# Section 7. Terms of Reference

## 1. INTRODUCTION

The Government of Belize (GOB) has received a Technical Assistance (TA) Grant from the Inter American Development Bank (IADB) to assist in financing the services of consultants to conduct project preparation studies for the George Price Highway Rehabilitation Project. The project addresses a portion of the George Price Highway (GPH) commencing at its intersection with the Hummingbird Highway (HH) near mile 48 to the Belize-Guatemala Border past the town of Benque Viejo Del Carmen. The project includes the replacement of the Roaring Creek Bridge with a new structure. The Ministry of Works & Transport (MOWT) shall be the Executing Agency for the Project.

## 2. BACKGROUND

Belize is a small tropical country with a lightly spread population of 340,786. The country and its infrastructure, especially in the low lying coastal areas, are critically vulnerable to frequent tropical storms and hurricanes, flood damage and rising sea levels.

Belize's road network consists of 4,489.76 km of roads, of which 788 km are primary roads or highways, 765 km are secondary roads and 1,943 km are rural roads. Only 20% of the road network is paved. The existing network of roads and bridges is severely impacted by recurrent flooding. In recent decades tropical storms and hurricanes have recurrently affected the country. Impacts are likely to worsen due to increased (extreme) rainfall events and sea level rise associated with climate variability and climate change. Insufficient maintenance coupled with over-weight axle loadings and inadequate road alignments are contributing to both high internal freight costs and to one of the highest road fatality rates in the Latin American region. In recent years efforts have been made by the Government of Belize (GOB) to improve the safety standards of the highway system across the country. These efforts include a Road Safety Project which is being financed by the CDB. This project includes a

demonstration corridor along the George Price Highway from Belize City to Belmopan and includes a portion of the Hummingbird Highway and several main roads in Belmopan.

The George Price Highway (GPH), formerly known as the Western Highway, connects the following:

(i) Belize City [the economic center of the country];
(ii) Belmopan [the national capital of the country];
(iii) San Ignacio and Santa Elena [the second largest urban area in the country]; and
(iv) Benque Viejo Del Carmen on the Guatemalan Border.

The GPH is a two-lane highway that is 79.4 miles long that was originally built in the 1930's. The last comprehensive rehabilitation of the highway was done in the mid-1980's. Since then, the roadway's pavement has deteriorated significantly, in particular between Belmopan (mile 47.9) and the Guatemalan Border at Benque Viejo Del Carmen (mile 79.4), due to: (i) insufficient drainage; (ii) the steep increase in truck traffic from the expansion of the petroleum sector for the most part and, to a lesser extent, the agriculture and tourism sectors. Additionally, deterioration has been caused by very limited maintenance on the highway. The pavement's poor condition together with the absence of paved shoulders, unsafe road alignments, lack of pedestrian facilities in urban areas, and limited marking and signs have led to Belize's high incidence of road fatalities.

Flooding greatly restricts mobility along the road and makes evident infrastructure vulnerabilities during extreme weather events. This is significant as the highway is a primary evacuation route from coastal areas including Belize City. Of particular concern is the Roaring Creek Bridge (mile 48), located near Belmopan, which has been submerged at least twice in the last ten years and frequently has water straining its superstructure, possibly undermining its structural integrity. Loss of access to the bridge cuts off a critical evacuation route during severe storm events in the short-term and severely damages trade with Guatemala and tourism to important sites in Western Belize in the long-term. Additionally, the road system in the Succotz area, the entrance

to Benque Viejo Del Carmen and an area within the town of Benque Viejo Del Carmen are also subject to flooding. Similarly the Red Creek Bridge, the Garbutt Creek Bridge and other areas along the highway are also susceptible to floods.

To address these problems the Government of Belize (GOB), through funding requested from the Inter-American Development Bank, is committed to address the following components of the Project:

1) The rehabilitation of the GPH between its intersection with the Hummingbird Highway and the Guatemalan Border in Benque Viejo Del Carmen.

2) The construction of a new Roaring Creek Bridge.

Technical and Economic Feasibility studies were conducted in 2014 which included preliminary designs. These designs have addressed certain deficiencies along the highway, among them, the need to:

1. Improve vertical and horizontal alignments.
2. Improve the drainage systems to provide resilience to the frequent severe storm events and climate change.
3. Reconstruct the pavement system for the projected 20 years traffic.
4. Widen the roadway to a standard width of 33 feet including surfaced shoulders.
5. Develop two main intersections at the Iguana Creek Road Junction and at the Entrance to BVDC.
6. Construct a new bridge across Roaring Creek and to retrofit or replace other minor bridges.
7. Improve the general road safety.

