# GUIDELINES FOR GENERAL HYDROTECHNICAL ENGINEERING SERVICES

This document is provided as a template for hydrotechnical engineering contracts and will be modified by the contract originator to suit unique project specific requirements. It is provided to promote consistent application of hydrotechnical engineering principles across Ministry projects.

Language in this document is not meant to take precedence over other project specific requirements.

## 1. INTRODUCTION

The Ministry is seeking to provide a framework to ensure consistency in obtaining Hydrotechnical Engineering Consultant services.

Assignments may include, but may not be limited to, hydrotechnical engineering services to support bridge and large culvert projects including determination of hydraulic design recommendations, design of stream bank protection schemes, design of stream diversions, design of foreshore erosion protection, etc. The services may also include site inspections, field surveys, hydraulic evaluations, reporting and timely emergency response as required throughout the province. The information in this guideline provides details on the nature of work the consultant can be expected to do when working for the Ministry of Transportation and Infrastructure.

The Ministry will develop Terms of Reference consistent with this guideline and consistent with regional and provincial engineering practice.

## 2. MINISTRY OBLIGATIONS

The Ministry may undertake the following with respect to the assignment:

**a. General Responsibilities**

- Appoint a Ministry Manager to act as the Consultant's primary point of contact with the Ministry on all matters related to the performance of the Services.
- Provide access to all available pertinent reports, inventories, survey data and correspondence.
- Provide the source of available record or design drawings of existing highways, structures and electrical facilities under Ministry jurisdiction that might be affected by the proposed Work.
- Provide drawing series numbers for all drawings.
- Prepare and undertake a communications strategy to communicate and receive input from project funding partners, stakeholders and residents on the design and engineering scope.

- Take the lead role in advising and consulting with DFO, the Coast Guard, private property owners, local municipal, regional district, provincial and federal government officials, utility owners, railway authorities (through the Ministry's Rail/Navigable Waters Coordinator), environmental agencies and other stakeholders as required to complete the Project.
- Coordinate between engineering and other resources on multi-discipline engineering assignments.
- Determine the acceptability of all sub consultants proposed to work on the assignments.
- Review the work as it proceeds and advise on matters regarding standards, guidelines and policy when possible. This review does not constitute an acceptance of liability by the Ministry or its employees, for the design. It is solely conducted as a check to ensure the Ministry's interests are being considered and assured.
- Review and approve all scope changes, revisions to the design criteria and any changes to the agreed to assignment schedule.
- Assign new structure identification numbers as required.
- Consider the Consultant's advice and recommendation for changes in the Assignment scope and delivery.
- Advertise for tenders. Print and issue contract documents.
- Act as Project Manager.
- Conduct periodic performance evaluations typically after each deliverable has been received.
- Be available on reasonable notice to meet with the Consultant to;
    - Review progress of the Services.
    - Discuss and authorize the Consultant to proceed with General Engineering Services, if and when appropriate.
    - Review and approve where appropriate, invoices in a timely manner.

**b. Geotechnical Engineering**

- Provide geotechnical design criteria.
- Coordinate contaminated site overview investigations if required.

**c. Environmental**

- Liaise with Fisheries and Oceans Canada (DFO) and notify or obtain authorization for work, as required.

**d. Regulatory Liaison**

- Liaise with Transport Canada regarding navigable waters issues.
- Provide advice regarding utility relocations and copies of any available permits for utilities located in the Ministry Right of Way.

The Ministry reserves the right to expand or reduce the scope of its obligations during the term of the Contract.

## 3. SCHEDULE AND MILESTONES

The Consultant will be expected to conform to the assignment schedules as negotiated with the Ministry Representative at the outset of each assignment. The consultant shall agree to provide additional resources to an assignment where required in order to provide the deliverables on the agreed to dates.

## 4. SCOPE OF CONSULTANT SERVICES

Overview

The Ministry contract originator will prepare a suitable Scope statement in this section to suit unique project specific requirements.

Scope

The scope of Services for the assignment is outlined in the following sections to provide an overview of the involvement and level of effort for the engineering assignment for the Project. This overview may not capture all tasks and details required for the Proponent to complete the engineering assignment.

The Ministry reserves the right to conduct a Value Engineering assessment if required. The Proponent should be prepared to accommodate Value Engineering recommendations provided by the Ministry into the design.

Except as expressly permitted in writing by the Ministry, all tasks forming a part of the Services must be performed personally by the key personnel named in the Contract and in the accepted Work Plans.

Where any part of the Proponent's Proposal, whether incorporated into the Contract or not, contradicts or conflicts with any other part of the Contract, the other part of the Contract shall prevail.

