This clause does not contain geotechnical requirements for bridges or other structures. In general, the provisions [here insert details of the Code of Procedure to be followed for bridges and structures.

The Concessionaire shall take into account the following requirements and standards regarding road pavement and geotechnical designs.

2.4.2 Road Pavement Designs

The design codes and methods currently used by and acceptable to the Authority are listed below but do not exclude the use of any other recognised or innovative design method(s). [here insert details].

2.4.3 Cut and fill design

It is a general requirement that the stability (subsurface and other) of cuts and fills shall be properly investigated and designed. In doing so the Concessionaire shall procure that the services of a reputable and professional geotechnical engineer be used.

The minimum factor of safety for the stability of cuts and fills shall be **. The stability of cuts and fills shall be certified safe in all respects by a professional geotechnical engineer.

2.4.4 Road building materials

The Concessionaire shall ensure that all materials are compatible with the environment and health regulations and practices. The procurement and quality of road building materials shall be the responsibility of the Concessionaire including the acquisition of a mining permit in the event of material obtained from a non-commercial source. The following standards/guidelines are generally used by the Authority:

[here insert details]

2.5 Design Requirements for Toll Plazas

2.5.1 Scope

The design of toll plazas includes the following disciplines:

- a. Civils (geometric alignments, pavement structures, drainage, water supply, sewerage, etc.)
- b. Structures (toll islands, canopies, tunnels, foundations, manholes, etc.)
- c. Buildings (plaza buildings, plant buildings, toll booths etc., inclusive of all internal Utilities)
- d. Electrical (area lighting, uninterrupted power supply (UPS), generators and lightning protection)
- e. Mechanical (fresh air supply, pressurised air supply to toll booths, air-conditioning, heating, etc.)
- f. Electronic lane equipment (toll collection equipment, toll collection control equipment, traffic event logger (TEL), etc.)
- g. Management Information System (MIS) (this includes the computer hardware, computer software packages and MIS programmes.)

2.5.2 Standard Procedures and Specifications

The standard procedures for geometric design, pavement design, geotechnical design, structural design and drainage design as covered by the preceding clauses as well as the latest version of the following additional publications shall apply:

[here insert details].

2.5.3 Requirements for Civil and Structural Works

Notwithstanding the requirements given elsewhere the following shall apply:

- a. Vertical canopy clearance: ** m minimum
- b. Highway approach gradient: %% maximum for a distance of * km on each side of the toll plaza measured from the tollbooths
- c. Longitudinal gradient for mainline plazas: **% maximum (* m either side of plaza centre line)
- d. Longitudinal gradient for ramp plazas: % **maximum** (* m either side of plaza centre line)
- e. Plaza approach tapers: ** minimum
- f. Plaza exit tapers: ** minimum
- g. Length of plaza approaches: ** m minimum on approach and exits at full width both sides
- h. Type of pavement for toll plaza area: concrete or block paving

- i. Normal toll lane width within the toll plaza area: **m minimum
- j. The minimum width for an electronic toll collection lane shall be **m.
- k. Extra wide toll lane width for abnormal vehicles (one per direction): ** m minimum
- l. Toll island width in toll plaza area: ** m minimum
- m. Toll island length in toll plaza area:** m minimum
- n. Total length of canopy along the road centreline (including overhang): ** m minimum
- o. The number of lanes for the toll plaza shall be adequate to provide an average waiting time, including transaction time, of less than ** seconds, **% of the time for the **th highest hourly traffic volume of the design year (see requirement in clause 4.4)
- p. Tollbooth protection structures shall be provided
- q. Impact attenuators for the safety of road users against direct impact shall be provided

2.5.4 Requirements for Electrical and Mechanical Works

The power supply to the toll plaza area shall consist of:

- a. **/** volts as locally supplied.
- b. Power connection from a commercial power supplier where available, a generator set, and an UPS set capable to support the operations of the toll plaza for at least one hour.
- c. Where no commercial power supply is available a second generator set shall be provided.
 - i. Suitable electro-mechanical interlock mechanisms shall be provided
Both generators shall be of the same type and capacity
[here insert other details]
- d. Supply of fresh air / ventilation equipment
 - i. The mechanical systems shall provide an environment for the toll collector that shall comply with the minimum standards as specified in [here insert standards for : Fresh Air Ventilation].
 - ii. The Carbon monoxide level within the tollbooth shall be limited to less than ** parts per million (ppm) at all times.

2.5.5 Requirements for Lane Equipment and Management Information Systems

The design for the toll plazas must cover the toll collection equipment, toll collection control equipment, traffic event logger (TEL), computer hardware, computer software packages and management information systems (MIS) programmes.

The design and configuration of all lane equipment shall be compatible with the existing toll plaza systems in [here insert location] under the jurisdiction of the Authority.

The management information system (MIS) to be used shall be compatible with that described in [here insert cross reference] and must be approved by the Authority.

All proposed changes to the lane equipment and MIS subsequent to the original approval(s) must be agreed with the Authority. Furthermore any changes to lane equipment and MIS required by the Authority shall be implemented by the Concessionaire within three months from the date of serving notice or such longer period as may be reasonable.

Electronic Toll Collection (ETC) used by the Concessionaire shall conform to the requirements of [here insert cross reference].

Comment [ID10]: [note this should be connected into the change procedure recommended in the comments to the Concession Contract].

2.6 Operational Requirements

The operational requirements are divided into requirements for toll plazas and for roads. These operational requirements shall also be read in conjunction with the Operations and Maintenance Manuals as well as other clauses herein.

2.6.1 Toll Plazas

2.6.1.1 Scope

The operation of the toll plazas consists of, but is not necessarily limited to, the establishment of suitable resources and manpower to operate the toll plazas, the training of personnel, the provision of a toll collection and a financial management function, the management of services at plazas, liaison with relevant public and emergency authorities and the provision of a day to day cleaning and domestic service.

2.6.1.2 Standard Procedures and Specifications

The requirements set forth in [here insert cross reference] shall apply.

2.6.1.3 Detailed Requirements

- a. The toll plazas shall be operational 24 hours per day
- b. The Concessionaire shall submit to the Authority within two (2) months prior to the commencement of operations of any toll plazas, operation manuals including, *inter alia*, the following:
 - i. An outline of personnel resources to be employed
 - ii. Security aspects
 - iii. Procedures relating to auditing - financial and technical
 - iv. Procedures for handling complaints
 - v. Procedures for financial management and reporting
 - vi. Procedures for incidents and emergencies
 - vii. Quality assurance procedures for operating functions

- c. The Concessionaire shall submit monthly to the Authority the following reports:
 - i. Total income per plaza, break down per payment method and discount and/or concessions granted.
 - ii. Total operating cost per plaza.
 - iii. Traffic data for each toll plaza per day and per class.
 - iv. Statistics on percentage attraction in comparison with alternative routes
 - v. Number of vehicles which drive through toll booths without paying appropriate toll fees
 - vii. Other relevant information that may be required.
- d. The methods of payment shall be in accordance with the methods of payment currently processed by the MIS used at all toll plazas in [the host country or other location]. Any new payment method and/or toll authority cards must be approved by the Authority and the MIS must process the transaction.
- e. A system shall be implemented to process vehicles exempted from paying tolls as provided for in the Concession Contract.

2.6.2 The Highway

2.6.2.1 Scope

The operation of the Highway consists of, but is not necessarily limited to, route management and route patrol services specifically regarding the accommodation of traffic at incidents, maintaining a traffic management function, inclusive of road user interaction and liaison with Relevant Authorities.