Another component of the Preparation Studies was an Environmental and Social Impact Assessment, which contains mitigation measures to be incorporated in the Final Designs.

These preparation studies shall guide the elaboration of the Final Designs for the Project.

## 3. OBJECTIVES

The Consultant shall prepare detailed final designs based on the Preliminary Designs and recommendations of the Full Feasibility Report and the Environmental and Social Impact Assessment Report ( ESIA for all three sections of the project, including the bypass route in the Succotz area, the replacement bridge structure for the Roaring Creek, rehabilitation of the existing Roaring Creek Bridge, all major intersections, drainage system upgrades, safety features, other minor bridges and culverts, and other associated works). The Final Design Report will include detailed drawings for all the above-stated works and all support documentation including final cost estimates for each section of the project including all bridges and other works, bills of quantities, full bid documents for construction including contract conditions and technical specifications and other support documents as required and outlined in these Terms of Reference and elaborated under the following section.

## 4. SCOPE OF ASSIGNMENT

SCOPE OF ASSIGNMENT

The George Price Highway Rehabilitation Project comprises the following sections:

a. **Section 1:** From the intersection of the George Price Highway and the Hummingbird Highway (including the new and existing Roaring Creek Bridges as well as works up to and including integration with a new roundabout to be built by others at the intersection) to the intersection of the George Price Highway and Iguana Creek Road. The latter intersection is included under section 2 of the project. This section includes a total of 15,980 m (9.93 miles) and commences at mile 47.9 and ends at mile 57.83).

   The commencement of this section will be integrated into works to be done under the CDB funded Road Safety Project, which includes a new roundabout at the intersection of the Hummingbird Highway and the George Price Highway.

b. **Section 2:** From the intersection of the George Price Highway and Iguana Creek Road to the new Loma Luz roundabout in Santa Elena on the George Price Highway. This section includes a total of 16,560 meters (10.29 miles) and commences at mile 57.83 and ends at mile 67.67. The end of this section will be

integrated into a CDB funded Project which includes a new roundabout recently completed near the Loma Luz Hospital.

c. **Section 3:** From the intersection of the George Price Highway and Buena Vista Street in San Ignacio to the border in Benque Viejo Del Carmen (this section includes 13, 4328 meters (8.34 miles) and commences at mile 71 and ends at mile 79.4). This section also includes the bypass road within Section 3 of the works in the Succotz area as outlined in the Technical and Economic Feasibility Report. A segment of approximately 2 miles within the towns of Santa Elena and San Ignacio that physically joins Section 2 and Section 3 is excluded from the project.

   The commencement of this project will be integrated into the new roundabout recently constructed at the end of Buena Vista Street on the George Price Highway.

The general intent of the consultancy is to provide the preparation works necessary for the rehabilitation of the George Price Highway by providing high quality detailed designs and support documents for the project. The designs shall be based on national standards and guidelines of the Ministry of Works & Transport which shall be developed as a part of the assignment.

These Terms Of Reference allow for consultancy services comprising the final designs, support studies an preparation of bid and contract documents for the project as described herein. The final designs shall include but shall not be limited to the following:

TECHNICAL SPECIFICATIONS

The Final Designs shall include a Technical Specifications document, which shall be a bounded document that describes in detail the general requirements for all materials, workmanship and products. Additionally the Specifications shall include materials testing requirements including frequencies and minimum acceptance criteria.

FINAL DESIGN DRAWINGS

The Final Designs shall include complete and comprehensive design drawings submitted in electronic (.dwg) and hard copy forms. The final designs for the project shall be presented in sufficient details to clearly describe the scope of works requested under the project which shall include but shall not be limited to the following:

1. Conduct desk study of the Preliminary Designs, the Technical and Economic Feasibility Reports, the Environmental and Social Impact Analysis Report and other reports and available documentation prepared by others as a part of the Project Preparation Studies in order to become familiar with the project details.