General Engineering services shall not be undertaken without written approval from the Ministry.

Codes and Reference Documents:

The appropriate sections of the following documents will be the main design criteria reference documents:

- CAN/CSA-S6-06 Canadian Highway Bridge Design Code
- TAC Guide to Bridge Hydraulics (2001)
- B.C. Ministry of Transportation Bridge Standards and Procedures Manual.
- B.C. Ministry of Transportation Supplement to TAC Geometric Design Guide (2007).
- B.C. Ministry of Transportation Supplement to Canadian Highway Bridge Design Code.

- B.C. Ministry of Transportation Standard Specifications for Highway Construction (2012).
- Ministry technical circulars.
- FHWA HEC-18 Evaluating Scour at Bridges (5th Edition)
- FHWA HEC-20 Stream Stability at Highway Structures (4th Edition)
- FHWA HEC-23 Bridge Scour and Stream Instability Countermeasures: Experience, Selection, and Design Guidance (3rd Edition)

Services:

The Services for the engineering assignment throughout the duration of the contract may include, but not be limited to, the following:

- Review assignment information provided by the Ministry and advise what additional information is required to complete an assignment.
- Prepare a workplan, fee and disbursements cost estimate and delivery schedule based upon the agreed to contract hourly and disbursement rates and the Ministry objectives for an assignment.
- Attend a site meeting after receipt of approval to proceed with an assignment to discuss factors that affect the works with Ministry, the Ministry's contractors and other non government representatives.
- Provide design to Ministry Bridge standards including drawings, special provisions and cost estimates according to the most current Ministry tender document format.
- Conduct project review meetings with the Ministry at the preliminary design, 50%, 100% and final completion stages and any other additional meetings if deem required. The meetings will be held at the Ministry Regional Office in Burnaby. The Consultant shall prepare the agenda and minutes of these meetings and distribute them.
- Identify and perform all engineering services as required to achieve the assignment objectives including milestone dates and produce the deliverables as agreed to for each assignment.
- Provide sufficient resources to maintain an assignment schedule that reflects the agreed to work plan.
- Commit the professional services of both direct and sub-consultant staff presented in the Consultant's work plan for the entire period of defined tasks and activities in the work plan. Any changes in the Consultant's team structure or personnel will be subject to prior acceptance by the Ministry upon written request. Specialized engineering services and sub-consultant fees will be negotiated, as required, for each work assignment.
- Assist the Ministry in obtaining all necessary technical agreements, formal approvals and permits from Municipal, Regional, District, Federal and other Provincial Government Agencies, including Environmental Agencies. This includes preparing materials for submission to the aforementioned agencies.
- Attend meetings with the Ministry's Project Team as required for an assignment.
- Develop a Quality Control Plan and perform all Quality Control/Quality Assurance reviews and critically review all deliverables prior to submission to the Ministry.

- Provide progress reports submitted to the Ministry's Contact Person on a monthly basis. For each assignment, include statements regarding any potential changes to the scope of the work that might imply an increase in assignment, plus an estimate of the assignment progress and completion date including a summary of personnel hours expended with an estimate of the total hours required to complete the assignment. Progress reports will include a tabulated cash flow summary for each assignment which includes the cost of the work completed and the estimated value of work remaining on the assignment.
- Provide calculations and/or computer input and output files either on disk or in other acceptable form to the Ministry upon request. The Consultant shall record all calculations in an organized and complete format for this purpose.
- Liaise with:
    - the Ministry's structural engineers as required to coordinate structure design details;
    - the Ministry's geotechnical engineers as required to address the geotechnical design issues with regards to expected soils properties and drainage, embankment slope stability, foundation design, ditch widths etc.;
    - the Ministry's environmental services staff as required to address and coordinate environmental and fisheries issues and approvals;
    - the Ministry's highway design staff as required to coordinate highway and road design details;
    - the Ministry's Rail/Navigable Waters Coordinator as required to address and coordinate any NWPA issues;
    - the Ministry's local bridge and road area managers and maintenance contractors as required to resolve and exchange information with regards to maintenance and operation procedures, problems, etc with similar local facilities in the area and include necessary maintenance, emergency and operational features as may be necessary.

Design:

- Prepare all necessary hydrotechnical design and documentation for the Project in a format that meets the Ministry's requirements.
- Conduct field and office studies, as necessary, to provide estimates of waterway opening dimensions, scour depths, river training works, bank protection, erosion protection, flood control systems etc. and develop the hydraulic design recommendations for the Project. Summarize information in a concise Hydrotechnical Design Summary Report.
- Make revisions to the Hydrotechnical Design Summary Report as per the Ministry review comments and resubmit copies of the revised report as required. The Ministry will not pay for any errors or omissions that the consultant made.
- Complete the conceptual and detailed designs for the hydrotechnical components of the Project.