2.6.2.2 Standard Procedures and Specifications

The requirements set forth in the documents listed below shall apply:

[here insert details]

2.6.2.3 Detailed Requirements

- a. The Concessionaire shall submit to the Authority within two (2) months prior to the commencement of operations of any part of the Highway, operation manuals including, *inter alia*, the following:
 - i. Procedures relating to route patrol services
 - ii. Procedures relating to operating SOS-telephones
 - iii. Procedures for handling complaints
 - iv. Procedures for traffic management and reporting
 - v. Procedures for incidents and emergencies (Incident Management System)
 - vi. Quality assurance procedures for operating functions
 - vii. Preventative maintenance plan of critical plaza equipment
- b. The Concessionaire shall make available for inspection to the Authority and the Independent Engineer the following monthly reports:
 - i. Route Patrol Services Report
 - ii. Traffic Management Report
 - iii. Incident Management Report
 - iv. Other relevant information that may be required.
- c. The Concessionaire shall implement an emergency communication system in accordance with [here insert code or procedure].

- d. The Concessionaire shall prepare preventative maintenance plans aimed at the Routine Maintenance of critical items at the plazas, which plans shall be drawn up and made available for inspection as from the day of opening of each toll plaza.
- e. The Concessionaire shall implement route services to assist users of the Highway in case of an emergency incident and render support to emergency services till such time that the victims can be transported to the nearest medical facility by emergency services.
- f. Duties of the route patrol service shall also include the following as stipulated in the [here insert code or procedure]
 - i. Reporting of statutory control
 - ii. Emergency assistance at collisions and traffic incidents
The Concessionaire shall start the implementation of safety procedures (securing the collision site, putting out road signing, informing road users and the Relevant Authorities) as soon as possible, but in no event later than ** minutes from notification of the occurrence of a collision.
 - iii. General assistance to road users
The Concessionaire shall provide patrols in each direction of the whole Highway at least ** times a day, but during the holiday seasons the patrols shall be increased to at least ** times a day.
- g. Evaluate, comment on and keep a register of all applications for way-leaves, signage, accesses and other regulatory matters referred to the Concessionaire, according to the procedures agreed to with the Authority.
- h. The Concessionaire shall operate the road in accordance with the Environmental Approval.

2.7 Routine Maintenance Requirements

The Concessionaire shall take into account the following requirements regarding the Routine Maintenance of the Highway and the toll plazas. Excluded is periodic maintenance, which is covered elsewhere.

“Routine Maintenance” means repair and replacement work such as defined herein, aimed at maintaining the Highway in the specified condition. Such work is mostly carried out manually or with light equipment.

“Periodic Maintenance” means that maintenance work which is pre-planned over periods exceeding six (6) months and for which a programme and design has to be submitted for approval. Such work is mostly done by specialised contractors or with heavier equipment.

Routine Maintenance requirements for the road and for the toll plazas are described separately in the following paragraphs.

2.7.1 Toll Plaza Routine Maintenance

2.7.1.1 Scope

The Routine Maintenance work associated with toll plazas involves, but is not limited to, the following activities and also as described in the applicable standard specifications specified herein:

- a. Day to day gardening, cleaning and litter removal
- b. Structural maintenance
- c. Electrical and mechanical maintenance
- d. Sewerage and water reticulation maintenance

- e. Electronic toll equipment system maintenance
- f. Emergency call and road management control and monitoring systems maintenance
- g. Toll management information system support and hardware maintenance.

2.7.1.2 Standard Specifications

The standard specifications set forth in [here insert code or procedure] shall apply

2.7.1.3 Requirements

The requirements for the Routine Maintenance of toll plazas shall be those stipulated in the [here insert applicable standard specifications and codes].

2.7.2 Routine Road Maintenance

2.7.2.1 Scope

Routine road maintenance involves, but is not limited to, the following activities as described in the [here insert the Standard Specification for Routine Road Maintenance]:

- a. General Responsibilities
 - i. Route Patrol Services (excluding those duties covered under operational requirements)
 - ii. Accommodation of traffic at work sites
- b. Pavement Maintenance
 - i. Localized failures in pavement layers and surfacing repair
 - ii. Repair of potholes, edge breaks and patching
 - iii. Crack sealing
 - iv. Bleeding repair
 - v. Surface repairs of concrete pavements
 - vi. Localized areas of surface treatment of surfaced roads
 - vii. Emergency earth and layer works repairs
- c. Drainage Maintenance
 - i. Maintenance and repairs of existing culverts
 - ii. Maintenance and repairs of inlet, outlet and other structures
 - iii. Subsoil drain repairs and maintenance
 - iv. Cleaning of waterway structures
 - v. Cleaning of prefabricated culverts
 - vi. Cleaning of concrete drains and channels
 - vii. Cleaning and maintenance of earth channels
 - viii. Edge build-up removal
 - ix. Maintenance and repair of concrete drains and channels
- d. Roadside Maintenance
 - i. Maintenance of rest areas
 - ii. Closing of unsafe and/or illegal stopping areas
 - iii. Maintenance and repair of fencing including the clearing under fencing
 - iv. Collection and removal of debris and litter
 - v. Maintenance and repair of guardrails and barriers
 - vi. Maintenance of kerbing and channels
 - vii. Maintenance and repair of kilometre markers
 - viii. Maintenance and repair of dazzle screens
 - ix. Maintenance and repair of highway lighting
 - x. Maintenance and repair of other facilities such as impact attenuators
- e. Road Traffic Signs and Roadside Furniture Maintenance

- i. Repair and re-erection of road traffic signs
 - ii. Road sign cleaning and removal of illegal signs
 - iii. Road stud repair and replacement
 - iv. Road marking maintenance
- f. Protection Work
 - i. Maintenance of erosion protection facilities
 - ii. Slope and fill protection
- g. Vegetation Maintenance
 - i. Controlling vegetation growth: Mowing and cutting
 - ii. Chemical control of vegetation and eradication of undesirable vegetation according to legislation
 - iii. Physical eradication of undesirable vegetation
 - iv. Maintenance and re-establishment of plants, trees and shrubs
 - v. Re-establishment of grass
 - vi. Burning of fire breaks
- h. Maintenance to Structures
 - i. Small repairs to structures
 - ii. Maintenance of bridge joints
 - iii. Maintenance and cleaning of drainage holes in bridges

2.7.2.2 Standard Specifications

The standard specifications set forth in the documents listed below shall apply:
[here insert details]

2.7.2.3 Requirements

The requirements for the Routine Maintenance of the road shall be those set out in Section 3.5 in this Annexure and [here insert details of the applicable standard specifications and codes].

2.7.2.3.1 Classification of Routine Maintenance activities

Routine Maintenance Activities are divided into:

- Scheduled Routine Maintenance activities
- Ad-hoc Routine Maintenance activities, which are sub-divided into:
 - Critical activities, and
 - Non-critical activities

Critical Routine Maintenance activities are activities to be carried out on road elements, which are or could result in a safety hazard if not attended to urgently.

Non-critical Routine Maintenance activities are activities, which require attention of a less urgent nature and do not pose any immediate danger to the road user.

In addition to the requirements stipulated in the standard specifications, the following requirements shall apply:

- a. Scheduled Routine Maintenance activities

Scheduled Routine Maintenance activities are those activities, which are carried out on the road during a specific time of the year or on a more regular basis and are pre-scheduled. These activities are non-critical and are usually aimed at larger portions of work of a homogenous nature. Action plans are to be submitted to the Independent Engineer for the review in the Operations and Maintenance monthly report indicating when the Concessionaire plans to carry out the Scheduled Routine Maintenance activities.

b. Ad-hoc Routine Maintenance activities

Ad-hoc Routine Maintenance activities are those activities which occur as a result of collisions, incidents or deterioration of the road and/or Road Reserve due to traffic impact or other natural conditions which require relatively urgent attention to prevent a hazardous situation continuing or developing, or to maintain the highway in the specified condition of serviceability.