2. Conduct additional support studies to inform the Final Designs including but not limited to the following:

    a. Geotechnical investigations along the roadway and at the bridge locations. Probings into the proposed support strata will be required at the new bridge in Roaring Creek.

    b. Hydrological and hydraulic studies with specific attention paid to the effects of climate change and the effects of changes in the frequencies and intensities of precipitation and flood events.

    c. Structural evaluation of existing structures including bridges to be retrofitted.

    d. Highway planning including safety issues.

    Prepare detailed final designs and drawings for the project based on the general recommendations of the Full Feasibility Report and Preliminary Designs, for all three sections of the project including the bypass route in the Succotz area, the replacement bridge structure for the Roaring Creek, rehabilitation of the existing Roaring Creek Bridge, all major intersections, drainage system upgrades, safety features, other minor bridges and culverts, and other associated works.

3. Prepare Final Design Report along with support documentation including final cost estimates for each section of the project including all bridges and other works, bills of quantities, full bid documents for construction including contract conditions and technical specifications, other support documents as required and outlined in these Terms of Reference.

The Design Drawings shall at a minimum include the following:

1. Cross Sections (existing and proposal) at 20m intervals along the entire road works.

2. Longitudinal centerline sections (existing and proposed) along the entire road works.

3. Comprehensive details of all features including road furniture, super-elevation details, signs, drainage structures, electrical works, bus sheds, sidewalks, etc.

4. Bridge designs including foundation plans and details, cross sections, longitudinal sections, reinforcement arrangement, general arrangements, connection details, fabrication/ installation requirements, rehabilitation details, etc.

The Final Designs shall include large scale details of all critical areas and aspects of the proposed works such that the requirements for construction are clear, fully detailed and unambiguous.

The services shall be carried out in accordance with generally accepted professional practices and following recognized engineering and management principles and practices. The Final Design Consultants' scope of work shall cover all activities necessary to accomplish the stated objectives and outputs of the services as outlined herein, while adhering to the aforementioned principles and practices. This is not an exhaustive list of the requirements and the absence of any and all activities necessary for the Final Design Consultant to meet the project intent and to satisfy the objectives and outputs, shall be executed by the Final Design Consultants under these services and shall be covered under these Terms of Reference.

The Civil Works for the project will include a maintenance scheme for a period of two (2) years after completion of the works, and as such, the designs and supporting documents shall be reflective of this.

DESCRIPTION OF SERVICES

The Services shall be carried out in accordance with generally accepted standards of professional practice and recognised engineering and management principles and practices. The Consultants' scope of work shall cover all activities necessary to accomplish the stated objectives of these services, while adhering to the aforementioned principles and practices, whether or not a specific activity is cited in these Terms of Reference (TOR).

The consultancy will include the followings tasks:

(a) Conduct a desk study of the Technical and Economic Feasibility Report, the Environmental and Social Impact Assessment Report, and other information and reports available and prepared by others to become familiar with the project area, the constraints, local norms and the project itself.

(b) Conduct the requisite detailed geo-technical surveys necessary to prepare the final detailed designs for the proposed works including the analyses of all results. The tests shall comprise of all that is necessary to properly characterize the sub-surface geotechnical conditions for various segments of the pavement system, the major and minor bridges and culverts, the cutting of rock hills, and other areas as necessary to properly inform the final detailed designs and support documents. The geo-technical surveys shall include but shall not be limited to the further investigation of the necessary foundation system for the new Roaring Creek Bridge, the new crossing required along the bypass road in the village of Succotz, as well as areas with suspected poor subsurface soils such as in Camelote Village. At a minimum the geotechnical investigations for the road works shall include bore holes and associated tests for each kilometre of the road, with more detailed tests performed at critical locations.

(c) Review the topographical and cadastral surveys for the road systems prepared by others and conduct any and all additional cadastral, topographical and engineering surveys where required to provide an accurate and comprehensive detailed final designs. Allow to modify and update the existing survey drawings as necessary providing suitable bench marks along the route of the project suitably referenced on the final design drawings. Allow to verify and/or re-establish all benchmarks as necessary and verify coordinates of same. Conduct additional checks along all full project route at intervals of at least 1,000 meters. Allow to make all necessary adjustments and updates as necessary to account for all discrepancies identified and re-formatting necessary.

(d) Conduct necessary sub-structure and super structure designs for the new bridge at Roaring Creek as well as necessary designs to rehabilitate the existing bridge at Roaring Creek for pedestrian traffic and other minor bridges as noted in the Full Feasibility Report.