- As required, assist in the preparation and/or review of NWPA drawings and environmental impact drawings as appropriate. The drawings will be used for obtaining approvals required from external agencies.
- Prepare, in general conformance with the Ministry's Bridge Standards and Procedures Manual, drawings with complete detail and geometry to enable the works to be constructed or, in the case of proprietary structures, drawings with complete detail and geometry to allow for fair and competitive selection of proprietary designs. All designs shall conform to the Design Criteria and Procedure in the following section.
- Develop special provisions supplementary to the Ministry's Standard Specifications for Highway Construction as may be necessary and compile project specific special provisions, as required, for the preparation of tender documents.
- Prepare detailed materials quantities and cost estimates, including appropriate contingency amounts to arrive at a reasonably accurate overall cost estimate, and summarize as Schedule 7 - Schedule of Approximate Quantities and Unit Prices. Notify the Ministry of any factors which are considered by the Consultant to be beyond his control and which are likely to qualify the accuracy of his cost estimates.
- Review drawings, special provisions and cost estimates prepared by others to ensure that all recommendations have been properly accounted for and effectively implemented.
- Prepare or review general arrangement drawings and design terms of reference for any proprietary structures related to the design.
- Assume responsibility as the Engineer of Record and submit Letters of Assurance for designs as outlined in Technical Circular T06-09 available at:

  http://www.th.gov.bc.ca/publications/Circulars/lister.asp?set=Current&circ=T&year=2009

- Contract tender documents may include the following:
  - Schedule 3 - Special Provisions;
  - Schedule 4 - List of Drawings;
  - Schedule 5 – Time Schedule;
  - Schedule 7 - Schedule of Approximate Quantities and Unit Prices.

Construction Support Services:

- Respond to Ministry requests for design revisions, interpretation of designs, supplemental surveys and site inspections and resolve specific queries during the tender and construction phases of the Project as required.
- If applicable, conduct flow and water level duration analysis for construction planning purposes.
- Assist the Ministry in the review of contractor Value Engineering Proposals and requests for material and product substitutions.
- Provide construction engineering services with respect to hydraulic issues which may include, but are not limited to:
  - Review of proprietary design submissions;

  - Review of shop drawings;
  - Review of erection and demolition procedures;
  - Review and respond to queries from construction field crews on issues requiring interpretation, review or amendment of design;
  - Provide advice to field crews when adverse construction conditions are encountered;
  - As required by the Ministry's Representative to attend meetings and/or carry out site assessments. Submit a written inspection report for each site visit indicating what was observed and what instructions were given to the Ministry's Representative on site.

- If requested by the Ministry, provide Field Review of designs and perform duties necessary and complete Letters of Assurance for Field Reviews as outlined in Technical Circular T06-09. The Technical Circular is available at:

  http://www.th.gov.bc.ca/publications/Circulars/lister.asp?set=Current&circ=T&year=2009

- After construction of a project, provide a set of Record Drawings prepared in accordance with Technical Circular T07-09, available at:

  http://www.th.gov.bc.ca/publications/Circulars/lister.asp?set=Current&circ=T&year=2009

  Record Drawings shall be signed and sealed by the Consultant and suitable for microfilming, together with a CD ROM disk containing the signed and sealed Record Drawings in *.pdf format for archiving purposes. The Record Drawing submission will also include all final versions of any shop drawings and proprietary design submissions that have been reviewed by the Consultant.

Emergency Services:

- Respond within 24 hours to a request for an emergency inspection of damaged structures; approach fills, or roadways.
- Carry out a joint visual inspection of the damage with Ministry representatives that may include the Ministry's regional bridge engineer, local bridge area managers and/ or representatives of the Ministry's maintenance contractors.
- Recommend a course of action to the Ministry's regional bridge engineer that takes into account the nature of the damage, the need for public safety and economic impacts of the decision. Recommendations may include minor temporary repairs followed by a permanent repair.
- Design temporary repairs in general conformance with this guideline as time constraints permit.
- Design permanent repairs in general conformance with this guideline.
- Submit an Emergency Response Report to the Ministry's regional bridge engineer.

Inspection and Assessment:

- Inspect hydraulic structures and conditions as required and in conformance with the Ministry's Inspection procedures.
- Record on sketches and in field books any significant deviations from the as built drawings, the amount and location of damage as well as any other substandard conditions that may exist.
- Supply all sounding, photographic, access and safety equipment required to carry out inspections.
- Prepare all Inspection and Assessment Reports as required.
- Make revisions to the Inspection and Assessment Reports as per the Ministry's review comments and resubmit copies of the revised report as required.