2.7.2.3.2 Reports

Together with the submission of the Operation and Maintenance Manuals, the Concessionaire shall submit to the Authority and the Independent Engineer the format of the monthly Routine Maintenance Report for approval.

The Concessionaire shall make available on request to the Independent Engineer the monthly Routine Maintenance Report and the monthly Incidence Report.

3. HIGHWAY PERFORMANCE REQUIREMENTS

On the Effective Date the Operation and Maintenance of the existing Highway Sections shall, except for Traffic as described in sub clause 3.2, Toll Plazas as described in sub clause 3.4 and Routine Maintenance as described in sub clause 3.5 not be evaluated in terms of the minimum performance criteria as specified in this clause. Such sections will, however, be subject to compliance after the Initial Construction Period and will be included for future review in the Additional Construction Works Programme discussions.

3.1 Pavement and Geotechnical

3.1.1 Scope

Pavement and geotechnical performance requirements cover pavements and the stability of cuts and fills. The objective of the specification is to ensure that:

- a. During the contract period, the functional condition of the Highway will be operated at a level that :
 - will limit excessive road user cost due to road roughness (riding quality), and
 - will limit the risk of accidents due to poor functional condition.
- b. The extent and frequency of patching operations as part of Routine Maintenance are limited.
- c. The condition of the pavement and the stability of cuts and fills do not prejudice the safety of the public.
- d. The pavement structure will meet the specified minimum visual,

functional and structural requirements at the end of the Contract period.

In respect of certain functional and structural requirements the Highway Sections are classified in ** categories. The Highway Sections are described [here insert cross reference]. The Highway Sections included in each Category are the following:
[here insert details]

To obtain the stated objective, the following methodology will be used:

3.1.1.1 Functional Parameters

The functional parameters as presented in Table 3.1 will be measured at specified positions, frequency and accuracy, and the result of these measurements must meet specified minimum requirements during the execution of the Additional Construction Works after completion of the Initial Construction Works.

TABLE 3.1: Functional Parameters

PARAMETERS	APPLICABLE PAVEMENT TYPE		
1.Road roughness (Riding quality)			
2. Surface friction			
3 .Rut depth			
4. Faulting			
5. Texture depth			

3.1.1.2 Limitation of patching operations during maintenance

The extent of potholes and patches shall be monitored through visual inspections. If the extent exceeds specified limits, appropriate action shall be taken to reduce the extent of patches and stop the need for further patching.

3.1.1.3 Structural Parameters

The structural condition of the pavement will be determined by:

- Visual assessments of the pavement condition, and
- Deflection measurements.

The deflection measurements and visual condition must meet the specified requirements at the end of the Concession Period as set out in Tables 3.19 and 3.22 respectively. The results of the deflection measurements in Table 3.22 will not be considered in isolation.

If indications exist that the deflection results are excessive or that the visual assessment requirements herein specified are not met, a detailed evaluation, as agreed to and approved by the Authority, of the remaining pavement life and the structural capacity thereof will be carried out by the Concessionaire. This assessment shall be used for final decision making.

3.1.1.4 Stability of cut and fill slopes

The stability of problematic cuts and fills shall be determined and monitored with appropriate instrumentation and other methods approved by the Independent Engineer in conjunction with the Authority.

3.1.1.5 Data capturing and management systems

The frequency of monitoring given in this section must be considered as a minimum requirement only and the Concessionaire must determine appropriate higher frequencies according to needs. The data must be processed and captured in a compatible and acceptable management system agreed with the Authority.

3.1.2 Specifications for Functional Condition

3.1.2.1 Introduction

Assessments of functional conditions shall be undertaken by the Concessionaire or its agent at prescribed dates and reported in an agreed format.

Before such assessments commence the Concessionaire must notify the Authority and afford it the opportunity to be represented during the assessments. In addition the Authority reserves the right to carry out its own assessments.

The systems for the functional conditions are described below:

- Specification of the field measurement process:
 - Definition of items to be measured.
 - Accuracy of measurement.
 - Position of measurements.
 - Frequency of measurements.
 - Measuring equipment.
- Specification of data processing and outputs:
 - Calculation of functional parameter.
 - Statistical processing.
- Specification of acceptance criteria:
 - Percentile acceptance limits.
 - Absolute minimum acceptable values.

3.1.2.2 Road Roughness (Riding Quality)

3.1.2.2.1 Definition

Road roughness is defined as the deviation of a pavement from a true planar surface that affect vehicle dynamics, riding quality and the dynamic loads exerted on the pavement.

3.1.2.2.2 Measuring equipment

Measurements will be done with an inertial profilometer or similar equipment capable of producing here insert Class] vertical measurement resolution, and a [here insert Class] longitudinal sampling distance, as defined in [Here in se code or procedure].

3.1.2.2.3 Calibration and operation

Calibration, validation and operation of the inertial profilometer must be done in accordance with the manufacturer's requirements, which shall at least meet the requirements of the Authority.

3.1.2.2.4 Position and frequency of measurements

The specification for the measurement of roughness is given in Table 3.2

TABLE 3.2: Specification for Measurement of Road Roughness

SPECIFIC ITEM	SPECIFICATION (Min)
Frequency of measurement	Annual
Position of measurement	Slow lanes, both directions in both wheel paths
Testing interval	Measurements cumulated and stored as m/km roughness for every ** m

3.1.2.2.5 Data Processing

Data shall be processed to produce the results in the format specified in Table 3.3.

TABLE 3.3: Specification for Output of Road Roughness Results

ITEM	SPECIFICATION
Unit	International Roughness Index (IRI) calculated for each ** m
Segment Lengths	* km
Statistical Summary	Produce cumulative distribution graph for each segment

3.1.2.2.6 Acceptance criteria

Using the cumulative distribution graph, the processed roughness data shall meet the acceptance criteria presented in Table 3.4.

TABLE 3.4: Acceptance Criteria for Road Roughness

LIMITING ROUGHNESS VALUES (IRI)			MAXIMUM LENGTH (%) OF SEGMENT WITH ROUGHNESS WORSE THAN LIMITING VALUE
Category (*)	Category (*)	Toll plaza area	
			**%
			**%
			**%

3.1.2.3 Surface Friction

3.1.2.3.1 Definition

The surface friction is measured as the ratio of the force to the normal load on the wheel of a SCRIM (Sideway-Force Coefficient Routine Investigation Machine) or equivalent approved under wet road surface conditions. This ratio is termed as the sideway-force coefficient of friction (SFC) or the International Friction Index (IFI) according to [here insert reference for Texture and Surface Friction Resistance Measurements].

3.1.2.3.2 Equipment

The equipment used for the measurement of surface friction (outside the toll plaza area) shall be the SCRIM (developed by [here insert equipment standard]) or similar accepted machine.

Within ** m of the toll plaza and at stop signs the surface friction shall be measured with a pendulum tester.

The manufacturer of the equipment, or its agents, shall certify that the equipment is in good working order and the work must similarly be certified as having been carried out in accordance with the manufacturers operating instructions.

3.1.2.3.3 Position and frequency of measurement

Surface friction measurements shall be taken in accordance with the specification presented in Table 3.5

TABLE 3.5: Specifications for Measurement of Surface Friction

ITEM	SPECIFICATION
Frequency of measurement	** years after Effective Date and thereafter every** years
Speed of measurement	** km/h
Position of measurement	Slow and fast lanes outer wheel paths, both directions
Testing interval	Record data over 1**m intervals

3.1.2.3.4 Data Processing and outputs

Data shall be processed to produce the results in the format as specified in Table 3.6.