(e) Review and update the extent of land take that will be necessary for all aspects of the final designs and conduct all necessary cadastral surveys and prepare authenticated survey drawings showing required areas to be acquired by the GOB and submit to the MOWT for review and approval.

Meet with all local authorities and utility providers and obtain updated information of all existing and planned assets that would be affected by the project. Allow to illustrate the

locations of all such assets within the final designs and for necessary modifications, removal and the like.

(f) Review all available information and conduct additional data gathering as necessary to verify the AADT data and to validate and supplement as necessary traffic studies presented in the feasibility studies to be used in the final designs. Allow to conduct axel load studies on each of the three sections of the highway to an acceptable standards which shall at a minimum include surveys for seven consecutive days with at least one 24-hour period during the weekday and one during the weekend for each of the sections.

(g) Review all available information and prepare detailed designs, drawings and technical specifications as necessary for all civil, electrical, structural works and all road counter-measures necessary under the project. The Final Designs shall include verification of the impacts of the design storms on the various drainage systems, bridges and the road system; a review of the measures taken to improve existing horizontal and vertical curves and other safety standards provided, etc.

(i) Based on the detailed designs and technical specifications noted above, prepare detailed bills of quantities and detailed cost estimates for the proposed works.

(j) Prepare additional support bidding documents as necessary to invite contractors to bid on each of the three sections of the project as well as for the bypass road including qualification information, contract conditions, bidding data, contract data and other documents as required under the bank procedures necessary for the procurement of contractors under the International Competitive Bidding Process.

(k) Conduct a cost benefit analysis with HDM-4 using the data from new traffic studies conducted under this assignment, as well as the final cost estimates for the project.

## 5. DESIGN STANDARDS

It is envisaged that the rehabilitated sections of the George Price Highway will become a part of the International Network of Mesoamerican Highways (RICAM),and, to this end, MOWT has proposed typical cross-sections and other design parameters and

recommends using appropriate AASHTO's Geometric Design Standards for Primary Road of Two Lane Undivided Highway with Paved Shoulders, with a design speed of 100 km per hour in rural settings and 40 km per hour in urban areas. As such, the designs of the road network shall be based on the abovementioned AASHTO standards with modifications as necessary to suit local conditions and needs, as agreed in writing with the MOWT and as outlined in the approved design standards submitted as a part of the Inception Report.

The road system including culverts as well as the minor bridges, including the Barton Creek Bridge, the Garbutt Creek Bridge and the Red Creek Bridge, shall be designed to withstand and properly drain a one in 20 year design storm with consideration of the impacts of climate change. The new bridge across Roaring Creek shall be designed to withstand a one in 100 year design storm.

The project will include double layer chip seal surfacing and shall be in general accordance with the preliminary designs for the project.

The design standards to be used for the final designs shall specifically consider and address the effects of climate change and shall consider the effects of changes in frequencies and intensities of rain events and their impact on the various components of the project.

## 6. DURATION

It is expected that the consultancy will be completed over a six (6) calendar months period. It is expected that the assignment will commence within the first quarter of 2015.

## 7. EXECUTION

The Project is to be executed by MOWT, through its Project Execution Unit (PEU). The Project Coordinator of the PEU will be responsible for the day-to-day supervision of the consultants carrying out the assignment.

## 8. REPORTING REQUIREMENTS AND DELIVERABLES

The Consultant shall submit five hard copies of all submissions, four copies to GOB and one copy to IADB. Copies to the GOB and the IADB shall also include one electronic copy, with drawings in dwg. and pdf. formats. Reports shall include as an annex the raw field data acquired from surveys conducted. An electronic form of the reports in word format shall also be submitted.

Reports shall be as follows:

**INCEPTION REPORT**

An Inception Report shall be prepared and submitted within 20 days after commencement of the assignment which shall outline in detailed terms the approach to be adopted in the execution of the assignment. The Inception report shall include an updated work program in Gantt chart format, details of proposed approach including a comprehensive design standards to be utilized for the various aspects of the works, etc. The proposed design standards shall be developed in consultation with MOWT and shall be based on current national standards of the MOWT, as well as relevant international standards such as AASHTO. The standards shall be realistic considering local conditions, best practices, and be presented in sufficient details to address all aspects of the works.

**INTERIM REPORT**

An interim report shall be prepared and submitted within 80 days after commencement of the assignment. The report shall include an advance copy of the final designs and shall include details of specific parcels of lands to be acquired including survey drawings showing same as well as utilities to be relocated complete with estimates for the activities.