Other Engineering Services:

- Assist in the review of consultant design submissions and development approval proposals as required.
- Assist the Ministry in obtaining all necessary technical agreements, formal approvals and permits from Municipal, Regional, District, Federal and other Provincial Government Agencies, including Environmental Agencies. This includes preparing all necessary materials for submission to the aforementioned agencies
- Assist Ministry in house design teams by carrying out reviews and providing design checking for in house design assignments.

Design Criteria and Procedures

Hydrotechnical design for bridges, large culverts (greater than 3m span), and channel control works shall be done in accordance with the procedures outlined in the *TAC Guide to Bridge Hydraulics* and in compliance with the *MoT Supplement to Canadian Highway Bridge Design Code (CHBDC),* and the *CAN/CSA-S6-06 Canadian Highway Bridge Design Code*.

The Ministry will assess any proposed exceptions to specified codes on a case by case basis. The Consultant shall complete the hydrotechnical design, provide related services, and prepare reports and sketches and/or drawings consistent with the following guidelines:

- Assemble and review office based information including available maps, airphotos, surveys and GIS data related to the stream and proposed crossing site.
- Conduct a field investigation of the bridge or project site:
    - Review and document local channel characteristics (natural stream width, depth, and slope), sediment supply and morphological setting, hydraulic controls and high water and ice marks.
    - Inspect other nearby structures on the same stream to evaluate hydraulic openings and the performance of scour and erosion counter measures.
    - Assess existing survey information; if adequate surveys do not exist, obtain the required information according to Chapter 400 of the MoT General Survey Guide or advise the Ministry to obtain the required information utilizing its own forces.

- Assess the existing bridge location and provide advice on the morphological limitations of the stream reach.
- Prepare hydrologic estimates for the $Q_{200}$ and/or $Q_{100}$ maximum instantaneous discharge, and calculate the resulting design high water levels.
- Carry out the waterway design and analysis including hydraulic design of the waterway opening and scour prediction.
- If applicable, determine design ice thickness, strength, levels and loads (static and dynamic) that may occur at the site.
- Assess limitations with respect to drift, debris, water levels and freeboard.
- Based on the waterway opening design, make recommendations for scour protection and channel control requirements.
- If appropriate, provide advice/comment on the feasibility of various structure options and possible environmental enhancements.

Deliverables

The general deliverables for each assignment may include, but not be limited to, the following:

- A concise Hydrotechnical Design Summary Report for Ministry review and acceptance. The report shall describe all methods, assumptions, and limitations used for design. A sensitivity analysis shall be provided for all quantities that have a significant influence on results such as channel roughness parameters, scour depth multipliers, natural channel characteristics, etc. The Hydrotechnical Design Summary Report should document the following:
    - Drainage basin area; design discharge and frequency; design hydraulic gradient; channel roughness estimates; and hydraulic controls.
    - Bridge waterway opening dimensions and elevations; recommended bridge skew; inlet and outlet transitions; channel control works details; and design velocities through the waterway opening.
    - Design high water levels; degree of constriction and backwater calculations; and freeboard.
    - Total potential scour depths distributed across the bridge opening ; debris risk assessment; and ice conditions if applicable.
    - Proposed river training, scour protection and channel control requirements including riprap specifications.
    - Hydrotechnical tender special provisions.
    - Effect of the works on adjacent facilities.
    - Future maintenance recommendations.
- Drawings and/or sketches that show the bridge waterway opening including:
    - A plan view showing the orientation of the proposed structure, the river training works and/or the proposed bank protection works to the stream channel (offset dimensions or working points must be given on the drawing);

  - Toe and terminal end bank protection keying details must be specified, and working points to allow accurate construction layout must be shown on the drawings.
  - An elevation view showing the proposed waterway opening dimensions, riprap layout including a detail showing top and toe elevations, Class (kg), slope, thickness, filters, and dimensions; design water levels, freeboard, and anticipated total scour depth.
  - A stream profile showing the channel thalweg, surveyed water or ice level, the design water levels or hydraulic gradient and design ice levels as applicable.

- BMIS Hydrotechnical Inventory data sheet, attached as part of the reference document of this RFP. Consultant is required to submit a completed Hydrotechnical inventory data sheet to the Ministry Manager when requested.
- Bridge Scour Evaluation Report. Consultant is required to submit a completed bridge scour evaluation report to the Ministry Contact person when requested. The report shall follow the methodology to be provided by the Ministry. A sample bridge scour evaluation report can be found in the reference document of this RFP.