TABLE 3.6: Specification for Output of Surface Friction Results

ITEM	SPECIFICATION
Unit	Sideway Force Coefficient (SFC) at **km/h
Segment lengths	* km for the Highway and appropriate lengths on either side of junctions
Statistical summary	Produce average coefficient over each section
Classification of segments	Classify all segments into one of the "Site" categories listed in Table 3.7

3.1.2.3.5 Investigatory Levels

The processed surface friction (SFC₅₀) data shall be evaluated against the lowest permissible limit for the applicable terrain category shown in Table 3.7. If the SFC₅₀ value at any particular location is found to be at or below the limit specified in Table 3.7, further investigations must be carried out to establish the likelihood of associated unsafe situations requiring remedial action.

TABLE 3.7: Investigatory Levels SFC₅₀

SITE DEFINITION	LOWER LIMIT SFC ₅₀ LEVELS PER SEGMENT						
	**	**	**	**	**	**	**
Dual carriageway (all purpose) - non-event sections. ¹							
Single carriageway - non-event sections. ¹							
Dual carriageway (all purpose) - minor junctions.							
Single carriageway - minor junctions							
Approach to and across major junctions (all limbs)							
Gradient 5% to 10%, longer than 50 m dual (downhill only), single (uphill and downhill)							
Horizontal curve (not subject to 70 km/h or lower speed limit). Radius □ 250 m.							
Approach to traffic signals, pedestrian crossing, railway level crossing or similar.							

1 = Non event - not at grade intersections

The minimum allowable surface friction in wheel paths where a pendulum tester is prescribed must exceed a PEN value of **.

3.1.2.4 Rut Depth

3.1.2.4.1 Definition

The rut depth is defined as the maximum vertical distance (mm) in the wheel path measured between the road surface and the bottom of a ** metre straight edge placed transversely across a wheel path.

3.1.2.4.2 Equipment and Accuracy

No specific equipment is specified. The accuracy of the equipment and method used shall be such as to achieve (over a *** m section), an accuracy on the average rut depth within * mm of the true mean, as measured from a two metre straight edge at * metre intervals. The required accuracy shall be achieved on * successive tests on the same section.

3.1.2.4.3 Measurement specification

Rut depth measurements shall be taken in accordance with the specification presented in Table 3.8.

TABLE 3.8: Specification for Measurement of Rut Depths

ITEM	SPECIFICATION
Frequency of measurement	** years after Effective Date thereafter every ** years
Position of measurement	Outside wheel paths in the slow lane, in both directions
Testing intervals	** metres

3.1.2.4.4 Data Processing

Rut depth data shall be processed to produce the results in the format specified in Table 3.9.

TABLE 3.9: Specification for Output of Rut Depths

ITEM	SPECIFICATION
Unit	mm
Segment lengths	* km
Statistical summary	Produce cumulative distribution graph for each segment

3.1.2.4.5 Acceptance Criteria

Using the cumulative distribution graph for each segment, the measured rut depths shall meet the acceptance criteria presented in Table 3.10.

TABLE 3.10: Acceptance Criteria for Rut Depth

LIMITING RUT DEPTH (mm)	MAXIMUM LENGTH (%) OF SEGMENT WITH RUT DEPTH WORSE THAN LIMITING VALUE
**	**%
**	*%
**	*%

3.1.2.5 Faulting

3.1.2.5.1 Definition and measurement specification

Faulting is measured as the difference in elevation across transverse and longitudinal joints. Measurement shall be taken in accordance with the specification presented in Table 3.11.

TABLE 3.11: Specification for Measurements of Faulting

ITEM	SPECIFICATION
Frequency of measurement	** years after Effective Date thereafter every ** years
Position of measurement	On wheel paths in both travelling lanes in both directions
Testing intervals	Each transverse joint and every * m length on the longitudinal joints.

3.1.2.5.2 Data Processing

Faulting measurement data shall be processed to produce the results in the format specified in Table 3.12.

TABLE 3.12: Specification for output of Faulting Measurement Data

ITEM	SPECIFICATION
Unit	mm
Segment lengths	*** m
Statistical summary	Produce cumulative distribution graph for each segment.

3.1.2.5.3 Acceptance Criteria

Using the cumulative distribution graph for each segment, the measured faulting depths shall meet the acceptance criteria presented in Table 3.13.

TABLE 3.13: Specification for Acceptance Criteria for Faulting

LIMITING FAULTING (mm)	MAXIMUM NUMBER OF TRANSVERSE JOINTS (%) OR 5 m LENGTHS OF LONGITUDINAL JOINTS
*	**%
*	*%

3.1.2.6 Surface Macrotexture

3.1.2.6.1 Definition

Macrotexture is the deviation of a pavement surface from a true planar surface with the characteristic dimensions along the surface of **_ * mm.

3.1.2.6.2 Equipment and accuracy

The macrotexture shall be measured using a non-contact laser spot sensor capable of meeting the requirements contained within ISO 13473 1.

3.1.2.6.3 Measurement specification

Macrotexture measurements must be taken in accordance with the specification presented in Table 3.14.

TABLE 3.14: Specification for Measurement of Macrotexture

ITEM	SPECIFICATION
Frequency of measurement	Every ** years
Position of measurement	Outside wheel path in the slow lane, in both directions
Testing intervals	** metres

3.1.2.6.4 Data processing

Macrotexture data must be processed so as to produce results in the format specified in Table 3.15.

TABLE 3.15: Specification for Output of Surface Macrotexture

ITEM	SPECIFICATION
Unit	Mean profile Depth (ISO 13473-1) calculated for each *** metres
Segment lengths	* km
Statistical summary	Produce cumulative distribution graph for each segment

3.1.2.6.5 Acceptance Criteria

As no minimum specification exists, the macrotexture is used along with the surface friction to report the IFI.

3.1.3 Specification for Extent of Distress

3.1.3.1 Introduction

During the Concession Period, the extent of the paved area that is structurally severely distressed (failures or potholes) may not exceed specified limits, as such extensive distressed areas will indicate an urgent need for pavement rehabilitation.

3.1.3.2 Measurement

The measurement of the extent and number of failures and potholes shall be done as specified in Table 3.18.

3.1.3.3 Acceptance criteria

The extent of patches and failures measured according to the specification in Table 3.18, shall not be more than ** m for any * km segment and * pothole(s) per * km segment.

3.1.4 Specification of Structural Condition

3.1.4.1 Introduction

It is the responsibility of the Concessionaire to provide and maintain a pavement structure of sufficient structural capacity and in an adequate condition to carry the traffic safely and comfortably during the Concession Period. In addition to the assessment of functional items, the structural condition of the pavement shall also be monitored through visual assessment and deflection measurements during prescribed seasons. This information must be made available to the Authority, in a form complying with output specifications.

During the Concession Period neither the visual assessment results nor the deflection measurements hereinafter specified may be used in isolation for the determination of the structural condition of the pavement. In the event that either criteria is not met, a detailed evaluation, subject to the approval of the Authority, to determine the structural capacity and the remaining pavement life shall be carried out to the satisfaction of the Authority. The procedure for assessing the remaining structural capacity for any uniform section or subsection of road will be agreed between the Authority and the Concessionaire.

At the end of the Concession Period, the Concessionaire shall transfer the Highway to the Authority. The Highway shall be returned to the Authority with a specified minimum structural capacity. The analysis to determine the remaining pavement life shall be carried out by consultants appointed by the Concessionaire and agreed with the Independent Engineer.

The Authority reserves its rights to appoint an independent expert to either verify results or carry out its own investigation or calculations. The Independent Engineer also retains the right to do his own calculations to audit the results of the above analysis. The Highway shall have the following remaining pavement structural life for the pavement categories as indicated in Table 3.16.