**DRAFT FINAL REPORT**

A Draft Final Report shall be prepared and submitted within 120 days after commencement of the assignment. The Report shall present detailed designs, technical specifications, overview design criteria and calculations for the various aspects of the works, as well as, detailed cost estimates and complete construction bidding documents. The Report shall include as an Annex all raw field data acquired from the various surveys conducted as well as .dwg files of all drawings. At least three (3) copies of the draft final designs shall be submitted to scale in large format hard copies along with the report.

The Client shall complete its review of the Draft Final Design Report and shall submit its comments to the Consultant within a period of 30 calendar days after receipt of the draft report.

**FINAL REPORT**

On or before six calendar months after commencement, the Consultants shall review all comments made by the MOWT and shall make all necessary adjustments to the final designs and support documents and shall submit a Final Report to the Ministry of Works and Transport. The Final Report shall include as an Annex, all raw field data acquired from the various surveys conducted as well as .dwg. files of all drawings, Excel files for the bills of quantities and cost estimates, and word files for contract conditions and other support bid documents. All five copies of the final designs drawings shall be submitted to scale in large format (hard copies) along with the report.

## 9. MEETINGS

The Consultants shall conduct and attend all meetings called by the MOWT throughout the duration of the contract. Meetings shall be held at the MOWT offices in Belmopan, on site or in Belize City as directed. Meetings shall be called at the project inception and at least once for every month of the assignment but not exceeding twice per month on average.

## 10. MINIMUM MANPOWER REQUIREMENTS

In estimating man-month requirements and cost of the services, the Final Design Consultants shall ensure that the proposal takes full account of all of the above. The following includes a list of key personnel required for the assignment and an estimate of the minimum input for each. However, the Design Consultants shall make his own estimates of the require input which shall not be less than those noted below. Support staffs are not shown.

| Key Personnel | | Minimum Time Input Required |
|---|---|---|
| (a) | Project Manager (Team Leader) | 6.0 man-months (Full Time) |
| (b) | Bridge Design Engineer | 2.0 man-months |
| (c) | Structural Engineer | 1.0 man-months |
| (d) | Hydraulics Engineer/ Hydrologist | 2.0 man months |
| (e) | Pavement/ Road Design Engineer | 2.5 man months |
| (f) | Registered Electrical Engineer | 0.25 man months |
| (g) | Geotechnical Engineer | 1.5 man months |

| | | |
|---|---|---|
| (h) | Licensed Land Surveyor | 2.0 man months |
| (i) | Transport Economists | 1.0 man months |

The following include minimum requirements for the listed personnel.

**a. Project Manager (Team Leader)**

The Project Manager and Team Leader shall be qualified with at least a Master's Degree in Civil Engineering or similar field with a minimum of fifteen (15) years experience in Project Management works, which must include at least three (3) assignments of similar nature and complexity.

**b. Bridge Design Engineer**

The Bridge Design Engineer shall be qualified with at least a Masters Degree in bridge engineering, Structural Engineering or similar field with a minimum of ten (10) years experience in the design of bridges of which he/she has been the lead designer of at least three (3) bridges of a similar size and nature.

**c. Structural Engineer**

The Structural Engineer shall be qualified with at least a Bachelors Degree in Structural or Civil Engineering or similar field and a minimum of ten (10) years experience in the field.

**d. Hydrologist/ Hydraulic Engineer**

The Hydrologist and Hydraulic Engineer shall both be qualified with at least a Bachelors Degree in Hydrology, Civil Engineering or similar field respectively each having a minimum of 10 years experience in relevant highway design works of similar size and nature.

**e. Pavement/Road Design Engineer**

The Pavement/Road Design Engineer shall be qualified with at least a Bachelors Degree in Civil Engineering or similar field with a minimum of 15 years experience in the design of road systems of a similar nature.

**f. Geotechnical Engineer**

The Geotechnical Engineer shall be qualified with at least a Masters Degree in Geotechnical Engineering, Civil engineering or similar field with a minimum of 10 years experience in geotechnical designs of similar highway systems.

## 11. COMMENTS BY THE CONSULTANTS

Consultants are requested to make comments and suggestions for the improvements to this TOR. The financial implications, if any, of these recommendations shall be indicated separately in the Financial Proposal.