TABLE 3.16: Remaining Pavement Structural Life

CATEGORY	REMAINING STRUCTURAL LIFE (E80) AT END OF CONCESSION PERIOD
	** Million
	** Million

3.1.4.2 Visual Assessment

3.1.4.2.1 Assessment methodology:

Visual condition assessment will be carried out by certified assessors approved and appointed by the Concessionaire in accordance with the standard visual condition manuals. The data will be processed and captured by the Concessionaire in a pavement management system (PMS). Table 3.17 specifies requirements of the visual assessments. The detailed requirements for patching potholes and failures are summarised in Table 3.18.

TABLE 3.17: Specification Requirements for Visual Assessment

ITEM	SPECIFICATION
Method:	As described in:
- Flexible pavement	[here insert Manual]
- Rigid pavement	[here insert Manual]
Frequency:	** : Between the months of *and *.
Segment length:	* km *** m
- Flexible pavement	
- Rigid pavement	
Carriageways:	Each carriageway is assessed separately
Distress items:	As specified in the approved pavement management system
Detail extent of certain individual distress items: (see Table 3.19)	Where required by the Authority, the extent of certain individual distress items shall be measured by tape measure (per lane), during the final * years of Concession Contract, to determine if the extent exceeds the acceptance criteria in Table 3.19. The minimum length of distress (longitudinally) shall be taken as ** m for any single occurrence.

SAMPLE

TABLE 3.18: Specification for Measurement of Extensive Patches

ITEM	SPECIFICATION
Frequency of measurement	As required by the Authority
Position of measurement	Measured per lane
Method of measurement	Measure by tape measure in longitudinal direction (Maximum cross-section)
Accuracy of measurement:	Measure to nearest 0.* m
- Patches	Measure actual length
- Potholes	Measure 0.* m additional on both sides
- Failure	Measure * m additional on both sides
Description of patches, failures and potholes	As described in the latest version of [here insert the relevant Visual Assessment Manual]

3.1.4.2.2 Data Processing

The visual distress data must be processed by the method specified in the PMS to determine a Visual Condition Index (VCI) for each road segment. The VCI for each road segment together with the classification into condition categories must be reported.

3.1.4.2.3 Acceptance criteria

The acceptance criteria presented in Table 3.19 shall be met during the final ** years of the Concession Period and also in accordance with Clause 3.10 of the Concession Contract.

Any improvements in the visual condition of the pavement due to any rehabilitation measures undertaken in the last ** years of the Concession Contract will not be taken into account, unless the measures include adequate structural patching and crack sealing plus an asphalt overlay of **mm thickness or more.

TABLE 3.19: Acceptance Criteria for Visual Assessments

VISUAL CONDITION ITEM	ACCEPTANCE CRITERIA	
	Category 1	Category 2
VCI	≤ **	≤ **
Change in VCI units per year	≤ **	≤ **
Individual distress items per lane: TMH9	Extent: % of length	
1. Flexible pavements:		
a. Crocodile cracking (1<degree ≤3)	≤*	≤*
b. Longitudinal cracking (1<degree ≤3)	≤*	≤*
c. Pumping (1<degree≤3)	≤*	≤*
d. Patching (1<degree≤3)	≤*	≤*
e. Failures (1<degree≤3)	≤*	≤*
	Extent: Number	
f. Potholes (1<degree ≤3)	≤*	≤*
2. Rigid pavements: (refer to Manual)	Extent: Number of slabs	
a. Cracked slab (Open or spalled)		
b. Shattered slab (Open or spalled)		
c. Joint associated cracks (Open or spalled)		
d. Blow-up, failures, potholes		
e. Patches - concrete with defect		
f. Asphalt patches		
g. Joint seal condition (Degree ≤3)		
h. Pumping (Degree ≤5)		
i. Faulting (moderate ≤10 mm)		
j. Faulting (severe >10 mm)		

3.1.4.3 Deflection Measurement

3.1.4.3.1 Measurement of surface deflection

The surface deflection of the pavement as measured by a Falling Weight Deflectometer (FWD) must be used as an indicator of the structural capacity of the pavement structure.

Measurements must be carried out by the Concessionaire or its agent. Table 3.20 specifies the requirements for the monitoring of deflection measurements. All measurements must be taken at the same positions during the same month of the year.

In the assessment of deflections measured, the following factors influencing the deflection measurements will be recognised:

- Surface temperature
- Moisture content and movement at the specific measuring point
- Stabilisation "cracked-block-rocking" where cemented layers are present in the pavement structure.

TABLE 3.20: Specification for Measurement of Surface Deflection

ITEM	SPECIFICATION
Equipment	
Sensor positions (mm)	
Calibration	
Test position	
Test interval	
Frequency	
Test load	
Test pressure	
Surface temperature	
Air temperature	

3.1.4.3.2 Data processing

The deflection data must be processed to produce the information specified in Table 3.21.

TABLE 3.21: Specification for Output of Deflection Results

ITEM	SPECIFICATION
Deflection measurements	
Deflection parameters	

3.1.4.3.3 Acceptance criteria

At the end of the Concession Period, the Highway shall be returned to the Authority with at least the specified minimum ^{***}th percentile residual of the structural capacity given in Table 3.16.

A holistic approach, which recognises the guidelines criteria given in Table 3.19, using the results of the deflection surveys and visual assessments in the last ** years of the Concession Period, but using neither of these in isolation, together with the current and proven deflection based pavement design method and other appropriate technology available at the time, must be compared to the guidelines criteria given in Table 3.22 and must be used in arriving at the structural capacity of the road pavement at the end of the Concession Period.

Despite the existence of internationally recognised deflection based criteria for concrete pavements, no criteria are specified in this Volume. When the technology for deflection based criteria are improved and locally validated, the deflection based guidelines for concrete pavements shall be agreed upon between the Authority and the Concessionaire.

Uniform sections consisting of accumulated segments, each of maximum total length * km, must be identified on the following basis:

- Pavement structure
- Traffic volume and
- Co-efficient of variation which shall be less than ** per cent.

The ^{***}th percentile value per uniform section must be used in judging acceptance. Outliers must be excluded from uniform sections and evaluated individually to determine appropriate action and extent of action required. To determine whether or not a value is an outlier, the procedure given in [here insert Manual] must be followed.

TABLE 3.22: Guideline Criteria for Surface Condition Deflection

BASE TYPE	90 th PERCENTILE VALUE (micron)						ANNUAL CHANGE IN VALUES
	Category			Category			
	Ymax	BLI	MLI	Ymax	BLI	MLI	
Base							
Asphalt							
Base							

3.1.5 Stability of Cuts and Fills

3.1.5.1 Introduction

It is the responsibility of the Concessionaire to ensure and maintain the stability of cuts and fills for the duration of the Concession Contract. All systems, measures and procedures applied by the Concessionaire for this purpose, shall be subject to review by the Independent Engineer and the Authority. The risk of failure shall be identified and monitored, and the slope shall be stabilised if necessary.

3.1.5.2 Assessment Methodology

The type and frequency of assessments will vary according to the nature of the slope, environmental and other conditions and therefore no predetermined method or frequency is prescribed. The Concessionaire shall institute a system as agreed with the Independent Engineer after the Initial Construction Period that will identify the risk of failure and categorise slopes accordingly. Depending on the risk category the Concessionaire shall

institute appropriate monitoring procedures. The monitoring procedures shall, amongst other things, include the recording of movements, crack development, seepage, slides, slips, rockfall etc.

All geotechnical measures used for stabilising fills and slopes like core drains, anchors, dowels, pins, subsurface and other drains, retaining walls etc. shall also be monitored regularly for effectiveness.

3.1.5.3 Acceptance criteria

The output from the regular assessments shall be analysed by a professional geotechnical engineer and compared with acceptable criteria for the type and nature of the slopes. During this process stabilisation measures shall be identified and, where necessary, implemented to safeguard motorists and the integrity of the facility.

3.2 Traffic

3.2.1 General

The Concessionaire shall install and maintain a system of traffic monitoring stations as part of a traffic management system, in order to monitor traffic movements and loading along, across and entering and leaving the Highway.

The counts shall include all details required to calculate the Level of Service (LOS) at all segments along the road as well as at interchanges and at intersections as and when required.

Where Construction Works necessitate the removal or destruction of a counting station, it must be reinstated as soon as practically possible. Whenever damage is caused to one of the Authority's Comprehensive Traffic Observations (CTO) counting stations by the Concessionaire's Activities, the Concessionaire must reimburse the Authority for reinstating such counting station.

3.2.2 Traffic Monitoring

To evaluate traffic flows and traffic loading, monitoring is required on an ongoing basis. The Concessionaire shall provide the Authority with traffic data annually and when required. The traffic counting programme shall comply with the following requirements:

- a. Counting stations shall be installed by the Concessionaire and shall be made operational and be maintained. Where construction or rehabilitation work necessitates the removal or destruction of a station, this station shall be replaced on completion of the construction/rehabilitation work, or alternatively, on agreement between the Authority and the Concessionaire, relocated to another location.
- b. A traffic counting plan will be drawn up and discussed on an annual basis.
- c. In addition to the above, counts available from the toll plazas shall be utilised for traffic assessments.
- d. It is a requirement that all the counting stations are permanent. The Authority requires counting stations to be fully functional for an average of at least **% of the time calculated on a yearly basis.
- e. Traffic information required for a specific section where no counter or counting station has been installed will be derived from traffic study information if suitable. Should it however be required, short term machine counting will be arranged to substantiate traffic study figures and or other permanent counting stations.
- f. { Does the Authority currently have an existing CTO station on the Highway?} The Concessionaire must, however, install, operate and maintain a permanent counting station in accordance with the agreed traffic counting plan. A suitable location for this would be at the Toll Plaza.
- g. At all significant interchanges and intersections automatic traffic counts of ** week duration annually shall be undertaken. These counts shall be supplemented by a ** day (** hr) count to individually account for all turning movements at the

intersections. The specific week for conducting the **week intersection counts shall be determined from the output of the permanent stations outside normal peak hours and subject to the approval of the Authority. Interchange ramp terminals must be dealt with in the same way.

3.2.3 Traffic Analysis Strategy

a. For the Highway

Uniform segments of the Highway must be identified in terms of cross-sections, horizontal and vertical design standards, access control, and traffic patterns. These uniform segments must be recorded on a distance-flow rate diagram. Traffic patterns can be derived from permanent and other traffic counting stations.

Each uniform segment of Highway must be analysed for specific road characteristics as indicated in the latest Highway Capacity Manual (HCM). The variables used in the analysis must be in accordance with good industry practice.

The following information must be made available in advance of every meeting pertaining to the establishment of an Additional Construction Works Programme:

- i. a distance-flow rate diagram for "LOS 'D' " of the Highway, indicating capacity demand and capacity provided;
- ii. reporting on and re-assessment of traffic volumes;
- iii. level of service of each uniform segment of Highway;
- iv. the estimated remaining period for each uniform segment of Highway before upgrading will be required; and
- v. safety report and remedial measures necessary to ensure safe operations.

b. For intersections

Data from detailed intersection traffic counts and other counts shall be subjected to detailed capacity analysis of all turning and through movements using the latest suitable computer software. Such an analysis must be conducted for each intersection annually.

A report of the results of each analysis must be prepared and must contain:

- i. the prevailing levels of service, average delays, and volume to capacity ratio experienced for each movement at the intersection concerned;
- ii. the expected capacity lifespan of the intersection or parts thereof in terms of the traffic capacity requirements specified; and
- iii. recommendations for the upgrading of the intersection or parts thereof to fulfil the capacity criteria.

c. For the [relevant] Interchange

Data from detailed traffic counts at interchange ramp terminals and other available traffic counts must be used for conducting detailed analyses of all turning movements at ramp terminals, as well as merging and diverging movements at on- and off-ramps. Such an analysis must be conducted for each Interchange annually. A report must be prepared of the results of the analysis and must contain;

- i. the prevailing levels of service, average delays and volume to capacity (V/C) ratios experienced for each movement at the interchange ramp terminals;
- ii. levels of service for merging and diverging movements for the on- and off-ramps;
- iii. the expected capacity lifespan of the interchange and all parts thereof in terms of the traffic capacity requirements specified; and

- iv recommendations for upgrading the interchange or parts thereof to fulfil the required capacity criteria.

3.2.4 Highway Capacity

a. Capacity criteria for the Highway

Subject to the requirements of the Concession Contract the Concessionaire shall ensure that a Level of Service D (LOS_D), [here insert relevant reference manual] will be achieved along the road during all hours of the year except the ** hours with the highest traffic volumes. In addition, Level of Service D (LOS_D) shall be achievable during the peak hour.

The peak hour for urban road Level of Service assessment shall be taken as the average weekday peak hour, where “average weekday peak hour” means the average peak hour traffic volume for ** consecutive weekdays (excluding Saturdays and Sundays) outside holiday periods. For dual carriageway roads in urban areas, the average weekday peak hour as well as the peak hour assessment shall be calculated separately for each carriageway.

Comment [ID11]: [note-week-end depends upon cultural background and will be depend upon location of the Project].

If this cannot be achieved, capacity improvements shall be introduced by means of industry accepted traffic management procedures, additional lanes, climbing lanes, passing lanes or other suitable acceptable means as agreed with the Authority. The maximum cross section of freeways in an urban environment shall be ** lanes per direction.

Where the level of service on an ** lane freeway in an urban environment exceeds (LOS_D) during the average weekday peak hour and will not be addressed by the construction of other portions of the road network in the area, the Concessionaire undertakes to introduce management systems to remedy the situation such as:

- Access Management to limit the demand on the specific section of Highway involved
- Differential tolling rates to achieve a more balanced distribution of traffic and thus limit the demand in the peak hours.
- Any other systems approved by the Authority.

The Concessionaire also undertakes to take due cognisance of blockages of cross roads and to enter into discussions with the Relevant Authorities on road planning issues with the objective of resolving the situation. In urban sections along the road, intersection capacity analysis as per prescribed specifications shall be used to carry out level of service calculations. The specified level of service to be maintained at intersections is as specified in sub-paragraph (b) below.

b. Capacity criteria for intersections

i. For urban intersections

Capacity related requirements for urban intersections must be judged in terms of the performance (measure of effectiveness) of the intersections during average weekday morning and afternoon peak hours and the Saturday peak hour. The measure of effectiveness is the average stopped delay and/or volume to capacity ratio per lane group for a signalised intersection and average total delay for a priority controlled intersection. The level of service at which a lane group operates is based on the delay per vehicle. Intersections must be upgraded when the level of service of any particular lane group is worse than LOS_D and/or the average volume to capacity ratio exceeds ** for a signalised intersection. In addition, for right turning movements at signalised intersections, the capacity requirements, namely LOS_D and volume to capacity

ratio not exceeding **, will only be applicable once the number of right turning vehicles is more than ** the number of cycles per hour.

The Level of Service in the above regard will be calculated using accepted criteria for priority controlled and signalised intersections, these being:

TABLE 3.23: Capacity Criteria for Intersections

LEVEL OF SERVICE	TYPE OF INTERSECTION	
	PRIORITY CONTROLLED	SIGNALISED
VOLUME/CAPACITY RATIO (V/C)		
LOS _D		

ii. For rural intersections

The level of service criteria for intersections in rural areas must be calculated as above with the same criteria. However, if deemed more practical, the annual **highest hourly volume may be used for assessment purposes for expansion and upgrading.

iii. Combination of intersections

Where the analysis performed as above shows that an intersection or an approach to an intersection requires upgrading due to Level of Service requirements, such specific upgrading need not be undertaken if it is demonstrated that the expansion of an additional interchange, intersection or other new intersection or network improvement within one (1) year, in close proximity to the said intersection, will improve the traffic.

c. Capacity criteria for temporary works

During construction of portions of the Highway as well as during Routine Maintenance activities, the Level of Service requirements specified in the preceding clauses shall generally apply and be in accordance with good industry practice. The effects of temporary deviations on the Level of Service of the portions of the Highway immediately preceding the deviation should be carefully considered in the design and operational stages of the construction. Notwithstanding the provisions of the [here insert relevant Standard Specifications for Road and Bridge Works well as the provisions of the [here insert relevant Standard Specifications for Routine Maintenance } traffic disruptions should be kept to an absolute minimum.

3.3 BRIDGES AND DRAINAGE STRUCTURES

This section on the performance requirements shall be read in conjunction with the latest available [here insert relevant Code of Procedure for the Planning and Design of Structures].

3.3.1 Inspections

[Here insert details of use of a bridge management system].

On bridges older than ** years, even if visually intact, special inspections shall be carried out every ** years to test for carbonation, chloride attack etc. so that preventive measures may be applied before visual damage occurs.

The projected lifespan of major drainage structures and bridges at the end of the Concession Period shall not be less than ** years unless the Concessionaire can demonstrate that all due

care had been taken to limit the penetration of carbonation or chloride salts or other chemical activities that lead to the corrosion of the reinforcement steel.

The project lifetime calculations, and the tests required for these, shall be carried out by an authority mutually agreed to by the Authority and the Concessionaire.

3.3.2 Ratings of Bridge Elements

The bridge management system to be adopted by the Concessionaire (the Bridge Management System) shall be based on [here insert relevant Defect, Extent and Relevancy (DER) system]. For a bridge to be considered acceptable the rating of any defect of all its elements shall not be more than *. Any element that has a relevancy or urgency rating of * shall be regarded as Critical or Urgent and shall be dealt with as soon as possible.

3.3.3 Concrete Defects

Any defects falling below an acceptable rating shall be monitored and shall be repaired before the defect becomes so serious as to be hazardous. The Concessionaire shall use [here insert relevant code or procedure for the Rehabilitation and Repair of Concrete Bridges] as a guide for the repair of all concrete elements.

3.3.4 Accidental Damage to Structures

The structure shall immediately be made safe and repairs effected to restore the structure to its original condition.

3.3.5 Expansion Joints

a. General

All expansion joints shall be tested to ensure that they are watertight at the time of installation and during its service life. In addition the maximum gap between concrete nosings, or metal cross beams in the case of multi-element joints, shall be **mm under the worst minimum temperature conditions. For new bridge structures under **m in length jointless bridges shall be preferred (if possible) to minimize maintenance in the future.

The bridge inspections shall be carried out at maximum ** year intervals in compliance with the Bridge Management System and which shall include watertight tests as described below.

b. Water tightness test

On completion of the joint or component installation, the Concessionaire shall perform a water tightness test of the joint. The test shall consist of ponding water to a depth of at least **mm above the highest point of the joint constructed under the particular phase of work (i.e. half width). The ponding shall be maintained for **hour(s) and if no evidence of leakage is detected, the joint shall be accepted as being of watertight construction.

If the joint is found to be leaking, the Concessionaire shall remedy the situation and repeat tests on the affected section of joint. The testing shall be carried out immediately on completion of the section of the joint to take advantage of the accommodation of traffic arrangements in existence at the time.

3.3.6 Rehabilitation

The rehabilitation of a bridge shall include the following:

a. The repair of existing balustrades/parapets.

- b. The refurbishment / replacement of bearings.
- c. The replacement of neoprene seals in gland type joints, the removal of failed pressfit seals which are replaced by a silicon sealant if the concrete nosings are in a sound condition or the total replacement of an expansion joint.
- d. The repair of concrete spalling, crack repair by injection/ sealing, corrosion repair of reinforcement, replacement/ repair/painting of guardrails.
- e. Reinstatement of embankment erosion/scour protection.
- f. Repair of road approaches and bridge surfacing.

Upgrading

[here set out regime if one is to be created]

3.4 Toll Plazas

The average service time (queuing and processing) at the toll plazas shall not be longer than ** seconds. When ** random observations are made during any ** minute period the maximum number of vehicles queuing shall not exceed more than once the value of ** multiplied by the number of open lanes (see requirement in subclause 2.5.3.)

3.5 Routine Maintenance

3.5.1 Scope

The scope of Routine Maintenance shall be as specified in Clause 2.7, and Schedule 1 and in the relevant standard specifications of the [here insert relevant code or procedure].

3.5.2 Performance Inspection

The Independence Engineer may, at any time, and at any frequency determined by the Independent Engineer inspect any Test Section (or any number of Test Sections) to audit compliance of a relevant Routine Maintenance Section with the Acceptance Criteria.

For the purpose of this clause 3.5:

“Acceptance Criteria” means the acceptance criteria of the Highway specified in Schedule 1.

“Non-Performance Points” means a point or points given to the urgency rating / weighing for Routine Maintenance features listed in Schedule 1.

“Test Section” means any continuous or cumulative** km portion of a Routine Maintenance Section (as randomly determined by the Independent Engineer) as measured along the centreline of the Highway.

“Routine Maintenance Section” means continuous ** km sections of the Highway as agreed by the parties prior to the Effective Date.

3.5.3 First Non-Conformance Certificate

3.5.3.1 If, on an inspection of any Test Sections, the Independent Engineer determines that any Acceptance Criteria is not satisfied then the Independent Engineer shall notify the Concessionaire of the non-compliance.

3.5.3.2 Within * Business Days of the Independent Engineer having delivered to the Concessionaire the notification referred to in clause 3.5.3.1 above, the Concessionaire may deliver to the

Independent Engineer proof that the non-conformance with the Acceptance Criteria has not continued for a period longer than the relevant Correction Period for such non-conformance as specified in Schedule 1 (the "Correction Period").

3.5.3.3 If the Concessionaire has not demonstrated to the reasonable satisfaction of the Independent Engineer within the period specified in clause 3.5.3.2 that the non-conformance of any Routine Road Maintenance feature in terms of the Acceptance Criteria has not continued for a period longer than the Correction Period, the Concessionaire shall accrue Non-conformance Points for such non-conforming features (as specified in Schedule 1) which exceeded their respective Correction Periods.

3.5.3.4 If 5 or more Non-Performance Points have accrued in respect of a Test Section (as determined by the Independent Engineer)

- a) the Independent Engineer shall issue a notice to the Concessionaire (the "First Non-Conformance Notice") setting out the aggregate of Non-Performance Points for the relevant Test Section in a particular ** km Routine Maintenance Section as determined by the Independent Engineer, and
- b) the Concessionaire shall pay to the Authority a penalty calculated pursuant to clause 3.5.3.5 in respect of the relevant Routine Maintenance Section.

3.5.3.5 The penalty for non-compliance with the Acceptance Criteria specified in a First Non-Conformance Notice shall be equal to an amount calculated as follows :

$$P = Y (\text{Gross Daily Toll revenue} \times F_p)$$

Where

P = the penalty

Y = a percentage (of the full penalty) being equal to:

If there are X or less Non-Performance Point in aggregate 0%

If there are between * and * Non-Performance Points (inclusive) in aggregate where; **% x (N-X)

N=Non-Performance Points accrued in relevant Test Section.

If there are more than ** Non-Performance Points in aggregate **%

Gross Daily Toll Revenue = the Gross Daily Toll Revenue of the Highway Section to which the Routine Maintenance Section belongs

F_p= the relevant penalty adjustment factor specified in Table 3.24

TABLE 3.24 : Routine Maintenance Penalty Adjustment Factor per Toll and O&M Sector

HIGHWAY SECTION	PENALTY ADJUSTMENT FACTOR (F _p)
Section 1	This factor needs to be tendered

Section 2	
Section 3	
Section 4	
Section 5	
Section 6	
Section 7	

3.5.4 Second Non-Conformance Certificate

3.5.4.1 If, following the issue of a First Non-Conformance Notice pursuant to clause 3.5.3.4, the Concessionaire fails to rectify any non-conforming feature specified in the First Non-Conformance notice within a further period equivalent to the Correction Period specified for that non-conforming feature:

- a) the Independent Engineer shall issue a notice (the “Second Non-Conformance Notice”) to the Concessionaire (and a copy to the Authority), setting out all the Routine Maintenance features specified in the First Non-Conformance Notice that still do not satisfy the Acceptance Criteria; and
- b) the Concessionaire shall pay to the Authority a further penalty calculated as follows :

$$P = \text{Gross Daily Toll Revenue} \times F_p$$

where

P = the penalty

Gross Daily Toll Revenue = the Gross Daily Toll Revenue of the Toll O&M Sector to which the Routine Maintenance Section belongs.

F_p = the relevant penalty adjustment factor specified in Table 3.24

3.5.5 Third Non-Conformance Certificate

3.5.5.1 If the Concessionaire fails to rectify any Routine Maintenance feature specified in a notice issued pursuant to clause 3.5.4.1 a period equal to *times the relevant Correction Period specified in Schedule 1 for that failure (which period shall commence on the date of the notice referred to in clause 3.5.3.1)

- a) the Independent Engineer shall issue a further notice (the “Third Non-Conformance Notice”) to the Concessionaire with a copy to the Authority, to inform the Concessionaire of the features that remain non-conforming in terms of the Acceptance Criteria; and
- b) the Concessionaire shall pay to the Authority a further penalty calculated pursuant to clause 3.5.4.1(b).

If such non-conformance(s) is not rectified to the satisfaction of the Independent Engineer within a period of * days following such notification, the Authority shall be entitled to draw on the Operations and Maintenance Bond in terms of the Concession Contract to rectify the non-compliance.

3.5.6 Safeguarding

The Concessionaire shall safeguard any hazardous situation occurring on the road. Safeguarding of hazardous situations occurring as a result of failures of Routine Maintenance features are required within the reaction periods specified in Schedule 1. Reaction periods are specified for all the critical Routine Maintenance features.

If the Concessionaire fails to take such safeguarding action within the specified reaction periods it shall pay to the Authority a penalty per Routine Maintenance Section, calculated pursuant to clause 3.5.4.1(b).

3.5.7 **Hand-back**

3.6 Schedule 1 : Performance Based Routine Maintenance Requirements

3.6.1 Preamble

Schedule 1 consists of a table specifying Routine Maintenance performance requirements presented in eight parts, namely:

- Part 1: General Responsibilities
- Part 2: Pavement Maintenance
- Part 3: Drainage Maintenance
- Part 4: Roadside Maintenance
- Part 5: Maintenance of Road Traffic Signs
- Part 6: Protection Works
- Part 7: Vegetation Maintenance
- Part 8: Maintenance of Structures

For each feature requiring maintenance acceptance criteria, correction periods to correct the deficiencies and reaction periods are specified.

Reaction period is defined as that period required to safeguard a hazardous situation according to the requirements specified herein.

The correction period includes the reaction period.

Comment [ID12]: [note-in the comments on the Concession Contract it was suggested that the hand-back procedure should start some 3-5 years before expiry of the Concession Period and should be more fully set out. It is deserving of a full section in either this or another annexure rather than a short paragraph as was set out in the original draft].

SCHEDULE 1
PERFORMANCE BASED MAINTENANCE REQUIREMENTS

SAMPLE

SPECIFICATION TABLES

PART 1: GENERAL RESPONSIBILITIES

FEATURE	DESCRIPTION	CATEGORY	URGENCY RATING / WEIGHTING	SPECIFICATION	ACCEPTANCE CRITERIA PER TEST SECTION	CORRECTION PERIOD TO CORRECT DEFICIENCY	REACTION PERIOD TO SAFEGUARD SITUATION

PART 2 : PAVEMENT MAINTENANCE

FEATURE	DESCRIPTION	CATEGORY	URGENCY RATING / WEIGHTING	SPECIFICATION	ACCEPTANCE CRITERIA PER TEST SECTION	CORRECTION PERIOD TO CORRECT DEFICIENCY	REACTION PERIOD TO SAFEGUARD SITUATION	COMMENT

FEATURE	DESCRIPTION	CATEGORY	URGENCY RATING / WEIGHTING	SPECIFICATION	ACCEPTANCE CRITERIA PER TEST SECTION	CORRECTION PERIOD TO CORRECT DEFICIENCY	REACTION PERIOD TO SAFEGUARD SITUATION	COMMENT

PART 3 : DRAINAGE MAINTENANCE

FEATURE	DESCRIPTION	CATEGORY	URGENCY RATING / WEIGHTING	SPECIFICATION	ACCEPTANCE CRITERIA PER TEST SECTION	CORRECTION PERIOD TO CORRECT DEFICIENCY	REACTION PERIOD TO SAFEGUARD SITUATION

PART 4 : ROADSIDE MAINTENANCE

FEATURE	DESCRIPTION	CATEGORY	URGENCY RATING / WEIGHTING	SPECIFICATION	ACCEPTANCE CRITERIA PER TEST SECTION	CORRECTION PERIOD TO CORRECT DEFICIENCY	REACTION PERIOD TO SAFEGUARD SITUATION
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PART 5 : MAINTENANCE OF ROAD TRAFFIC SIGNS

FEATURE	DESCRIPTION	CATEGORY	URGENCY RATING / WEIGHTING	SPECIFICATION	ACCEPTANCE CRITERIA PER TEST SECTION	CORRECTION PERIOD TO CORRECT DEFICIENCY	REACTION PERIOD TO SAFEGUARD SITUATION

FEATURE	DESCRIPTION	CATEGORY	URGENCY RATING / WEIGHTING	SPECIFICATION	ACCEPTANCE CRITERIA PER TEST SECTION	CORRECTION PERIOD TO CORRECT DEFICIENCY	REACTION PERIOD TO SAFEGUARD SITUATION
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PART 6 : PROTECTION WORKS

FEATURE	DESCRIPTION	CATEGORY	URGENCY RATING / WEIGHTING	SPECIFICATION	ACCEPTANCE CRITERIA PER TEST SECTION	CORRECTION PERIOD TO CORRECT DEFICIENCY	REACTION PERIOD TO SAFEGUARD SITUATION

PART 7 : VEGETATION MAINTENANCE (Vegetation maintenance is a scheduled activity)

FEATURE	DESCRIPTION	CATEGORY	URGENCY RATING / WEIGHTING	SPECIFICATION	ACCEPTANCE CRITERIA PER TEST SECTION	CORRECTION PERIOD TO CORRECT DEFICIENCY	REACTION PERIOD TO SAFEGUARD SITUATION

PART 8 : MAINTENANCE OF STRUCTURES

FEATURE	DESCRIPTION	CATEGORY	URGENCY RATING / WEIGHTING	SPECIFICATION	ACCEPTANCE CRITERIA PER TEST SECTION	CORRECTION PERIOD TO CORRECT DEFICIENCY	REACTION PERIOD TO SAFEGUARD SITUATION
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